Ministry of Environment and Water of Bulgaria

FIRST BIENNIAL TRANSPERANNCY REPORT OF BULGARIA

under

the Paris Agreement

12/31/2024

Contents

1. INTRODUCTION

This report represents the First Biennial Transparency Report (BTR) from Bulgaria.

The BTR is a pivotal part of the Enhanced Transparency Framework, established by Article 13 of the Paris Agreement. The purpose of this BTR is to provide a clear understanding of climate change action in the light of the objective of the Convention and enhanced implementation thereof as set out in Article 2 of the Paris Agreement, including clarity and tracking of progress towards achieving Parties' individual nationally determined contributions (NDCs) under Article 4, support provided and received by relevant individual Parties and Parties' adaptation actions under Article 7, including good practices, priorities, needs and gaps, to inform the global stocktake under Article 14.

The BTR of Bulgaria was prepared according to decision 18/CMA.1[1] of the Conference of the Parties under the UNFCCC.

The information in the report is structured as follows:

Chapter 1 provides a brief introduction to the BTR.

Chapter 2 summarizes the main trends in national greenhouse gas emissions and removals over the period 1990-2022, as described in the annual National Inventory Report of the Bulgaria (submitted as a separate report).

Chapter 3 first sets out the particular national circumstances and institutional arrangements of Bulgaria that are of relevance in the context of climate action, before outlining the key aspects of the joint EU NDC (indicators, definitions, methodologies). It then goes on to describe the climate policy framework of Bulgaria, highlighting policies and measures (PaMs) per sector and the impact thereof; as well as the main projections results for greenhouse gases for the period 2025 – 2040, based on the National Climate and Energy Plan.

Chapter 4 describes the institutional arrangements and governance of climate adaptation in Bulgaria, in which the different roles, responsibilities and policy frameworks within the government are outlined regarding adaptation.

[1] https://unfccc.int/resource/tet/0/00mpg.pdf

Chapter 5 details Bulgaria's support for climate action in developing countries and provides information on financial, technology development and transfer and capacity-building support provided and mobilized.

Chapter 6 identifies some areas of improvement in reporting by Bulgaria compared to previously submitted national reports.

Bulgaria submitted its most recent National Inventory Report (NIR) for the 1990-2022 period to the UNFCCC in December 2024 as a separate report. The NIR consists of the National Inventory Document (NID) with accompanying methodology reports and the Common Reporting Tables (CRT).

The Common Tabular Format (CTF) tables as required by decision 5/CMA.3

The list of tables can be found in the Annex 1 of the BTR1 of Bulgaria.

2. NATIONAL INVENTORY REPORT

2.1. INTRODUCTION

Bulgaria submitted the National Inventory Report (1990-2022) to the UNFCCC as a separate report. The NIR consists of the National Inventory Document (NID) on its GHG Inventories for 1990 to 2022 in line with 18/CMA.1 and the Common Reporting Tables (CRT).

The summary of the GHG inventory data presented in this chapter of the Biennial Transparency Report (BTR) is consistent with the GHG inventory of the EU submitted in its 2024 National Inventory Report.

2.2. SUMMARY OF GHG EMISSIONS TRENDS

This section provides a brief description of the trends in GHG emissions.

TRENDS IN TOTAL GHG EMISSIONS

In 2022 Bulgaria's greenhouse gas emissions totalled 58 420 Gg CO_2 eq. without reporting of sequestration from LULUCF sector. The emissions decreased by 48.59% compared with the base year. Emissions in 2022 were 8.12% increase in comparison with the emissions of the previous year.

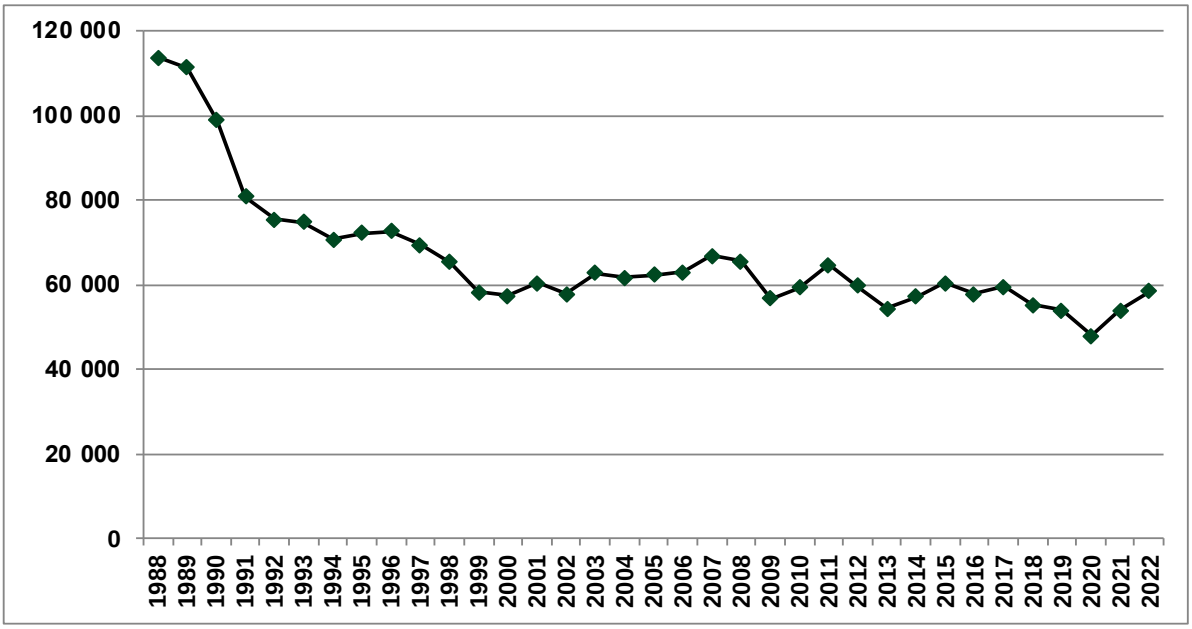


Figure 1 Total GHG emissions (without LULUCF) for 1988 – 2022, Gg CO_2 eq.

The net emissions including reporting of sequestration from LULUCF sector were 48 880 Gg CO_2 eq. The emissions decreased by 49.05 % compared with the base year.

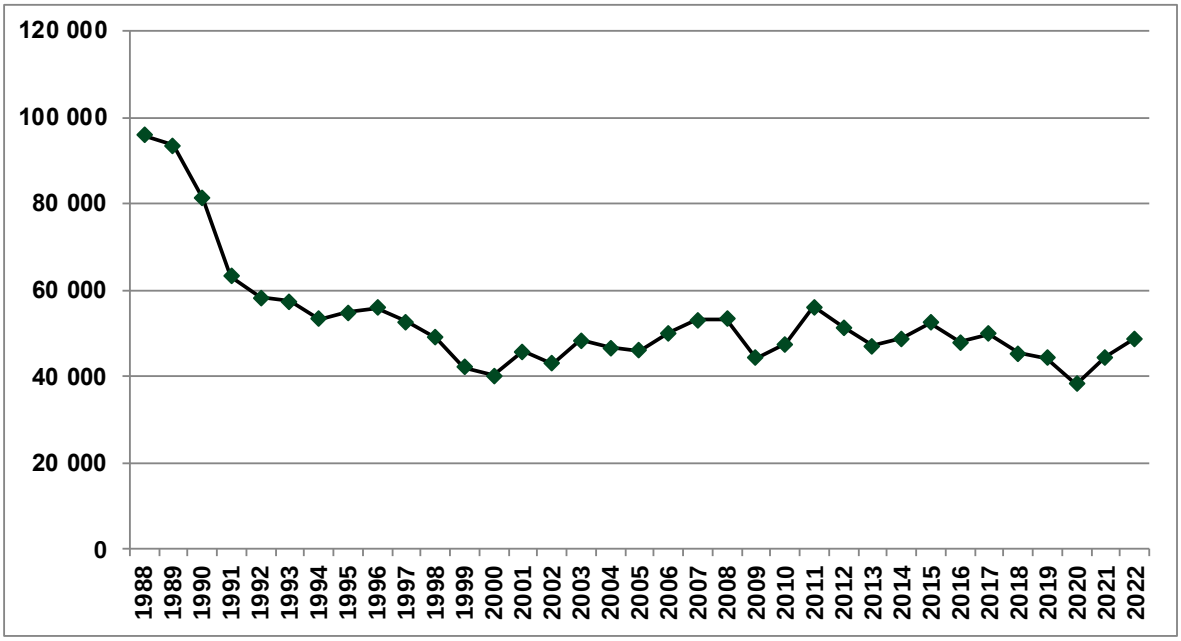


Figure 2 Total GHG emissions (with LULUCF) for 1988 – 2022, Gg CO_2 eq.

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 1990-2022, which resulted in the reduction of population by 28.25%.

EMISSION TRENDS BY GAS

The most important greenhouse gas in Bulgaria is carbon dioxide. The share of CO_2 emissions from the total greenhouse gas emissions varies around 80.33% excluding LULUCF and 76.24% including LULUCF. In absolute terms CO_2 emissions have decreased 49.05% since 1988. Around 77.19% of total CO_2 eq emissions originate from the Energy sector. The amount of energy-related CO_2 emissions has fluctuated much according to the economic trend, the energy supply structure (including electricity exports) and climate conditions.

Methane emissions (CH_4) have decreased by 56.80% 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 52.72% which has been occasioned mostly by the reduced nitrogen fertilisation of agricultural fields, the biggest decline was in the beginning of time series.

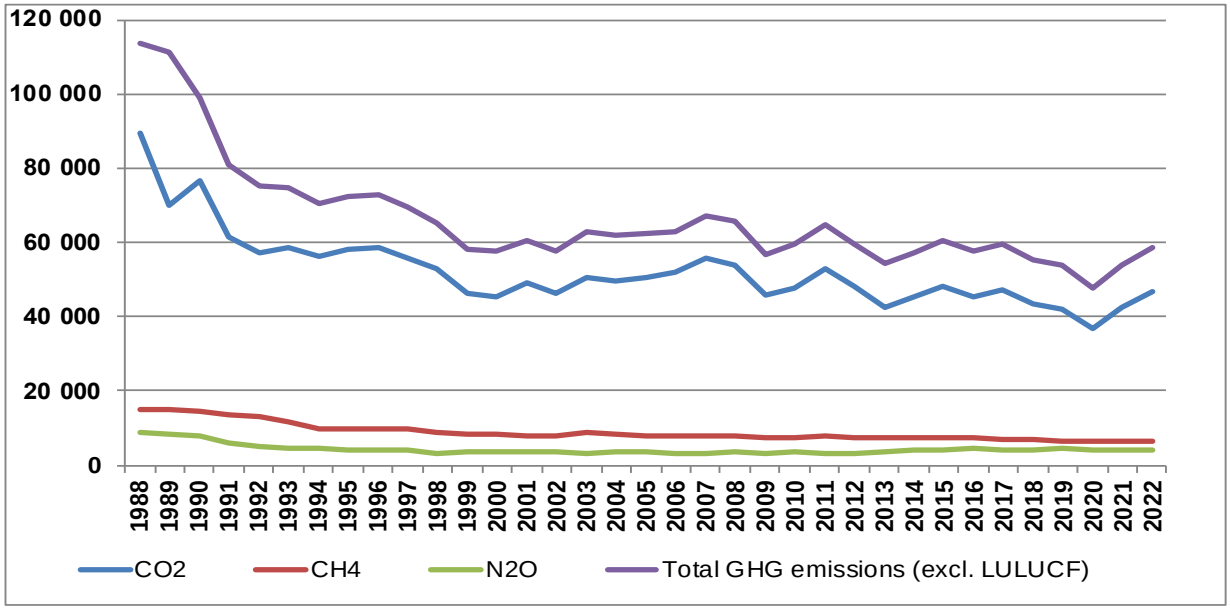


Figure 3 Total GHG emissions in Gg CO_2 eq. for 1988 – 2022

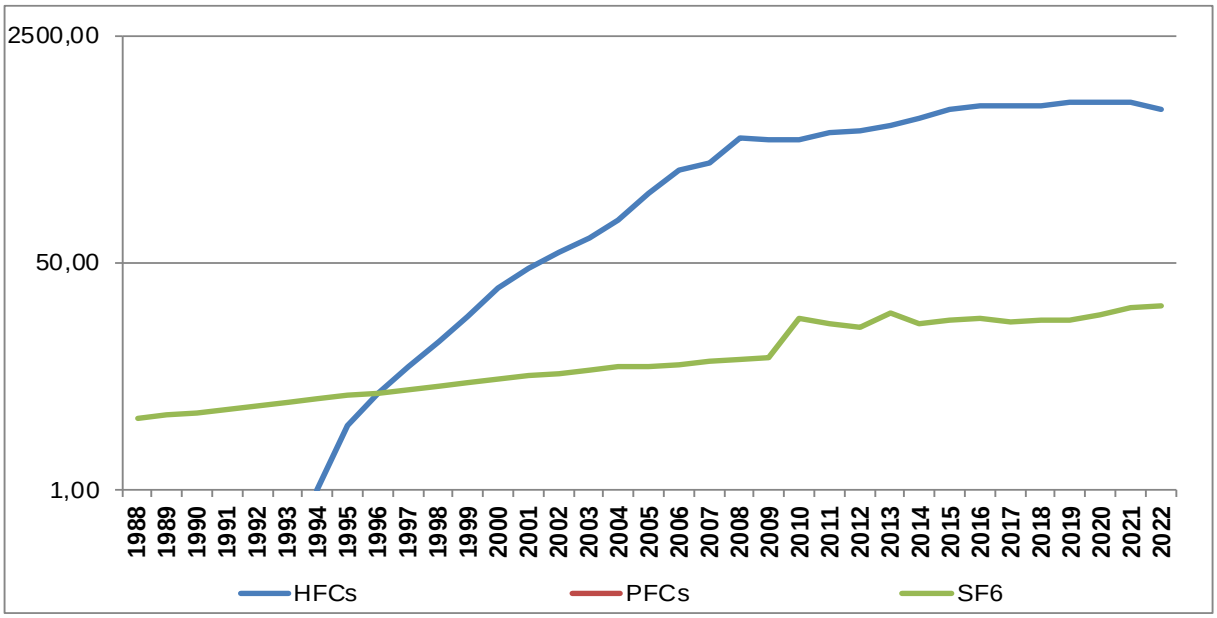


Figure 4 Actual emissions of HFCs, PFCs and SF6 for 1988 – 2022, Gg CO_2 eq.

The emissions of F-gases have increased over tenfold during 1995-2022. A key driver behind the trend has been the substitution of ozone depleting substances (ODS) by F-gases in many applications.

EMISSION TRENDS BY CATEGORY

Figure 5 below shows the GHG aggregated emission trends by IPCC sectors. The Energy sector, where GHG emissions come from fuel combustion, headed the list in 2022 with the biggest share – 77.19%. Sector Agriculture ranked the second place with 10.17% and sectors IPPU ranked the third place with 7.83% and Waste with 4.81%.

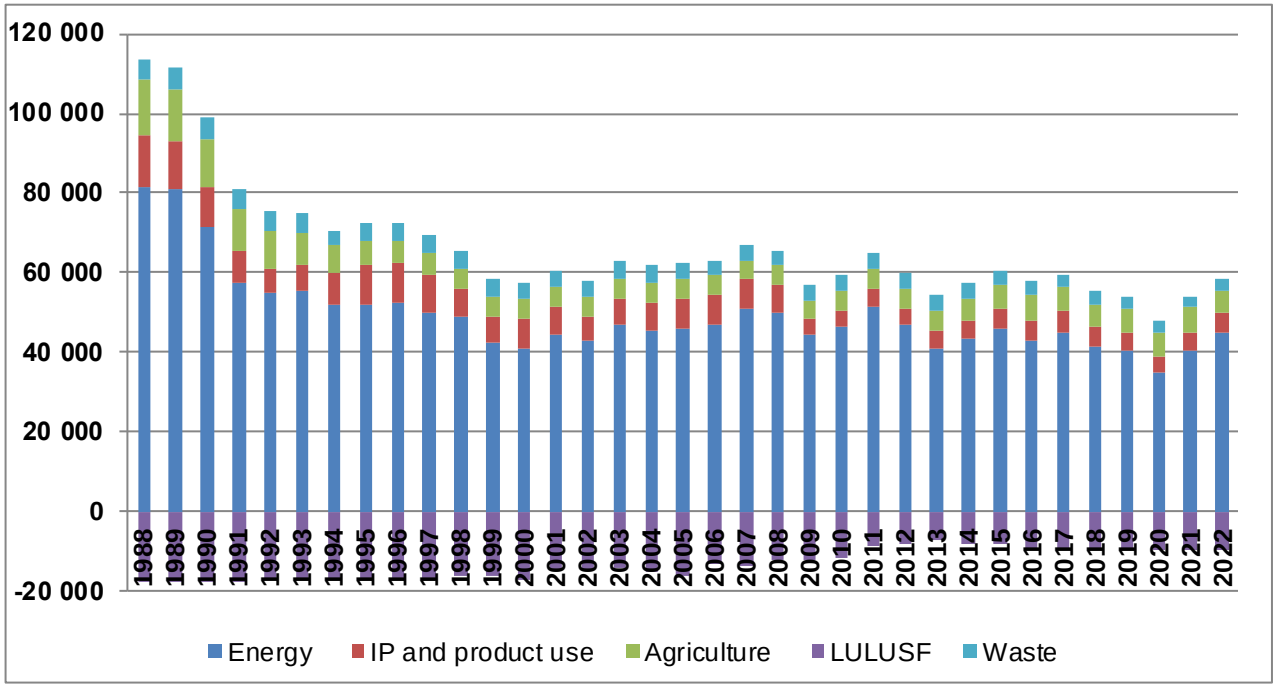


Figure 5 Total greenhouse gas emissions in CO_2-eq. per IPCC sector 1988-2022

Table 1 The reductions of GHG emissions by sectors by base year

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Change from base to latest reported year
1. Energy	-44.71%
2. Industrial Processes and product use	-65.28%
3. Agriculture	-56.36%
4. Land Use, Land-Use Change and Forestry	-46.13%

5. Waste	-46.85%
6. Other	0.00
Total (including LULUCF)	-49.05%

ENERGY

Emissions from the energy sector in 2022 decreased by 44.71% compared to the base year (45 094 Gg CO_2eq in 2022 compared to 81 562 Gg CO_2eq in 1988). Compared to previous year, the emissions in 2022 increased with 11.3%.

The main source of emissions in the energy sector is combustion of solid fuels, which is responsible for 46.25% of the emissions from fuel combustion in 2022.

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 2022 was defined by a substantial fluctuation of emissions from fuel combustion in energy industries. Fuel combustion decreased by 45.5% compared to the base year. The energy use in manufacturing industry and construction decreased by 75.08% compared to the base year and in other sectors (commercial, residential, agriculture and forestry) (76.8%), as well as a clear increase in GHG emissions from transport (40.7%).

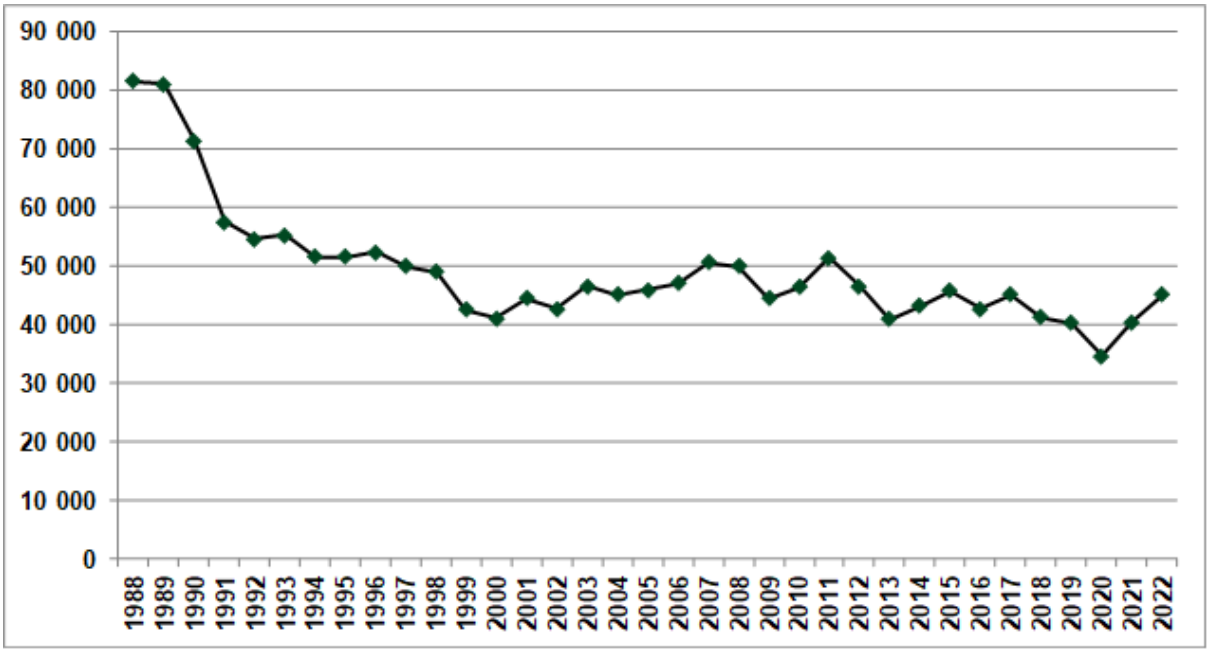


Figure 6 GHG emissions from Energy sector for 1988 – 2022, Gg CO_2 eq.

Chapter 3 of Bulgaria's National Inventory Report 2024 contains a more detailed analysis of GHG emissions in the sector.

INDUSTRIAL PROCESSES AND PRODUCT USE

A non – steady trend with some fluctuations towards emission reduction in this sector is observed since 1988. The emissions in 2022 decreased with 65.28% compared to the base year.

In the year 2022 – 7.83% of national total greenhouse gas emissions (without LULUCF) originated from industrial processes and product use, compared to 11.6% in the base year 1988. In 2022, greenhouse gas emissions from Industrial Processes and Product Use are 4 574.92 Gg CO2eq compared to 13 176.76 Gg CO2eq in the base year.

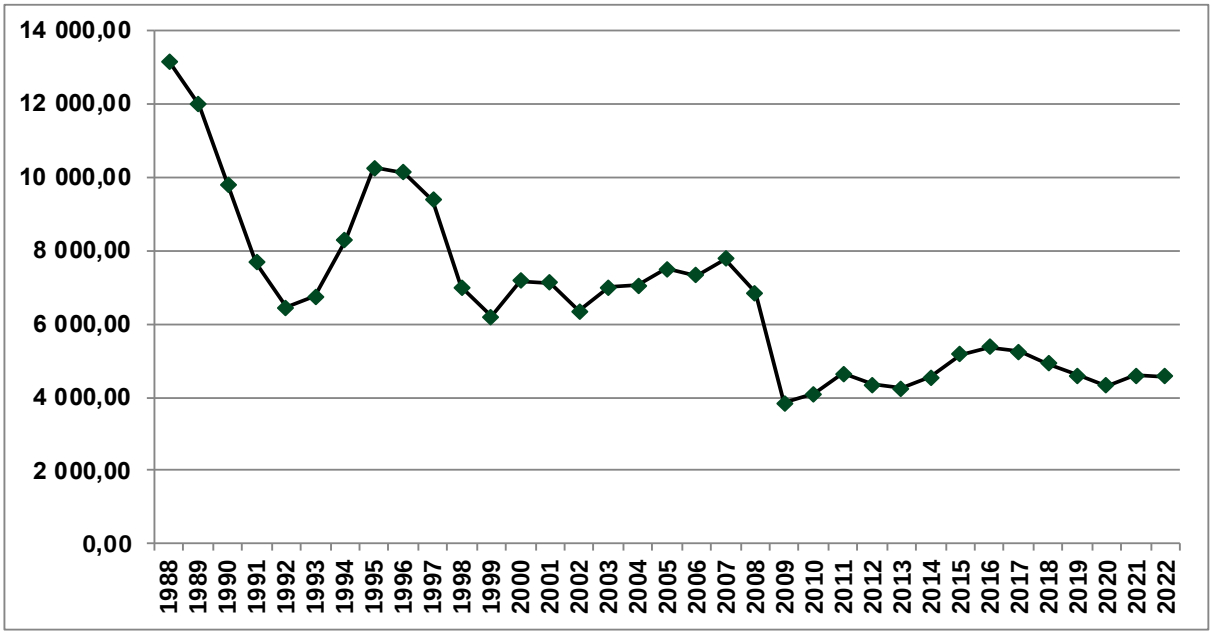


Figure 7 GHG emissions from Industrial processes and Product Use sector for 1988 – 2022, Gg CO_2 eq.

In 2022 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 57.95%. The second category by share is Chemical Industry (ammonia and nitric acid production) with 21.77% share, followed by Product uses as ODS substitutes (Consumption of Halocarbons) with 15.34% and finally Metal Production (steel) with 3.31%.

Greenhouse gas emissions from the Industrial Processes and Product Use sector fluctuate during the period and reach a minimum in 2009. The reduction in 2022 for the whole sector is 65.28% while the biggest reduction (compared to the base year) can be seen in Metal Production category – 96.2%.

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

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.

Chapter 4 of Bulgaria's National Inventory Report 2024 contains a more detailed analysis of GHG emissions in the sector.

AGRICULTURE

The overall emission reduction in the sector has amounted to 56.4% since 1988. In the year 2022 the sector agriculture contributed 10.17% to the total of Bulgaria's greenhouse gas emissions (without LULUCF).

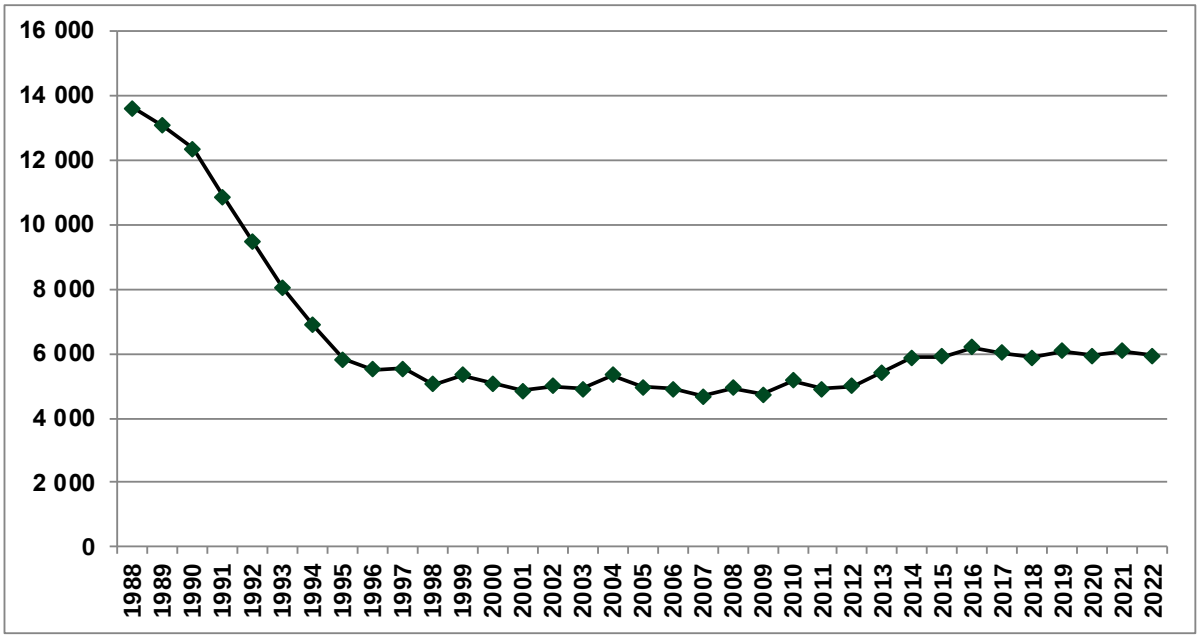


Figure 8 GHG emissions from Agriculture sector for 1988 – 2022, Gg CO_2 eq.

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.

Chapter 5 of Bulgaria's National Inventory Report 2024 contains a more detailed analysis of GHG emissions in the sector.

LAND USE, LAND-USE CHANGE AND FORESTRY (LULUCF)

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 53.87% 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_2 eq) 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 – 16.3%.

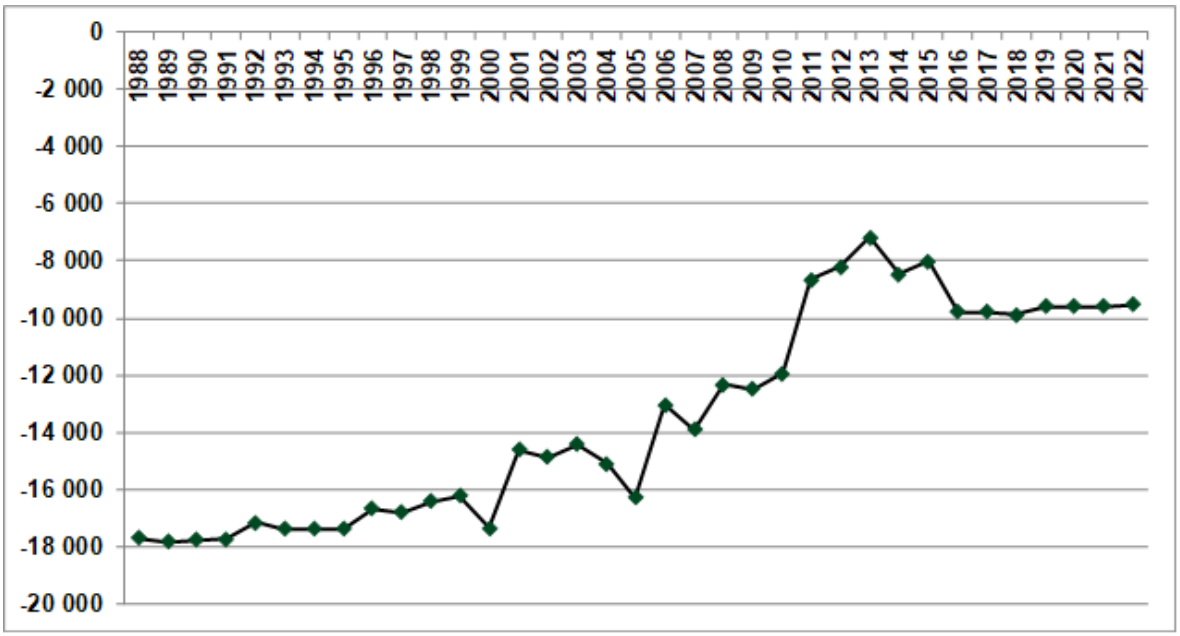


Figure 9 LULUCF emissions and removals for 1988 – 2022 CO_2 eq.

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.

Chapter 6 of Bulgaria's National Inventory Report 2024 contains a more detailed analysis of GHG emissions in the sector.

WASTE

The total sector emission reduction from the base year is 46.9 %. The decline was mainly driven by a steady population decrease over the past 25 – 30 years.

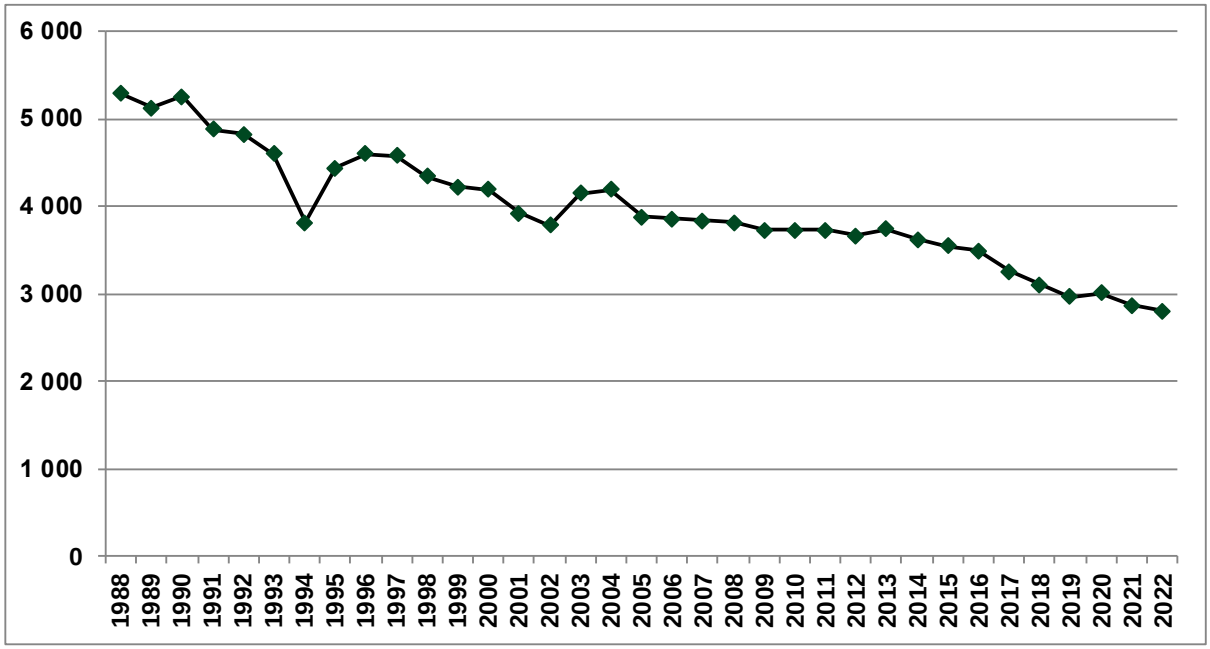


Figure 10 GHG emissions from Waste sector for 1988 – 2022, Gg CO_2 eq.

Chapter 7 of Bulgaria's National Inventory Report 2024 contains a more detailed analysis of GHG emissions in the sector.

INDIRECT GREENHOUSE GASES AND SO2 EMISSIONS

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

- NOx with 51.92%
- CO with 88.54%
- SO_2 with 28.92%
- NMVOC with 62.19%

2.3. DESCRIPTION OF THE NATIONAL INVENTORY 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	Present BGNIS (submission 2008-2024)	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: MEW	→

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.

As it is illustrated in figure 11 and outlined in the following chapters the preparation of the inventory has an institutional "home" that is ultimately responsible for managing the process and has a legal authority to collect data and submit it on behalf of the Bulgaria.

Bulgaria's reporting obligations to the UNFCCC, UNECE and EC are being administered by the MEW. All activities on preparation of GHG inventory in Bulgaria are coordinated and managed on the state level by MEW.

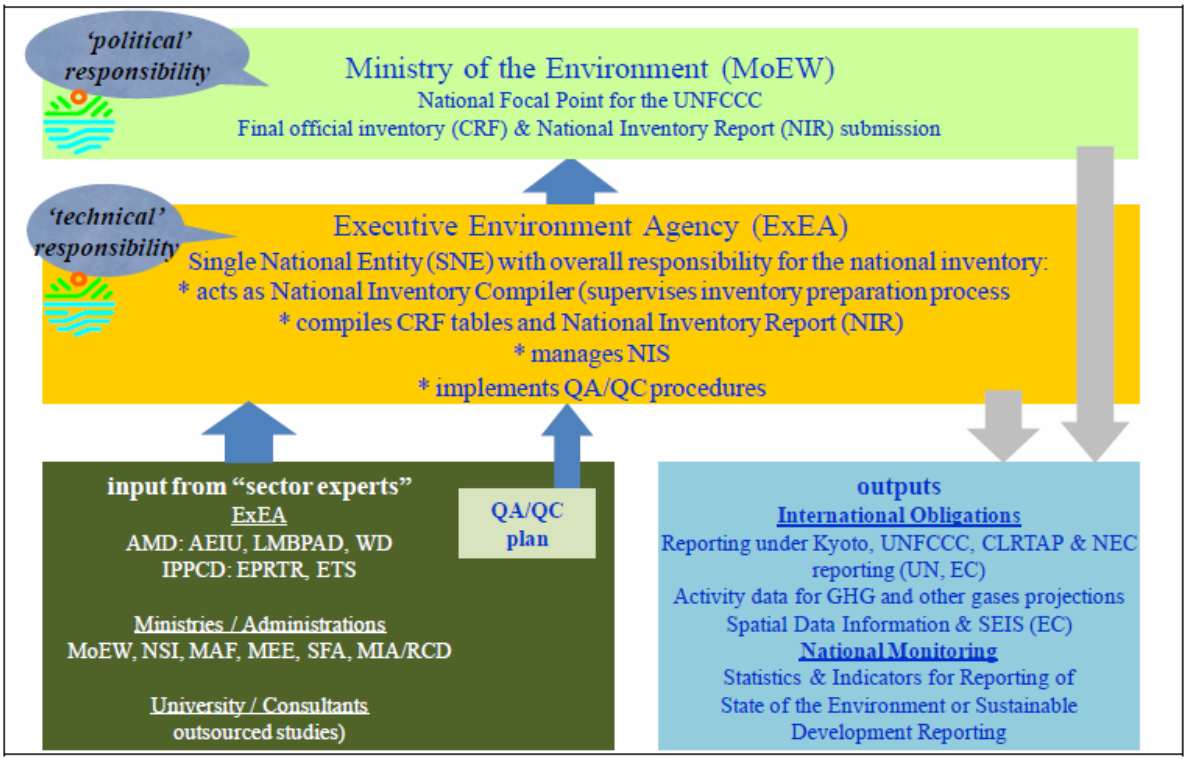


Figure 11 Organizational Chart of the Bulgarian National Inventory System

The Bulgarian Government by MEW (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.

The following strategic goals in climate change area were achieved by the Ministry of Environment and Water in 2022:

Climate change mitigation law

Climate change mitigation law adopted on first reading in the National Assembly on 23.10.2013. 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 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).

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

The ExEA is represented and managed by an Executive Director

The 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).

The legal bases for BGNIS are:

Environmental Protection Act (EPA, State Gazette No. 91/25.09.2002; corrected, SG No. 96/2002; last amendment March 2021);

Statute on the organization and structure of ExEA (Decision of Council of ministers 162/03.08.2010 – final update 20.09.2019);

Order № 344/01.12.2020 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 (last update 227/16.10.2017 SG 84/2017)

In order to strengthen the institutional arrangements and to fulfil the required general and specific functions of BGNIS an official agreement 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, Food and Forestry (MAFF) 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).

LEGAL BASIS OF THE BULGARIAN NIS – SPECIFIC FUNCTIONS

SINGLE NATIONAL ENTITY

The postal and electronic addresses of the single national entity are:
Executive Environmental Agency at the Ministry of Environment and Water
136 “Tzar Boris III” Blvd
Sofia 1618, Bulgaria
P.O.Box 251
Tel.:+359 2 9559011
Fax: +359 2 9559015
E-mail: iaos@eea.government.bg
http://eea.government.bg/en

National Inventory Focal Point (NIFP): Detelina Petrova
Organization: Ministry of Environment and Water
Address: 22 “Maria Luiza” blvd., 1202 Sofia, Bulgaria
E-mail: dpetrova@moew.government.bg
Tel.: +359 2 940 61 44

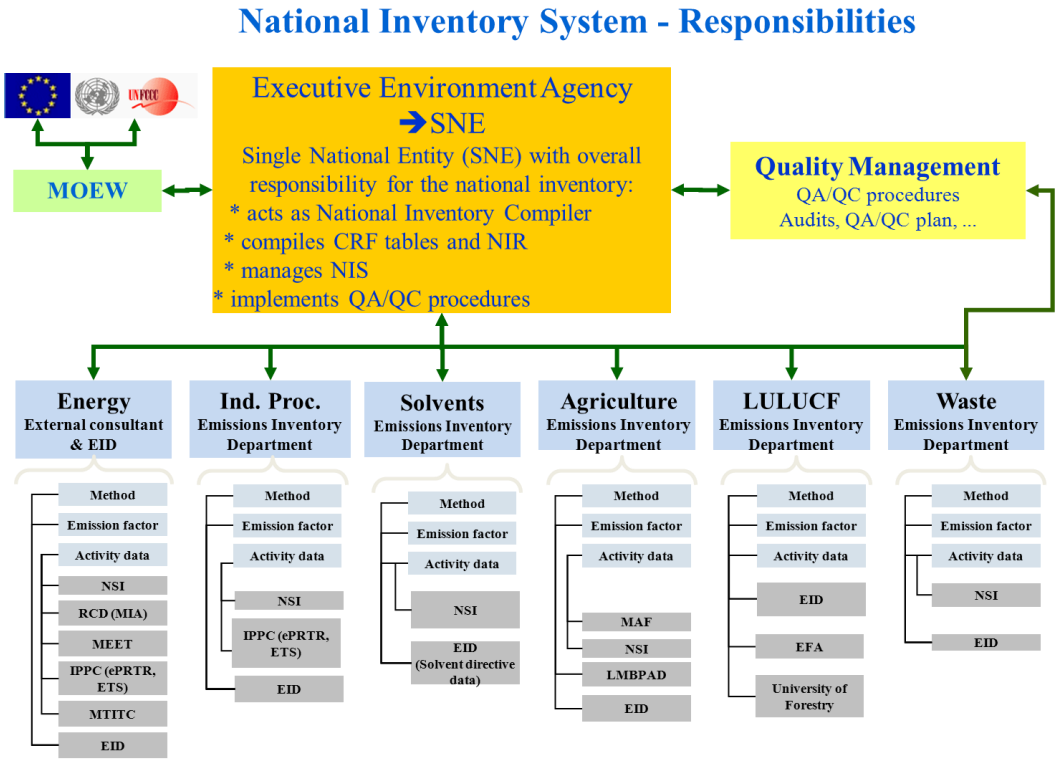
Head of Emission Inventory Department & National Inventory Compiler: Violeta Stoeva
Organization: Executive Environmental Agency
Address: 136, “Tsar Boris III” blvd., 1618 Sofia, Bulgaria
e-mail: v.stoeva@eea.government.bg
Tel.: +359 2 940 64 66
Fax: +359 2 955 90 15

INVENTORY PREPARATION
The inventory preparation process covers:
- Identification key source categories;
- Prepare estimates 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 for each source category and for the inventory in total recalculations 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 (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 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.



Bulgarian National Inventory System – Responsibilities

QUALITY ASSURANCE, QUALITY CONTROL AND VERIFICATION

The ExEA is also responsible for coordination and implementation of QA/QC activities for the national inventory. A quality manager 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.

BRIEF GENERAL DESCRIPTION OF METHODOLOGIES

The most recent greenhouse gas inventory for the period 1988 to 2022 (NIR 2024) 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 – CO2, CH4 and N2O (plus relevant ODS and SF6).

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 – 2019.

The emission factors are mainly from:

- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC GL);
- EMEP/EEA air pollutant emission inventory guidebook – 2019;
- Country-specific.

3. INFORMATION NECESSARY TO TRACK PROGRESS

3.1. NATIONAL CIRCUMSTANCES AND INSTITUTIONAL ARRANGEMENTS

NATIONAL CIRCUMSTANCES

Governmental 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.

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 2 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
2022	8,8	-9,6	4,0	45,2	6,45

According to calculated data, Bulgaria's population is 6 447 710 people at the end of 2022, representing 1.5% of the EU population. The population density is 58.1. per sq. km at the end of 2022.

During the period between the last two Censuses 2011-2021 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. 73.6% live in urban areas and 26.4% live in rural areas.

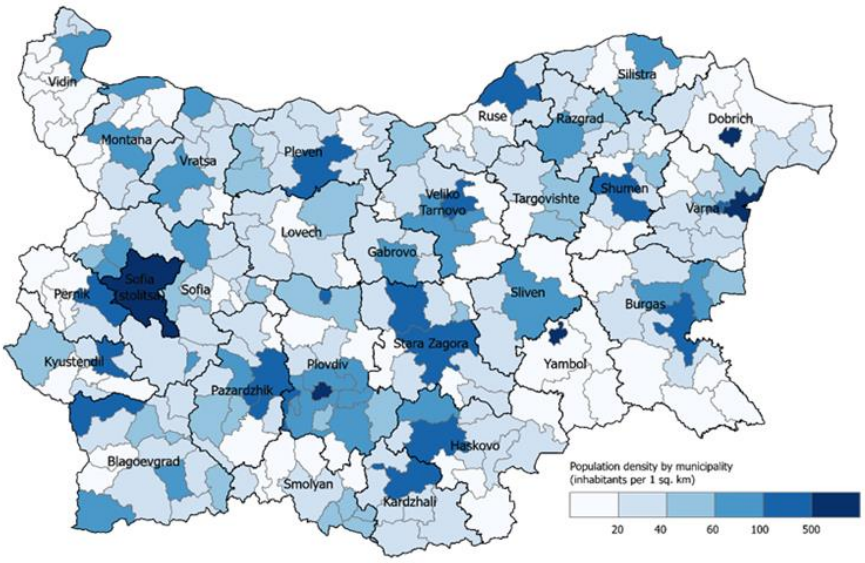


Figure 13 Density of population per sq. km by district as of 2021

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. In 2022 the share of population at working age is 58.5% of the total population. The population ageing over the years lead to increase of the population mean age. It has increased from 40.4 years in 2001 to 45.2 years at the end of 2022. The mean age of the population is 44.3 years in urban areas, compared to 47.5 years in rural areas. Average life expectancy in Bulgaria is 68.3 for male and 75.8 for female for the 2022. 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 (51.9 %).

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 45.2in 2020.

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 km^2 and water volume of 211 mln m3, and 23 dams with total area of 376 km^2 and water volume of 4,571 mln m3. 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.

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.

At the start of the COVID-19 pandemic, economic conditions in Bulgaria were favourable. The positive trend of robust economic growth over the period 2015-2019 (3.2% on average) has been underpinned by growing private consumption and positive labor market developments.

The Bulgarian economy has almost fully recovered from the pandemic-induced shock. After falling by 4.4% in 2020, real GDP rebounded by 4.2% in 2021, driven by household consumption and goods exports. Private consumption remained relatively unaffected in 2020 compared to the EU average, given that the sectors most hit by the supply restrictions, such as accommodation and catering services, account for a much smaller share of consumer.

In 2021, private consumption expanded robustly, supported by job retention schemes, positive wage dynamics, higher pension expenditures, low household debt, and improvements in consumer sentiment. Conversely, investment growth remained subdued in 2020, but dropped significantly in 2021. Exports of goods reached their pre-pandemic level in 2021, after a sharp drop at the start of the pandemic. In contrast, in 2021 real exports of services were still 18% below their 2019 levels, as nominal revenues from foreign tourism stood at only 55% of the prepandemic levels. Price pressures are set to weigh on household consumption in 2022.

In 2022, growth rate of GDP is 3.9% compared to 2021. In 2022, GDP (PPP) was estimated as 168 360 mil. lv.

The labour force is 2.30 million people, of whom 2,8 per cent are employed in agriculture, 23,6 per cent are employed in industry and 73,6 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. In last years between 2015 and 2022 there are study increase in the agricultural output in bouth – livestock breeding and crops. 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. 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.

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 3.2.1.

Table 3 Statistical information on the main economical indicators

	GDP, real growth	Real annual GDP growth	Export	Import	GDP per capita	Unemploy-ment
	% per year	% per year	EUR million	EUR million	Lv	%
2005	14,1	7,1	9 466	14 668	6 075	10,1
2010	2,3	1,5	15 561	19 245	9 938	10,3
2015	6,5	3,4	22 982	26 357	12 483	9,2
2020	3,6	-4,0	28 008	30 743	17 299	5,1
2021	7,7	7,7	34 988	39 238	20 207	4,9
2022	3,9	3,9	47 508	55 175	25 956	4,3

Source: National Statistical Institute

Real GDP growth is approximately 2% for the period 2010 - 2011, and due to the COVID pandemic, the GDP growth decreased dramatically reached -4% in 2020.

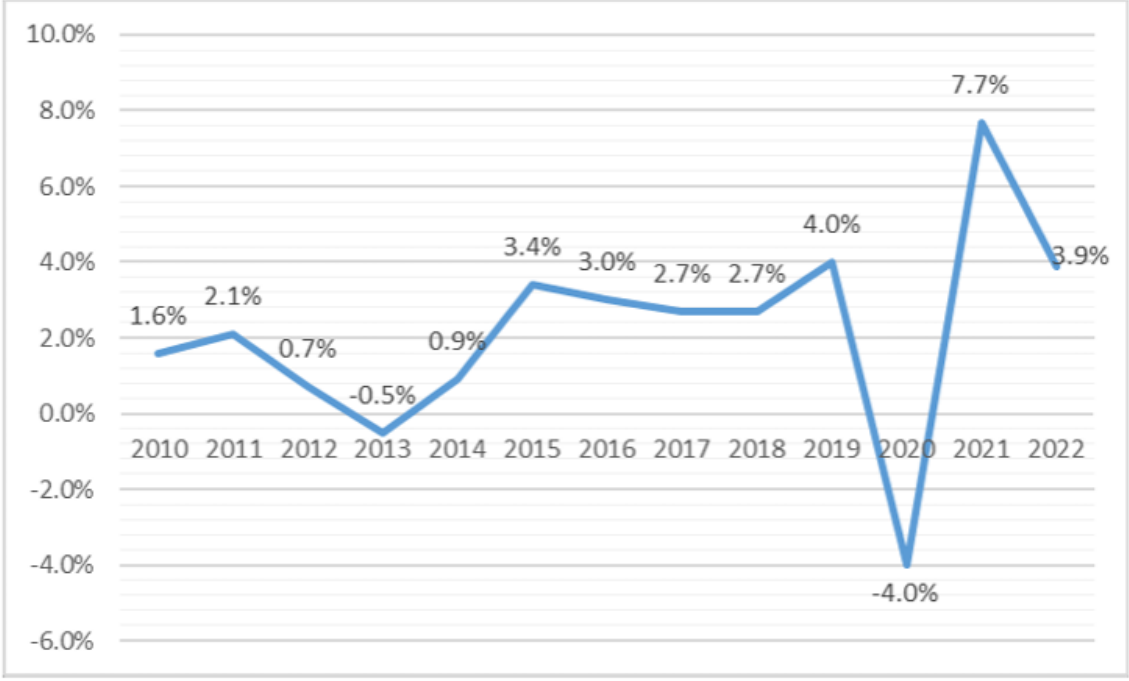


Figure 14 GDP Growth – Bulgaria

Source: National Statistical Institute

GVA in total and by economic sectors

The relative share of Industry sector in GVA in 2022 is 28.6%, which is an increase of 4.8 percentage points compared to 2021.

The Agriculture decreases its relative share in GVA of the national economy by 0.6 p.p. to 4.4%.

The relative share of the value added of the activities in the Services sector decreased to 67.0% compared to 71.2% in 2021.

Updated annual data show an increase of the GDP for 2022 in real terms by 3.9% compared to 2021. For the same period, GVA increased by 5.3%.

The increase in Gross Value Added is determined by the growth in the following economic activities:

- Mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; water supply, waste management and remediation activities - 13.1%;
- Financial and insurance activities - 8.0%;

- Public administration and defence; compulsory social security; education; human health and social work activities - 7.0%;
- Construction - 5.4%;
- Professional, scientific and technical activities; administrative and support service activities - 5.0%;
- Real estate activities - 4.1%;
- Information and communication - 1.6%;
- Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities - 0.9%;
- Arts, entertainment and recreation, repair of household goods and other services - 0.4%.
- A decline by 4.4% was registered in Agriculture, forestry and fishing.

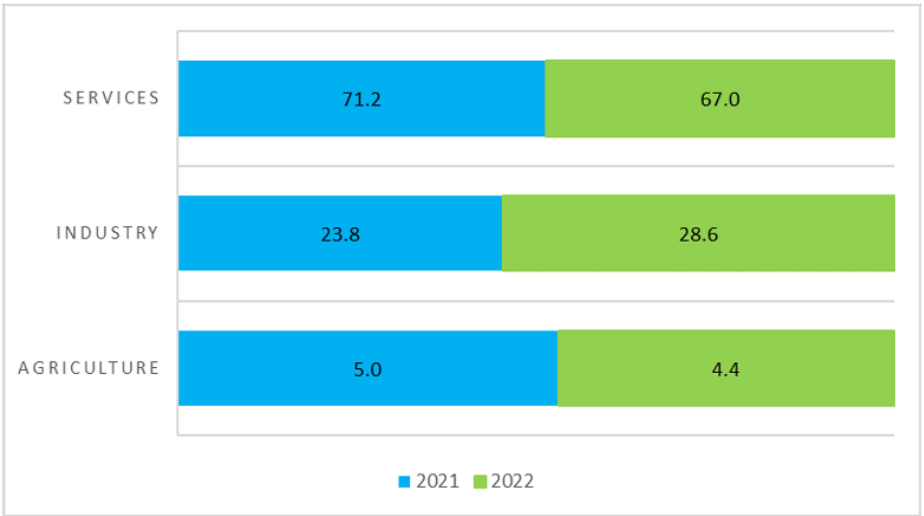


Figure 15 Gross value added by economic sector in 2021 and 2022*Source: NSI*

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. 3.6.) in the Republic of Bulgaria the objective unemployment has decreased and has reached levels lower than the EU..

In 2022 there were 140.4 thousand unemployed persons, of whom 78.2 thousand (55.7%) men and 62.2 thousand (44.3%) women. The unemployment rate was 4.3%.

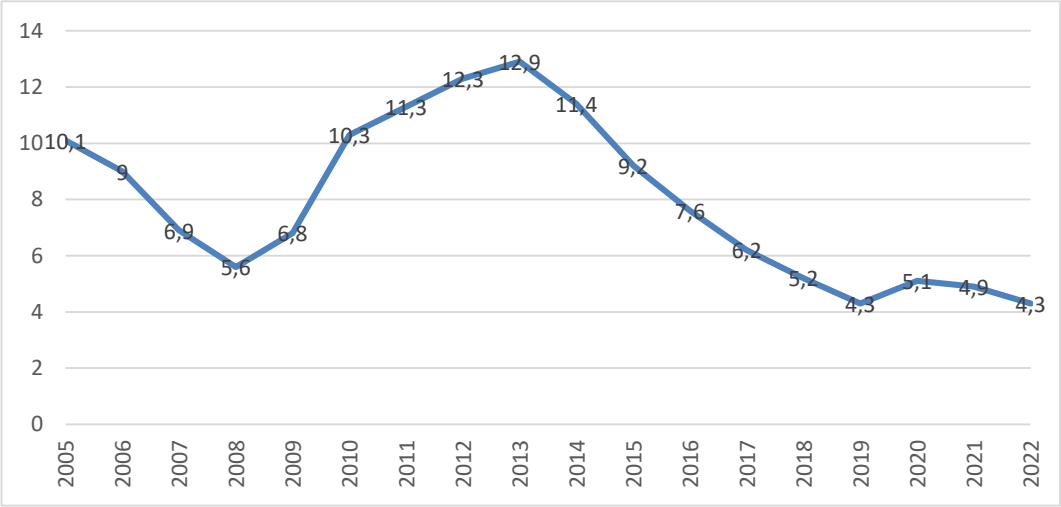


Figure 16 Unemployment, %

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.

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 17 Trade balance

Year	Export mil. EURO	Import mil.	Trade balance
2005	94 66,3	14 667,7	-5201,4
2010	15 561,2	19 244,8	-3683,6

2015	22 982	26 356,7	-3374,4
2020	28 008	30 743	-2734,3
2021	34 988	39 238	-4250
2022	47 508	55 175	-7667

Source: NSI

In 2022, regarding the expenditure components of GDP, contributors to the registered positive economic growth are the Final consumption with a growth of 4.2% and Gross fixed capital formation - 6.5%. In 2022, the exports of goods and services increased by 11.6% and imports of goods and services - by 15.0%, compared to 2021.

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 0.8 °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, 2022 (with an average annual temperature 12.8 °C) is the fourth warmest year in the period 1988-2022, and the month of December is the fourth warmest since 1930. with an average anomaly of +2.7°C in Northern Bulgaria and +3.4°C in Southern Bulgaria.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).

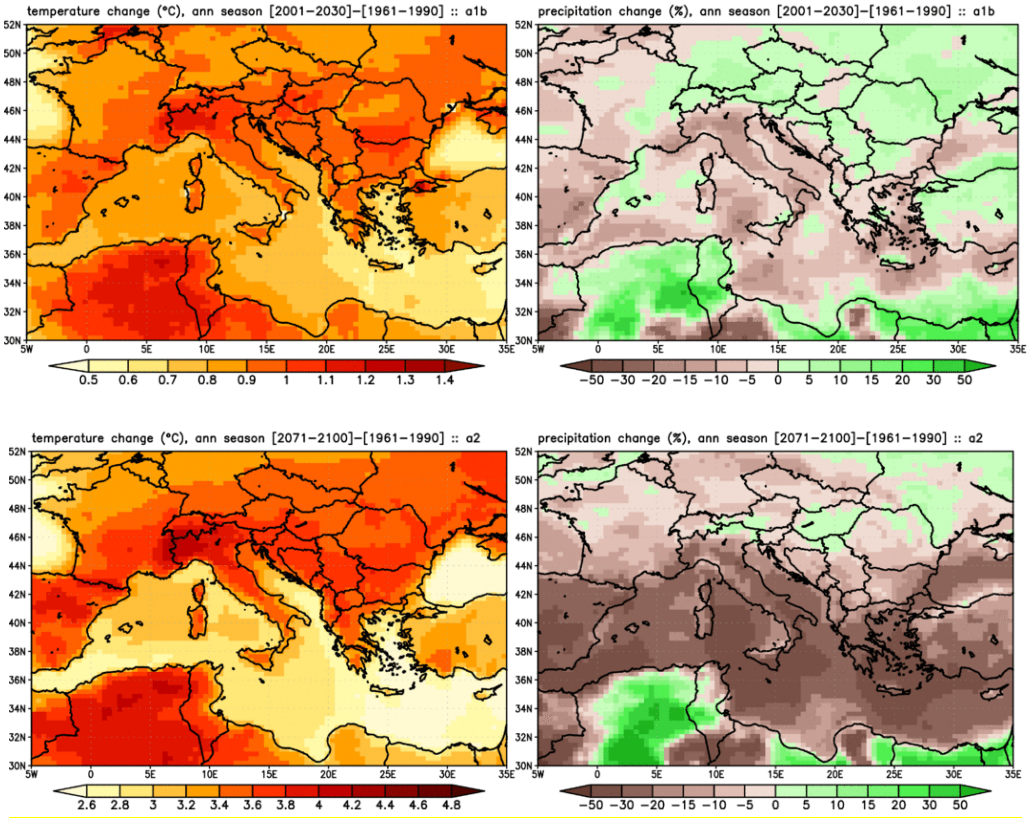


Figure 18 Temperature and precipitation annual change for periods 2001-2030 (A1B scenario) – upper panel, and 2071-2100 (A2 scenario) – lower panel

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.

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.

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Table 19 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
	2015	**2020**	**2021**	**2022**	
Industry	28,8	27,8	27,8	27,4	
Transport	34,7	33,8	33,8	35,2	
Households	23,6	25,0	23,6	21,7	
Others	12,8	13,4	14,8	15,7	
Total	100	100	100	100	

Source: NSI

Industry is the biggest energy consumer in Bulgaria's economy, but it's share in 2022 decreased with 56% compared to 1990. Instead energy consumption in transport sector in 2022 has increased from to 35% of the final energy consumption.

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 20 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
2015	12 033	18 681	9 389	18,2	36,7
2020	10 831	17 836	9 514	23,3	37,9
2021	12 136	19 371	9 857	19,5	36,2
2022	13 154	19 635	9 520	19,1	37,1

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

Transport sector

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 km2.

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.

Table 21 Goods carried by different transport modes 2005 – 2022, thousand tonnes

Year	Goods carried – thousand tonnes			
	Land transport	Waterway transport	Air transport	Total
2005	102 100	16 315	21	118 436
2010	79 441	7 964	11	87 416
2015	123 626	1 867	5	125 498
2020	110 270	2 827	21	113 118
2021	120 781	3 992	31	124 804
2022	126 881	3 608	15	130 504

Source: NSI

Table 22 Passengers carried by transport modes 2005-2022, thousand tonnes

Year	Passengers carried – thousands				
	Land transport	Waterway transport	Air transport	Urban electrical transport	Total
2005	698 014	86	2 071	288 410	988 581
2010	542 536	166	2 327	291 167	836 196
2015	464 770	115	2 240	248 081	715 206
2020	318 768	91	591	193 008	512 458
2021	307 614	152	603	191 815	500 184
2022	348 402	214	2417	230 498	581 531

Source: NSI

Environmental categories of the road vehicles

A unique feature of the Bulgarian vehicle fleet is its age structure. In 2022 about 88.1% of the vehicles were above 10 years old, whereas new vehicles (1 to 5 years) were 4.6 % of the total and 7.3% were aged between 6 and 10 years.

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.

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.

Industry sector

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 23 Output (Production value) of industrial enterprises, thousand BGN

	Total	Mining and quarrying	Manufacturing	Electricity, gas, steam and air-conditioning, supply	Water supply, sewerage, waste management and remediation
2015	645483388	2578600	52666985	7882904	1478627
2020	73658021	3097435	61759156	7005546	2000441
2021	88100015	3713231	70861171	11559868	1965745
2022	120045561	4323326	90775334	22617058	2329843

Source: NSI

Agriculture sector

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.

Forests

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

Table 24 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	**2015**	**2020**	**2021**	**2022**	
Total	4223	4270	4269	4273	
Coniferous	1261	1237	1232	1229	

Deciduous	2962	3033	3037	3044	
High-stemmed	938	967	972	974	
Low-stemmed	2024	2066	2065	2070	
of which: Wooded forest area	3858	3603	3921	3926	
Coniferous	1134	1117	1115	1113	
Deciduous	2724	2801	2806	2813	
High-stemmed	878	911	913	915	
Low-stemmed	1846	1890	1893	1898	

Source: National Statistical Institute, Statistical Reference Book 2023

Table 25 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	**2015**	**2020**	**2021**	**2022**	
Preparation of area	2025	1613	1508	2420	
Afforestation	1592	1760	1645	1179	
Reforestation of artificial forest	298	482	625	760	

Source: National Statistical Institute, Statistical Reference Book 2021

Waste sector

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.

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.

The total amount of municipal waste generated in Bulgaria in 2022 is 3157 kt. 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.

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 2022 (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 26 Time series of sewage sludge production and landfilling

Year	1990	2000	2005	2010	2015	2020	2021	2022
Sewage sludge production (Gg)	45,8	43,06	41,7	49,8	57,36	33,47	39,19	
Sewage sludge landfilled (Gg)	21,73	20,43	23,4	13,97	8,54	1,6	1,8	1,9

Source: National Inventory Report 2024

INSTITUTIONAL ARRANGEMENTS

Institutional arrangements for tracking progress

As an EU Member State, Bulgaria contributes to the implementation of the European Union's NDC (see paragraph 3.2). To track progress of its implementing and achieving the European target for 2030, institutional arrangements are in place both on the EU-level as on Member State level, as outlined below. As such, those sections regarding specific arrangements at the EU-level may contain common text for the BTRs of the EU and the Member States.

Institutional arrangements in the European Union

The EU's Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action ('Governance Regulation') establishes a governance mechanism and specific arrangements to track the progress of the Union and its Member States towards the implementation and achievement of the EU's climate and energy targets and commitments under the UNFCCC and the Paris Agreement. These arrangements include the monitoring of GHG emissions and removals, the reporting of policies and measures, projections of GHG emissions and removals and progress on adaptation to climate change.

Under the Governance Regulation, the EU has established a Union Inventory System to ensure the timeliness, transparency, accuracy, consistency, comparability and completeness of the data reported by the EU and its Member States. This inventory system includes a quality assurance and quality control programme, procedures for setting emission estimates, and comprehensive reviews of national inventory data to enable the assessment of compliance towards climate goals.

Each EU Member State compiles its GHG inventory in accordance with the requirements of the Paris Agreement and the relevant Intergovernmental Panel on Climate Change (IPCC) guidelines. Inventory data on GHG emissions and removals, including information on methods, are submitted electronically using a reporting system managed by the European Environment Agency (EEA). The submitted data are subject to quality control procedures and feed into the compilation of the GHG inventory of the EU. Net GHG emissions, calculated from emissions and removals reported in the GHG inventory of the EU, are the key information used for tracking progress towards the EU NDC target of a least -55% net emission reduction by 2030 compared to 1990.

Given the scope of the EU NDC related to international aviation and navigation, a specific share of international aviation and navigation emissions as reported in the GHG inventory data is calculated based on the Joint Research Centre's Integrated Database of the European Energy System (JRC-IDEES). Details on the methodology applied to identify GHG emissions from international aviation and navigation in the scope of the EU NDC, which are added to the national totals from the EU GHG inventory, are given in Annex 2 to this BTR.

Under the Governance Regulation each Member State must report to the Commission biennially on the status of implementation of its integrated national energy and climate plans (NECPs). This process allows the Commission to ensure that the EU and the Member States remain on track to achieve the climate-neutrality objective and progress on adaptation. Under the Governance Regulation, Member States further operate national systems for policies and measures and projections and submit and report standardised information, which is subject to quality and completeness checks. Based on the submitted data, the EEA compiles projections of GHG emissions and removals for the EU. The EU-wide information is summarised annually in the Climate Action Progress Report by the European Commission and in the 'Trends and projections' report by the EEA. Both the Union and the national systems are subject to continuous improvements.

The national energy and climate plans (NECPs) were introduced by the Governance Regulation.

For Member States, the NECP for 2021-2030 play a key role to enabling the tracking of progress towards the 2030 climate and energy targets. The update of the NECPs provides

an opportunity for Member States to assess their progress, identify gaps and revise existing measures or plan new ones where needed.

Member States were due to submit their final updated NECPs, taking account of the Commission's assessment and recommendations, by 30 June 2024.

Member States also report biennially on the progress of implementation of their National Energy and Climate Plan, the so-called "NECP Progress Reports", as required by the Governance Regulation. The progress reports integrate reporting on both the implementation of climate and energy policies, various indicators and the progress towards the achievement of contributions to EU targets.

Institutional arrangements for tracking progress in Bulgaria

Climate Change Mitigation Act (CCMA)

The Climate Change Mitigation Act (SG 22/2014, last amended SG /2024) adopted on first reading in the National Assembly on 23.10.2013, provides the legal basis for climate change policies in Bulgaria. 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.

outlines the overall policy to climate change mitigation and its impacts and fulfil international obligations within the UNFCCC and Paris Agreement, 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 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;
- 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, 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, 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.

Integrated national energy and climate plan until 2030

Bulgaria's integrated national energy and climate plan (NECP) aims to meet, with additional measures its 2030 target for greenhouse gas (GHG) emissions not covered by the EU Emissions Trading System (non-ETS) of 0 % compared to 2005. It also plans to comply with the Land Use, Land Use Change and Forestry (LULUCF) no-debit commitment (i.e. emissions do not exceed removals).

The NECP sets a share of 27 % renewable energy in gross final consumption of energy for 2030 as contribution to the EU renewable energy target for 2030. This contribution is in line with the share of 27 % in 2030.

For energy efficiency Bulgaria's contribution to the EU 2030 target amounts to 17.5 Mtoe for primary energy consumption and to 10.3 Mtoe for final energy consumption.. Bulgaria has indicative interim targets for renovation of residential and non-residential buildings in renovated area with estimates for energy savings and CO2 emission savings. For buildings owned and occupied by the central government, there is an intention to go beyond the 3 % annual renovation target enshrined in the EU legislation and take measures to improve the energy performance of at least 5 % of the total gross floor area of all heated and cooled state-owned buildings used by the public administration.

In its plan, Bulgaria sets objectives for energy security and internal energy market in terms of diversification of supply of energy resources; enhanced flexibility of the national energy system; increased resilience of the regional and national energy systems as well as in terms of enhanced network and information security (cybersecurity). The electricity interconnection level foreseen for 2030 amounts to 15 %.

The NECP contains several national objectives and funding targets related to research, innovation and competitiveness focusing inter alia on the long-term development of a low-carbon economy; on the improvement of energy and resource efficiency in transport; on the modernisation of existing electricity networks; on innovation in the field of nuclear energy, on the competitiveness of the core energy-intensive industries and on the development of electric cars and hydrogen technologies.

Long-term strategy until 2050

The LTS presents alternative scenarios, including a pathway to approach climate neutrality by 2050. The LTS is a strategy starting from NECP without committing to a specific strategy to achieve the long-term objectives, but shows pathway(s) to develop the energy system beyond 2030 in order to comply with drastic emission reduction targets.

Starting point is thus the NECP until 2030, which implies that drastic changes need to occur in the decade 2030-2040.

The LTS's analysis includes all the main greenhouse gases. The LTS's analysis covers all domestic sectors, including LULUCF. It is not specified whether it includes international maritime and aviation. Decarbonisation scenarios consider the capture and storage of CO2 for electricity generation, including BECCS.

In addition to the baseline scenario (NECP), aligned with Bulgaria's National Energy and Climate Plan, the LTS presents five long-term decarbonisation scenarios:

- Electricity and Energy Efficiency (EE) Improvement for 2 °C (EE2°C)
- Electricity and Energy Efficiency (EE) Improvement 1.5 °C (EE1.5°C)
- New energy carriers (NC) for 2 °C (NC2°C)
- New energy carriers (NC) for 1.5 °C (NC1.5°C)
- New energy carriers, nuclear and CCS (NC_var)

Institutional arrangements for implementation of the NDC

The EU and its Member States have set up a comprehensive system for the implementation of the EU climate change mitigation targets. The European Climate Law sets the goal of climate neutrality by 2050 and the intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. This target for 2030 corresponds to the target of the EU NDC.

To ensure that the EU and its Member States achieve their target, the 2030 Climate and Energy Framework was put in place. The main elements of this framework are the EU Emissions Trading System (EU ETS), which caps GHG emissions in energy, industry, aviation and maritime transport; the LULUCF Regulation which includes national net removal targets for the LULUCF sector; and the Effort Sharing Regulation (ESR) which establishes national reduction targets for GHG emissions not covered by the EU ETS or the LULUCF Regulation. The implementation of the ESR is supported by additional sectoral policies and measures (details can be found in this BTR in the chapter on mitigation policies and measures). The legislative acts under the 2030 Climate and Energy Framework require the European Commission and the EU Member States to set up the institutional arrangements for implementing the specific policies and measures.

The revised EU ETS Directive increases the level of ambition in the existing system from 43% to 62% emissions reductions by 2030, compared to 2005 levels and extend the system to also apply to international maritime transport. A separate carbon pricing system will apply to fuel combustion in road transport and buildings and small-emitting sectors (ETS2) with a 42% emission reduction target compared to 2005 across the sectors covered. The amended Effort Sharing Regulation (ESR) increased, for the sectors that it covers, the EU-level GHG emission reduction target from 29% to 40% by 2030, compared to 2005, which translates in updated 2030 targets for each Member State. The new LULUCF Regulation sets an overall EU-level objective of 310 Mt CO_2 equivalent of net removals in the LULUCF sector in 2030.

The ESR sets national targets for the reduction of GHG emissions in the Member States by 2030. Member States are also subject to gradually decreasing annual emission limits for each year from 2021 to 2030. The annual progress towards the national targets under the Effort Sharing Legislation is assessed by comparing effort sharing sector GHG emission levels with the relevant annual targets under the legislation. To achieve compliance under the ESR, Member States are permitted to use flexibility options to a certain extent.

Under Article 9(2) of the ESR, any debit (i.e., excess emissions) under the LULUCF Regulation in the period 2021 to 2025 is automatically deducted from Member States' AEAs under the ESR first compliance period.

Progress in the implementation of these policies and measures is monitored under the Governance Regulation. Relevant information which is reported regularly and archived at the EEA include GHG inventories, approximated GHG inventories for the previous year, information on policies and measures, projections, and progress towards the implementation of integrated National Energy and Climate Plans (NECP). This information helps the EU and its Member State to correct their course if progress towards the targets of the 2030 Climate and Energy Framework is behind schedule. As an example, the European Commission assesses the drafts of new or updated NECPs and provides recommendations for improved planning and implementation. In addition, the reported information is subject to quality checks, and the GHG inventories reported by EU Member States are subject to comprehensive reviews in 2025, 2027 and 2032.

All EU legislation, including the legislation under the 2030 Climate and Energy Framework, is subject to a stakeholder engagement process. So-called 'better regulation tools' ensure that policy is based on evidence and the best available practice. During the preparation of legislative proposals, the European Commission invites citizens, businesses and stakeholder organisations to provide their views on the subject of the new legislation. These comments are documented in a dedicated portal, and the European Commission reports on how it takes these comments into account in the development of the legislative proposals.

3.2. Description of the Nationally Determined Contribution

Under their updated NDC20 the EU and its Member States, acting jointly, are committed to a legally binding target of a domestic reduction of net greenhouse gas emissions by at least 55% compared to 1990 by 2030. The term 'domestic' means without the use of international credits. The NDC consists of a single-year target, and the target type is 'economy-wide absolute emission reduction'. The scope of the NDC covers the 27 Member States of the EU.

The 17 October 2023 updated NDC scope is supplemented by additional information to clarify the precise amount of international aviation and maritime emissions which are covered under the EU NDC. Details on the EU NDC can be found in Table 27 and Table 28 below.

Table 27 Description of the NDC of the EU

Information	Description
Target and description	Economy-wide net domestic reduction of at least 55% in greenhouse gas emissions by 2030 compared to 1990. The term 'domestic' means without the use of international credits.
Target type	Economy-wide absolute emission reduction.
Target year	2030 (single-year target)
Base year	1990
Base year value	Net greenhouse gas emissions level in 1990: 4 700 168 kt CO_2eq.
Implementation period	2021-2030
Geographical scope	EU Member States (Belgium, Bulgaria, Czechia, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, the Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden) including EU outermost regions (Guadeloupe, French Guiana, Martinique, Mayotte, Reunion, Saint Martin (France), Canary Islands (Spain), Azores and Madeira (Portugal)).
Sectors	Sectors as contained in Annex I to decision 5/CMA.3: Energy, Industrial processes and product use, Agriculture, Land Use, Land Use Change and Forestry (LULUCF), Waste. International Aviation: Emissions from civil aviation activities as set out for 2030 in Annex I to the EU ETS Directive are included only in respect of CO_2 emissions from flights subject to effective carbon pricing through the EU ETS. With respect to the geographical scope of the NDC these comprise emissions in 2024-26 from flights between the EU Member States and departing flights to Norway, Iceland, Switzerland and the United Kingdom. International Navigation: Waterborne navigation is included in respect of CO_2, methane (CH_4) and nitrous oxide (N_2O) emissions from maritime transport voyages between the EU Member States.
Gases	Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), nitrogen trifluoride (NF_3)
LULUCF categories and pools	The included LULUCF categories and pools are as defined in decision 5/CMA.3.

Information	Description
Intention to use cooperative approaches	The EU's at least 55% net reduction target by 2030 is to be achieved through domestic measures only, without contribution from international credits. The EU will account and report for cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA.
Any updates or clarifications of previously reported information, as applicable	The information on the NDC scope contains clarifications/further details compared to the information provided in the updated NDC of the EU.

Note: This table is identical to table 'Description of a Party's nationally determined contribution under Article 4 of the Paris Agreement, including updates,' which has been submitted electronically together with this BTR. This table is also annexed to this BTR.

Source: Updated NDC of the EU2

As specified in X, the NDC covers the emissions and removals from all sectors of the EU GHG inventory. In addition, CO2 emissions from specific international flights (covered by the EU ETS) and GHG emissions from maritime voyages between EU Member States are included in the scope of the NDC.

3.3. Indicator, definitions, methodologies and progress

3.3.1. Indicator

For the tracking of progress towards implementing and achieving the NDC of the EU, an indicator is used which has the same unit and metric as the NDC base year and target values. The chosen indicator is 'annual total net GHG emissions consistent with the scope of the NDC in CO2eq'. Table 2 provides more information on this indicator.

Table 28 Indicator for tracking progress

Information	Description
Selected indicator	Annual total net GHG emissions consistent with the scope of the NDC in CO_2eq.
Reference level and base year	The reference level is total net GHG emissions of the EU in the base year (1990). The reference level value for the EU is 4 700 168 kt CO_2eq.

[2] The update of the nationally determined contribution of the European Union and its Member States, https://unfccc.int/sites/default/files/NDC/2023-10/ES-2023-10-17%20EU%20submission%20NDC%20update.pdf.

Information	Description
Updates	This is the first time the reference level is reported, hence there are no updates. The value of the reference level may be updated in the future due to methodological improvements to the EU GHG inventory and to the determination of international aviation and navigation emissions in the NDC scope.
Relation to the NDC	The indicator is defined in the same unit and metric as the target of the NDC. Hence it can be used directly for tracking progress in implementing and achieving the NDC target.
Definitions	Definition of the indicator 'annual total net GHG emissions in CO_2eq': Total net GHG emissions correspond to the annual total of emissions and removals reported in CO_2 equivalents in the latest GHG inventory of the EU. The totals comprise all sectors and gases listed in the table entitled 'Reporting format for the description of a Party's nationally determined contribution under Article 4 of the Paris Agreement, including updates'.

Note: The information in this table is identical to the information in Common Tabular Format (CTF) tables 1 ('Description of selected indicators') and 2 ('Definitions needed to understand the NDC'), which were submitted electronically together with this BTR. These tables are also annexed to this BTR.

Source: The reference level is based on the Annual European Union GHG inventory 1990-2022.

3.3.2. Methodologies and accounting approach

The EU and its Member States use the following accounting approach for tracking progress towards the EU NDC: Annual GHG data from the national GHG inventory of the EU, complemented for international aviation and navigation with estimations from the Joint Research Centre's Integrated Database of the European Energy System. The total net GHG emissions are provided in the scope of the EU NDC and are compared to the economy-wide absolute emission reduction target as defined in the NDC. The EU will account for its cooperation with other Parties in a manner consistent with guidance adopted by the CMA.

As far as emissions and removals from the LULUCF sector are concerned, net emissions are used for tracking progress towards the 2030 target of the NDC based on all reported emissions and removals. Details on methodologies and accounting approaches consistent with the accounting guidance under the Paris Agreement can be found in CTF table 3 ('Methodologies and accounting approaches'), which was submitted electronically together with this BTR. This table is also annexed to this BTR.

3.3.3. Structured summary – status of progress

An important purpose of the BTR is to demonstrate where the EU and its Member States stand in implementing their NDC, and which progress they have made towards achieving it. The most recent information on GHG emissions and removals in the scope of the NDC constitutes the key information for tracking this progress. Table 3 summarises the current status of progress.

Table 29. Summary of progress towards implementing and achieving the NDC

	Unit	Base year value	Values in the implementation period			Target level	Target year	Progress made towards the NDC
			2021	2022	2030			
Indicator: Total net GHG emissions consistent with the scope of the EU NDC	kt CO_2eq	4 700 168	3 276 832	3 210 895	NA	2 115 076 (55% below base year level)	2030	The most recent level of the indicator is 31.7 % below the base year level.

NA: Not Applicable.

Note that an annual emissions balance consistent with chapter III.B (Application of corresponding adjustment) will be provided in a subsequent BTR upon finalisation of relevant further guidance by the CMA, based on the annual information reported under Article 6.2.

Note: More detailed information can be found in CTF table 4 ('Structured summary: Tracking progress made in implementing and achieving the NDC under Article 4 of the Paris Agreement'), which has been submitted electronically together with this BTR. This table is also annexed to this BTR.

Source: The indicator values are based on the Annual European Union GHG inventory 1990-2022.

Based on the GHG inventory data and data on international aviation and navigation for 2022, the EU and its Member States reduced net GHG emissions by 31.7 % compared to 1990. The EU and its Member States made progress towards implementing and achieving their NDC. The legal and institutional framework is in place to make further progress in the years ahead and to achieve the NDC target by 2030.

3.4. Mitigation policies and measures

The European Union (EU) aims to be a global leader in the fight against climate change and is therefore striving to achieve the targets set in Paris Agreement reached by the Conference of the Parties (COP 21) to the United Nations Framework Convention on Climate Change while simultaneously ensuring clean energy across the Union.

As a Member State of the European Union, Bulgaria shares the common value of developing a fair and prosperous society with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050.

The formulation of clear climate targets allows them to be translated into legislation and contribute to home modernisation and lower energy bills, greener and more efficient transport for current and future generations.

For more effective implementation of climate policies and better predictability for business, decarbonisation is linked to sectoral policies with a focus on energy, industry, transport, buildings, agriculture and land use.

The EU's 2030 target is to reduce greenhouse gas emissions by 55% and reach 0% net greenhouse gas emissions in 2050. To achieve this, the European Union is renewing its legislation.

The 'Fit for 55' legislative package reflects the need to speed up the green transition. It includes (i) strengthening and expanding the EU emissions trading system (ETS), with the creation of a new, second, ETS for transport and buildings together with a dedicated Social Climate Fund to help citizens during the transition; (ii) increasing targets under the effort sharing regulation; and (iii) a revised regulation for Land Use, Land Use Change and Forestry (LULUCF). The package has been fully adopted, and the Member States have been implementing the legislation.

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.**CROSS SECTORAL**

EU level

European greenhouse gas trading scheme (EU ETS)

The system sets a limit or cap on the total amount of GHGs that can be emitted at the EU level. Within this limit, companies buy emissions allowances (one allowance gives the right to emit 1 tonne of CO2 eq (carbon dioxide equivalent)), in auctions or through trading allowances with others. The cap is reduced annually to ensure that overall emissions in the sectors covered decrease over time.

The emissions under the ETS decreased by 42% from 2005 to 2023.

About 72% of the greenhouse gases from Bulgaria's ETS installations came from power generation, significantly more than the EU average of 57%. Of the total emissions from all industry sectors, 31% came from the chemical industry, 31% each from refineries and from cement and lime production, 21% from other industries, and 8% from the metals industry. Since 2019, the power sector's emissions have declined by 35%. The industry sectors' emissions have declined by slightly less, 33%. Since 2013, greenhouse gas emissions have declined by 48% in power generation and by 10% in the industry sectors. Greenhouse gas

emissions in both the power sector and the industry sectors showed both increases and decreases in that decade.

Emissions Trading System 2 (EU ETS 2)

In 2023, a new emissions trading system (ETS 2) was introduced, which also covers CO2 emissions from road transport, buildings and small industries not covered by the existing EU ETS. The introduction of carbon pricing in those sectors will provide a market incentive for investments in building renovations and low-emission mobility. Like the existing EU ETS, ETS 2 is a 'cap-and-trade' emission mechanism, but it will address fuel suppliers rather than end consumers such as households or car users. Fuel suppliers will have to monitor and report emissions from fuels supplied by them and buy sufficient allowances at auctions to cover these emissions. The ETS 2 cap will be set in such a way as to bring emissions down by 42% by 2030 compared with 2005 levels. Part of the revenues will be earmarked for the Social Climate Fund.

Effort sharing

The Effort Sharing Regulation (ESR) covers GHG emissions from domestic transport (excluding CO2 emissions from aviation), buildings, agriculture, small industry and waste. Emissions from these sectors account for around 60% of the EU's domestic emissions. The regulation sets the EU-wide target to reduce emissions from the effort sharing sectors by 40% by 2030 compared to 2005 levels. This overall target for the EU translates to binding national emission reduction targets for each Member State. Bulgaria's target is -10%.

In addition to the 2030 targets, Member States have annual GHG emissions limits (annual emission allocations), reducing every year until 2030.

There is some flexibility to take account of annual fluctuations in emissions, by trading emissions and transfers from the ETS and LULUCF.

IPPC DIRECTIVE

The national legislation is harmonized with the EU Directives 96/61/EC concerning integrated pollution prevention and control, 2008/1/EC and 2010/75/EU on industrial emissions (integrated pollution prevention and control). The implementation of EU legislation related to IPPC in Bulgaria is ensured by the Environmental Protection Act, promulgated, St. G. № 91/2002 and its amendments. The provisions of the Act are obligatory for new installations from 2002 and for existing installations from 2012.

The act is not dealing directly with greenhouse gas emissions. The IPPC legislation has an indirect impact on GHG emissions through emission limits for pollutants and use of best available technologies. The strengthened emission limits may have an important impact especially on coal-fired power plants and combined power and heat plants. However, it is difficult to estimate the impact of this directive on the GHG emissions.

National Instruments

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.

- Draft 2030 Strategy for Sustainable Energy Development, with a 2050 horizon;
- Roadmap for Climate Neutrality of the Republic of Bulgaria;
- National Strategy for Development of the Mining Industry by 2030;
- Strategy for the Participation of Bulgaria in the Fourth Industrial Revolution;
- Long-term national strategy to support the renovation of the national stock of residential and non-residential buildings with an implementation horizon of 2050;
- Long-term Strategy for Mitigation of Climate Change by 2050 of the Republic of Bulgaria;
- Innovation strategy for smart specialisation;
- National Programme for Energy Efficiency of Multi-Family Residential Buildings;
- National policy framework for the development of the market for alternative fuels in the transport sector and for the deployment of the relevant infrastructure;
- An integrated transport strategy for 2030;
- National Plan for the Development of Combined Transport of the Republic of Bulgaria by 2030;
- National Action Plan for Forest Biomass Energy 2018-2027;
- National Strategy for Adaptation to Climate Change of the Republic of Bulgaria and Action Plan;

- National Strategy for the Development of Scientific Research in the Republic of Bulgaria 2017-2030;
- Bulgaria's electricity transmission network development plan for 2023-2032;
- National roadmap for improving the conditions for unleashing the potential for the development of hydrogen technologies and mechanisms for the production and supply of hydrogen.
- National Regional Development Strategy

Integrated national energy and climate plan until 2030

Delivering on the Energy Union's commitment to climate neutrality in line with the Paris Agreement and achieving the 2030 energy and climate targets requires the contribution of each MS. The integrated national energy and climate plans mandated by the Energy Union Governance Regulation therefore serve as strategic planning, focusing on the period 2021-2030, while taking into account longer-term perspectives

The INECP reflects the higher targets set by the European Green Deal and the European Climate Law, the Fit for 55 package, the RePowerEU Plan, as well as the latest report on Bulgaria under the European Semester.

The updated INECP defines ambitious targets and measures related to:

- The process of transformation of the national energy mix;
- Decarbonisation with sustainable and sufficient emission reductions in the energy sector thanks to new low-carbon technologies and a smooth transition to low-carbon sources;
- Adopt a national 2050 climate neutrality target.

The main objectives set out in the INECPs are:

- Stimulating the low-carbon development of the economy;
- Developing competitive and secure energy;
- Increasing energy efficiency and reducing carbon emissions, including by using the full potential of natural gas as an energy source and transitional fuel;
- Reducing dependence on imported fuels and energy;
- Ensuring affordable energy for all consumers.

Under the decarbonisation dimension, Bulgaria promotes and supports a reduction in greenhouse as emissions and an increase in the share of renewable energy in gross final energy consumption.

National GHG emission reduction target for 2030 compared to 2005 for non-ETS sectors (buildings, agriculture, waste and transport) under the Regulation (EU) 2023/857 (Effort Sharing Regulation), is minus 10% compared to its emissions in 2005;

National target in the land use, land use change and forestry sector under Regulation (EU) 2023/839 for the periods from 2021 to 2025, GHG emissions do not exceed removals, calculated as the sum of total emissions and total removals on its territory in all land accounting categories combined, and a national annual net removals target in the period from 2026 to 2030 of – 9 718 ktonnes CO2eq.

The national target set for the share of RES in gross final energy consumption by 2030 is 34.96%.

The electricity sector accounts for a 49.34% share of renewable energy in gross final electricity consumption. This share is projected to be achieved by increasing the electricity consumption of newly built renewable energy capacity (mainly wind and solar) by up to 7 160 MW for the period after 2022.

Important for the achievement of the target in the electricity sector is the promotion of investments for the development of the electricity transmission and distribution networks of the country, which will allow the technical connection and integration of the produced electricity from RES, in compliance with the criteria for security of the electricity system. The planned introduction of energy storage systems will allow the rapid deployment of new capacities using intermittent renewables and address grid congestion, balancing and market distortion.

Energy efficiency plays an important role in improving the country's energy security by reducing dependence on energy imports, reducing energy costs for businesses and households, creating more jobs, contributing to improving air quality and reducing greenhouse gas emissions and improving the quality of life of citizens.

In this regard, national targets have been set to achieve an 11.6% reduction in primary energy consumption and a 10.7% reduction in final energy consumption by 2030 compared to the Reference Scenario 2020.

In its plan, Bulgaria sets objectives for energy security and internal energy market in terms of diversification of supply of energy resources; enhanced flexibility of the national energy system; increased resilience of the regional and national energy systems as well as in terms of enhanced network and information security (cybersecurity). The electricity interconnection level foreseen for 2030 amounts to 15 %.

The NECP contains several national objectives and funding targets related to research, innovation and competitiveness focusing inter alia on the long-term development of a low-carbon economy; on the improvement of energy and resource efficiency in transport; on the modernisation of existing electricity networks; on innovation in the field of nuclear energy, on the competitiveness of the core energy-intensive industries and on the development of electric cars and hydrogen technologies.

Long-term strategy until 2050

The LTS presents alternative scenarios, including a pathway to approach climate neutrality by 2050. The LTS is a strategy starting from NECP without committing to a specific strategy to achieve the long-term objectives, but shows pathway(s) to develop the energy system beyond 2030 in order to comply with drastic emission reduction targets.

Starting point is thus the NECP until 2030, which implies that drastic changes need to occur in the decade 2030-2040.

The LTS's analysis includes all the main greenhouse gases. The LTS's analysis covers all domestic sectors, including LULUCF. It is not specified whether it includes international maritime and aviation. Decarbonisation scenarios consider the capture and storage of CO2 for electricity generation, including BECCS.

In addition to the baseline scenario (NECP), aligned with Bulgaria's National Energy and Climate Plan, the LTS presents five long-term decarbonisation scenarios:

- Electricity and Energy Efficiency (EE) Improvement for 2 °C (EE2°C)
- Electricity and Energy Efficiency (EE) Improvement 1.5 °C (EE1.5°C)
- New energy carriers (NC) for 2 °C (NC2°C)
- New energy carriers (NC) for 1.5 °C (NC1.5°C)
- New energy carriers, nuclear and CCS (NC_var)

Long term strategy for the renewal of the national building stock of residential and non-residential buildings until 2050

The long-term national strategy is a systematized target instrument, through which the vision for the renovation of the building stock of the Republic is outlined Bulgaria until 2050, the strategic goals for achieving the desired vision, the priorities within the scope of each strategic objective, the envisaged measures and policies on the identified priorities and the indicators for measuring the achievements results for the period 2021-2030.

Building fund of the Republic of Bulgaria, renewed and decarbonized by 2050, which provides a high quality of life in a healthy, safe, energetic efficient, modernized and high-tech living environment based of a complex of related factors, such as active participation of users for the efficient use of energy, production management and energy consumption in the building and professional management of the building fund.

The strategic objectives are synchronized with the EU's energy objectives efficiency and are based on the European strategic documents, the European and national energy efficiency legislation.

The strategic document defines indicators for measuring the results achieved for the following periods: 2021-2030, 2031-2040 and 2041-2050, which reflect staged target values of the renewal process the building stock of Bulgaria,

The national aspects of the implementation of energy efficiency policies to date, such as the use of high grant components in incentive schemes, the limited experience with the structuring and promotion of financial instruments. The low rate of renovation of buildings and poor awareness of users and owners for the effect of energy efficiency and its benefits in a broader sense, no contribute to the mass market entry of new technologies, materials and construction practices. In the period up to 2030, it is realistic to expect a gradual activation of renewal actions and a gradual increase in energy demand efficient services. Realistic and conservative goal setting is also related with the need to accumulate experience and funds for the financial instruments and gradually overcoming expectations of high levels of grant aid from citizens and owners of public service buildings.

In this scenario, by 2050, 60% of the residential building will be renovated fund and nearly 17% of non-residential. The area of the renovated buildings from the whole built fund will be over 45%. The reason for this distribution is as stated in item 1.1.3 that state and municipal

non-residential buildings represent only 29% of the non-residential building stock. A large part of the categories of buildings in the non-residential fund are related to economic activity, such as hotels, commercial buildings, business centers, establishments. The possibilities for improving energy efficiency in them is related to increasing their competitiveness and this is driven by market mechanisms that cannot be predicted.

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 /2024)

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 Paris Agreement, 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 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.

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.

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.

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.

Energy sector – production of electricity and district heating and residential and service sector

Instruments at EU level

Energy Efficiency Directive

First adopted in 2012, the directive was updated in 2018 and 2023, setting rules and obligations for achieving the EU's ambitious energy efficiency targets.

Energy efficiency helps reduce overall energy consumption and is therefore central to achieving the EU's climate ambition, while enhancing present and future energy security and affordability. To ensure that the EU's 2030 target of reducing greenhouse gas emissions by at

least 55% (compared to 1990) can be met, the Commission has revised the Energy Efficiency Directive, together with other energy and climate rules.

The revised Energy Efficiency Directive (EU/2023/1791) significantly raises the EU's ambition on energy efficiency. It establishes 'energy efficiency first' as a fundamental principle of EU energy policy, giving it legal-standing for the first time. In practical terms, this means that energy efficiency must be considered by EU countries in all relevant policy and major investment decisions taken in the energy and non-energy sectors.

Full implementation of the Energy Efficiency Directive will be key for the EU to comply with the commitment of the Global Pledge to double the global rate of energy efficiency improvements from about 2% to over 4% by 2030.

Renewable Energy Directive

The EU has adopted a binding target stating that the proportion of renewable energy has to increase up to 20% of total energy use over the period 2005-2020. The responsibility for attaining this target has been shared among the Member States.

Building on the 20% target for 2020, the recast Renewable Energy Directive 2018/2001/EU established a new binding renewable energy target for the EU for 2030 of at least 32%, with a clause for a possible upwards revision by 2023.

To meet the higher climate ambition, as presented in the European Green Deal in December 2019, further revisions of the directive were needed.

The revised Renewable Energy Directive EU/2023/2413 raises the EU's binding renewable target for 2030 to a minimum of 42.5%, up from the previous 32% target, with the aspiration to reach 45%.

It means almost doubling the existing share of renewable energy in the EU.

The national target for the share of energy from renewable sources in gross final consumption of energy from renewable sources set by the Republic of Bulgaria by 2030 is 34.96%. The national target thus set is higher than the 33% target set for Bulgaria in COM/2023/796.

Energy Performance of Buildings Directive 2010/31/EC

This is a framework directive within which the Member states decide on minimum requirements for example for energy performance, energy declarations and inspections or

advice on thermal boilers. Amendments of 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 are being prepared.

To boost the energy performance of buildings, the EU has established a legislative framework that includes the revised Energy Performance of Buildings Directive (EU/2024/1275) and the revised Energy Efficiency Directive (EU/2023/1791).

Together, the directives promote policies that will help achieve a highly energy efficient and decarbonised building stock by 2050 create a stable environment for investment decisions enable consumers and businesses to make more informed choices to save energy and money.

It also supports better air quality, the digitalisation of energy systems for buildings and the roll-out of infrastructure for sustainable mobility.

Eco-design Directive (2009/125/EC) and Energy Labelling Directive 2010/30/EU and their implementing regulations

The Energy Labelling Directive is used together with the Ecodesign Directive in order to set combined energy label requirements and energy efficiency requirements for products.

The directives state which products have to be labelled and contains provisions on how the labelling of household products is to be established. The aim is to reduce energy use from household products. The Directives and their implementing regulations are implemented in the Bulgarian legislation by the Act on the technical requirements for products and secondary legislation (Regulation on the labelling).

National instruments

Energy Act (EA) SG 107/2003, last amended SG 39/2024)

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 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 is Ordinance on the issue of certificates of origin for electricity produced by cogeneration.

Energy from Renewable Sources Act (ERSA) (SG 35/2011, last amended SG 106/2023)

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.

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, the Minister of Environment and Water, 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;
- Ordinance on the conditions and procedure for issuance, transfer, cancellation and recognition of guarantees of origin of the energy from renewable sources.

Energy Efficiency Act (EEA) (SG 35/2015, last amended SG 41/2024)

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 Energy 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 m2 (as of 12 March 2013 the threshold is reduced to 500 m2) and owners of industrial systems with annual energy consumption over 3000 MWh.

The operated buildings with a total floor area over 500 m2 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;

For the energy sector, the majority of measures influencing decarbonisation are included in the sections on RES, energy efficiency,internal market and energy security, as general changes in these dimensions lead to GHG emission reductions.

All listed measures of the Third National Climate Change Action Plan (2013-2020) have been extended to 2030 as follows:

- Reconstruction of cogeneration installations and central heating boilers with natural gas turbines;
- Reduction of losses from distribution and transmission networks;
- Reduction of losses in the heat transmission networks;
- Substitution of fuels - from coal to natural gas;
- Increasing high-efficiency cogeneration;
- Increasing the share of heating and cooling based on renewable energy sources;
- Improving production efficiency in existing coal-fired power plants.

The main aggregated measures of direct and indirect relevance for reducing greenhouse gas emissions are:

EN1 - **Promoting and facilitating the development of renewable self-consumption and the creation of renewable energy communities**

Scope: Increase the production of energy from renewable sources

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2021-2030

Scenario in which the measure is included: WAM

Potential emissions reductions: 1125 - 2230.55 Gg CO_2

EN2 - **Promoting the use of high-efficiency heating and cooling systems, the introduction of innovative geothermal and solar technologies and the use of waste heat and cold**

Scope: 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.

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2013-2030

Scenario in which the measure is included: WEM, WAM

Potential emissions reductions: 1440.81 - 1760.1 Gg CO_2

EN3 - **Promoting the use of biomass for centralised and local heat production**

Scope: 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, subject to the requirements of Article 28(2) to (7) and (10) of Directive (EU) 2018/2001.

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2022-2030

Scenario in which the measure is included: WAM

Potential emissions reductions: 1137.25 - 2164.7Gg CO2

EN4 - **Promoting the production of advanced biofuels, renewable liquid and gaseous transport fuels of non-biological origin, recycled carbon fuels and renewable electricity**

Scope: Promoting the production of advanced biofuels, renewable liquid and gaseous transport fuels of non-biological origin, recycled carbon fuels and renewable electricity, for the road and rail transport sectors and, for air transport, sustainable aviation fuels. The consumption of these fuels and energy should contribute to achieving the policy objectives for energy diversification and decarbonization of the transport sector. For the use of electricity from renewable sources in transport, efforts will be directed towards the deployment of electric mobility, the development and stimulation of the use of public electric transport, as well as accelerating the integration of modern technologies in the railway sector.

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2021-2030

Scenario in which the measure is included: WAM

Potential emissions reductions: Including in the transport sector (IE)

EN5 - **Enabling offshore wind energy development**

Scope: Legislative changes are being developed that will regulate the conditions for exploring the potential of the energy resource, the suitability of selected areas for the implementation of investment projects and the construction of energy facilities in the marine spaces with a view to the effective utilization of wind potential and the creation of conditions for the implementation of future joint projects with other member states.
Directly affected greenhouse gases: CO_2
Implementation period: 2028-2050
Scenario in which the measure is included: WAM
Potential emissions reductions: NE

EN6 - **Introducing a process of planning priority zones for accelerated development of energy sites for the production of electricity from wind energy**
Scope: A Plan for determining priority areas for the development of wind power generation facilities is being developed. The planning process will prioritize artificial built-up areas, such as building roofs, areas with existing transport infrastructure, parking areas, waste sites, industrial zones, industrial parks, quarries, artificial water basins and reservoirs, urbanized areas, disturbed terrain, pastures, tailings ponds, waste dumps and degraded lands that cannot be used in agriculture. In the priority areas, short deadlines will be introduced for administrative permits for the construction, reconstruction and commissioning of energy facilities, as well as for the conduct of environmental impact assessments.
Directly affected greenhouse gases: CO_2
Implementation period: 2028-2050
Scenario in which the measure is included: WAM
Potential emissions reductions: NE

EN7 - **Enabling the transition from coal to low-carbon fuels**
Scope: It is appropriate to provide new incoming gas transmission infrastructure for transmission to thermal power plants and other potential consumers in coal regions to create market-based conditions for the modernisation of combustion plants of thermal power plants and other energy consumers, for switching from coal to natural gas.

This will also create the necessary conditions for the flexible and efficient operation of the installations after their modernisation, in line with the commitments to decarbonise the energy sector and transition to net carbon neutrality.

Directly affected greenhouse gases: CO_2

Implementation period: 2018-2030

Scenario in which the measure is included: WAM

Potential emissions reductions: 2451.31- 3943.88 Gg CO_2

EN8 - **Introduction of a national financing mechanism for energy efficiency - National Decarbonisation Fund**

Scope: The initiative is proposed for inclusion as a RePowerEU reform. The implementation of the reform should be carried out jointly by the teams of the Ministry of Finance, the Ministry of Labour and Social Policy, the Ministry of Regional Development and Public Works and the Ministry of Energy (responsible institutions for the implementation of appropriate support measures under the provisions of Article 38e of the Energy Act) and supported by an international financial institution following the example of the implementation of other major reforms in the country

Directly affected greenhouse gases: CO_2

Implementation period: 2026-2030

Scenario in which the measure is included: WAM

Potential emissions reductions: Regulatory

EN9 - **National Programme for Energy Efficiency of Multi-Family Residential Buildings**

Scope: The implementation of energy efficiency measures in multi-family residential buildings will contribute to:

- higher level of the energy efficiency of multi-family residential buildings and energy costs decrease;
- improving the exploitation features for extending the life cycle of the buildings;
- providing conditions of living environment in line with the sustainable development criteria

Directly affected greenhouse gases: CO_2

Implementation period: 2018-2030

Scenario in which the measure is included: WEM, WAM
Potential emissions reductions: 253.72 - 588.2 Gg CO_2

EN10 - **Long-term national strategy to support the renovation of the national stock of residential and non-residential buildings by 2050**

Scope: A long-term national strategy for the renovation of buildings in Bulgaria until 2050, is focusing on improving energy efficiency and decarbonizing residential and non-residential buildings. It includes an analysis of the current condition of the buildings, identifies cost-effective approaches for enhancing their energy performance, and forecasts expected energy savings and benefits for the environment and society. The document also outlines policies and measures to promote economically efficient deep renovation of buildings and provides a roadmap to achieve the goals by 2050.
Directly affected greenhouse gases: CO_2
Implementation period: 2023-2050
Scenario in which the measure is included: WAM
Potential emissions reductions: 1426.78 Gg CO_2

EN11 - **Introduction of a mandatory energy efficiency scheme** (reduction of fuel and energy consumption in final energy consumption);
Scope: This measure is proactive and is consistent with the announced direction and actions of the EC aiming at reducing fuel and energy consumption
Directly affected greenhouse gases: CO_2
Implementation period: 2015-2030
Scenario in which the measure is included: WAM
Potential emissions reductions: 1756.2 Gg CO_2

EN12 - **Households affected by the mandatory phase-out of stoves to switch to natural gas heating, district heating**

Scope: Households affected by the mandatory phase-out of stoves to switch to natural gas heating (reconnection and new connections), district heating (reconnection and new

connections) or eco-design-compliant heating appliances, in line with the National Air Pollution Control Programme 2020-2030

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2021-2030

Scenario in which the measure is included: WAM

Potential emissions reductions: 70.6 - 98.55Gg CO2

Industrial emissions from combustion and processes (including emissions of fluorinated greenhouse gases)

Instruments at EU level

Directives and Regulations governing emissions of fluorinated greenhouse gases

To control emissions from F-gases, including HFCs, two legislative acts are in place: the Mobile Air Conditioning (MAC) Directive3 on air conditioning systems used in small motor vehicles, and the F-gas Regulation4, which covers all other key applications in which F-gases are used.

The MAC Directive introduced a gradual ban on emissions of F-gases from mobile air conditioning systems with a GWP higher than 150 in passenger cars. Since 1 January 2017, the use of fluorinated greenhouse gases with a GWP higher than 150 has been banned in all new passenger cars and certain lorries put on the EU market.

Following a review of the F-gas Regulation, a revision laying down more ambitious targets was adopted in 2024. The aim is to phase out HFCs placed on the EU market by 2050. A quota system was established in 2015 to control and reduce HFC emissions. Annual quantitative limits (quotas) on HFCs placed on the EU market by producers and importers are set every year and will gradually be reduced over time, ending at net zero in 2050. This revision is expected to cumulatively prevent greenhouse gas emissions of 310 Mt CO2eq by 2050[5].

Further key measures of the new F-gas Regulation are:

- integrating HFCs used in metered dose inhalers into the quota system;
- stricter rules to prevent emissions where F-gases are produced or used;

[3] Directive 2006/40/EC relating to emissions from air conditioning systems in motor vehicles and amending Council Directive 70/156/EEC, https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32006L0040

[4] Regulation (EU) 2024/573 on fluorinated greenhouse gases, amending Directive (EU) 2019/1937 and repealing Regulation (EU) No 517/2014, https://eur-lex.europa.eu/eli/reg/2024/573/oj

[5] Fluorinated greenhouse gases, https://climate.ec.europa.eu/eu-action/fluorinated-greenhouse-gases_en.

- facilitating better enforcement and monitoring through more digitalisation and electronic automation;
- initiating a gradual reduction in the production of HFCs in the EU

The measures in the industry sector aim to achieve:

- higher energy efficiency and lower heat losses in the industry sector;
- increased use of natural gas in industry through new gas infrastructure;
- use of alternative fuels;
- creating a technological park by introducing incentives to encourage the private sector to invest in research and development and in innovation in widely used production methods aimed at optimum resource efficiency;
- promoting the exchange of good practices between enterprises in reference to efficient use of inputs in production.
- Systems for monitoring of energy use in industry
- Energy efficiency audits and implementation of the measures prescribed

In addition to the EU Emissions Trading Scheme, EU law on industrial emissions (integrated prevention and control of pollution), the reduction of fluorinated greenhouse gases and the control of substances that deplete the ozone layer also contribute to lowering GHG emissions and air pollutants.

The main measures to reduce greenhouse gases in the industrial sector are:

IP1 - **Higher energy efficiency in industry and reduction of heat losses**

Scope: Measures to increase the efficiency of production in a cost effective way.

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2013-2030

Scenario in which the measure is included: WEM, WAM

Potential emissions reductions: 15.63 - 19.38 Gg CO_2

IP2 - **Energy efficiency audits and implementation of prescribed measures**

Scope: 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.

Directly affected greenhouse gases: CO2, HFCs, SF6

Implementation period: 2013-2030

Scenario in which the measure is included: WEM, WAM

Potential emissions reductions: Regulatory

IP3 – Prohibitions and restrictions on fluorinated greenhouse gases

Scope: Implementation of Regulation (EU) 2024/573 on fluorinated greenhouse gases, amending Directive (EU) 2019/1937 and repealing Regulation (EU) No 517/2014: aims to phase out the use of climate-impacting fluorinated gases by encouraging the use of climate-friendly natural refrigerant gases. Measures under the regulation include: measures for emission prevention and leakage controls; new provisions on the containment, use, recovery, recycling, reclamation and destruction of fluorinated gases; certification and training; restrictions on the placing on the market and sale of specific equipment with certain HFCs; gradual reduction of the amount of hydrofluorocarbons put on the market to zero by 2050..

Directly affected greenhouse gases: HFC, SF_6

Implementation period: 2024-2050

Scenario in which the measure is included: WAM

Potential emissions reductions: 2057.16 Gg CO_2

IP4 - **Promote the production and consumption of alternative renewable fuels, namely hydrogen, including through the development of alternative fuels infrastructure**

Scope: Developed and adopted in 2023, the National Roadmap for Improving the Conditions for Unleashing the Development Potential of Hydrogen Technologies and Hydrogen Production and Supply Mechanisms sets the path for building a hydrogen industry. The aim of the Roadmap is to create the basis for a coherent framework for the efficient, smooth and consistent introduction of technologies for the production, transport and use of hydrogen in industry,

energy, transport and households, to create favourable conditions for innovation and investment. It is envisaged that the introduction of hydrogen electric transport will start from the urban bus transport, for which the municipalities are responsible. This approach is more cost-effective due to the possibility of a larger start-up with a large number of means of transport and charging infrastructure with a high percentage of regulated usability..

Directly affected greenhouse gases: CO2, CH4, N2O

Implementation period: 2025-2050

Scenario in which the measure is included: WAM

Potential emissions reductions: 15.88 - 17.23 Gg CO_2

IP5 - **Promoting carbon capture and storage projects**

Scope: Supporting innovative low-CO2 technologies in energy-intensive industries

Directly affected greenhouse gases: CO2,

Implementation period: 2028-2050

Scenario in which the measure is included: WAM

Potential emissions reductions: 2950.32 Gg CO_2

Transport

Instruments at EU level

Regulation setting emission performance standards for new passenger cars

To deliver a more ambitious climate policy and the targeted reduction of GHG emissions by at least 55% by 2030 compared to 1990 levels, the Commission launched the following transport proposals in 2021:

- amendment of the Regulation setting CO2 emission performance standards for new passenger cars and for new light commercial vehicles;
- revision of the Alternative Fuels Infrastructure Directive;
- revision of the Energy Taxation Directive;
- new ReFuelEU Aviation Regulation;
- new FuelEU Maritime Regulation;
- revision of the Renewable Energy Directive,

In April 2023, the European Parliament and the Council amended the Regulation on CO2 emission performance standards[6]. The amendment increased the CO2 emission performance standards for new passenger cars and vans from 2030 onwards (compared to 2021 levels):

- from 2030: 55% for cars and 50% for vans;
- from 2035: 100% for cars and 100% for vans.

This is expected to reduce total CO2 emissions from cars and vans by 32-33 % by 2030 and 54-66 % by 2035 compared to 2005.

Aviation in the EU Emissions trading system

Aviation is included in the EU Emissions trading system from year 2012 in accordance to Regulation (EU) No 421/2014 of the European Parliament and of the Council of 16 April 2014 amending Directive 2003/87/EC.

The ReFuelEU Aviation Regulation[7], which entered into force in November 2023, aims to increase both demand for and supply of sustainable aviation fuels (SAF). It obliges aviation fuel suppliers at EU airports200 to gradually increase the minimum share of SAF supplied to aircraft operators from 2% in 2025 to 70% in 2050. The obligation also includes an increase in the minimum share of synthetic aviation fuels from 1.2% in 2030 to 35% in 2050. Airports are required to guarantee that aircraft operators can access all the necessary infrastructure to deliver, store and refuel with the required shares of SAF. The Regulation obliges all aircraft operators departing from EU airports to refuel with at least 90% of the fuel necessary for their flights.

Maritime transport

Starting from 1 January 2024, the EU Emissions Trading System has been extended to cover CO2 emissions from large ships entering ports in the European Economic Area regardless of the flag they fly. By defining the maximum amount of greenhouse gases that can be emitted under the system, the EU ETS ensure that all the sectors covered under its scope contribute to the EU's climate objectives following a pre-defined trajectory.

[6] Regulation (EU) 2023/851 amending Regulation (EU) 2019/631 as regards strengthening the CO2 emission performance standards for new passenger cars and new light commercial vehicles in line with the Union's increased climate ambition, http://data.europa.eu/eli/reg/2023/851/oj

[7] Regulation (EU) 2023/2405 on ensuring a level playing field for sustainable air transport (ReFuelEU Aviation), https://eur-lex.europa.eu/eli/reg/2023/2405/oj

The FuelEU Maritime Regulation, which enters into force in 2025, lays down rules limiting the greenhouse gas intensity of the energy used on board ships above 5 000 gross tonnage calling at European ports, regardless of the flag they fly. The rules apply to 50% of the energy used for voyages starting or ending outside the EU and 100% of the energy used for voyages between two EU ports.

The annual average reduction in greenhouse gas intensity will gradually increase (-2% in 2025 to - 80% in 2050 compared to the average in 2020). The targets cover not only CO2 but also methane and nitrous oxide emissions over the full lifecycle of the fuels used onboard, on a Well-to-Wake (WtW) basis. The Regulation contains an obligation for passenger and container ships to use onshore power supply while moored at a quayside unless they use another zero-emission technology as of 2030.

RES directive

The revised Renewable Energy Directive entered into force in November 2023[8]. For the transport sector, it sets a target of 14.5% lower greenhouse gas intensity of transport fuels by 2030 or 29% renewable energy in final energy consumption by 2030. The Directive also includes a target for renewable fuels of non-biological origin

National instruments

The main objectives of GHG emissions reduction policy in the transport sector are to:

- boost the production of electric and other environmentally friendly vehicles;
- boost the use of/demand for new environmentally friendly vehicles;
- accelerated deployment of the infrastructure for charging electric and hybrid cars;
- promote research and development in the area of environmentally friendly vehicles and toll systems;
- organise awareness campaigns and build stakeholder capacity for development of resilient mobility.

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

[8] Directive (EU) 2023/2413 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC, http://data.europa.eu/eli/dir/2023/2413/oj.

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.

The main objectives of Bulgaria's policy to reduce greenhouse gas emissions in the transport sector are:

- Promote the production of electric and other environmentally friendly vehicles;
- Promote the use/demand of new environmentally friendly vehicles;
- Accelerated deployment of charging infrastructure for electric and hybrid vehicles;

- Promote research and development activities related to green vehicles;
- Promote the production of sustainable aviation fuels (SAF) by introducing mandatory blending mandates under Annex I of Regulation (EU) 2023/2405 of the EP and of the Council of 18 October 2023 on ensuring a level playing field for sustainable air transport (ReFuelEU Aviation initiative);
- Promoting the supply and use of sustainable aviation fuels;
- Provision of infrastructure for the refuelling of sustainable aviation fuels at airports for public use;
- Promoting research and development activities related to the production of sustainable aviation fuels;
- Organisation of awareness-raising campaigns, capacity building of stakeholders with regard to the development of sustainable mobility.

The priorities set out under the 2021-2027 Transport Connectivity Programme are:

- Priority 1 'Development of railway infrastructure along the "core" and "comprehensive" TEN-T networks';
- Priority 2 "Development of road infrastructure along the "core" Trans-European Transport Network" and road connections;
- Priority 3 'Improving intermodality, innovation, modernised traffic management systems, improving transport security and safety';
- Priority 4 "Urban intermodality".

They contribute to the implementation of the Green Deal, the Sustainable and Smart Mobility Strategy of the European Commission, as well as to the implementation of the national transport policy.

The investments foreseen under the priorities of the programme promote the use of environmentally friendly modes of transport and alternative fuels, improve the quality of road and rail infrastructure, promote intermodality and intelligent transport systems and thus contribute to reducing the harmful environmental impact of transport.

The investments foreseen under Priority 1 will contribute to attracting passenger and freight traffic to rail by improving the quality of rail infrastructure.

The investments for the development of the railway infrastructure are concentrated mainly along the section of the Orient/East-Mediterranean corridor, passing horizontally through the middle of the country.

The investments under Priority 3 will contribute to the development and expansion of inland water and sea ports for public transport for carrying out multimodal operations, modernization

and development of terminals and port facilities for combined transport, as well as to the development of the railway junctions Gorna Oryahovitsa, Ruse and Varna. Investments are also planned for the construction of alternative fuels infrastructure along the main directions of the national road network (RFN). Interventions are for road sections between some of the largest cities in the country, where transport has been identified as an air pollutant. In addition, the deployment of recharging infrastructure for alternative fuels also in public transport ports will be supported.

Under Priority 3, two main procedures are set out as follows:

Intermodal Operators procedure, under which a grant scheme of up to 50% is planned to support all intermodal operators for:

- Purchase of equipment;
- Construction/rehabilitation of railway/road infrastructure;
- Cargo handling sites;
- Implementation of IT systems and charging stations.

The investments will contribute to the development and expansion of intermodal terminals for combined transport, thus creating the necessary conditions and prerequisites for carrying out multimodal operations.

Alternative fuels procedure, which will finance the construction of alternative fuels infrastructure under the NFP (TEN-T) as well as in public transport ports (maritime and inland waterways) along the TEN-T.

The procedure aims to establish a national scheme to support the construction of recharging infrastructure to allow funding for the development of charging infrastructure for light and heavy-duty electric vehicles, as well as in public transport ports (maritime and inland waterways) on the TEN-T. It will be launched in 2024.

Integrated transport strategy up to 2030

The strategy outlines the main directions for the development of the national transport system in the period up to 2030.

The document sets out 3 strategic objectives covering 9 strategic priorities, each containing a framework of specific objectives (tasks). On this basis, measures have been identified which are the most appropriate to achieve the relevant objectives.

The strategic objectives of the transport policy until 2030 are:

- Increasing the efficiency and competitiveness of the transport sector;
- Improving transport connectivity and accessibility (internal and external);
- Limiting the negative effects of the development of the transport sector.

The strategic priorities in the development of transport are:

- Effective maintenance, modernization and development of transport infrastructure;
- Improving the management of the transport system;
- Development of intermodal transport;
- Improving the conditions for the implementation of the principles of liberalisation of the transport market;
- Reducing fuel consumption and increasing the energy efficiency of transport;
- Improving the connectivity of the Bulgarian transport system with the single European transport area;
- Providing quality and affordable transport in all regions of the country;
- Limiting the negative impact of transport on the environment and human health;
- Increasing the security and safety of the transport system.

Within the scope of the strategic document, a National Transport Model has been prepared, which has been developed for passenger and freight transport and is applicable to individual modes of transport within the country, international and transit transport.

The main measures affecting greenhouse gas emissions in the transport sector are:

T1 - **Increasing the share of public electric transport** - railway, trolleybus, tram, metro

Scope: Increase the share of public electric transport. Increasing the share of electric rail – improving infrastructure; Increasing the share of electric rail – rolling stock renewal; Increasing the share of electric mass public transport – infrastructure improvements; Increasing the share of electric mass urban transport – vehicle renewal

Directly affected greenhouse gases: CO2, CH4, N2O

Implementation period: 2014-2030

Scenario in which the measure is included: WEM

Potential emissions reductions: 92 - 110.1 Gg CO_2 eq.

T2 - **Increasing the share of biofuels**

Scope: 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 vegetable oils. In Bulgaria, the most promising projects are for the production of ethanol and biodiesel. The Energy from Renewable Sources Act (Art. 47. (1) there are stages in which certain percentages of biodiesel and bioethanol must be achieved in the fuels concerned, as well as requirements on the type of biofuels and the sustainability criteria they must meet. Biofuels will continue to be used in the coming years, gradually increasing the share of new biofuels used.
Directly affected greenhouse gases: CO_2, CH_4, N_2O
Implementation period: 2014-2030
Scenario in which the measure is included: WEM, WAM
Potential emissions reductions: 292 - 510.1Gg CO_2 eq.

T3 - **Introduction of intelligent transport systems on the national and urban road network**

Scope: Intelligent Transport Systems (ITS) cover a wide range of technical solutions designed to improve transport by improving mobility and improving road safety. Telematics (a combination of telecommunications and informatics) uses advanced technologies to meet the needs of transport. Intelligent transport systems and telematics solutions help to improve road safety, promote the efficiency of existing infrastructure used and contribute to reducing environmental pollution by controlling traffic and managing traffic volumes.
Directly affected greenhouse gases: CO_2, CH_4, N_2O
Implementation period: 2014-2030
Scenario in which the measure is included: WEM, WAM
Potential emissions reductions: NE

T4 - **Development and construction of intermodal terminals for combined transport**

Scope: The measure aims to achieve a two-fold effect, consisting on the one hand in increasing the degree of usability of more environmentally friendly modes of transport and on the other - in creating the right conditions for increasing the added value of transport activity, with an overall reduction in transport costs per unit of GDP.

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2014-2030

Sources of funding: European funds with state and municipal co-financing, state and municipal budget

Scenario in which the measure is included: WEM

Potential emissions reductions: 246.1 - 295.32 Gg CO_2 eq.

T5 - **Promoting the use of hybrid and electric vehicles**

Scope: Under the Innovation Strategy for Smart Specialisation (ISIS) 2021-2027, in the thematic area 'Clean Technologies, Circular and Low-Carbon Economy', one of the priority areas is the development and deployment of technologies related to sustainable mobility (battery and hydrogen) based on hydrogen and other alternative fuels, connected infrastructure and eco-mobility.

One of the centres identified as a specific beneficiary is the HITMOBIL Competence Centre – Technologies and Systems for Generation, Storage and Consumption of Clean Energy. The Centre focuses on research, experimental development and knowledge transfer in the field of 'Technology and systems for the generation, storage and consumption of clean energy'.

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2014-2030

Sources of funding: Climate investment programme, private investment

Scenario in which the measure is included: WEM

Potential emissions reductions: 95.36 - 190.72 Gg CO_2 eq.

T6 - **Establishment of a national scheme to support the construction of recharging infrastructure**

Scope: Alternative fuels procedure, which will finance the construction of alternative fuels infrastructure under the NFP (TEN-T) as well as in public transport ports (maritime and inland waterways) along the TEN-T.

The procedure aims to establish a national scheme to support the construction of recharging infrastructure to allow funding for the development of charging infrastructure for light and

heavy-duty electric vehicles, as well as in public transport ports (maritime and inland waterways) on the TEN-T. It will be launched in 2024.

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2024-2030

Scenario in which the measure is included: WAM

Potential emissions reductions: 220.31 Gg CO_2 eq.

T7 - **Promoting the development of combined transport**

Scope: The Ministry of Transport and Communications has developed a National Plan for the Development of Combined Transport in the Republic of Bulgaria until 2030 (approved by Decision No 504 of the Council of Ministers of 21 July 2022). It is a reference document for the implementation of the policy to support sustainable modes of transport. An Implementation Agenda linked to the 2030 time horizon and potential sources of funding is also proposed. Three groups of measures have been identified: 1) organisational and administrative, 2) operational and service support, and 3) infrastructure. Their implementation is of great importance because it will increase the efficiency of the transport system by using the advantages of combined transport (lower emissions of harmful substances, increased road safety, noise reduction due to a reduction in road transport, reduced use of conventional fuels in transport) over using only road transport for freight transport.

The plan will support the implementation of projects for the development of a network of modern intermodal terminals and the definition of incentives for businesses to implement more efficient and environmentally friendly transport solutions and chains. By 2030, the construction of intermodal terminals in Sofia and Northern Bulgaria is planned, as well as a study of the need to build a terminal in Vidin. The document includes measures for the development of logistics centers in Bulgaria and for the improvement of the leading railway infrastructure to existing port and rail-road terminals.

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2022-2030

Scenario in which the measure is included: WAM

Potential emissions reductions: 72.45 - 86.94 Gg CO_2 eq.

T8 - **Promote the production and consumption of alternative renewable fuels, namely hydrogen, including through the development of alternative fuels infrastructure**

Scope: Developed and adopted in 2023, the National Roadmap for Improving the Conditions for Unleashing the Development Potential of Hydrogen Technologies and Hydrogen Production and Supply Mechanisms sets the path for building a hydrogen industry. The aim of the Roadmap is to create the basis for a coherent framework for the efficient, smooth and consistent introduction of technologies for the production, transport and use of hydrogen in industry, energy, transport and households, to create favourable conditions for innovation and investment. It is envisaged that the introduction of hydrogen electric transport will start from the urban bus transport, for which the municipalities are responsible. This approach is more cost-effective due to the possibility of a larger start-up with a large number of means of transport and charging infrastructure with a high percentage of regulated usability.

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2028-2050

Scenario in which the measure is included: WAM

Potential emissions reductions: 1480 Gg CO_2 eq.

Measures with an indirect effect on GHG emission reductions

T9 - Facilitate the informed choice of a transport vehicle to increase the number of vehicles purchased with a lower level of harmful emissions (corresponding to Euro IV, V or VI).

T10 - Restructuring of city streets;

T11 - Promoting sustainable driving;

T12 - Legal provisions have been introduced for the possibility of establishing low-emission zones (LEZs) in cases where the type and extent of ambient air pollution significantly increase the risk to human health and/or the environment or in the event of failure to meet the standards for harmful substances (pollutants) in ambient air and standards for the deposition of harmful substances (pollutants), approved by regulations of the Minister for the Environment and Water and the Minister for Health.

Adaptation measures from the Action Plan to the National Adaptation Strategy contributing to decarbonisation:

T13 - Development and implementation of a programme to strengthen the resilience of the road network to extreme weather events;
T14 - Development and implementation of a programme to strengthen the resilience of the railway network to extreme climatic events;
T15 - Regular updating of the norms for the design of roads and railways.

Waste

Instruments at EU level

The **Waste Framework Directive**[9] is the key legal framework for treating and managing waste in the EU. It establishes an order of preference for managing and disposing of waste, referred to as the waste hierarchy: prevention, preparing for re-use, recycling, recovery and disposal. The Directive sets three main targets:

- by 2020, the preparation for re-using and recycling waste materials (such as paper, metal, plastic and glass) from households is to be increased overall to a minimum of 50% by weight;
- the preparation for the re-use and recycling of municipal waste is to be increased to a minimum of 55% by 2025 60% by 2030 and 65% by 2035;
- by 2020, the preparation for the re-use, recycling and other material recovery, including backfilling operations that use waste to substitute other materials, of non-hazardous construction and demolition waste is to be increased to a minimum of 70% by weight.

The EU's waste hierarchy establishes landfilling as the least preferable option for waste disposal. It should be kept to an absolute minimum. The **Landfill Directive**[10] sets stringent operational and technical requirements for landfill sites with the goal of minimising any negative effects on human health and the environment (including methane emissions). Key measures of the Directive are:

• introducing restrictions on the landfilling of all waste that is suitable for recycling or other material or energy recovery from 2030;

• limiting the share of municipal waste landfilled to 10% by 2035 (by weight).

[9] Directive 2008/98/EC on waste and repealing certain Directives, http://data.europa.eu/eli/dir/2008/98/2024-02-18
[10] Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste, http://data.europa.eu/eli/dir/1999/31/oj.

The **Urban Wastewater Treatment Directive** (UWWTD)[11] aims to ensure that domestic and industrial wastewater is effectively collected, treated and discharged. According to the European Environment Agency 98% of EU wastewater is adequately collected and 92% is adequately treated.

Instruments at national level

Waste Management Act (WMA) (SG 86/2003, last amended SG 85/2025)

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;

[11] Council Directive 91/271/EEC of 21 May 1991 concerning urban wastewater treatment, https://eurlex.europa.eu/eli/dir/1991/271/oj.

- 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 84/2023)

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

National Waste Management Plan 2021-2028

Regulatory, environmental, economic measures; implementation: 2021-2028

It plays a key role in the effective and efficient management of waste in the country. The main objectives of the Plan include reducing the harmful impact of waste by preventing and promoting re-use, increasing the amount of recycled and recovered waste, and reducing the quantities and risk of landfilled municipal and other waste.

Five programmes have been developed to achieve the objectives as part of the Plan, namely:

- Waste prevention programme with a sub-programme on food waste prevention;
- Programme to achieve the preparing for re-use and recycling targets for municipal waste;
- Programme for achieving the targets for recycling and recovery of construction and demolition waste;
- Programme for achieving the targets for recycling and recovery of mass waste with a sub-programme for packaging waste management;
- Programme to reduce the quantities and risk of landfilled household and other waste.

The programs contain both investment measures and non-investment - "soft" measures. Investment measures mainly include the construction of infrastructure. "Soft" measures include a diverse range of activities, including regulatory changes; recruitment of staff; training of employees; preparation of calls for projects; preparation of projects; development of methodologies, instructions and other administrative acts; performance of control activities; conducting information campaigns; development and implementation of information systems, etc.

The estimated value of the programmes valued under this approach is BGN 1 428.51 million.

Investment measures account for 78% of planned spending in NWMP 2021-2028, while soft measures account for 22%, respectively. The Programme to reduce the quantities and risk of municipal waste landfilled accounts for 51% of the total planned investments in NWMP 2021-

2028, followed by the Programme to achieve the preparing for re-use and recycling targets for municipal waste with 27.4% of the investments.

Waste prevention is the most efficient way to improve resource efficiency and reduce the environmental impact of waste.

The Waste Framework Directive 2008/98/EC introduces a waste management hierarchy for institutions, businesses and households to deal with waste and prioritises measures in the following order:

- Prevention of waste generation;
- Preparation for re-use;
- Recycling;
- Other recovery, e.g. energy recovery;
- Disposal (controlled landfilling, incineration without energy recovery, etc.).

The measures of the Third National Climate Change Action Plan 2013-2020, which are planned to be continued and upgraded until 2030, are:

- Continue and increase separate collection of green waste in municipalities;
- Capture and incineration of biogas in all new and existing regional landfills;
- Capture and incineration of biogas in reclaimed municipal landfills;
- Assessment of the energy potential of biogas from regional landfills planned to be recultivated;
- Introduction of anaerobic sludge stabilization with biogas capture and incineration in new installations and installations under reconstruction in settlements with more than 20 000 population equivalents;
- Construction of municipal facilities for the recovery of biodegradable waste, with energy and compost production;
- Introduce differentiated fees for waste generated.

New policies and measures in the waste sector

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Regulatory, environmental, economic measures; implementation: 2021-2028

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Measures of direct and indirect relevance for the reduction of greenhouse gas emissions:

W1 - Completion/upgrading of regional municipal waste management systems

Description: Programme to achieve the preparing for re-use and recycling targets for municipal waste. Performance indicator: share (%) of funds absorbed; number of completed contracts; number of installations built. Responsible institutions: MA of PIC, municipalities; RSO

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2021-2030

Potential emission reductions: 45.12 - 69.7 Gg CO_2 eq.

W2 - Construction of municipal sites for the free delivery of separately collected household waste, including large-scale waste, and other separately collected waste in all settlements with a population greater than 10 000 inhabitants

Description: Programme to achieve the preparing for re-use and recycling targets for municipal waste. Performance indicator: Number of sites built. Responsible institutions: MA of POS, municipalities, RWMA.

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2021-2030

Potential emission reductions: 26.3 - 47.85 Gg CO_2 eq.

W3 - Composters for green and other bio-waste provided free of charge to households

Described: Waste prevention programme with a sub-programme on food waste prevention. Performance indicator: Number of composters provided to households. Responsible institutions: municipalities, households.

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2021-2030

Potential emission reductions: 15.1 - 18.72 Gg CO_2 eq.

W4 - Reducing waste paper and other office supplies by implementing national and sectoral e-Government programming documents

Description: Waste prevention programme with a sub-programme on food waste prevention. Performance indicator: Implemented e-governance projects. Responsible institutions: MA of Road Traffic Accident 2021-2027, state and municipal administrations.

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2021-2030

Potential emission reductions: NE

W5 - Construction of waste recycling plants

Description: Programme to achieve the preparing for re-use and recycling targets for municipal waste. Performance indicator: Number of waste recycling plants built. Responsible institutions: MoEW, Municipalities, legal entities for profit.

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2021-2030

Potential emission reductions: 172.01 - 244.76 Gg CO_2 eq.

W6 - Separate collection and recycling of construction waste, incl. in industrial zones when proven necessary Number of projects implemented for separate collection and recycling of construction waste. Responsible institutions: Municipalities, legal entities for profit, MA of PIC.

Description: The programme to achieve the targets for recycling and recovery of construction and demolition waste.

Directly affected greenhouse gases: CO_2

Implementation period: 2021-2030

Potential emission reductions: 10.5 - 12.64 Gg CO_2 eq.

Agriculture

Instruments at EU level

The Common Agricultural Policy

On 16 December 2013 the Council of EU Agriculture Ministers formally adopted the four Basic Regulations for a reformed CAP as well as Transition Rules for 2014. Farmers should be rewarded for the services they deliver to the wider public, such as landscapes, farmland biodiversity, climate stability even though they have no market value. Within the CAP second pillar, rural development, Member States have the possibility and are requested to adopt measures on climate mitigation and adaption.

The CAP has various impacts on agriculture and forestry but also on the preservation of the environment on some 70% of the EU territory, and the quality of life of 50% of the EU population. CAP is supposed to contribute to the objectives of the Cohesion Policy by promoting balanced territorial development, but also to ensure the safety and quality of foods consumed in the Common Market.

National instruments

Agricultural Producers Support Act (APSA) (SG 58/1998, last amended SG 85/2024)

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 the "Natura 2000" network.

There are three sources of agricultural support to Bulgarian farmers: the CAP First Pillar instruments (financed by the EAGF), the CAP Second Pillar instruments (financed by the EAFRD) and the national support schemes (state aid schemes) as notified to the European Commission.

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

APSA regulates some of the activities through which the measures envisaged for the Agriculture sector of the INECP 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.*

Agricultural Land Protection Act (ALPA) (SG 35/1996, last amended SG 41/2024)

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 INECP, such as counteracting the burning of stubble and plant waste and promoting agricultural practices aimed at reducing greenhouse gas emissions.

Strategic Plan for the Development of Agriculture and Rural Areas of the Republic of Bulgaria for the period 2023-2027

The development of the agriculture sector and the implementation of the various measures are mainly managed by the Strategic Plan for the Development of Agriculture and Rural Areas of the Republic of Bulgaria for the period 2023-2027 and the implementation of the sustainable agriculture component of the National Recovery and Resilience Plan of the Republic of Bulgaria.

The Strategic Plan for Agriculture and Rural Development 2023-2027 sets out 9 specific objectives (SPs), among which are three objectives with a direct and indirect impact on climate and climate change:

CP 4 - Contribute to climate change mitigation and adaptation, including by reducing greenhouse gas emissions and enhancing carbon sequestration, as well as promoting sustainable energy;

CP 5 - Promoting sustainable development and efficient management of natural resources such as water, soil and air, including by reducing chemical dependency;

CP 6 - Contribute to halting and reversing biodiversity loss, enhancing ecosystem services and preserving habitats and landscapes.

To achieve the specific objectives, interventions aimed at supporting farmers in making voluntary commitments in farm management related to climate change adaptation and mitigation and the protection and restoration of biodiversity and agricultural ecosystems are planned.

Farmers are obliged to comply with basic standards on the environment, climate change, public health, plant health and animal welfare. The basic standards cover certain statutory management requirements (SMRs) and standards for good agricultural and environmental condition of land (GAEC standards). These basic standards take better account of the environmental and climate challenges and the new environmental architecture of the Common Agricultural Policy, thus demonstrating higher environmental and climate ambitions.

Environmental schemes for the climate, the environment and animal welfare included in the Strategic Plan for Agriculture and Rural Development 2023-2027 shall contribute directly or indirectly to the achievement of the objectives and priorities of the decarbonisation dimension.

The following eco-schemes have been developed in response to the needs of reducing emissions from the agricultural sector and protecting and restoring biodiversity and soils and are available for farmers to implement:

I.C.1 - Eco scheme for organic farming (agricultural animals);

I.C.2 - Eco scheme for maintaining and improving biodiversity and ecological infrastructure;

I.C.3 - Eco scheme for preserving and restoring soil potential – promotion of green fertilisation and organic fertilisation;

I.C.4 - Eco-scheme for pesticide use reduction;

I.C.5 - Eco scheme for ecological maintenance of permanent crops;

I.C.6 - Eco scheme for extensive maintenance of permanent grassland;

I.C.7 - Eco scheme for maintaining and improving biodiversity in forest ecosystems;

I.C.8 - Eco scheme for diversification of cultivated crops.

To improve the knowledge and skills of farmers, the National Agricultural Advisory Service (NAAS) provides advice and individual advice to farmers on measures with an indirect and direct effect on greenhouse gas emission reductions for the following measures:

- Hummus conservation activities (fertilisation – precision fertilisation, green fertilisation; liming; sparing tillage, crop rotation, anti-erosion activities, etc.);
- Water-saving and energy-saving irrigation technologies;
- Extensive grazing of animals;
- Possibilities for the use of plant residues and the threats of stubble burning.

Consultations on measures with a direct effect on greenhouse gas emission reductions shall cover the following areas:

- Improving manure storage and application;
- Low-carbon manure processing practices (composting, anaerobic biogas processing, etc.).

The State Fund for Agriculture – Paying Agency (DFZ-PA) is the controlling authority and makes payments in respect of applications submitted by farmers applying for support. The intended use of the areas declared and their maintenance in good agricultural and environmental condition shall be established by checks carried out by the Technical Inspectorate of the DFZ-PA. Non-compliance with the standards found during a check shall be penalised by reducing the farmer's payments.

The measures in the Third National Climate Change Action Plan 2030 and the National Air Pollution Control Programme 2020-2030 aim at reducing emissions from the main sources in the sector. One of the main challenges facing the CAP is to address the increasingly deteriorating production conditions in agriculture due to climate change and the need for farmers to reduce their share of greenhouse gases, play an active role in mitigating climate change and providing renewable energy.

Based on the analysis of the main emission sources in agriculture, the following two main objectives are set:

- Reducing and/or optimising greenhouse gas emissions from the agricultural sector;
- Raise awareness and knowledge of both farmers and administration regarding actions and their impact on climate change.
- These main objectives are addressed by the following priorities:
- Reducing greenhouse gas emissions from agricultural land;
- Reducing methane emissions from biological fermentation in livestock farming;
- Improving manure management;
- Optimising the use of crop residues in agriculture;
- Improving the management of rice fields and rice production technologies;
- Improve farmers' and administration's knowledge of reducing emissions from the agricultural sector.

The measures envisaged in the Third National Climate Change Action Plan 2030 and the National Air Pollution Control Programme 2020-2030 that continue to contribute to reducing greenhouse gas emissions are:

A1 - **Stimulating the use of appropriate crop rotations**, especially with nitrogen fixing crops

Scope: Crop rotation refers to the scientifically justified sequential rotation of crops in time and place on a particular arable area. The period required for all crops to pass through all fields in the order determined by the crop rotation scheme is called the rotation period or rotation. The introduction of sustainable crop rotations that include winter vegetation cover and leguminous crops (legumes, soybeans, alfalfa, clover) will protect soils from erosion and carbon sequestration, a potential means of reducing greenhouse gas emissions.

Directly affected greenhouse gases: CH_4

Implementation period: 2013-2030

Scenario in which the measure is included: WEM, WAM

Potential emission reductions: 375.4 - 984.17 Gg CO_2 eq.

A2 - **Management of degraded agricultural land through biological revegetation with grass species typical of the region and application of erosion control measures and soil tillage methods**

Scope: Soil erosion is a process of mechanical destruction and removal of soil mass by the action of water and wind. Under its influence, the amount of nutrients and humus in the soil gradually decreases. As a result of erosion, the structure and water-air regime of the soil deteriorates. The combination of the specific natural and economic conditions on the territory of Bulgaria creates prerequisites for a high risk of development of soil degradation processes used in agriculture. The most common soil degradation processes include: water and wind erosion, pollution, reduction of stocks of organic matter (humus), compaction, acidification, salinisation, loss of biodiversity.

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2013-2030

Scenario in which the measure is included: WEM

Potential emission reductions: 48.75 - 50.87 Gg CO_2 eq.

A3 - **Improving manure management and use**

Scope: Manure production, processing and management is one of the most significant sources of CH4 greenhouse gas emissions in agriculture. All activities aimed at manure storage and treatment must take into account both the type of manure, solid or liquid, and collection and processing technologies.

Investment support is essential to motivate farmers to build such expensive facilities.

Directly affected greenhouse gases: CH_4

Implementation period: 2013-2030

Scenario in which the measure is included: WEM, WAM

Potential emission reductions: 10.27 - 15.54 Gg CO_2 eq.

A4 - **Introduction of low-carbon manure treatment practices**, e.g. composting, conversion of manure to biogas under anaerobic conditions

Scope: By introducing low-carbon practices for manure processing, emissions from manure storage can be reduced. This requires considerable knowledge and experience at regional level, as the effectiveness of the implementation of the measure depends on the conditions under which it is implemented. For this reason, it is advisable to build model farms in the different production regions of the country in order to gain practical experience that can be visualized to farmers.

Given the resource-intensiveness of such an investment and the need for a change in the production process, investment support is also advisable.

Investment support is essential to motivate farmers to build such expensive facilities.

Directly affected greenhouse gases: CH_4

Implementation period: 2014-2030

Scenario in which the measure is included: WEM

Potential emission reductions: 8.8 - 12.36 Gg CO_2 eq.

New measures to reduce greenhouse gas emissions:

A5 - **Application of the Rules of Good Agricultural Practice for the control of ammonia emissions** into the air from agricultural sources, based on the UNECE Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions: good practices for low-emission fertiliser/manure application, good practices for manure management and strengthening the implementation of the Nitrates Directive).

Scope: Promote the introduction and continued use of environmentally friendly nitrogen management methods in agriculture; Preventing and reducing nitrogen pollution of water from agricultural production; better management of organic fertilisers; reducing the use of fertiliser/manure on arable land; improved livestock management; actions to improve the management of arable land.

Directly affected greenhouse gases: N_2O

Implementation period: 2023-2027

Scenario in which the measure is included: WAM

Potential emission reductions: 24.66 - 36.7 Gg CO_2 eq.

A6 – Promotion of organic farming

Scope: The objective of the measure is to support and enhance the competitiveness of organic farming, increase biodiversity and landscape diversity, and maintain and improve soil fertility and water quality. The measure will contribute to reducing greenhouse gas emissions by using organic fertilisers instead of mineral ones.

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2023-2027

Scenario in which the measure is included: WAM

Potential emission reductions: 47.23 - 68.96 Gg CO_2 eq.

A7 - Strategic Plan for Agriculture and Rural Development 2023-2027 - **Eco scheme for crop diversification**

Scope: - The intervention requirements ensure a higher number of agricultural crops grown on the farm. The increased number of different crops contributes to minimising the risks to the farm due to climate change (adaptation and mitigation) through crop diversification. The intervention aims to improve crop rotation, which increases the humus and nutrient content of the soil and prevents erosion by ensuring the presence of permanent soil cover to avoid soil leaching and compaction.

Directly affected greenhouse gases: CO_2, CH_4, N_2O

Implementation period: 2023-2027

Scenario in which the measure is included: WAM

Potential emission reductions: 10.25 - 88.2 Gg CO_2 eq.

A8 - Strategic Plan for Agriculture and Rural Development 2023-2027 - **Eco scheme for preserving and restoring soil potential**

Scope: The intervention provides for two main methods of introducing external organic matter into the soil: the cultivation of suitable types of intermediate non-productive crops with subsequent green fertilisation and the introduction of external organic matter subject to circular economy products (treated organic matter from waste biomass). The intervention aims

to reduce the use of artificial fertilisers – replacing them with natural nutrients formed as a result of the introduction of external natural organic matter.
Directly affected greenhouse gases: CO_2, CH_4, N_2O
Implementation period: 2023-2027
Scenario in which the measure is included: WAM
Potential emission reductions: 5.68 - 12.3 Gg CO_2 eq.

A9 - Strategic Plan for Agriculture and Rural Development 2023-2027 - **Eco scheme for extensive maintenance of permanent grassland**
Scope: The intervention will prevent the loss of the grassland ecosystem by reducing trampling and erosion processes, ruderalisation and the development of atypical species, which significantly improves the ability of grassland systems to absorb carbon and mitigate climate change.
Directly affected greenhouse gases: CO_2, CH_4, N_2O
Implementation period: 2023-2027
Scenario in which the measure is included: WAM
Potential emission reductions: 18.2 - 22.63 Gg CO_2 eq.

Adaptation measures from the Action Plan to the National Adaptation Strategy contributing to decarbonisation:
AA1 - Developing Appropriate Irrigation Systems
AA2 - Preservation of existing pastures
AA3 - Improving the maintenance of soil structure
AA4 - Development of insurance and risk management programs

Land use, land use change and forestry (LULUCF)

The LULUCF Regulation[12], originally published in 2018, was amended in 2023 to introduce an EU wide net carbon removal target of 310 million tonnes of CO2 equivalent by 2030. From 2021

[12] Regulation (EU) 2018/841 on the inclusion of greenhouse gas emissions and removals from land use, land-use change and forestry in the 2030 climate and energy framework, as amended, https://eur-ex.europa.eu/eli/reg/2018/841/2023-05-11.

to 2025, countries have to adhere to the 'no debit' rule, meaning that accounted emissions from specific managed land categories must be entirely compensated by corresponding accounted CO2 removals. In contrast, from 2026 to 2030, Member States will have to reach binding national LULUCF targets to contribute to the EU-wide target for 2030. The Member States' targets for 2030 are defined as the average of net emissions/removals in 2016-2018 plus an individual binding target, which collectively corresponds to 42 MtCO2e, to be able to reach the EU target. The scope of the revised regulation has also been extended to cover all managed land from 2026 onwards.

The revised LULUCF Regulation will improve the quality of monitoring, reporting and verification and promote strong synergies between climate mitigation and environmental protection measures to ensure more cohesive national and EU policymaking and implementation.

National Instruments

The Forestry Act (FA) (SG 19/2011, last amended S.G. 67/2024)

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

Forestry plans and programmes shall determine the eligible amount of forest resource use and the guidelines for achieving forest area management objectives over a period of 10 years. The Forestry Act does not allow the reduction of the existing forest on the territory of the Republic of Bulgaria, as well as on the territory of municipalities whose forest is less than 10% of the total percentage of forest land in the country. Changing land use in forest areas is only possible in certain specific cases.

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

National Strategy for Development of the Forestry Sector in the Republic of Bulgaria for the period 2013-2020 (NSDFSRB)

The strategic document reflects the European and national policies and strategic documents related to forests and forestry sector in Bulgaria, basic principles and analysis of the forestry sector in Bulgaria, the vision, mission and objectives, priorities and measures, sources of funding to achieve the objectives of the Strategy and monitoring its implementation.

Final monitoring of the implementation of the National Strategy for Forest Sector Development in the Republic of Bulgaria 2013-2020 was carried out by an interdepartmental working group with the participation of the non-governmental sector.

The approval by the Council of Ministers of the National Strategy for the Development of the Forest Sector in the Republic of Bulgaria for the period up to 2030 is forthcoming.

On the basis of the approved document, a new Strategic Plan for the Development of the Forest Sector will be prepared.

The process also includes final monitoring of the implementation of the Strategic Plan for Forest Sector Development 2014-2023.

Strategic Development Plan for the Forestry Sector (SDPFS) 2014-2023

This plan was developed with the financial support of the European Social Fund under the project 'Strategic Planning in Bulgarian Forests - Guarantee for Effective Management and Sustainable Development' under the Operational Programme 'Administrative Capacity'.

The implementation of the operational objectives with the relevant budget, timetable, expected results, performance indicators, responsible institutions and stakeholders is regulated in specific sub-activities in the FRAGS as follows:

Operational objective 1: 'Increase in forest area, tree stocks and forest carbon stocks';

Operational objective 2: 'Improving forest management and use';

Operational objective 3: 'Increasing the effectiveness of preventing and combating forest fires and illegal activities in forests';

Operational objective 4: Increasing the resilience and adaptability of forest ecosystems to climate change.

The achievement of these objectives is also guaranteed by the implementation of the Programme of Measures for Adaptation of Forests in the Republic of Bulgaria and mitigation of the negative impact of climate change on them.

The existing provisions of the Agricultural Land Ownership and Use Act provide that the decision of the municipal council determines annually the rules for the use of meadows and pastures. Those provisions shall contain:

- A grazing action plan;
- Parts of grassland and pastures, mainly for mowing;
- Measures for protection, maintenance and improvement of pastures, such as cleaning of shrubs and other unwanted plant species, anti-erosion activities, fertilization, temporary fencing;
- Parts of grassland and pastures for artificial pastures for planting with appropriate grass mixtures;
- Method of use, prohibitions and restrictions depending on landscape features, soil, climate and other natural conditions.

With regard to arable land, Article 7 of the Agricultural Land Ownership and Use Act stipulates that eroded, polluted, saline, acidic and water-underground agricultural land is restored 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 an Expert Council. Valleys, quarries and other areas with disturbed soil profile, ashtrays, tailings ponds, landfills and other landfills, old river beds, roads of abandoned canals, roads, railways and construction sites after dismantling engineering equipment, cladding and superstructures are subject to reclamation. Recultivation is based on a pre-established, agreed and approved project, which is an integral part of the project for the construction of the site. The procedure for the use of humus after its removal, recultivation, land improvement and acceptance of the recultivated areas are laid down in Regulation No 26 on land recultivation, improvement of low-productive land, removal and utilization of the humus layer.

To date, the report on the second interim monitoring and evaluation of the implementation of the Strategic Plan for the Development of the Forest Sector 2014-2023 has been approved. Forests are a major carbon dioxide (CO2) sink and have a leading role in the absorption of carbon through photosynthesis. They are an important link in the global carbon cycle due to their ability to capture CO2 from the atmosphere and retain it in their biomass, dead forest litter and forest soil. Tree species growth is largely net carbon accumulation, so assessing and predicting the state and productivity of forests is essential to analyse the evolution of carbon emissions. In addition, the growth of woody biomass in forests plays a role in reducing greenhouse gas concentrations in the atmosphere. For these reasons, the analysis of the state of forest ecosystems and forest resource management methods are of interest in view of the possibility of increasing the potential of forests as sinks.

Bulgaria has a significant forest resource and its sustainable management and development is an important factor in reducing greenhouse gases. Forest areas in the country occupy a third of its area.

In the long term, there is a need to further develop the idea of sustainable and multifunctional forest management aimed at maintaining or increasing wood and hence carbon stocks in forests, while ensuring sustainable annual harvesting of wood and wood products.

Forestry Act

Forest planning is carried out on three levels and includes a National Strategy for the Development of the Forest Sector in the Republic of Bulgaria and a Strategic Plan for Forest

Development, Regional Plans for the Development of Forest Areas and Forestry Plans and Programs.

Forestry plans and programmes shall determine the eligible amount of forest resource use and the guidelines for achieving forest area management objectives over a period of 10 years. The Forestry Act does not allow the reduction of the existing forestity on the territory of the Republic of Bulgaria, as well as on the territory of municipalities whose forestity is less than 10% of the total percentage of forest land in the country. Changing land use in forest areas is only possible in certain specific cases.

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

Final monitoring of the implementation of the National Strategy for Forest Sector Development in the Republic of Bulgaria 2013-2020 was carried out by an interdepartmental working group with the participation of the non-governmental sector.

The approval by the Council of Ministers of the National Strategy for the Development of the Forest Sector in the Republic of Bulgaria for the period up to 2030 is forthcoming.

On the basis of the approved document, a new Strategic Plan for the Development of the Forest Sector will be prepared.

The process also includes final monitoring of the implementation of the Strategic Plan for Forest Sector Development 2014-2023.

One of the main strategic documents containing measures for land use, land use change and forestry is the third NAPCC 2013-2020, whose measures will continue beyond 2020.

Measures contributing to the reduction of greenhouse gas emissions are:

LULUCF 1 - **Utilization of "non-wooded areas intended for afforestation" in forest areas**

Scope: The implementation of the measure is important for achieving the objectives of the plan, as forests are a major carbon sink and reservoir of 90-95% of the total carbon removal within the LULUCF sector. Increasing forest area plays an important role in offsetting greenhouse gas emissions in other sectors. With the use of unforested areas for afforestation in forest areas, the capacity of forests as a greenhouse gas sink will increase in the long term.

Directly affected greenhouse gases: CO_2

Implementation period: 2013-2030

Scenario in which the measure is included: WEM

Potential emission reductions: 42.44 - 50.92 Gg CO_2 eq.

LULUCF 2 - **Increase of areas for urban and suburban parks and green zones**

Scoe: The expansion of urban areas and intensive construction in recent years is a prerequisite for significant greenhouse gas emissions. Increasing the area of urban and suburban parks and green areas and maintaining them in good condition will contribute to increasing the absorption of greenhouse gases and improving the quality of the living environment. The implementation of the measure will also contribute to the gradual achievement of the standards laid down in the LFS for green areas.

Directly affected greenhouse gases: CO_2

Implementation period: 2013-2030

Scenario in which the measure is included: WEM

Potential emission reductions: 0.35 - 0.42 Gg CO_2 eq.

LULUCF 3 - **Restoration and sustainable management of wetlands**. Protection and conservation of wetlands in forest areas, peatlands, marshes

Scope: Wetlands are highly biodiverse and play an important role in carbon sequestration as they are some of the most productive ecosystems. Restoration and conservation of wetlands in forest areas and their appropriate management will also increase their effectiveness as carbon pools. The NPRDP 2023-2027 provides for an intervention for the construction or renovation of areas for wide public use.

Directly affected greenhouse gases: CO_2

Implementation period: 2013-2030

Scenario in which the measure is included: WEM

Potential emission reductions: 1.15 - 1.38 Gg CO_2 eq.

LULUCF 4 - **Restoration and maintenance of protective forest belts and new anti-erosion afforestation**

Scope: In addition to the direct effect on the absorption of carbon from the afforestation in these belts, there is also a significant indirect effect related to the prevention of wind erosion after the restoration of the belts.
No such measure has been implemented under the RDP 2014-2020. In the National Programme for Rural Development and Rural Development 2023-2027, intervention II.D.10 - Afforestation and Restoration is envisaged for implementation.
Directly affected greenhouse gases: CO_2
Implementation period: 2013-2030
Scenario in which the measure is included: WEM
Potential emission reductions: 11.9 - 14.28 Gg CO_2 eq.

LULUCF 5 - **Increasing density in listed natural and artificial plantations**
Scope: Activities to increase the density of listed plantations by supporting their natural regeneration or by other means.
Directly affected greenhouse gases: CO_2
Implementation period: 2013-2030
Scenario in which the measure is included: WEM
Potential emission reductions: 27.5 - 33.01 Gg CO_2 eq.

LULUCF 6 - **Introduction of a new measure/activity related to the creation of crops of fast growing tree species** for the production of wood for energy purposes (short rotation plantations)
Directly affected greenhouse gases: CO_2
Implementation period: 2013-2030
Scenario in which the measure is included: WEM
Potential emission reductions: 5.6 - 6.73 Gg CO_2 eq.

The Action Plan to the National Strategy on Adaptation to Climate Change provides for the following adaptation measures in the forest sector:
GA1 - Modeling the potential behavior of the most important tree species at the moment and of those species that may have potential in Bulgaria in a future changed climate, throughout the

country and under different climate change scenarios and different time frames and taking into account different topographical parameters

GA2 - Development of spatially bound models for the risk of natural disturbances from wind, fires, insects and diseases, etc.

GA3 - Strengthening the existing forest resource through enrichment and proactive management of risky plantations

GA4 - Restoration of forest areas severely affected by natural disturbances or drying and afforestation to improve the water and soil protective functions of the forest

GA5 - Establishment of short rotation plantations for biomass production

GA6 - Preservation of highly biodiverse sites, areas of old-growth forests and areas with available habitat (biotope) trees

Biodiversity and ecosystems

BEA1 - Development and adoption of the new Biodiversity Strategy and Action Plan and a new Green Infrastructure Strategy in terms of ecosystem-based management, conservation, restoration and CCA

BEA2 - Operationalization of Ecosystem-Based Monitoring and Assessment of Environmental Impacts

BEA3 - Setting up carbon accounts for the environment

BEA4 - Linking carbon and environmental carbon accounts

BEA5 - Regional/local 'red lines' to prevent loss of ecosystem services vital to CCA

BEA6 - Ecosystem Restoration - A Long-Term Business Opportunity

3.5. Summary of greenhouse gas emissions and removals

Bulgaria is providing information on GHG emissions and removals in the BTR Chapter 3.5 and in a separate National Inventory Document 2024 and in the CRT Tables 1990 – 2022 accompanied this First Biennial Transparency Report 2024.

Summary of the main trends in national greenhouse gas emissions and removals as described in the in the Chapter 2 of the National Inventory Document of Bulgaria 2024 accompanied this Report.

3.6. Projections of greenhouse gas emissions and removals

The macroeconomic forecast provides framework forecasts for the demographic and economic development of Bulgaria in the coming decades. This is a consistent set of projections for **population development**, **GDP growth** and the expected evolution of sectoral growth. Physical activity (industrial production, etc.) is similarly extracted on the basis of historical data and forecasts. The decoupling of value-added growth from physical production supposedly stems from the expectation that higher value-added products will be developed. The macroeconomic forecast offers a vision of the future structure of the sectors and activities of the national economy and the dynamics of the population. It is based on the latest demographic and economic forecasts provided by EUROSTAT.

Projections of **sectoral value added** and the structure of the economy are based on current national economic trends, historical data, as well as global economic trends (redirection to more value-added services and products such as machinery, engineering, etc.) over the longer term and are common to both scenarios (WEM and WAM).

Alongside socio-economic projections, the (B)EST model uses projections of **international energy prices**. The projections are based on REPowerEU forecasts for crude oil and hard coal, while TTF Netherlands gas futures (lower than those published earlier in REPowerEU) are used for natural gas in the short term. In the long term, the growth rates of the REPowerEU gas trajectory have been applied.

Table 4 presents key projection parameters as applied in the base year 2022 and cross years for projections.

Table 4 Summary of key variables and assumptions used in the projections analysis

Key variables	Units	2022	2025	2030	2035	2040	2045	2050
GDP	EUR2015	56	59	65	70	75	81	86
Population	Millions	7	7	6	6	6	6	6
Value added growth rate - Agriculture	EUR2015 million	2 634	2 722	2 734	2 710	2 712	2 711	2 711
Value added growth rate - Construction	EUR2015 million	1 502	1 611	1 707	1 788	1 894	1 982	2 069
Value added growth rate - Services	EUR2015 million	35 073	37 536	41 251	45 015	48 852	52 451	56 013
Value added growth rate - Industry	EUR2015 million	1 907	1 950	2 039	2 125	2 221	2 289	2 335
Value added growth rate - Energy Sector	EUR2015 million	8 276	8 904	10 020	10 867	11 727	12 544	13 443
Hard Coal	EUR '15/MWh	30	10	10	10	11	11	12
Crude Oil	EUR 15/MWh	49	49	49	49	52	56	63

Natural Gas	EUR 15/MWh	118	28	24	24	24	24	25

As a result, two scenarios for GHG emission projections until 2050 were developed, analysed and compared:

- With measures - WEM
- With additional measures – WAM

The scenario "with measures" reflects all implemented and adopted policies and measures in order to reduce GHG emissions in the country by the end of 2022, 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 2022 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.

These projections were compiled on the basis of 2024 inventory data for the 2022. using 2006 IPCC Guidelines and GWP from 5AR.

Sectoral projections

Energy (excluding Transport)

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 energy efficiency.

The Energy Industries subsector covers the following activities:

- Electricity generation and transmission, including cogeneration;
- Production and transmission of heating and cooling for public needs;
- Natural gas transmission (pressure maintenance of compressor stations).

The energy industry sector consists of facilities for the production of electricity and heating and cooling on a large scale. This is the sector responsible for the largest amount of GHG emissions. This sector is projected to continue to emit the largest share of emissions.

Subsector Manufacturing and construction

Forecasts for this sub-sector are based on economic development expectations and forecasts, the share of individual sub-sectors, forecasts for fuel use, as well as general forecasts for the use of some of the main energy sources.

The energy sector consists of the facilities for power and heat generation on large scale. This is the sector that is responsible for the largest quantity of GHG emissions. It is projected that this sector will continue to emit the biggest part of the emissions.

The power plants with the highest power generation are the NPP Kozloduy, the lignite and coal fired thermal power plants, and the district heating and power generation plants in the biggest cities.

In 2022, this sector accounted for approximately 60% of total emissions and by 2050, its share decreases to about 27% in WEM scenario and to 4.3% in WAM scenario. Trend in WEM scenario is steady decline, with emissions dropping by around 79% between 2022 and 2050. WAM scenario reflecting a faster and more substantial reduction. Trend is stronger declining, with emissions decreasing by more than 99% from 2022 to 2050.

Table 5. Emission projections for the Energy sector – WEM and WAM scenario, Gg CO2 eq

WEM	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Energy (excluding Transport)	35 154	23 360	13 284	9 713	8 258	7 715	7 260
WAM	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Energy (excluding Transport)	35 154	29 379	16 448	10 769	6 165	3 927	371

Transport

The forecast for the development of the Transport sector has been prepared in accordance with the given forecast for the use of fuels in the sector.

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

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

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

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

Transport emissions are 17% of the total in 2022 and in WEM they initially rise to a peak of 32% in 2025 and reached 29% by 2050.

Trend shows a short-term increase followed by a steady decline, reducing emissions by approximately 21% between 2022 and 2050 in WEM and sharp decline by 96% in WAM scenario.

Emission projections under the WEM and WAM Scenarios in Transport are presented in table below:

Table 6. Emission projections for Transport sector - WEM and WAM scenarios, Gg CO_2 eq

WEM	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Transport	9 940	10 540	10 551	10 235	9 640	8 761	7 855
WAM	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Transport	9 940	9 959	8 327	6 024	3 630	2 128	424

Industrial Processes and Product Use (IPPU)

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.

The emissions reduction during the whole time period from 1988 to 2017 is due to mainly economic reasons. The general reduction in the emissions in the later years of the time period is influenced also by the starting introduction of better technologies on plant level.

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

Mineral products and chemical industry are the main sources of CO2 emissions in Industrial Processes sector. Data from all cement and lime producing companies is included in the projections.

In the Mineral Industry sector with the largest part of the emissions originates from cement production. Other sources of CO2 emissions come from lime production, soda ash use, glass production, bricks production.

The second largest source of greenhouse gases under industrial processes sector is Product uses as ODS substitutes (Consumption of Halocarbons). The consumption of HFCs in Bulgaria depends on industry for domestic productive consumption manufacturing) – filling of newly manufactured products, refilling of equipment – or in pre-charged equipment.

GHG emissions under chemical industry branch originated by ammonia, nitric acid, carbide production, calcium carbide production, soda ash and methanol production but activity data are confidential. This is the reason that emissions projections are made for the chemical industry as a hole.

Smaller quantities of GHG-s originate from the sectors: Non-energy products from fuels (CO2) and Solvent use (NMVOC-s) and other product manufacture and use (SF6 and N2O). Since there are no additional measures planned in the Industrial Processes sector.

This sector contributes 8% in 2022 and 14.0% in 2050 – WEM scenario, and 6% in WAM scenario, which shows slower decrease in trend. The emissions decrease by 21% under WEM scenario and 88% in WAM scenario.

Table 7. GHG emissions from IPPU - - WEM and WAM scenarios, Gg CO2 eq.

WEM	2022	2025	2030	2035	2040	2045	2050
IPPU	4 575	3 918	3 996	3 997	3 984	3 960	3 909
WAM	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
IPPU	4 575	3 721	3 393	2 873	2 380	1 651	549

AGRICULTURE

This sector has not implemented significant measures to reduce emissions. The reduction 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 and Food 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.

The GHG emissions projections are estimated based on the methodology and emission factors, according the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

After Bulgaria joined the EU the major structural changes in this sector consisted in reducing the number of farms and increasing their average area.

Agriculture emissions represent the share of 10% in 2022 and maintain a similar proportion, ending at 22% in 2050 in WEM scenario and 68% in WAM scenario. Emissions trend in WEM remain almost flat, with minor changes across the years. In WAM scenario emissions maintain a relatively stable share of the total.

Table 9. Aggregated GHG emissions from the Agriculture Sector - - WEM and WAM scenarios, Gg CO_2 eq.

WEM	2022	2025	2030	2035	2040	2045	2050
Agriculture	5 943	5 574	5 690	5 764	5 839	5 917	6 009
WAM	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Agriculture	5 943	5 414	5 545	5 624	5 696	5 763	5 812

LULUCF (LAND USE, LAND-USE CHANGE, AND FORESTRY)

Bulgaria in its GHG Inventory preparation uses a mix of the IPCC approaches to get a consistent and complete historic area statistic of the country.

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

In 2022, LULUCF acts as a carbon sink, offsetting about -16% of total emissions. By 2050, its offsetting is about 34% in WEM scenario. Reduced carbon sequestration over time in WEM and WAM scenario, indicating potential challenges in land-use management.

Table 10. LULUCF emission/removal projections - - WEM and WAM scenarios in Gg CO2 eq.

WEM	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
LULUCF	-9 540	-9 543	-9 467	-9 455	-9 388	-9 309	-9 231
WAM	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
LULUCF	-9 540	-9 547	-9 516	-9 455	-9 388	-9 309	-9 231

WASTE

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.

In the Waste projection estimates Bulgaria follows the methods used in its GHG Inventory report 2019 in accordance with the IPCC 2006 Guidelines. In order to calculate the emission projections, basic parameters on which base emissions from the waste sector are estimated in the National Inventory of Greenhouse Gases Emissions were used as a starting point. The projections are based on existing policies and measures for reduction of waste generation and estimates of future quantities of landfilled waste.

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

The 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 share of Waste emissions on national totals are 5% in 2022 and in WEM scenario is stable similar as 7% by 2050 in WEM scenario and declining to 17% in WAM scenario. Trend shows gradual reduction, with emissions decreasing by about 31% in WEM, resp. 49% in WAM scenario.

Table 11. GHG emissions from Waste sector - WEM and WAM scenarios, Gg CO2 eq.

WEM	2022	2025	2030	2035	2040	2045	2050
Waste	2 808	2 284	2 135	2 052	1 983	1 953	1 929
WAM	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Waste	2 808	1 733	1 599	1 528	1 420	1 427	1 441

Aggregated GHG emissions by gases

CO2 emissions accounted for 80% of total GHG emissions in 2022 (excluding CO2 from LULUCF). in 2050, CO2 emissions excluding LULUCF in WEM scenario are expected to decrease by 65% compared to 1988 In WAM scenario emissions are expected to decrease by 101% compared to 1988. In 2050, CO2 emissions including LULUCF in WEM scenario are expected to decrease by 90% compared to 1988. In WAM scenario emissions are expected to decrease by 115% compared to 1988. Projections of CO2 emissions according to WEM and WAM scenarios are presented in Table 12.

Table 12. Emission projections of CO2 in Gg sector in WEM and WAM scenarios up to 2050

WEM	2022	2025	2030	2035	2040	2045	2050
CO2 emissions excl. LULUCF	46 931	34 341	24 931	21 233	19 284	17 915	16 586
CO2 emissions incl. LULUCF	37 266	24 547	15 214	11 528	9 647	8 356	7 105
WAM	**2022**	2025	2030	2035	2040	2045	2050
CO2 emissions excl. LULUCF	46 931	38 922	24 785	16 697	9 547	5 278	-981
CO2 emissions incl. LULUCF	37 266	29 125	15 019	6 992	-91	-4 281	-10 462

CH4 emissions accounted for 11% of total GHG emissions in 2022 (excluding CO2 from LULUCF). in 2050, CH4 emissions excluding LULUCF in WEM scenario are expected to decrease by 65,1% compared to 1988 In WAM scenario emissions are expected to decrease by 67.3%

compared to 1988. In 2050, CH4 emissions including LULUCF in WEM scenario are expected to decrease by 64.8% compared to 1988. In WAM scenario emissions are expected to decrease by 67.1% compared to 1988. Projections of CH4 emissions according to WEM and WAM scenarios are presented in Table 13.

Table 13. Emission projections of CH4 in Gg of CO2 eq. in WEM and WAM scenarios up to 2050

WEM	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
CH4 emissions excl.LULUCF	6 562	6 407	5 802	5 587	5 446	5 367	5 304
CH4 emissions incl. LULUCF	6 583	6 449	5 844	5 629	5 488	5 409	5 346
WAM	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
CH4 emissions excl. LULUCF	6 562	6 232	5 616	5 332	5 100	5 014	4 959
CH4 emissions incl. LULUCF	6 583	6 274	5 658	5 374	5 142	5 056	5 001

N2O emissions accounted for 7% of total GHG emissions in 2022 (excluding CO2 from LULUCF). in 2050, N2O emissions excluding LULUCF in WEM scenario are expected to decrease by 55,1% compared to 1988 In WAM scenario emissions are expected to decrease by 56.1% compared to 1988. In 2050, N2O emissions including LULUCF in WEM scenario are expected to decrease by 53.1% compared to 1988. In WAM scenario emissions are expected to decrease by 54.2% compared to 1988. Projections of N2O emissions according to WEM and WAM scenarios are presented in Table 14.

Table 14. Emission projections of N2O in Gg of CO2 eq. in WEM and WAM scenarios up to 2050

WEM	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
N2O emissions excl. LULUCF	4 202	3 962	3 934	3 937	3 953	3 973	3 993
N2O emissions incl. LULUCF	4 305	4 170	4 142	4 145	4 161	4 181	4 201
WAM	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
N2O emissions	4 202	3 937	3 877	3 859	3 850	3 869	3 898

excl. LULUCF							
N2O emissions incl. LULUCF	4 305	4 145	4 085	4 067	4 058	4 077	4 106

Emissions of F-gases accounted for over 1% of total GHG emissions in 2022 (excluding CO2 from LULUCF). The most produced gases are HFCs with a share of almost 97%, followed by SF6 with a share of 3% in 2022. In 2050, emissions of F-gases in WEM scenario are expected to increase by 96% compared to 1988 and in WAM scenario emissions are expected to increase by 99.4% compared to 1988. Projections of F-gases emissions according to WEM and WAM scenarios are presented in

Table 15. Emission projections of F-gases in Gg of CO2 eq. in WEM and WAM scenarios up to 2050

WEM	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
HFCs	702	935	963	985	1 008	1 039	1 067
PFCs	NO	NO	NO	NO	NO	NO	NO
SF6	24	32	27	19	12	12	12
NF3	NO	NO	NO	NO	NO	NO	NO
WAM	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
HFCs	702	1 083	1 001	896	759	699	683
PFCs	NO	NO	NO	NO	NO	NO	NO
SF6	24	32	33	34	35	36	37
NF3	NO	NO	NO	NO	NO	NO	NO

EU ETS and ESR

The EU Emissions Trading System (EU ETS), which caps GHG emissions in energy, industry and the Effort Sharing Regulation (ESR) which establishes national reduction targets for GHG emissions not covered by the EU ETS, i.e. domestic transport (excluding aviation), buildings, agriculture, small industry and waste are the main instruments to cut greenhouse gas emissions. The projected influence of the assumed carbon price on emissions reductions is substantial.

Table 16. GHG emission projections split in EU ETS and ESR by sectors in Gg of CO2 eq.

WEM	2022	2025	2030	2035	2040	2045	2050
EU ETS	31 972	20 422	11 155	8 034	7 004	6 694	6 476
ETS2	0	0	0	0	0	0	0
ESR	27 053	25 254	24 503	23 728	22 700	21 612	20 486

ETS GHG reduction (% 2005)	-19	-48	-72	-80	-82	-83	-84
ESR GHG reduction (% 2005)	12	5	1	-2	-6	-11	-15
WAM	2022	2025	2030	2035	2040	2045	2050
EU ETS	31 972	17 090	7 196	4 552	2 945	2 043	-318
ETS2	0	0	7 975	5 609	3 241	1 685	177
ESR	27 053	23 159	12 073	10 980	9 891	9 223	8 455
ETS GHG reduction (% 2005)	-18	-56	-82	-88	-92	-95	-101
ESR GHG reduction (% 2005)	21	4	-10	-26	-41	-51	-61

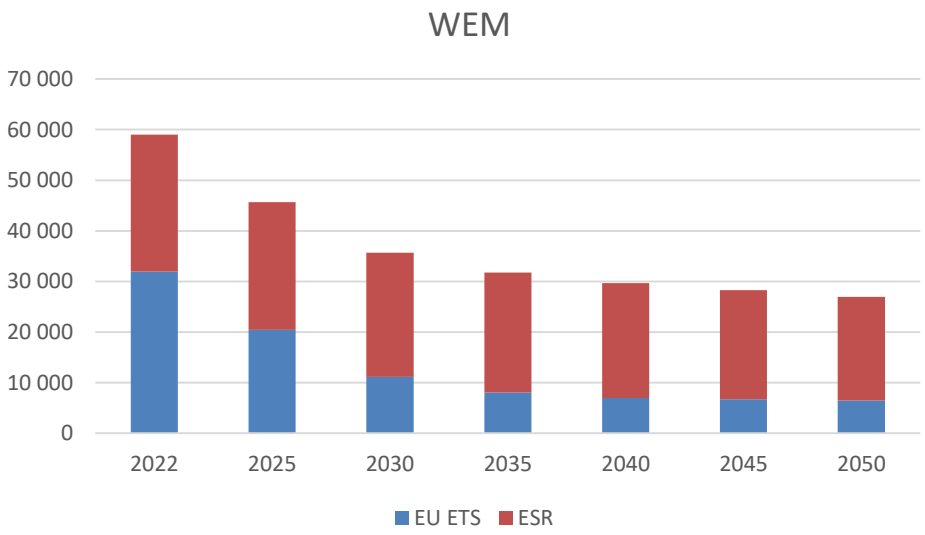


Figure 30. GHG emission projections split in EU ETS and ESR in Gg of CO2 eq. in WEM scenario

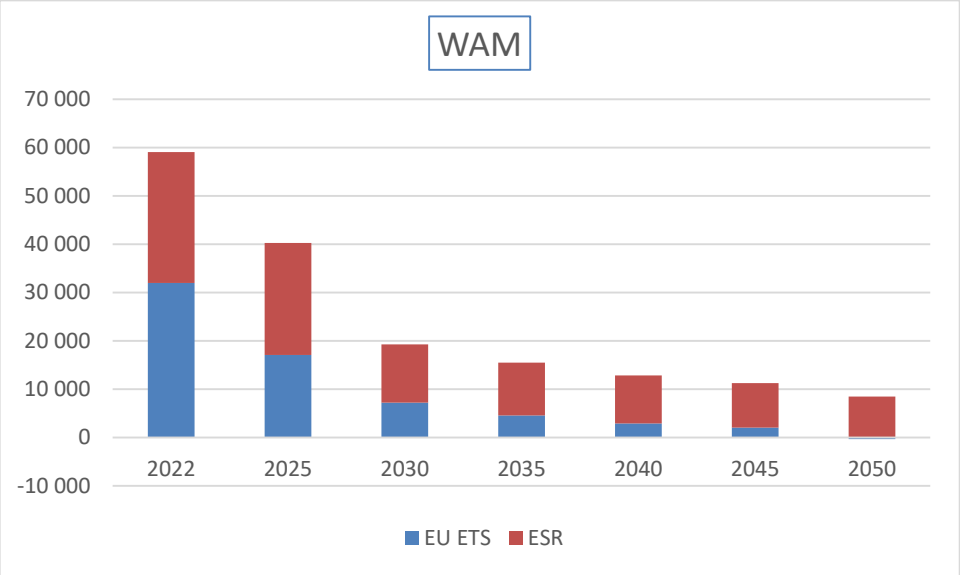


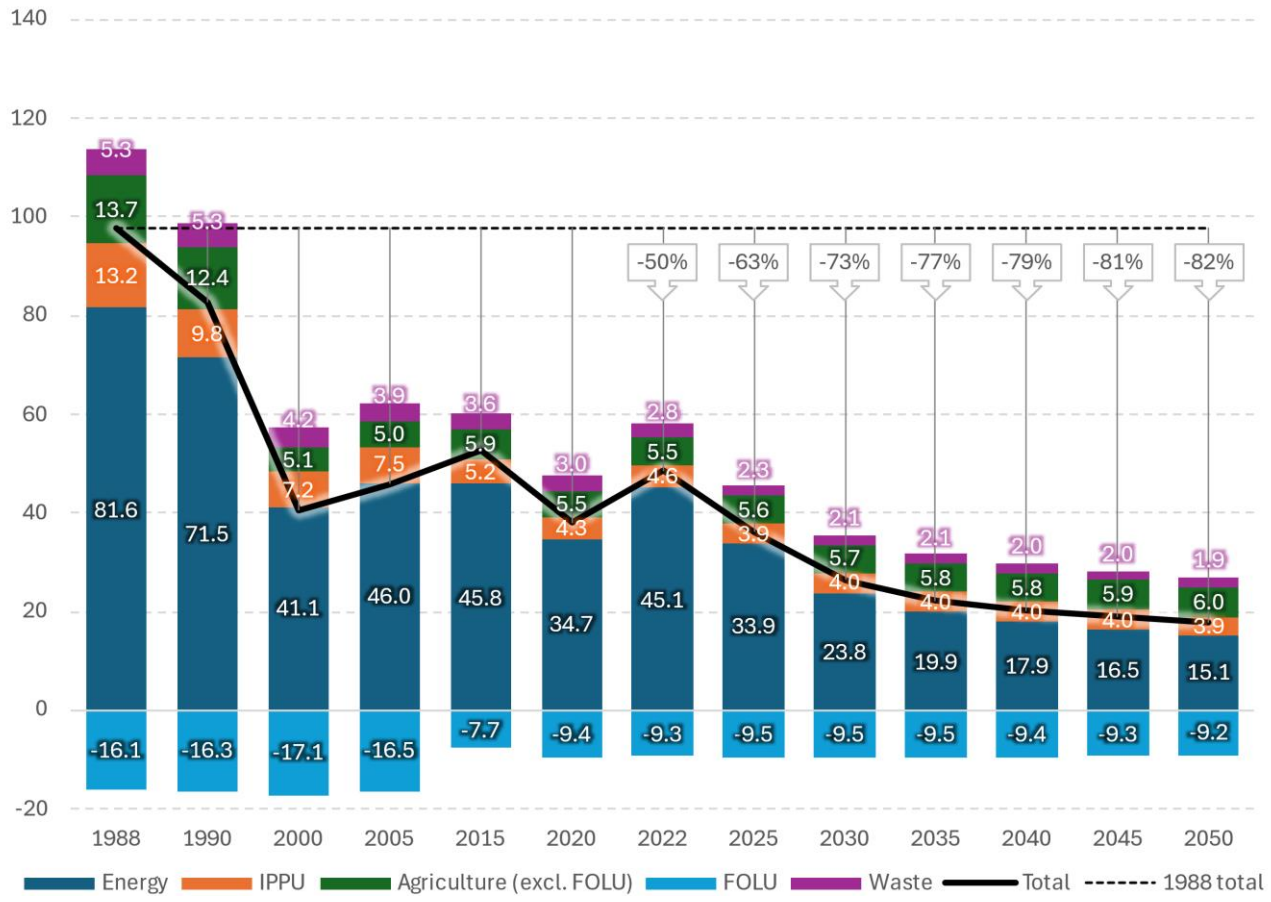
Figure 31. GHG emission projections split in EU ETS and ESR in Gg of CO2 eq. in WAM scenario

TOTAL PROJECTIONS

Figure 32 shows historical and projected data for total aggregate GHG emissions according to the "with existing measures" scenario for period 1988 – 2050. Trends of curves indicate our reduction of GHG emissions.

In 2030, the WEM scenario anticipates a 46% reduction in net GHG emissions compared to 2022 levels, or a 73% reduction compared to 1998, reaching 26.19Mtn CO2-eq (Figure 32). This reduction is primarily driven by the power sector, which historically accounts for more than 84% of net GHG emissions in Bulgaria. By 2030, GHG emissions from the power sector are projected to decrease by 47% compared to 2022 (or 71% compared to 1988), reaching 23.84Mtn CO2-eq.

Within this scenario, net GHG emissions in the country are projected to decrease at an average annual rate of 3.5% from 2022 to 2050, ultimately reaching 17.73Mtn CO2-eq by the end of the projection horizon, an 82% reduction compared to 1988 levels.

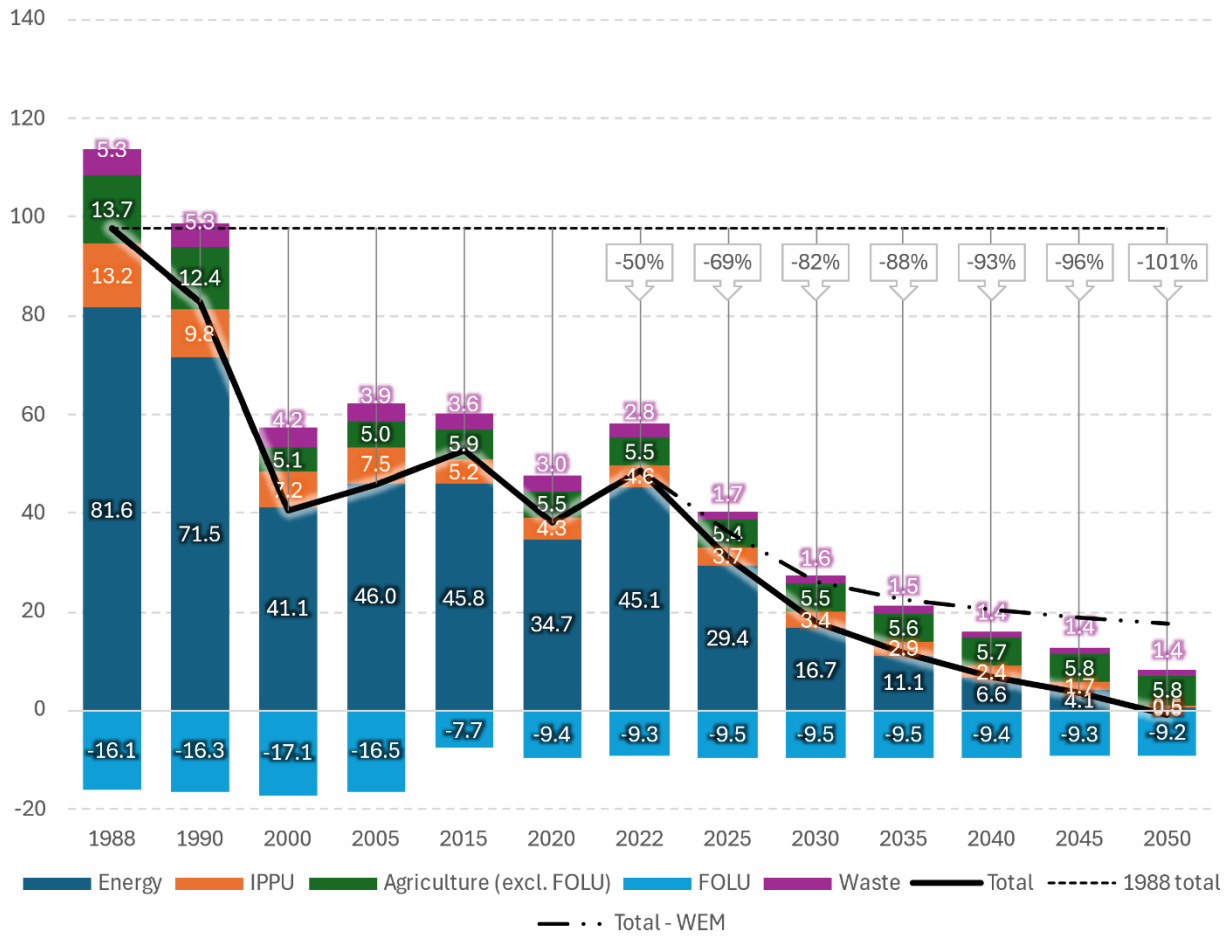


Sources: (B)EST projection.

Figure 32. GHG emissions by source and GHG removals in Bulgaria, historical data (1988-2022) and (B)EST WEM projection (2025-2050) (Mtn CO2-eq).

Under the conditions of the WAM scenario, net GHG emissions in 2030 reduce by 82% compared to 198813, reaching net zero in 2050.

[13] In compliance with Article 4.6 and 4.2(b) of the Framework Convention on Climate Change, Bulgaria, as a country undergoing the process of transition to a market economy, has adopted 1988 as a base year for the implementation of the Convention instead of 1990.



Sources: (B)EST projection

Figure 33. GHG emissions by source and GHG removals, historical data (1988-2022), (B)EST WAM projection (2025-2050), and total GHG emissions in (B)EST WEM projection (2025-2050) in Bulgaria (Mtn CO_2-eq).

Models and methods used

The (B)EST model, developed in the General Algebraic Modelling System (GAMS), is a fully-fledged energy demand and supply model, designed as a single-country tool for detailed energy system projections, energy demand forecasting, power sector planning, as well as for impact assessment of national climate and energy policy decisions with a horizon up to 2050.

Methodologically, the model is actor- and market-oriented, in the sense that it represents individual actors' decisions in demand and supply of energy and the balancing of their decisions in simultaneous markets cleared by prices. As economic theory suggests, the simultaneous market clearing under perfect competition conditions leads to an overall optimum of economic welfare, which coincides with minimum cost of energy for the end-users. In this sense, the model explicitly projects energy forms' prices into the future as derived from cost minimization

in the supply side and the price-elastic behaviors of demanders for energy, thus achieving market equilibrium.

The model includes key energy sector metrics at a detailed level: demand of energy by sector, various energy saving possibilities in terms of energy efficiency and heat recovery, energy and electricity use, technology capacities, power and steam generation, cogeneration, energy supply technology and energy form mix, fuel prices and system costs from an end-user perspective, investments by sector, CO2emissions, as well as key energy and climate indicators.

The model structure permits linkages with the external (outside the country) markets to get international fuel prices. All exogenous assumptions, including fossil fuel prices, price elasticities, technological or policy constraints are presented in a transparent manner and can be tested in sensitivity analysis.

The simulation results are dynamic over time and are influenced by factors which are exogenously specified. The user can easily build multiple scenarios to assess a variety of parameters. Input data for each scenario include the following:

- Sectoral activity projections
- Fuel price projections
- Fuel availability constraints (e.g. renewables potential by type, domestic available reserves by fossil fuel, import limitations)
- Taxes and subsidies
- Discount rates
- Technology standards
- Emission, renewables and energy efficiency regulations
- Targets for emissions, renewables and energy efficiency
- Perceived or hidden costs
- Exogenous investments, decommissioning or retrofitting of power and heat plants.

The outputs of each Module are the following:

➢ Demand Module:

- Energy Demand by sector and fuel
- CO2 emissions by sector

- Energy Savings, Energy and Carbon Intensity
- Costs (capital, fuel, non-fuel, emissions & taxation costs)
- Capacity Investments & Investment Expenditures

➢ Power Module:

- Power & Heat/Steam Generation by plant type
- Fuel Consumption by plant type and fuel
- CO2 emissions & Carbon Intensity by plant type
- Costs of electricity & heat supply (capital, fuel, non-fuel, emission & taxation, grid costs)
- Capacity Expansion & Investment Expenditures by plant type

➢ Balancing Module:

- Energy balance for each projection year based on end-use approach (explained later on

The (B)EST modelling framework consists of four (4) main folders:

1. main energy model

2. (B)EST_ProcessCO2, which contains the results of the GAMS-based sub-model accounting for process CO2 emissions in industrial sectors (IPPU categories).

3. (B)EST_Non-CO2, which includes the tool accounting for the non-CO2 emissions in Bulgaria.

4. (B)EST_LULUCF, which includes the tool simulating the emissions and removals from LULUCF sources and sinks. In this respect the model calculate emission projections for all relevant sectors and for all greenhouse gases.

The basic principles of the model approaches in relation to the different PaMs included in the scenarios can be find below.

A rich representation of policy instruments is incorporated in the Model, enabling the user to influence projections via:

- Price-related instruments:

Taxes (excise tax, VAT) & fuel subsidies

Equipment purchasing subsidies: reducing capital costs of new technologies

Feed-in-tariff for renewables: virtual subsidy for the promotion of RES in investment planning of the power sector

Carbon price: influencing emission costs for power supply and industrial sectors included in the EU ETS

Carbon value: influencing emission costs for non-ETS sectors (determines fuel mix but is not finally paid)

Renewable value (RES value): virtual cost benefit of using renewables, taken into account in the decisions without receiving a subsidy

Energy Efficiency value (EE value): virtual cost benefit of energy savings, taken into account in the decisions without receiving a subsidy

Discount rates: influencing annuity payments of investments

- Non-price instruments:

Technology standards: defining equipment/technology mix by inducing carbon & efficiency targets

Perceived/hidden costs: representing uncertainties or non-price barriers

Learning-by-Doing index (LBD): reducing capital costs of new technologies

Non-identified policies: increasing the potential of renewables and other resources

Availability of technology options for the power sector investments

Exogenous investment, decommissioning or retrofitting of power and heat production units, storage units, etc.

We can draw conclusions by comparing the projections of a baseline/reference and a policy/decarbonisation scenario, or between 2 policy scenarios. The main points of interest are:

- Cumulative CO2 emissions
- CO2 emissions reduction percentage with respect to 2005
- RES-shares: RES percentages in consumption of Heating & Cooling and Transport sector and Electricity Generation
- Total System Costs by sector
- Investment Expenditures by sector
- Energy efficiency/Primary Energy Savings
- Final energy consumption by fuel

Sensitivity analysis

The current methodologies for the projections of emissions and removals have been used since the NC8 and BR5, however, sensitivity analysis for the projections is not performed, but is planned for the next round of scenario work.

Changes in results, methodologies and assumptions compared to previous GHG projections

1) Update of the national projected energy balance until 2030;

2) Revised the GHG projections models in order to estimate WEM and WAM scenarios for all sectors and gases;

3) Implement the QA/QC activities for the projection development.

3.7. Other information

According to paragraph 103 of the annex to decision 18/CMA.1, 'each Party may provide any other information relevant to tracking progress made in implementing and achieving its NDC under Article 4 of the Paris Agreement'.

All relevant information can be found in sections 3.1 to 3.7, above. Hence, no additional information is provided here.

4. CLIMATE CHANGE IMPACT AND ADAPTATION

4.1. National circumstances, institutional arrangements and legal frameworks

An outline of the national circumstances of Bulgaria which covers the geographic, demographic and economic profile of the country, including in relation to adaptation, can be found in the chapter 3.1 National circumstances and institutional arrangements.

Adaptive Capacity

Bulgaria is committed to addressing climate change adaptation in line with its international obligations under the **United Nations Framework Convention on Climate Change (UNFCCC)** and the **Paris Agreement**. As a signatory to the Paris Agreement, Bulgaria is committed to enhancing its climate resilience and reducing vulnerability to climate impacts. This includes the implementation of adaptation measures aligned with global goals to limit temperature rise and promote sustainable development.

Under the UNFCCC, Bulgaria participates in the regular review of progress through the National Adaptation Plans (NAPs) and the Biennial Transparency Report (BTR), which track the country's progress in climate adaptation and mitigation. As part of the EU, Bulgaria also adheres to the EU Adaptation Strategy, which supports the integration of adaptation measures into national policies and promotes the sharing of best practices across member states.

In addition to these frameworks, Bulgaria is also contributing to the Sendai Framework for Disaster Risk Reduction 2015-2030, which emphasizes the importance of disaster risk reduction and climate resilience as key components of sustainable development. The National Strategy for Disaster Risk Reduction in Bulgaria aligns with this framework, ensuring that disaster risk management and adaptation efforts are integrated into national and local planning processes.

Bulgaria's adaptive capacity reflects its efforts to address the impacts of climate change through well-established institutional frameworks, scientific research, and sectoral initiatives. The **National Climate Change Adaptation Strategy and Action Plan (NCCASAP)**, adopted in 2019, serves as the foundation for adaptation measures across priority sectors such as agriculture, water resources, energy, infrastructure, and health. The Ministry of Environment and Water leads coordination efforts at the national level, supported by sectoral ministries and research institutions, striving to ensure that adaptation remains a central focus of climate policy.

The country benefits from a strong scientific base, with institutions like the National Institute of Meteorology and Hydrology (NIMH) and the Bulgarian Academy of Sciences contributing to climate monitoring, modeling, and research. These organizations provide valuable data to support decision-making and help enhance understanding of climate risks and vulnerabilities. Municipalities are increasingly involved in implementing local adaptation measures, supported by national policies and capacity-building programs aimed at enhancing technical expertise and fostering stakeholder engagement.

Financial support for adaptation comes from a combination of national resources and European Union funding mechanisms, such as the Cohesion Fund and the LIFE Program. These resources enable investments in disaster risk reduction, water management infrastructure, and climate-resilient agriculture, among other priorities. Additionally, sector-specific measures are being implemented to address vulnerabilities, such as flood protection systems, drought-resistant crop varieties, and biodiversity conservation projects.

Public awareness of climate risks and the importance of adaptation is growing, with educational campaigns and community initiatives playing a key role in enhancing resilience. Efforts to strengthen early warning systems and disaster preparedness are helping to mitigate risks and reduce vulnerabilities at both the national and local levels. By continuing to build on these strengths, Bulgaria is well-positioned to advance its adaptive capacity and respond effectively to the challenges posed by a changing climate.

To fully realize its adaptive capacity, Bulgaria must focus on improving coordination across governance levels, updating climate monitoring systems, and ensuring that adequate resources are allocated to adaptation priorities. Enhancing the technical capacity of institutions and municipalities, alongside fostering public and private sector collaboration, will be critical in addressing the impacts of climate change effectively.

Institutional arrangements

Bulgaria's climate change adaptation efforts are coordinated by the Ministry of Environment and Water, which oversees the development, implementation, and monitoring of national strategies and ensures compliance with European Union and United Nations Framework Convention on Climate Change obligations. The National Climate Change Adaptation Strategy

and Action Plan, adopted in 2019, provides a comprehensive framework for addressing climate vulnerabilities and implementing adaptation measures across key sectors, including agriculture, water, energy, and health. The strategy aligns with the EU Strategy on Adaptation to Climate Change, ensuring consistency with European policies and facilitating access to funding opportunities.

Institutional coordination mechanisms play a critical role in addressing sectoral impacts and cross-cutting issues. Coordination Council on Climate Change led by the MoEW ensures collaboration among ministries and promotes integration of adaptation efforts into sectoral policies, while the National Expert Council on Climate Change offers scientific and technical guidance to inform decision-making. These mechanisms enable the prioritization and adjustment of activities based on evolving climate risks and policy goals.

Bulgaria integrates climate change adaptation into sectoral policies through the Climate Change Mitigation Act, which mandates that all relevant ministries develop sector-specific adaptation measures. Key sectors include energy, agriculture, forestry, transport, health, construction, regional development, and disaster risk management. The Regional Development Act further requires that national, regional, and local development strategies account for climate risks and adaptation needs.

At the national level, the National Strategy for Disaster Risk Reduction (2018–2030) aligns with international frameworks such as the Sendai Framework and the Paris Agreement, addressing natural hazards like floods, droughts, and extreme temperatures. Regional and municipal plans, such as the Integrated Territorial Strategies and Municipal Integrated Development Plans, incorporate climate adaptation and disaster risk reduction measures tailored to local vulnerabilities.

In Bulgaria, municipal climate action is supported by key frameworks, including Sustainable Energy and Climate Action Plans (SECAPs) and Municipal Integrated Development Plans (IDP). SECAPs are developed by municipalities that are signatories to the Global Covenant of Mayors for Climate and Energy. While adoption is limited, with examples including Sofia and Gabrovo, SECAPs are critical tools for integrating climate mitigation and adaptation measures. They focus on reducing greenhouse gas emissions, promoting energy efficiency, and addressing local climate risks. However, smaller municipalities often face challenges such as limited resources and technical capacity, which hinder broader implementation.

In contrast, Municipal Integrated Development Plans are mandatory for all Bulgarian municipalities, ensuring a broader reach. These plans include measures for climate adaptation, disaster risk reduction, and sustainable development tailored to local conditions. IDP serves as a comprehensive framework, enabling municipalities to address climate risks such as floods, wildfires, and droughts, while aligning with national and regional strategies. The widespread

adoption of IDP highlights its importance in fostering resilience and sustainability at the local level.

Effective adaptation efforts rely on robust data governance, with climate information systems and research institutions playing a crucial role in assessing climate impacts, identifying vulnerabilities, and determining adaptation needs. Monitoring and evaluation are conducted by the MOEW to assess progress, ensure accountability, and refine policies. Biennial reports track implementation of the measures in the adaptation action plan, with a mid-term evaluation planned for 2025 and a final review by 2031.

The government has introduced adaptation measures across various sectors and is working on updating disaster protection plans to address emerging risks. Progress in implementing these measures is expected to contribute to reducing vulnerabilities, improving adaptive capacity, and achieving national adaptation priorities. Coordination with international frameworks and the integration of cross-sectoral issues are areas identified for further improvement to ensure a cohesive and comprehensive approach to adaptation.

Bulgaria continues to make progress in its adaptation efforts, acknowledging the importance of addressing existing challenges in governance, data systems, and resources to enhance resilience at all levels.

4.2. Impacts, Risks and Vulnerabilities

Present climate in Bulgaria

Bulgaria's diverse climate, influenced by continental and Mediterranean systems, features four seasons and varying altitudes. The National Institute of Meteorology and Hydrology (NIMH) divides the country into two climatic areas (European-Continental and Continental-Mediterranean), four subareas, and 25 regions, including coastal and mountainous zones. Latitude significantly affects the heat balance, while the Black Sea and mountains shape local weather patterns.

The Köppen-Geiger classification identifies temperate (C), boreal (D), and polar (E) climates in Bulgaria. Between 1961–1990, temperate climates dominated (93%), with humid subtropical (Cfa) and oceanic (Cfb) types most common. Mediterranean climates (Csa, Csb) appeared in southeastern areas, while boreal (Dfb, Dfc) and alpine tundra (ET) prevailed in mountainous regions. Compared to earlier periods, wetter temperate climates replaced drier Mediterranean types in parts of the southeast. In 1991–2020, notable shifts occurred. Warmer and/or drier conditions affected 36% of the territory, while alpine zones decreased by 60–70%.

In the first half of the 20th century, Mediterranean cyclones, most active from November to June, strongly influenced South Bulgaria, while Atlantic cyclones affected North Bulgaria, peaking from February to June. Northwestern anticyclones caused late spring and early

summer cold spells, western anticyclones brought warm winters and cool summers, and southwestern anticyclones led to heatwaves and droughts from July to September. Arctic anticyclones brought heavy snowfalls in February and March, while local northeastern anticyclones resulted in the lowest temperatures.

Between 1961 and 2020, atmospheric circulation was classified into 11 main types, including cyclonic, anticyclonic, advective (e.g., N, NE, S, etc.), and low-gradient situations. Anticyclonic types were the most frequent, while low-gradient conditions peaked in summer. Advective flows accounted for about 40% of cases, with higher frequencies in winter and spring. In the 1991–2020 period, cyclonic circulation decreased in all seasons except autumn, with the largest drop in spring (3–4%). Anticyclonic circulation declined in autumn (~6%), while advective types saw relative changes of up to ±36%. These shifts align with broader regional trends, including reduced cyclonic activity in winter and spring and increased northern and eastern flows.

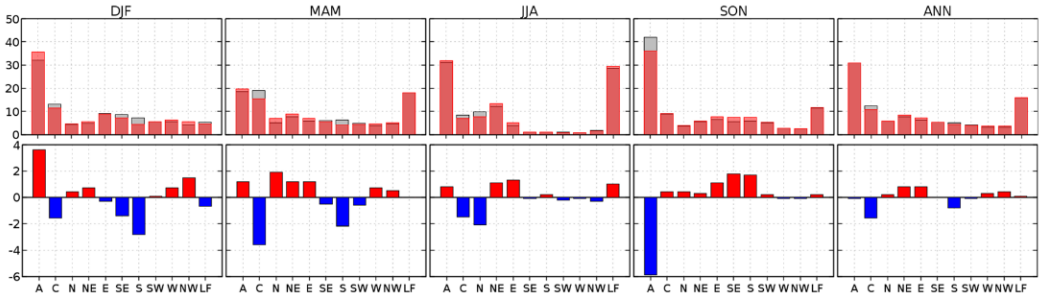


Figure 34. First row: multi-year seasonal and mean annual recurrence (in %) of the 11 circulation types for the periods 1961–1990 (in gray) and 1991–2020 (in red). Second row: absolute difference between repetitions of the second period compared to the first.

Changing circulation patterns drive temperature and precipitation shifts in Europe. Increased summer LF and E flows lead to higher temperatures, while winter easterly flows cause colder conditions. More warm and dry days, along with intensified droughts, are expected by the century's end.

Mean Air Temperature and Precipitation

Since the mid-20th century, significant changes in seasonal temperatures and rainfall have occurred across much of the country, including rising average temperatures and more frequent extremes. Precipitation patterns have also shifted, affecting seasonal totals and the distribution of light, moderate, and heavy rainfall.

Figures I.1.1-1 and I.1.1-2 show the spatial distribution of average annual and seasonal temperatures for 1961–1990 and 1991–2020, along with their differences. In 1961–1990, temperature conditions resembled those of the early 20th century. The coldest areas were the mountains (-3 °C to +8 °C), followed by the high fields in West Bulgaria (9–10 °C) and regions influenced by continental air masses (10–11 °C). Areas with stronger Mediterranean influence had annual averages exceeding 12–13 °C.

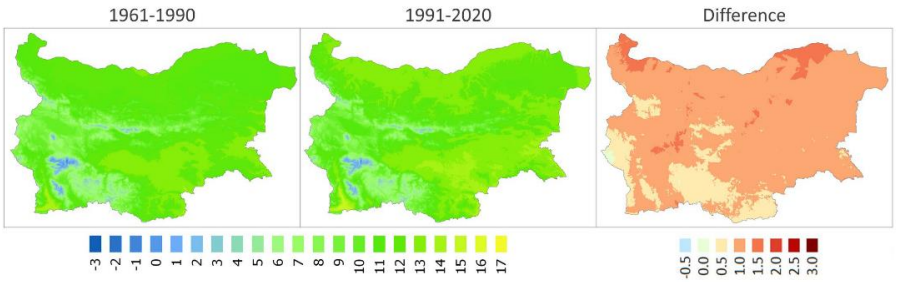


Figure 35. Spatial distribution of the average annual temperature for the time periods 1961–1990 and 1991–2020, along with the temperature difference (°C) between them.

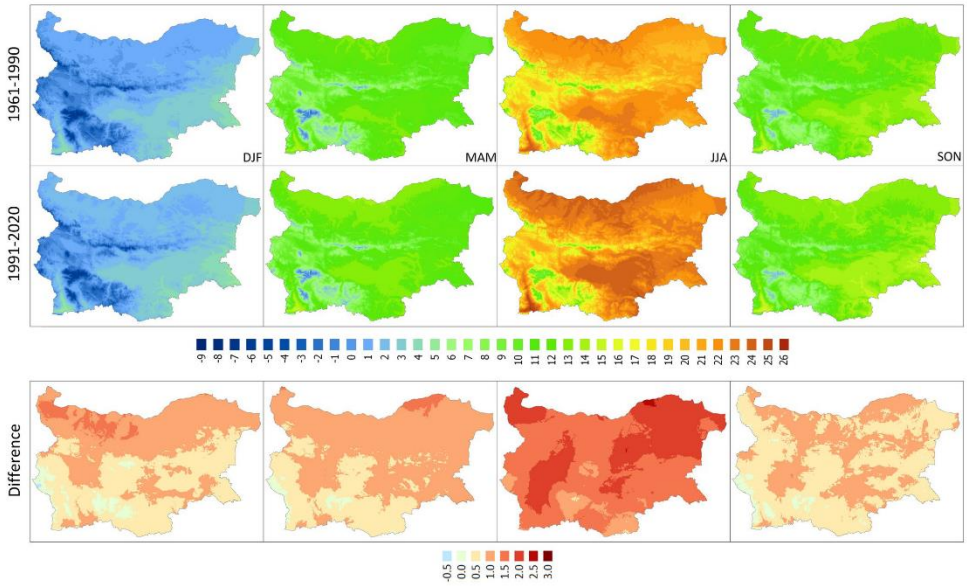


Figure 36. Spatial distribution of average seasonal temperatures for the periods 1961–1990 and 1991–2020, along with the temperature difference (°C).

Winter is colder in regions with a continental climate. In January, average temperatures are negative in the Danube Plain and the high fields of West Bulgaria (-2.3 °C to -1 °C) but positive in the Upper Thracian Lowland (0–1.5 °C) and the Southern Black Sea (above 3 °C). In the mountains, temperatures decrease by 0.3–0.4 °C per 100 m of altitude. In spring, temperature differences between northern and southern areas diminish, except in the southernmost regions. Average April temperatures range from 10–13 °C (below 10 °C in valleys, above 13 °C in southernmost areas), decreasing by 0.6–0.7 °C per 100 m in mountainous areas. Summer temperatures equalize between the north and south of the Balkan Mountains. In July, plains average 21–24 °C, while the high fields of West Bulgaria record 19–20 °C. Temperatures along the Black Sea are about 22 °C, and decrease by 0.7 °C per 100 m in mountains. In October, the Danube Plain and West Bulgaria's high fields are coldest (10–12 °C), while the Upper Thracian Lowland, Black Sea, and southernmost areas are warmer (12–14 °C). Mountain temperatures decrease by 0.5 °C per 100 m.

Between 1991 and 2020, Bulgaria's average annual temperature rose by 0.8 ºC compared to 1961–1990. Warming was most pronounced in North Bulgaria, exceeding 1.0 °C in some areas, and in the lowlands and river valleys. Winter temperatures rose by over 1 °C in parts of the northwest and central regions, while spring temperatures increased by 0.7 °C, especially in the southeast. Summer saw the greatest rise, averaging 1.5 °C and exceeding 2 °C in some northern areas. Autumn changes were smallest, ranging from 0.1–0.5 °C, with slight cooling in southern mountain regions.

Precipitation patterns remained mostly unchanged. Annual totals ranged from 400–500 mm in lowlands to over 1100 mm in mountainous areas, increasing with altitude. Winter precipitation is lowest (18–20%) in continental areas and highest (30%) in Mediterranean regions. In spring, it reaches 25–27% in continental areas and 23–25% in Mediterranean ones. Summer precipitation peaks in Moderate-Continental areas (30–35%) but drops to 20% in Mediterranean regions. Autumn accounts for 25% of annual precipitation in Mediterranean areas and less in continental ones.

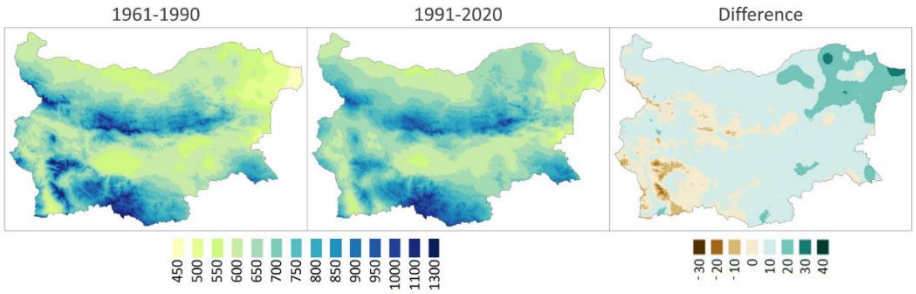


Figure 37. Spatial distribution of the annual precipitation amounts (mm) for the periods 1961–1990 and 1991–2020, along with the relative difference between the second and first periods in %.

The annual precipitation during the period 1991 - 2020 showed no significant change overall, but regional differences varied. It decreased by up to 30% in high mountain areas and increased

by up to 40% in North-East Bulgaria. There was a trend towards heavier precipitation (≥ 30 mm/24 h) and a decrease in lighter (≤ 5 mm/24 h) and moderate (5–15 mm/24 h) precipitation. Torrential rainfall (≥ 60 mm/24 h) increased significantly in North-East and Central-South Bulgaria.

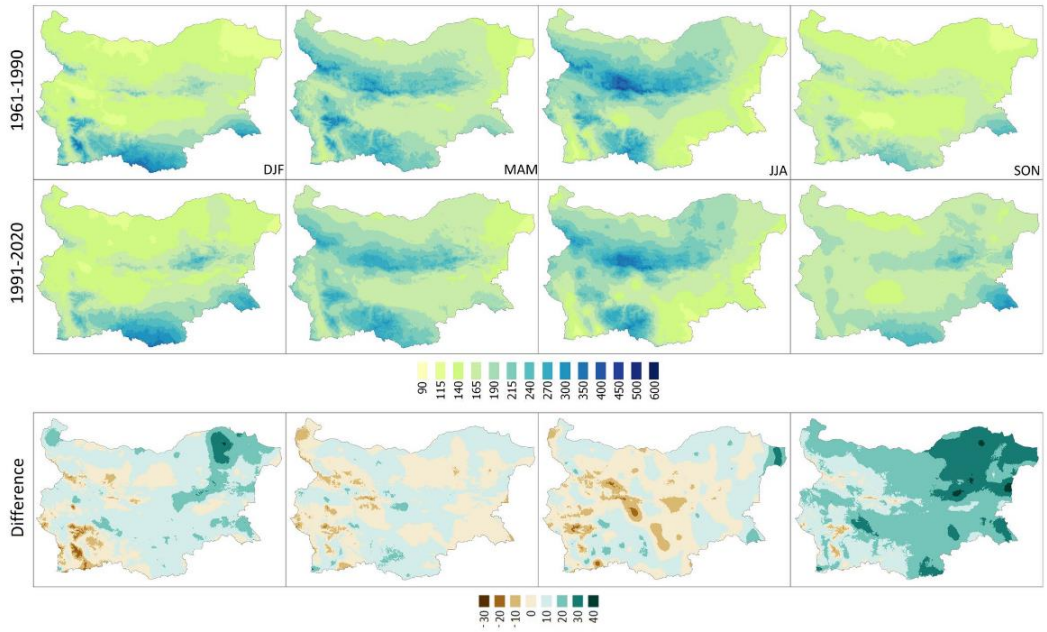


Figure 38. Spatial distribution of the seasonal precipitation amounts (mm) for the periods 1961–1990 and 1991–2020, along with the relative difference between the second and first periods in %.

Seasonal differences were around ±10%. Winter precipitation dropped by over 20% in high mountains and South-West Bulgaria, while it rose by 10–20% in North-East Bulgaria and along the Black Sea. Summer precipitation increased by 25% in the northeast, but decreased by 10–15% in higher mountains. Autumn saw the largest increase, especially in North-East Bulgaria, where it rose by 25–60%. The decrease in winter, spring, and summer precipitation is likely due to reduced cyclonic circulation, while the drop in anticyclonic circulation in autumn may explain the increased precipitation.

The analysis reveals a distinct warming, expressed in the spatial patterns and time evolution of all considered temperature variables over the whole domain.

- The climate change signal intensifies gradually as radiative forcing increases in the examined scenarios.
- The "warming asymmetry" can be recognized in the evolution of temperature variables the maximum temperature increases faster than the minimum temperature.
- Regarding annual precipitation, the results highlight the complexity and inherent uncertainty of the anticipated changes in precipitation. The projected decrease in precipitation for the southern and southeastern parts of Bulgaria, especially under the worst-case scenario SSP5-8.5 in the far future, could exacerbate the adverse effects of the expected hotter climate.

Extreme weather events - analyses and trends

Heatwaves

Prolonged heatwaves in Bulgaria are typically caused by the advection of tropical air masses over the Balkans, intensified by radiative heating under weak pressure gradients. Maximum temperatures exceeding 42-43°C are rare but possible. Statistically, heatwaves are defined as periods with daily maximum temperatures of ≥32°C, 34°C, 36°C, 38°C, and 40°C lasting at least 6, 5, 4, 3, and 2 consecutive days, respectively, reflecting their severity through intensity and duration.

Over the last decades, the frequency of heatwaves has significantly increased. Most extreme heat events with temperatures ≥38°C and ≥40°C, as well as nearly 90% of heatwaves above 32°C, 34°C, and 36°C thresholds, have occurred after the mid-1980s. In certain regions, such as Eastern Bulgaria and the western highlands, almost all heatwaves have been recorded post-1985. July and August are the peak months, but occurrences in June and September have risen to 5-8% of cases. The most intense heat events were in 2007, followed by 2000 and 2012.

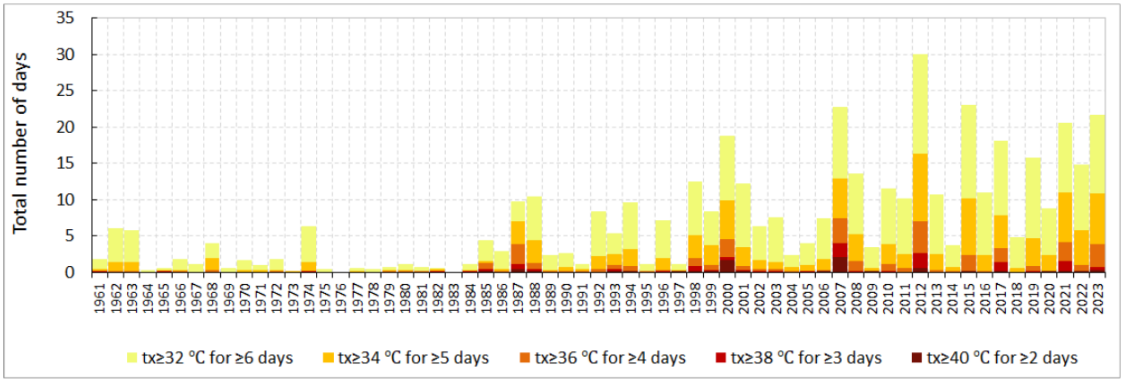


Figure 39. Multi-year variation of the hot spells duration indicator (country averaged) in the period 1961–2023.

The Struma River valley near the Kresna Gorge is the hottest area, with prolonged extreme temperatures exceeding 40°C for up to 6-8 days in some years. Between 1961 and 2020, the average number of hot days (maximum temperatures >32°C) in this region ranged from 40 to 55 annually. In mountainous and coastal regions, particularly along the northern Black Sea coast, hot days rarely exceed 2-3 annually. These numbers rise to 10-11 days in lowland areas and reach 25-35 days in central northern Bulgaria. The Thracian plain, Eastern Rhodopes, and valleys of the Struma and Mesta rivers experience over 50 hot days annually.

Extreme Precipitation

Maximum 24-hour rainfall, a core indicator in ETCCDI's 27 climate change indices, is a key measure of extreme precipitation and flood risk. Bulgaria has recorded numerous extreme rainfall events since 2000, especially in 2005 and 2014, causing severe damage and loss of life.

In continental regions, heavy rainfalls peak in late spring and early summer, while Mediterranean-influenced areas experience maximum rainfall during late autumn and early winter. Along the Black Sea coast, autumn is the wettest season.

Annual maximum 24-hour rainfall averages around 47-48 mm in both northern and southern Bulgaria, though variability is about 1.5 times higher in the north. Since the mid-1990s, an increasing trend of ~3 mm/decade has been observed, although it is not statistically significant. Certain areas, such as the Eastern Rhodopes and northeastern Bulgaria, show significant increases, while decreases are noted in southwestern Bulgaria and high mountain zones.

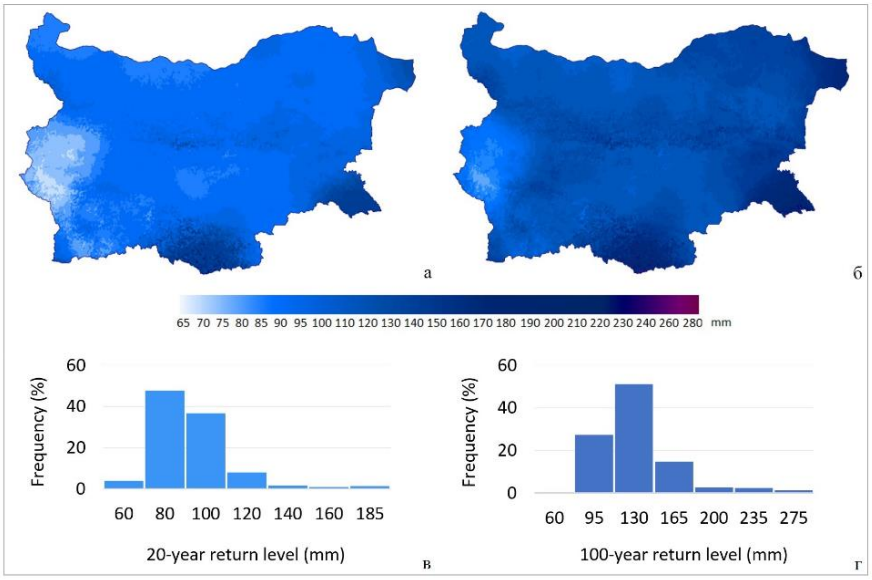


Figure 40. Distribution of the characteristic values of the maximum 24-hour precipitation with a return period once in 20 years (a, c) and once in 100 years (b, d)

Spatial distribution is influenced by large-scale atmospheric circulation and localized processes. Extreme 24-hour rainfall exceeding 60 mm/24h occurs in 87% of stations, with 90th percentile values classified as potentially hazardous. Median maximum rainfall is 111.5 mm, ranging from 60-80 mm in central western Bulgaria to over 200 mm in the Eastern Rhodopes, Strandzha, and along parts of the Black Sea coast (Fig. II.2.5-7).

Return levels of maximum 24-hour rainfall with exceedance probabilities of 5% (once every 20 years) and 1% (once every 100 years) are shown in Fig. II.2.5-8. National averages are 79.5 mm and 109.3 mm, respectively, with the highest values recorded in southern Rhodopes, Strandzha, and certain Black Sea areas.

Floods

Floods, as extreme hydrological events, have been and continue to be one of the most important natural hazards, causing human casualties and economic losses. Linking climate change to

floods is very challenging. Not only many meteorological but also human-related factors influence whether a flood will occur. The main types of floods characteristic for our country are:

- **River floods** – These are characterized by rising water levels due to prolonged, significant rainfall in the upper parts of river basins and overflow beyond the natural riverbanks or levees.
- **Flash floods** – Floods with a short duration and a large peak of water volume. These are rapidly developing phenomena (usually within 6 hours of the start of intense rainfall) over relatively small areas. These floods can also occur in small areas that are usually dry and lack a permanent river network.
- **Rain (surface) floods** – These occur when intense rainfall exceeds the infiltration capacity of the soil or the capacity of urban drainage networks.

Flash and rain floods, which result from intense rainfall and occur within a few hours of the start of the precipitation, account for 77% of all floods. The remaining 23% of registered floods are river floods. Even during the dry year of 2019, the database recorded 59 floods, most of them occurring in May and June.

As a result of the rising temperatures during the winter months and earlier snowmelt, the characteristic spring river floods in Bulgaria and the risk of river floods are shifting to the winter months - December and January. Intense rainfall is a consequence of convective processes in the atmosphere, which are typical of the summer season. On the other hand, summer droughts limit the infiltration capacity of the soil and create conditions for flash floods. In recent years, 93% of the floods occurring in the summer were flash and rain floods.

Drought

The total annual volume of river runoff in the country in 2019 was 52% less than in 2018, and compared to the norms for the periods 1961–1990 and 1981–2010, the decrease is 36.1% and 24.3%, respectively. For 2020, the comparison with the norms for the same two periods shows a decrease in the total volume of the river runoff by 45.2% and 35.0%, respectively.

The most significant is the decrease in runoff for the Black Sea region, followed by the West Aegean, East Aegean, and Danube River regions. During both dry years, groundwater reserves decreased, and in over 70% of the hydrogeological points across the entire country, a decrease in the levels and flow rates compared to the norms was recorded in individual months.

A comparison of the monthly values of the De Marton index (for further details on the indicators, see Chapter III) for two thirty-year periods, 1951–1980 and 1981–2010, shows that the climate in the second period has become drier compared to the previous one. The drought index (AIUNEP) for the period 1981–2010 was obtained by applying the formula recommended by the JRC-Ispra in the Methodology for identifying areas with natural constraints (Terres et al.,

2016). To designate an area as affected by the "drought" criterion, it must correspond to an AI value ≤ 0.5 in more than 20% of the years of the study period (in this case, 7 and more). The area of agricultural land affected by the "drought" criterion in each plot must be ≥ 60%.

In a study for the period 1981–2010, the regions with natural constraints according to the "drought" criterion were identified by land location. They cover the regions along the Danube River, and in the central northern regions, they reach the Pre-Balkans. North-East Bulgaria, including Dobrudzha, is the most affected by the drought. In South Bulgaria, separate places in the valleys along the Struma River (around Blagoevgrad and the Petrich-Sandanski region) and the Mesta River are affected. The shortage of water will be felt more and more often in the Upper Thracian Lowland and some areas in the Yambol and Burgas regions.

Frosts

Frost occurrence has a significant negative impact on crops, particularly in Southeastern Europe. Late spring and early autumn frosts are especially damaging. Spring frosts can affect fruit trees like almonds, apricots, peaches, cherries, and plums, damaging buds, flowers, and fruits, leading to reduced yields. Between 2000 and 2020, frost damage was observed in March and April, mainly in stone fruit crops. Spring frosts also harm field crops like sunflower, soybeans, corn, and vegetables. The dates of the last spring and first autumn frosts limit the growing season, varying across regions. In the southern regions, the frost-free period lasts longer, while the northern and higher areas have shorter periods. Over time, the occurrence of late spring frosts has become later, and the frost-free period has shortened. Early autumn frosts, especially in northern and western parts, are the most harmful to agriculture. The average frost-free period ranges from 187 to 232 days, with the southwest having the longest period. Climate warming is extending the frost risk period, affecting crop development stages like flowering and germination.

This section summarizes key climate risks and vulnerabilities in nine economic sectors of Bulgaria based on the conclusions from sector assessment reports in the National Adaptation Strategy, also drawing on the National Climate Change Risk and Vulnerability Assessment (MoEW 2014). It also highlights potential opportunities from climate change identified in these reports.

For all sectors, there are significant uncertainties in assessing climate vulnerabilities due to the complexity of considering multiple factors, including future environmental, economic, and social changes. A major source of uncertainty is the extent to which future greenhouse gas emissions will affect radiative forcing over the next century.

Agriculture

Agriculture is a vital part of rural Bulgaria's economy, contributing 2,9% to GVA and employing 5,7% of the labor force in 2023, one of the highest rates in the EU-28. Despite abundant natural

resources, rural areas face challenges such as lower incomes, limited job opportunities, an aging population, and high poverty rates, creating a divide between rural and urban areas.

Climate change poses significant risks to Bulgarian agriculture, with increased frequency of extreme weather events like droughts and floods. Projections indicate rising temperatures (by 2°C to 5°C) and changing precipitation patterns by the end of the century, leading to more frequent adverse events. The agricultural sector is highly vulnerable, affecting food production, economic stability, and rural livelihoods. However, the impact varies regionally. Large-scale farms are economically vulnerable to climate change but have more resources for adaptation, while smallholders, although vulnerable, have greater resilience due to diversified production and social networks.

Key climate change risks for agriculture include:

Changes in growing seasons, potentially benefiting certain crops and enabling the cultivation of new species.

- Altered agro-phenology, such as earlier flowering and changes in crop cycles, affecting yields.
- Decreased crop yields due to temperature rises and reduced rainfall, though increased CO2 levels could improve some crops.
- Increased spread of pests, diseases, and weeds due to climate changes affecting their growth and interactions.
- Heat stress impacting livestock health, breeding, and productivity.
- Increased soil erosion, desertification, and aridity, particularly in vulnerable regions.
- Water shortages affecting irrigation and increasing competition for water resources.
- Negative impacts on fisheries and aquaculture due to lower water levels and higher temperatures affecting fish species.

These combined risks are expected to affect agricultural production, with droughts and floods causing yield variability. Given agriculture's importance to Bulgaria's economy, these climate-related challenges will increasingly impact rural livelihoods.

Biodiversity and Ecosystem Services

Bulgaria has rich biodiversity, hosting around 41,493 plant and animal species, representing 26% of European species, including 25% listed in the Red Book of Europe. NATURA 2000 sites cover 34.9% of the country, while protected areas account for 5.3% (584 836.4 ha).

Climate change is expected to impact biodiversity and ecosystem services (BD&ES) in various ways, including abrupt and catastrophic effects. While rising temperatures may extend vegetation periods and support migration or controlled introduction of species for adaptation, vulnerabilities remain significant:

- Loss of genetic diversity: Climate change directly threatens vulnerable and endemic species, risking permanent loss. Indirect effects include competition for resources due to human activities such as water extraction and land-use changes.
- Disruption of species lifecycles: Changing lifecycles and phenological phases affect ecosystem processes like food chains and may enable invasive species to replace native ones, altering ecosystem integrity. Some invasive species could have adaptive value as indicators or contributors to ecosystem services.
- Habitat deterioration: High-altitude habitats and those listed as endangered in the Red Data Book of Bulgaria are particularly at risk.

Impacts on ecosystem services:

- Positive impacts: Longer growing periods may increase crop yields and timber harvesting. Ecosystem disturbances could result in new species compositions that improve ecosystem services.
- Negative impacts: Droughts, floods, fires, and pest outbreaks threaten ecosystem integrity and could reduce ecosystem service provision in vulnerable areas like southern forests, lowlands, wetlands, alpine zones, and coastal areas.

Assessing the vulnerability and adaptive capacity of BD&ES to climate change is complex due to scientific uncertainty, limited data, and insufficient understanding of system interactions.

Energy

The electricity generation sector in Bulgaria is characterized by a diverse energy mix, including nuclear power plants, thermal power plants, and facilities utilizing renewable energy sources (such as hydro, wind, solar, and biomass). In 2023, power plants using local coal contributed 29% of the electricity generation. The sole nuclear power plant in the country is a very large producer of electricity, providing more than one-third of the nation's annual electricity output. Gross electricity production for the year was 40 TWh, marking a 21% decrease compared to 2022. While renewable energy sources show an 8% increase in production and cogeneration facilities reported a slight growth of 0.3%, significant declines were observed in thermal power plants (46%), lignite-fired power plants (16%), pumped storage hydroelectricity (5%), and nuclear power (2%).

Climate change poses risks to the energy sector, with Bulgaria already facing natural hazards like floods, droughts, and fires. Extreme weather has caused some disruptions, mainly temporary power cuts and damage to the electricity grid, but energy infrastructure has largely remained unaffected so far.

Key vulnerabilities in the energy sector include:

- **Primary energy supply**

- Coal production: Risks from heavy precipitation can damage infrastructure, reduce coal quality, and increase heat stress for outdoor workers.
- Natural gas supply: Climate change increases fire risk and could disrupt gas transmission, especially during droughts and floods.

- **Electricity generation**
- Nuclear and thermal power plants: Increased temperatures will reduce plant efficiency and water availability for cooling. Warming temperatures may also lead to invasive species damaging energy infrastructure.
- Renewable energy: Hydropower may suffer from reduced precipitation, and solar and wind power efficiency may decrease due to changes in cloud cover, wind patterns, and extreme storms.
- **Supply/demand balance**: Climate change may alter energy demands for heating, cooling, and transportation, affecting peak demand.
- **Electricity transmission and distribution**: Extreme weather events may damage transmission lines, especially in mountainous areas, and heat waves may reduce transmission efficiency.
- **Heating production and distribution**: Increasing temperatures could reduce heating demand.

In conclusion, climate change will have both positive and negative impacts on the energy sector, with negative effects predominating. Despite this, the energy sector is considered "extremely resilient" to climate impacts until 2035 due to well-planned and maintained infrastructure.

Forestry

Forests cover one-third of Bulgaria, totaling 36,1 %. The standing wood volume has nearly tripled since the 1960s, reaching around 680 million m^3. Bulgaria's forests boast significant biodiversity, with 4,102 vascular plant species. The forestry sector contributes about €500 million annually and employs around 43,000 people, particularly in rural areas.

Climate change projections suggest higher temperatures, warmer winters, more summer droughts, and increased extreme weather events. These changes will reduce forest health, tree growth, and increase damage from insects, fungi, fires, and storms. Impacts are already evident, and future damage could result in significant economic losses, reduced carbon sequestration, and the loss of important ecosystem services.

A study suggests wood growth could decrease by 3.5 million m^3 annually, affecting forest product production and the rural economy. This would also impact forests' ability to protect water supplies, manage rainfall, stabilize soils, and support tourism and biodiversity.

Key vulnerabilities include:

- Species-specific responses: Some species may struggle to adapt to new climate conditions, leading to extinction or poor health.
- Species interactions: Climate change may alter resource competition, affecting forest composition and ecosystem services.
- Coniferous plantations at low elevations: These plantations may face growth decline and health issues due to drought, aging, and poor thinning practices.
- Increased disturbances: Fires, windthrows, and damage from snow and insects may alter forest structure and composition.
- Invasive species: Climate change could enhance conditions for invasive species, potentially harming rare habitats.
- Prevalence of firewood: High firewood usage contributes little to the sector's economic sustainability.

Despite efforts to address climate change, vulnerabilities remain that require urgent action to protect Bulgaria's forests and ecosystem services.

Human Health

Climate change in Bulgaria is marked by rising temperatures, more heatwaves and cold spells, altered rainfall patterns, increased heavy rainfalls, more extreme weather events (windstorms, cyclones, floods, droughts), and changes in ultraviolet (UV) radiation. These changes affect human health in complex ways, influenced by socioeconomic, health, and personal factors.

Health effects can be primary or secondary. Primary effects include direct impacts like heatwaves, cold spells, UV radiation, and floods. Secondary effects stem from climate-related factors such as pollen, vector-borne diseases, fires, contaminated food, water, and air, and compromised crops. These effects include heat-related morbidity, extreme weather-related morbidity, cardiovascular diseases, respiratory conditions, cancer, vector-borne diseases, foodborne diseases, waterborne diseases, mental health issues, and neurological disorders.

Key future vulnerabilities for Bulgaria include:

- **Temperature- and humidity-related health effects**: Expected increases in deaths from cardiovascular diseases and strokes during heatwaves, vector-borne diseases, respiratory issues due to higher CO2 and dust, and allergies due to earlier flowering and higher pollen concentrations.
- **Emergency weather-related health effects**: Higher mortality due to extreme weather and fires, especially among vulnerable groups, as well as increased morbidity from waterborne and foodborne diseases, and PTSD after extreme events.
- **Precipitation-related health effects**: More cases of Cryptosporidiosis and Campylobacteriosis, as well as diarrheal infections, due to increased precipitation, higher temperatures, and changes in water quality.

Assessing health impacts is complex due to uncertainties in greenhouse gas emission scenarios, data limitations, and climate-health models. Therefore, further research and assessments are needed.

Climate-related health impacts disproportionately affect vulnerable groups such as children, elderly people, those with chronic illnesses, low socioeconomic status, or harmful personal habits. Indicators show that Bulgaria is more vulnerable than many other EU countries. Health vulnerabilities may also be exacerbated by the health sector's infrastructure and personnel understanding of climate change impacts. The severity of health impacts will depend on the public health sector's capacity to address these issues and on factors like behavior, age, gender, socioeconomic status, and location.

Tourism

In 2023, the contribution of tourism to Bulgaria's economy is 6.9% of total GDP, which amounts to 6.8 billion USD. In terms of employment, the sector is representing 8.0% of the total number of jobs in the country. In 2023, the total number of visits by foreigners to Bulgaria reached 12,627,547. This marks a significant increase compared to 2022, when the number of visits was 10,887,952.

Weather and climate significantly affect tourism, influencing destination attractiveness, holiday timing, and tourist activities. Adverse weather, such as heatwaves, storms, and lack of snow, can negatively impact tourist satisfaction and return rates.

Tourism in Bulgaria is vulnerable to climate change due to its weather dependence and seasonal nature. Extreme events, such as heatwaves, intense rainfall, coastal flooding, and storms, are expected to increase. Winter tourism is already affected by higher temperatures, and ski areas may become economically unviable in the near future. Rising summer temperatures and sea-level rise will threaten coastal areas. Climate change may also indirectly affect tourism through resource scarcity (especially water) and higher energy demands, such as for air conditioning.

Climate change presents several short- and long-term risks to tourism, though warmer temperatures in shoulder seasons could attract more tourists. Key risks include:

- Lower number of tourists: Higher temperatures, heatwaves, and increased rainfall may reduce tourist numbers.
- Shorter winter season: Shorter snow cover and higher avalanche risks may shorten the winter season.
- Shorter average stay: Higher temperatures and humidity could shorten average stays.
- Health problems with tourists: Increased risk of heat-related health problems, especially in summer.

- Poorer conditions for outdoor recreation: Extreme weather and higher precipitation can hinder outdoor activities.
- Damage of tourist infrastructure and superstructure: Extreme weather events, including storms, floods, and landslides, may damage infrastructure.
- Poorer access to destinations: Floods, avalanches, and landslides could affect accessibility.
- Water shortages: Higher water demand in already scarce areas may affect tourism and deter visitors.

The opportunities can be seen in the following:

- **Longer summer and shoulder seasons**: Warmer temperatures could extend the summer and shoulder seasons.
- **Development of new tourism products**: Cultural tourism, wine and culinary tourism, and special events (e.g., festivals) can be developed.
- **Attracting new perspective tourism markets**: Attracting retirees and creating new destinations could diversify the market.
- **Less need for heating energy in winter and shoulder seasons**: Higher temperatures in winter and shoulder seasons may reduce heating needs, though cooling energy demand will increase in summer.

There are uncertainties in understanding how climate change will affect tourism, particularly regarding traveler responses to extreme events and long-term climate shifts. This can influence tourism choices, activities, and holiday timings.

Transport

In Bulgaria, road transport is the primary mode, with rail transport following as the secondary one. The main transport infrastructure includes roads, railways, water, and air transport, with the most significant weather-related impacts on the national road network, municipal transport infrastructure, and public transport services. The estimated annual costs of climate-related damage to transport infrastructure range from BGN 115–135 million, excluding social and economic costs.

Medium- to long-term risks for the transport system due to climate change include:

- **Floods**: Increased frequency and impact of floods will damage road and railway infrastructure, undermining subbase layers and causing catastrophic failures.
- **Landslides**: Despite projected decreases in total annual precipitation, more extreme rainfall events will increase the frequency of landslides, damaging roads, railways, and river banks, leading to operational disruptions and restricted access to key areas.

- **Blizzards and snowfall**: While snowfall is expected to decrease in the long term, blizzards and heavy snow will remain disruptive in the short- and medium-term, especially in northern and northeastern regions.
- **Extreme heat**: Heatwaves can soften asphalt, leading to deformation and cracks, increasing accident risks. Extreme heat may also cause rail buckling and disrupt Danube River navigation due to droughts.

Climate change will negatively affect transport sector stakeholders, including:

- **Infrastructure managers**, facing deterioration and damage to infrastructure and potential closures.
- **Transport operators**, experiencing higher costs and operational disruptions.
- **Transport users,** facing delays, longer transit times, and discomfort.
- **End consumers/society**, incurring higher costs for infrastructure and operations, and potential business losses from supply chain disruptions.

However, the transport sector is considered resilient until 2035 due to moderate climate change and infrastructure designed with local climate conditions in mind. Nevertheless, the sector's adaptive capacity is deemed insufficient.

Urban Environment

As of 2023, 73.5% of Bulgaria's population lived in urban areas. By 2050, it is projected that 81% of the population will reside in urban areas, intensifying pressures on land, infrastructure, and services and increasing the vulnerability of urban populations to disasters.

Urban areas in Bulgaria have experienced an increase in average annual temperatures and a higher frequency of intense precipitation, often accompanied by wind storms or hail, leading to a rise in floods.

Cities are categorized based on population size (large, medium, small) and location (coastal, plain, mountainous, semi-mountainous). Vulnerability is also assessed considering development patterns, zoning, and land use. The expected impacts include damage to buildings and infrastructure, health risks, endangered key services (e.g., food supply, electricity), reduced mobility, water stress, and increased financial pressure on municipalities for maintenance and emergency services.

Key Findings on Climate Change Risks:

***Extreme Temperatures*:**

- Heat islands are expected to form more often in large cities, with increased construction density and intensity. This will intensify the impact of high temperatures.

- Cold waves, though rare, may occur in both large and small mountain cities, potentially disrupting services, including food supply, especially when combined with snowfall.

Intense Precipitation:

- Flooding is anticipated to increase, affecting all settlements, particularly those near watercourses or illegal housing in flood-prone zones.
- Hailstorms, often occurring with intense precipitation, will cause floods and damage buildings, vehicles, and infrastructure.
- Prolonged precipitation, combined with rising groundwater or wastewater seepage, may trigger landslides, especially in vulnerable areas such as the Black Sea and Danube cities.
- Landslides may also be triggered by earthquakes, which, while not linked to climate change, should be considered in the adaptation process.

Water Resource Scarcity:

- High temperatures and droughts will increase water stress, particularly in areas with scarce water resources and outdated infrastructure prone to significant water losses.

Urban areas, particularly large cities, are vulnerable to climate change risks due to outdated and inadequate infrastructure, a large aging population, and significant numbers of low-income or impoverished residents. The lack of awareness among decision-makers and the public about climate change causes, risks, and prevention further exacerbates the urban environment's vulnerability.

Water

The water sector in Bulgaria encompasses both managed water systems (such as water supply, sanitation, hydro-melioration, hydropower, and industrial use) and natural water systems. Bulgaria's total renewable water resources are estimated at 21.3 km^3 annually, with 20.4 km^3 from surface water and 0.9 km^3 from net groundwater resources. The area covered by surface freshwater bodies is about 2,000 km^2, representing less than 2% of the country's territory. While Bulgaria has relatively significant freshwater resources compared to other European nations, they are unevenly distributed across the country and fluctuate seasonally.

Climate change is expected to significantly impact river hydrology, with total annual discharge rates projected to decrease. Seasonal distribution will also shift, with increased river discharge in winter and spring, while summer and autumn will experience reduced flow rates. Groundwater availability is projected to remain largely unchanged. Past and present extreme weather events, such as droughts and floods, have already negatively affected water sector infrastructure.

The conclusions of the Water Sector Assessment Report for climate change risk and vulnerabilities are as follows:

- **Floods and droughts hazards** are identified as major climate risks to the water sector. Flood risks are widespread across Bulgaria, while drought risks are more pronounced in regions with projected water scarcity. Despite the expectation of no significant changes in groundwater availability, water scarcity risks are higher in regions dependent on surface water, especially where tourism is expected to increase.
- **The Black Sea region is particularly vulnerable** due to its reliance on surface water and high levels of tourism. The poor condition of infrastructure in this region exacerbates the risk.

Key Vulnerabilities:

- **State and preparedness of the infrastructure**: Aging, poorly maintained, and overwhelmed infrastructure poses a significant vulnerability, as it may not be adequate to cope with climate-induced stresses such as floods and droughts.
- **Preparedness of the human factor, operator, or user**: Both the population and operators of water infrastructure lack sufficient experience and practices for dealing with floods and droughts, further increasing vulnerability.
- **Hydropower Production systems**: Hydropower systems are highly vulnerable to variations in river flow caused by droughts, potentially impacting energy generation.
- **Water Services**: Water supply, sanitation, and melioration services are also at risk, especially during drought periods, due to infrastructure and resource shortages.

Major Risks:

- **Risks to Managed Systems**: Risks include infrastructure damage, improper operation, and inadequate service levels due to climate-related events such as floods and droughts. Hydropower generation could be impacted by low or high river flows, disrupting electricity production.
- **Risks to Natural Systems**: Biodiversity in natural water systems is at risk from both flooding and droughts, as these events can disrupt ecosystems and aquatic habitats.

Used data and methodology for the climate scenarios

Modern coupled atmosphere-ocean general circulation models (CAOGCMs), which simulate the atmosphere's interactions with other geophysical spheres, are crucial tools for understanding climate change, according to the NIMH. The Coupled Model Intercomparison Project (CMIP) offers a standard protocol for CAOGCM simulations used in IPCC reports. The IPCC AR6 features advanced CMIP6 models with higher spatial resolution and new physical processes.

The NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP) includes climate scenarios based on 35 CMIP6 model runs across four SSP scenarios. The dataset provides high-resolution climate variables (0.25° spatial, daily temporal) for 1950–2100, including historical data (1950–2014) and projections (2015–2100). The E-OBS dataset serves as the reference for historical data.

The SSP scenario group Tier 1 consists of four climate change scenarios. Three of them (SSP1-2.6, SSP2-4.5, and SSP5-8.5) provide continuity with the AR5 representative concentration pathways (RCPs) by targeting a similar level of aggregated radiative forcing.

- SSP1-2.6 ('Sustainability'), targeting below 2°C warming with climate protection measures.
- SSP2-4.5 ('Middle of the Road'), a medium pathway for GHG emissions with climate protection measures.
- SSP3-7.0 ('Regional Rivalry'), representing a higher forcing scenario with limited policy intervention.
- SSP5-8.5 ('Fossil-fueled Development'), an extreme scenario with no emission policies.

The analysis uses the multimodel ensemble (MME) methodology, focusing on multimodel mean (MM), 25th, 50th, and 75th percentiles (X25, X50, X75). Projections are for two time frames: 2021–2050 (near future) and 2071–2100 (far future), with a reference period of 1981–2010.

Indicators for the analysis and trends of extreme weather events

The most commonly used climate change indices are developed by two WMO expert groups: ETCCDI and ET-SCI. These indices are categorized into five groups, with this analysis focusing on threshold indices that measure the number of days a climate variable exceeds or falls below a fixed threshold, highlighting significant, but not necessarily extreme, changes in temperature and precipitation.

Threshold indices help capture both extreme events and long-term shifts in climate. Changes in these indices can signal critical impacts of climate change on ecosystems and human health. The analysis uses four temperature-based and two precipitation-based indices, calculated annually or seasonally:

- Frost days (FD): days with minimum temperature below 0°C
- Ice days (ID): days with maximum temperature below 0°C
- Summer days (SU): days with maximum temperature above 25°C
- Tropical nights (TR): days with minimum temperature above 20°C
- R05mm: days with precipitation above 5 mm
- R10mm: days with precipitation above 10 mm

4.3. Adaptation priorities and barriers

Domestic priorities and progress towards those priorities

Bulgaria's adaptation priorities, as outlined in the National Climate Change Adaptation Strategy and Action Plan, focus on enhancing resilience across key sectors including agriculture, water management, energy, transport, health, biodiversity, and urban development. These priorities aim to mitigate vulnerabilities to climate impacts, such as droughts, floods, and extreme weather events, while ensuring sustainable economic and social development.

Progress has been made in integrating adaptation measures into national and local planning frameworks. Municipal Integrated Development Plans now include measures for climate risk management and disaster risk reduction. Sector-specific actions, such as promoting water-efficient practices in agriculture and upgrading energy infrastructure to withstand extreme weather, have been implemented. The National Risk Profile and Disaster Risk Management Plan were updated in 2023, reflecting the latest climate vulnerabilities and hazards.

Bulgaria has also advanced public awareness initiatives and leveraged European Union funding to support adaptation projects, particularly in regions most vulnerable to climate risks. These efforts align with EU policies, including the EU Adaptation Strategy, and demonstrate Bulgaria's commitment to enhancing resilience.

Adaptation challenges and gaps, and barriers to adaptation

Despite progress, Bulgaria faces several barriers to achieving its adaptation goals. Limited financial resources and technical capacity at the municipal level remain significant challenges, particularly for smaller municipalities that struggle to implement comprehensive adaptation measures.

Data gaps and outdated climate monitoring systems hinder accurate risk assessments and the development of targeted adaptation strategies. While the National Institute of Meteorology and Hydrology provides critical data, there is a need for enhanced integration and accessibility of climate information systems.

Coordination across governance levels and sectors is another challenge, with inconsistencies in the implementation of adaptation measures. This fragmentation can result in missed opportunities for synergy and efficiency in addressing cross-sectoral climate impacts.

Emerging climate risks, such as prolonged droughts, severe floods, and heatwaves, highlight the need for continuous updates to adaptation policies. Expanding insurance coverage for climate-related disasters and fostering private sector involvement in adaptation financing are also essential to address these risks effectively.

To overcome these barriers, Bulgaria is focusing on strengthening institutional frameworks, improving data systems, and increasing financial and technical support for adaptation. By addressing these challenges, the country can further enhance its resilience and achieve its adaptation priorities.

4.4. Adaptation strategies, policies, plans, goals and actions to integrate adaptation into national policies and strategies

Bulgaria's adaptation efforts align with the global goal on adaptation under Article 7, paragraph 1, of the Paris Agreement, focusing on enhancing adaptive capacity, strengthening resilience, and reducing vulnerability to climate change. The National Climate Change Adaptation Strategy and Action Plan serves as the cornerstone of these efforts, addressing vulnerabilities in priority sectors such as agriculture, forestry, water resources, energy, transport, health, biodiversity, tourism and urban environments. Adaptation actions are designed to safeguard sustainable development and reduce climate-related risks, contributing to the achievement of the global goal.

The National Climate Change Adaptation Strategy and Action Plan provides a cohesive framework for addressing climate vulnerabilities across Bulgaria's nine key sectors. Its overarching goals are to reduce vulnerability, enhance resilience, and strengthen adaptive capacity by integrating adaptation measures into sectoral and regional policies, aligning with the European Union's Green Deal and the Paris Agreement. Key actions include mainstreaming climate adaptation into national strategies, enhancing data and monitoring systems, promoting ecosystem-based adaptation, and building institutional and community awareness.

To address localized needs, sector-specific action plans and regional initiatives focus on tailored solutions, such as water-efficient agricultural practices, resilient water infrastructure, and health risk management. Priorities include improving disaster risk management for floods and droughts, safeguarding critical infrastructure, promoting sustainable land use, and fostering innovation and technology. Through these actions, Bulgaria aims to create a climate-resilient economy and society, ensuring alignment with both national development goals and international commitments.

Nature-based solutions are a cornerstone of Bulgaria's adaptation strategy, with significant efforts dedicated to restoring and preserving ecosystems to enhance resilience to climate change. A key initiative is the restoration of wetlands along the Danube River, including the Persina Nature Park and Kalimok-Brushlen Protected Site, where over 4,000 hectares of former marshlands have been reconnected to the natural hydrological cycle. These projects have

improved water retention, reduced flood risks, and enhanced biodiversity, with bird species increasing from 2 to 22 and fish species rising from 2 to 10 within months of the restoration efforts.

Reforestation and afforestation projects are also critical components of Bulgaria's nature-based adaptation measures. Approximately 21,000 hectares of riparian forests have been restored in 10 nature parks, including Vitosha, Strandja, and Rila Monastery, under initiatives coordinated by the Executive Forest Agency and WWF Bulgaria. These efforts stabilize soil, enhance carbon sequestration, and improve habitat connectivity.

In urban areas, green infrastructure solutions, such as urban forests and permeable pavements, are increasingly integrated into municipal development plans to mitigate the urban heat island effect and manage stormwater. These measures not only address immediate climate risks but also contribute to long-term sustainability and biodiversity conservation.

4.5. Progress on implementation of adaptation

The implementation of adaptation actions across the sectors is progressing according to the priorities outlined in the National Climate Change Adaptation Strategy. These actions are designed to enhance the resilience of key sectors, mitigate climate risks, and ensure sustainable development. Specific measures have been taken in each sector, with a focus on integrating climate adaptation into planning and decision-making processes.

Agriculture

Agriculture is one of the most vulnerable sectors of the Bulgarian economy, with three-quarters of agricultural output derived primarily from the cultivation of cereals and industrial crops. In response to climate change, Bulgaria has implemented several adaptation actions in the agricultural sector, including:

- Adjusting the timing of farm operations to better align with changing climatic conditions.
- Promoting the cultivation of thermophilic crops that are more resilient to higher temperatures.
- Developing and modernizing irrigation systems to optimize water use and ensure crop productivity during dry periods.
- Improving the management of existing woodland to enhance ecosystem services and carbon sequestration.
- Strengthening pest and disease control measures to mitigate the impact of climate-related changes on crop health.

Additionally, the Strategic Plan for the Common Agricultural Policy, which commenced on 1 January 2023, is a key instrument in supporting the transition to a sustainable, resilient, and modern agricultural sector in Bulgaria. The plan aims to foster the cultivation of special crops and varieties that are more suited to the evolving climate conditions, thus enhancing the agricultural sector's ability to adapt to climate change.

Water

Water resources in Bulgaria are unevenly distributed across regions and seasons, and climate change is expected to significantly affect the hydrology of rivers as well as underground water resources. To address these challenges, the operational objectives for the water sector include:

- Adapting the legal framework to ensure it is effective in addressing the impacts of climate change.
- Maximizing the use of research and educational institutions to support water management adaptation.
- Adapting the design, construction, and operation of water system infrastructure to enhance resilience to climate impacts.

Regarding the expansion and upgrading of monitoring networks for precipitation, water resources, and water use in response to climate change, the project "Monitoring the Amount of Water" is being implemented with financial support from the Operational Program "Environment 2014-2020." Additionally, the project "Digitalization for Complex Management, Control, and Efficient Use of Water" has been approved for implementation with funding under the National Plan for Recovery and Resilience.

Collaboration with water sector stakeholders is also ongoing to explore the links between water efficiency (e.g., reducing system losses) and energy efficiency.

Water companies across the country have implemented a range of energy efficiency measures, including:

- Replacing pumping units for the transportation of drinking water and wastewater drainage.
- Introducing autonomous automated control systems in water supply networks.
- Improving the condition of the building stock associated with water infrastructure.

Energy

In the energy sector, greater resilience to climate change impacts is essential for ensuring the technical viability of energy systems and their ability to meet energy demand in a cost-effective manner. The key measures for enhancing resilience and sustainability in the energy sector include:

- Achieving the national target share of energy from renewable sources in gross final energy consumption by 2030. This will be accomplished through the creation of a favorable regulatory framework and by increasing the use of renewable energy in the electricity, heating, cooling, and transport sectors. In the transport sector, the introduction of new-generation biofuels and renewable electricity will be promoted for road and rail transport. The consumption of these fuels and energy will contribute to achieving energy diversification and the decarbonization of the transport sector.
- Implementing innovative technologies for sustainable energy development. Innovations in the energy sector help reduce overall energy costs while setting new standards for energy efficiency and transitioning to more sustainable energy consumption.

Key regulatory and infrastructure developments in the sector include:

- The development and promulgation of **Regulation No. RD-02-20-3** (9 November 2022) on the technical requirements for the energy characteristics of buildings.
- In collaboration with the Ministry of Energy, the preparation and promulgation of **Ordinance No. E-RD-04-2** (16 December 2022) on energy efficiency surveys, certification, and assessment of energy savings in buildings.

Additionally, mainstreaming climate change resilience and improving contingency planning in infrastructure management that supports the energy sector has been a priority. Key actions include:

- The construction of a complex modular telemetric computer information system for monitoring and preventing issues in drainage systems, covering the catchment area of the company. This system ensures early notification of emergencies and other events that could threaten the normal operation of energy plants.
- The completion of the construction and reconstruction of 366.05 km of power lines during the 2021-2022 period.

The Electricity System Operator of Bulgaria (ESO EAD) has also launched the **project "Digital Transformation and Development of ESO's Information Systems and Real-Time Systems in the Context of Low-Carbon Energy"** This project, co-financed by the EU's Instrument for Recovery and Resilience, has a total value of BGN 611 million.

Furthermore, five large-scale projects of common interest, as defined by Regulation (EU) 347/2013, have been completed, with a total length of 367.18 km, contributing to the modernization and resilience of the energy infrastructure.

The National Trust EcoFund (NTEF) has implemented several projects to promote energy efficiency and climate adaptation in the energy sector:

1. **BEACON Project**: The "Bridge between European and Local New Climate Action" (BEACON) project, funded by the Federal Ministry for the Environment, Nature

Conservation and Nuclear Safety of Germany, aims to enhance sustainability of measures taken under the Operational Program Environment 2014-2020. The project focuses on energy-saving initiatives in schools and kindergartens. A key meeting with project partners was held on March 31, 2021, to discuss progress and future actions.

2. **Municipal Energy Management Systems (MEMS)**: In partnership with EnEffect and supported by the European Climate Initiative (EUKI) of the German Federal Ministry of Environment, NTEF has developed a model for municipal energy management in Bulgaria. This project aims to create a framework for financing energy efficiency projects and supporting local authorities in implementing energy-saving measures.
3. **Partnership for Adaptation to Climate Change**: This project, with a funding of BGN 940,266.60, focuses on building the capacity of the Municipality of Smolyan. It includes training for municipal employees and the implementation of measures for producing electricity and heat from renewable sources, as well as conducting energy efficiency surveys in partner municipalities.

Forestry

Bulgaria has implemented several adaptation measures to strengthen the resilience of its forests. These actions include:

- Conducting research, education, capacity building, and knowledge extension to provide a solid foundation for informed decision-making and adaptive forest management.
- Enhancing the resilience of regenerating, expanding, and strengthening forest resources to improve forest recovery operations and meet the increasing demand for wood.
- Establishing and maintaining systems for rapid forest fire detection, long-term disturbance monitoring, and forest resource monitoring. These systems help minimize losses from disturbances and enable effective management planning and adaptation in high-risk areas.
- Improving the potential for the long-term use of higher-value wood products, thereby increasing revenues from the wood-processing industries.

Additionally, in preparation for the spring-summer season and the associated risks of fires in forested, field, and agricultural lands, several information and awareness campaigns have been conducted among the population. As part of the summer forest fire protection campaign, coordination and joint events were organized with the Executive Agency of Forests under the Ministry of Agriculture to ensure effective fire prevention and response.

Human Health

Bulgaria is divided into six regions for air quality assessment and management. Sofia Municipality falls within a region characterized by excessive particulate matter (PM) air pollution, primarily generated by domestic heating and transport. To comply with national

legislation and **Directive 2008/50/EC**, Sofia Municipality developed its **Air Quality Programme (AQP)**, which is periodically updated. On a national level, air pollution from particulate matter smaller than 10 microns (PM10) represents the most significant air quality issue. In areas where monitoring is conducted, 88.7% of the population, or approximately 3.5 million people, are exposed to excessive levels of PM10.

Given these challenges, **Updated National Air Pollution Control Program 2020-2030** is aimed at reducing the impact of air pollution on human health and the environment. The program includes measures to reduce the main sources of pollution, such as industrial and transportation emissions, and aims to achieve cleaner air through the implementation of new technologies and policies.

In addition, the **LIFE IP CLEAN AIR project** will extend its implementation of municipal Air Quality Programmes to five other Bulgarian municipalities—Burgas, Veliko Tarnovo, Montana, Ruse, and Stara Zagora—all of which face similar air quality issues. Although these municipalities have AQs in place, they lack detailed and actionable measures. By including these areas, the project will reach an additional 2 million people, nearly one-third of the Bulgarian population.

The main objectives of the LIFE IP CLEAN AIR project are:

- To improve air quality in the municipalities of Sofia, Burgas, Veliko Tarnovo, Montana, Ruse, and Stara Zagora.
- To build administrative capacity in the six municipalities so they can:
    - Implement the measures outlined in their Air Quality Programmes.
    - Conduct monitoring and control to ensure air quality improvements.
    - Leverage various financing sources, including EU funds, to support air quality measures.
    - Develop AQP for the next programming period based on high-quality, reliable data.
- To raise awareness and create an informed community of citizens and NGOs capable of partnering with local administrations to drive change.
- To support capacity-building in air quality management for municipalities facing poor air quality.
- To enhance the transfer of knowledge and experience in air quality management through networking with other EU municipalities, institutions, projects, and partners.

The integrated project has a duration of six years, from October 2018 to October 2024, with a total budget of €16.7 million, 60% of which is financed by the European Commission.

Biodiversity and Ecosystems

The new **Biodiversity Strategy and Action Plan**, along with a **Green Infrastructure Strategy** for ecosystem-based management, conservation, restoration, and climate change adaptation (CCA), have been adopted.

By Decision No. 830 of 26 October 2022, the Council of Ministers approved legislative amendments to the **Biodiversity Act**, which were submitted to the National Assembly on 27 October 2022. These amendments will not fully reflect ecosystem-based adaptation policies, which will be implemented through the National Biodiversity Strategy and its Action Plan.

The Executive Environmental Agency leads the monitoring and assessment of environmental impacts on ecosystems, with additional activities conducted by the Bulgarian Academy of Sciences in 2022. Citizen science was also used for data collection.

To implement the CCA Strategy, activities related to ecosystem management and the protection of bird species in arable lands are included in the **National Framework for Priority Actions** (2021-2027). Specifically, Activity 2.6 focuses on forests and wooded areas, aiming to absorb greenhouse gases, prevent soil erosion, and capture carbon dioxide.

An agreement (No. D-30-38/20.07.2022) was signed between the Ministry of Environment and Water and the Institute of Biodiversity and Ecosystem Research to develop action plans for invasive alien species, in line with Regulation (EU) No. 1143/2014. The National Biodiversity Monitoring System will be upgraded to track the spread of these species.

Urban Environment

The urban environment requires the implementation of sectoral adaptation actions to address climate change. Several key measures have been taken to improve energy efficiency and reduce the environmental impact of buildings and infrastructure.

1. **Energy Efficiency in Buildings**:
    - In the period 2021-2022, **Ordinance No. RD-02-20-3** (promulgated in SG No. 92 of 2022) was developed and enacted, establishing the technical requirements for the energy characteristics of buildings. This ordinance aligns with the **Energy Efficiency Act** , which was amended in 2021 to meet the requirements of **Directive (EU) 2018/844** on energy efficiency and the energy performance of buildings.
    - In December 2022, **Ordinance No. E-RD-04-2** was promulgated (SG No. 102 of 2022), focusing on energy efficiency surveys, certification, and assessment of energy savings for buildings.
    - Additionally, **Ordinance No. E-RD-04-1** (2022) was developed to regulate energy efficiency checks for heating installations and air-conditioning systems in buildings, with the aim of enhancing energy savings.

2. **Integrated Energy and Climate Plan**:
    - In line with **Regulation (EU) 2018/1999**, Bulgaria developed its **Integrated Energy and Climate Plan (INPEC) for 2021-2030**, which includes measures for energy efficiency, the promotion of renewable energy, and the reduction of greenhouse gas emissions in the urban environment.
3. **Regional Development Program 2021-2027**:
    - The **Regional Development Program 2021-2027** aligns with **UN Sustainable Development Goal No. 13 ("Combating Climate Change")**, with approximately 30% of the resources for Priorities 1 and 2 focused on mitigating climate change. This includes measures for energy efficiency in buildings and the development of sustainable mobility. The program also emphasizes climate change adaptation and mitigation in housing measures.
4. **National Program for Energy Efficiency of Multi-Family Residential Buildings**:
    - The **National Program for Energy Efficiency** aims to improve the energy characteristics and overall condition of multi-family residential buildings, contributing to air quality protection, greenhouse gas reduction, and the long-term housing policy. As of December 31, 2022, 1,953 buildings covering 11,044,019 m^2 have been renovated, with an expected reduction of approximately **319 ktCO2/year** in greenhouse gas emissions.
5. **Support for Sustainable Energy Renovation**:
    - The **National Plan for Recovery and Resilience** includes a sub-measure for the sustainable energy renovation of the residential building stock. Approved in **Council Decision ST 8091/22** (May 4, 2022), this sub-measure is part of investment **C4.I1**, focusing on multi-family residential buildings across Bulgaria. The activities under this sub-measure are expected to be completed and reported by **June 30, 2026**.

Tourism

The tourism sector in Bulgaria is vulnerable to climate change, and the Ministry of Tourism has taken steps to assess and address the impacts of climate change on tourism development. The Ministry has reviewed the implementation of the **Adaptation Action Plan** for the period 2021-2022, considering the significant changes in the overall environment for tourism development in the country. This assessment also includes evaluating the **Updated National Strategy for Sustainable Tourism Development (2014-2030)** and its related action plans, which incorporate climate change adaptation measures.

To reduce the carbon footprint and climate impact of the tourism sector, particularly through energy efficiency and innovation, the Ministry has focused on raising awareness within the tourism business. Key activities include:

- **Green Innovations in Tourism**: A roundtable was held on December 7, 2021, with 71 participants, including 9 lecturers. The event discussed good practices, policies, and trends related to sustainable tourism and the circular economy.
- **Industry Information Meetings**: Three meetings were held in November 2021, September 2022, and October 2022 to promote innovations and energy efficiency in tourism enterprises. These meetings also provided guidance on applying for funding opportunities under EU programs, particularly the European Structural and Investment Funds (ESIF).
- **Funding Information**: Information on funding opportunities for the tourism sector under the **National Recovery and Resilience Plan** was published, including details on the **Low Carbon Economy** component of the **Green Bulgaria** pillar (published on May 12, 2022).

The Ministry's primary focus is on developing **cultural tourism** (historical, architectural, festival, wine-culinary, religious, etc.), **health tourism** (balneotherapy, SPA, medical tourism, and thalassotherapy), **business tourism**, **ecological tourism**, **rural tourism**, and other specialized tourism types. Efforts are also aimed at attracting new categories of tourists to diversify the sector.

Data for the period 2021-2022 show that Bulgaria has a relatively diverse tourism product. According to official data from the **National Statistical Institute (NSI)** in 2021, 55.8% of tourist registrations in accommodation facilities with 10 or more beds were outside the Black Sea regions. This indicates the growth of urban, SPA, business, cultural, mountain, and other types of tourism across the country.

Transport

Climate change has significant economic impacts on the Transport sector, including damage to infrastructure assets, vehicles, and vehicle safety. To address these challenges, the following adaptation measures have been implemented:

- **Development and Adoption of Adaptation Guidelines**: Climate change adaptation guidelines have been developed and adopted for transport projects in general, as well as for specific transport modes. These guidelines ensure that future transport projects are designed with climate resilience in mind.
- **Review and Adaptation of Operational Standards**: Existing operation and maintenance standards for transport infrastructure are being reviewed and adapted to better address the impacts of climate change. This includes updating procedures to enhance the resilience of transport systems.
- **Emergency Response Procedures**: Current emergency response procedures are being reviewed and adapted to ensure a more effective response to climate-related disruptions, such as extreme weather events.

- **Resilience of Future Transport Projects**: The **State Enterprise Port Infrastructure** (SEPI) is developing an investment program for 2021, which includes sites for the repair, rehabilitation, and reconstruction of port infrastructure in public transport ports. This program aims to improve the resilience of these ports to climate change impacts.
- **Environmental Management System (EMS)**: The Integrated Management System (IMS) of the **DPPI** has been upgraded with an Environmental Management System (EMS), in line with the requirements of the **ISO 14001:2015** standard. This upgrade supports the implementation of an effective environmental policy across the organization.
- **Project on Shipping Route Modernization**: In 2022, the project **"Modernization and Optimization of the Rehabilitation Activities of the Shipping Route in the Common Bulgarian-Romanian Section of the Danube River"** was completed. The project involved the supply of equipment aimed at enhancing the safety and efficiency of the shipping route, ensuring its resilience to climate impacts.

To enhance adaptation to climate change at the national and regional levels, several key actions have been taken:

1. **Increasing Institutional Capacity**: Efforts have been made to strengthen the institutional capacity within municipalities for climate change adaptation. This includes fostering coordination and cooperation between municipalities and other responsible institutions, both at the regional and national levels. Active engagement with stakeholders ensures a comprehensive approach to adaptation.
2. **Research and Monitoring**: Targeted research and monitoring activities have been carried out to enhance knowledge and data collection. These efforts support the effective planning and implementation of adaptation measures. Specific analyses are performed to reduce vulnerabilities and to inform the development of more effective adaptation strategies.
3. **Information Campaigns and Public Engagement**: Information campaigns have been organized to raise public awareness about climate change and the importance of adaptation. These campaigns aim to increase societal understanding and commitment to addressing climate change impacts.
4. **Effective Communication and Stakeholder Engagement**: Regular meetings with stakeholders have been held to communicate the progress and implementation of the national and regional adaptation strategies. These meetings foster an active dialogue, ensuring that all relevant parties are informed and involved in the process.
5. **Seeking Synergies and Co-benefits**: Proactive activities have been undertaken to prevent risks and reduce vulnerabilities, turning climate change challenges into opportunities for positive change. These activities focus on improving the quality of life,

developing local economies, and implementing effective solutions and good practices that contribute to both climate adaptation and sustainable development.

Implementation of Adaptation Actions Identified in Current and Past Adaptation Communications

The implementation of adaptation actions in Bulgaria is guided by various strategic frameworks and policies, including the **Innovation Strategy for Smart Specialization of the Republic of Bulgaria (ISIS) 2021-2027**. This strategy plays a crucial role in addressing climate adaptation needs, particularly through its emphasis on sustainable development, green transformation, and innovation.

1. **Innovation Strategy for Smart Specialization 2021-2027**: The updated ISIS is aligned with the United Nations Sustainable Development Goals and the European Commission's priorities for the 2019-2024 period. It emphasizes the digital and green transformation of the economy and society, which directly supports climate adaptation efforts.
2. **Thematic Areas for Smart Specialization**: One of the key thematic areas of the ISIS is "Clean Technologies, Circular and Low-Carbon Economy," which focuses on developing technologies and innovations that contribute to climate change mitigation and adaptation. The following sub-areas are prioritized:
    - **Energy Efficiency and Renewable Energy**: Innovations in energy production, storage, and consumption, including the use of renewable energy sources, are key to reducing emissions and adapting to climate impacts.
    - **Hydrogen-based Technologies**: The development of green hydrogen production, storage, transport, and utilization in various sectors (industry, energy, transport, households) is a priority, contributing to both adaptation and mitigation.
    - **Sustainable Mobility**: Technologies for sustainable transport, including battery and hydrogen-powered vehicles, and eco-mobility infrastructure, support climate adaptation by reducing transport-related emissions.
    - **Resource Efficiency**: Technologies aimed at efficient resource use, reducing hazardous substances, and promoting circular economy practices are essential for reducing vulnerability to climate change.
    - **Waste-to-Resource Technologies**: Waste-free technologies that incorporate waste products into other productions contribute to reducing environmental stress and enhancing resilience.
    - **CO2 Capture and Utilization**: Technologies for capturing and utilizing CO2 from the atmosphere help mitigate climate change and support adaptation efforts.

3. **Regional Adaptation**: The thematic area of clean technologies, circular economy, and low-carbon initiatives is being prioritized in all 28 regions of Bulgaria at the NUTS III level, ensuring that climate adaptation actions are tailored to regional needs and capacities.

4.6. Monitoring and evaluation of adaptation actions and Processes

The monitoring and reporting process under the National Climate Change Adaptation Strategy and its Action Plan is designed to be participatory, fostering capacity building, knowledge sharing, and the integration of lessons learned from implementation activities.

Monitoring will involve the systematic collection and analysis of data on implemented activities, ensuring it is accessible, easy to understand, and incorporated into reports. This process enables stakeholders to track progress, evaluate whether objectives are being met, and adjust actions to improve performance where necessary.

In line with the Regulation on the Governance of the Energy Union, which integrates provisions from the Climate Monitoring Mechanism Regulation and aligns with the Paris Agreement, reporting on national adaptation actions occurs biennially, starting in 2021. Progress on the implementation of measures outlined in the Action Plan will be assessed through two official reports:

- Mid-term report in 2025, and
- Final report in 2031, both of which will be submitted to the Council of Ministers.

The monitoring and evaluation system will be continuously strengthened and refined, drawing on experience and insights gained from the implementation of adaptation measures.

The monitoring and evaluation process under the National Climate Change Adaptation Strategy 2019–2030 focuses on assessing the achievements and impacts of implemented adaptation measures, ensuring that objectives are met and that actions contribute to building resilience. Adaptation actions across key sectors, such as water, agriculture, and energy, have been implemented to address vulnerabilities identified in the NCCAC.

Monitoring activities evaluate how implemented measures have strengthened resilience, particularly in vulnerable sectors and communities. This includes assessing the effectiveness of infrastructure upgrades, ecosystem restoration projects, and capacity-building programs.

The mid-term report (2025) will provide a comprehensive review of progress, focusing on measurable outcomes such as reduced vulnerability, improved adaptive capacity, and the integration of adaptation into sectoral policies. Lessons learned from the mid-term review will serve as the basis for the actualization of the NCCAS, ensuring that the strategy remains aligned with emerging climate challenges, national priorities, and international commitments under the Paris Agreement.

The Monitoring and Evaluation (M&E) of the Action Plan requires careful selection of information that best measures progress and performance. M&E arrangements should focus on both the processes and outcomes of implemented actions in achieving their objectives, while also capturing any unintended maladaptive consequences.

The identification of appropriate indicators should consider the following:

- Existing indicators and datasets: These may already measure the required outcomes or can be adjusted to align with the objectives of the Action Plan.
- Influences beyond planned actions: Progress (or lack thereof) toward objectives may also be affected by external factors, including autonomous adaptation occurring alongside planned measures.
- Cost-effectiveness: The cost of collecting indicator data should not exceed the value of the information for M&E purposes.

Each activity outlined in the Action Plan includes proposed indicators or sets of indicators for monitoring performance (see Annex 3 in the "Strategy and Action Plan" – Full Report: link). Wherever possible, current and expected outcomes have been specified. However, further agreement and refinement of these indicators will be required through consultations with the implementing institutions.

The NCCAS emphasizes transparent planning and execution of adaptation measures. It involves public consultations and stakeholder engagement to ensure inclusivity. The Ministry of Environment and Water coordinates the strategy, providing regular updates and reports accessible to the public, thereby maintaining transparency throughout the process.

Bulgaria engages in sharing information, good practices, and lessons learned on adaptation through national, regional, and international platforms. At the national level, efforts are focused on enhancing coordination and knowledge exchange among institutions, municipalities, and stakeholders involved in adaptation planning and implementation. This includes organizing workshops, training sessions, and conferences aimed at building capacity and disseminating scientific findings relevant to climate adaptation.

Regionally, Bulgaria collaborates with neighboring countries in the Danube and Black Sea regions to address transboundary climate risks. Through participation in initiatives like the EU Strategy for the Danube Region (EUSDR) and the Black Sea Economic Cooperation (BSEC), Bulgaria contributes to joint research, policy alignment, and the exchange of adaptation practices.

Internationally, Bulgaria contributes to the work of the Intergovernmental Panel on Climate Change (IPCC) and participates in knowledge-sharing initiatives under the United Nations Framework Convention on Climate Change (UNFCCC). These efforts include submitting reports, sharing case studies, and engaging in global dialogues on science-based adaptation planning and policy development.

Policy innovation and pilot and demonstration projects

Presented below are examples of pilot and demonstration projects implemented at the local level in Bulgaria over the past several years:

The Predefined Project No. 3, titled "Implementation of Innovative Measures for Mitigation and Adaptation to Climate Change in Municipalities in Bulgaria", is a significant initiative under the European Economic Area (EEA) Financial Mechanism, with a budget of 5,448,362 BGN. The project aims to enhance the capacity of local authorities to plan, monitor, and implement effective measures to address climate change, aligning municipal actions with national strategies.

A key focus of the project is capacity building for municipal authorities, enabling them to develop and execute climate strategies effectively. The initiative involves evaluating existing municipal plans and programs to identify gaps and risks related to climate change and introducing innovative urban planning solutions as pilot measures in selected municipalities. Educational programs and study visits to countries like Norway have been organized to learn from best practices in climate adaptation and mitigation.

The project also includes the implementation of pilot measures in eight municipalities, such as Sofia, Burgas, Ruse, and Stara Zagora, focusing on innovative urban planning solutions to mitigate and adapt to climate change. Stakeholder engagement plays a central role, fostering collaboration among local authorities, the National Trust Ecofund (NTEF), and international partners to ensure successful implementation.

The expected outcomes of the project include enhanced municipal capacity for climate-related planning and implementation, the introduction of innovative urban planning solutions that can be replicated in other municipalities, and better alignment of municipal plans with national climate strategies. This initiative represents a proactive step by Bulgaria to address climate change at the municipal level, fostering innovation and collaboration to build resilient communities.

Open Call No. 3, titled "Enhancing the Capacity of Local Communities to Reduce Greenhouse Gas Emissions and Adapt to a Changing Climate," was launched under the EEA Grants' Environment Programme in Bulgaria. The call aimed to strengthen the capacity of local municipalities to evaluate their strategic plans and programs concerning actions that reduce greenhouse gas emissions and adapt to the adverse effects of climate change.

The call promoted pilot and innovative projects implemented in a consortium of several municipalities—one beneficiary municipality with several partner municipalities—with the

aim of transferring results to more than one municipality and/or implementing bilateral initiatives. Specific activities under this call included improving the competence of municipal employees in planning climate change mitigation and adaptation measures.

By targeting local communities, Open Call No. 3 plays a vital role in ensuring that climate adaptation and mitigation efforts are grounded in local contexts while contributing to Bulgaria's broader climate commitments under the Paris Agreement and EU frameworks. This approach promotes a bottom-up model of climate action, where local capacity building serves as a foundation for national progress.

The GoGreenLocal project, "Active Local Climate Adaptation and Mitigation Policies," involves Pernik and Bobov Dol municipalities, with Pernik as the lead beneficiary. Funded under the EEA Financial Mechanism 2014–2021 through the "Environment Protection and Climate Change" Programme, the project runs from July 2022 to May 2024 with a budget of BGN 987,727.00. It aims to build municipal capacity for effective climate policies, evaluate existing plans, and implement innovative measures like hydrogen-oxygen production. The project also fosters stakeholder collaboration and organizes events to share its objectives and results, including a closing press conference in March 2024 in Bobov Dol.

The project "Integration of Measures and Activities for Adaptation to Climate Change" led by the Municipality of Dobrich with partners Krushari, Dobrichka, and Norway's GREENZONE AS, runs from July 2022 to May 2024 with a budget of €363,219.88. It aims to strengthen municipal capacity by training officials in climate change planning, evaluating local strategies, and implementing innovative measures like photovoltaic solar systems on public buildings to reduce emissions. The project also includes a visit to Norway to exchange experiences and integrate successful climate adaptation practices into local strategies, fostering improved environmental management.

The project "Sustainable Solutions for Mitigation and Adaptation to Climate Change in Small Municipalities" led by the Municipality of Chelopech with partners Mirkovo, Zlatitsa, Koprivshtitsa, and Norway's Ecotech Consult, runs from July 2022 to May 2024 with a budget of €875,283.71. It aims to build local capacity for reducing emissions and adapting to climate change through staff training, study trips to Norway, and local policy development. Pilot measures include solar installations in schools, kindergartens, and a youth center, a solar EV charging station in Chelopech, and composting containers for Zlatitsa residents. The project emphasizes adopting Norwegian best practices and developing plans for climate action.

The project "Implementation of Measures for Successful Adaptation to Climate Change" involves Blagoevgrad, Simitli, Kocherinovo, and Boboshevo municipalities, in partnership with the International Development Norway Association (IDNA). It aims to build local capacity for sustainable policies to reduce emissions and adapt to climate change through training sessions, an information forum with Norwegian experts, and a study visit to Oslo. Pilot measures include

solar hot water systems in kindergartens and social institutions in Blagoevgrad and Simitli, an electronic database of green spaces in Blagoevgrad, and home composting projects in Kocherinovo and Boboshevo.

The project "Introduction of Measures for Adaptation to the Changing Climate in the Municipalities of Galabovo, Gorna Oryahovitsa, and Stambolovo" aims to enhance local capacity to plan and implement climate change mitigation and adaptation strategies. The project focuses on training municipal employees, evaluating existing strategic plans, and addressing gaps in climate actions. Key measures include installing rooftop photovoltaic systems in Galabovo and Gorna Oryahovitsa, afforestation efforts in Stambolovo, and sharing best practices from Norway through study visits and informational events. Funded by the EEA Environmental Protection and Climate Change Program, with Utgard AS as a partner, the initiative strengthens municipal resilience to climate impacts while promoting renewable energy and biodiversity.

The Municipality of Straldza is implementing the project "Development and Implementation of Measures for Mitigation and Adaptation to Climate Changes" to enhance its capacity to address climate-related challenges. The initiative focuses on training municipal staff to improve their understanding and management of climate issues, developing strategic plans that integrate climate change considerations into local policies, and executing actions to reduce greenhouse gas emissions and adapt to climate impacts. These efforts aim to strengthen the municipality's resilience to climate change, promote sustainable development, and improve the quality of life for residents.

Integration of adaptation actions into planning at different levels

Adaptation actions in Bulgaria are systematically integrated into key sectoral strategic documents, ensuring alignment with the country’s climate goals and sector-specific priorities. The National Climate Change Adaptation Strategy serves as the overarching framework, guiding the incorporation of adaptation measures across various sectors.

In the agriculture sector, the Strategic Plan for Agriculture and Rural Development 2023–2027 emphasizes measures such as irrigation systems, improved ventilation and cooling systems for animal husbandry, and sustainable farming practices to enhance resilience to climate change.

In urban and regional development, the National Spatial Development Concept includes adaptation measures to support sustainable urban development and infrastructure planning, while the Long-Term National Strategy for Renovating the Building Stock by 2050 integrates thermal insulation and energy-efficient construction materials to reduce vulnerabilities.

The energy sector integrates adaptation through the Sustainable Energy Development Strategy to 2030 with a Horizon to 2050, which focuses on decarbonization, renewable energy sources, and the climate-proofing of energy infrastructure.

In water management, the River Basin Management Plans 2022–2027 and the National Strategy for the Management and Development of the Water Sector outline investments in hydromelioration systems and flood risk mitigation measures, ensuring water resource sustainability under changing climatic conditions.

The biodiversity sector addresses adaptation through the Biodiversity Strategy of Bulgaria, focusing on the conservation of ecosystems, particularly in the Black Sea region, and promoting sustainable practices within the "blue economy."

Cooperation to share information and to strengthen science, institutions and adaptation

In line with Bulgaria's commitment to public participation in international climate efforts, the Ministry of Environment and Water, as the national coordinator for the Intergovernmental Panel on Climate Change (IPCC), organized the 61st Plenary Session of the IPCC in Sofia from July 27 to August 2, 2024. The session gathered scientists and delegates from over 150 countries to discuss climate policy and approve outlines for the Special Report on Climate Change and Cities and the Methodology Report on Short-Lived Climate Forcers.

In addition to the main event, a satellite program was organized, featuring a variety of webinars and workshops aimed at engaging the public and a wide range of stakeholders. Highlights included events such as “Climate Risks in the Black Sea Region” and “Climate Fresk” event, an interactive session that encouraged active citizen participation through teamwork to visualize the causes and effects of climate change. The workshop “Climate Policies as Opportunities for Investment in Urban Development” explored practical solutions for integrating climate measures into economic growth strategies. Another event, “Science and Innovation Supporting Climate, Resilience, and Communities,” involved the public in discussions on innovations that enhance community resilience and quality of life. A webinar on “How to Become an IPCC Author” also encouraged scientists to contribute to IPCC reports. Citizens and NGOs actively participated by posing questions and sharing proposals during the satellite events.

Strengthening scientific research and knowledge related to:

The vulnerability of sectors in Bulgaria’s economy to climate change necessitates a systematic approach to assessing the associated risks. The most recent assessment for Bulgaria was conducted in 2014. However, the dynamic evolution of climate processes, scientific research, and EU policy requirements call for this assessment to be updated. This update is planned to take place in 2025.

The 2014 analysis does not reflect the latest climate data, projections, and trends, which have significantly evolved over the past decade. The lack of updated information poses risks for inadequate planning and ineffective adaptation measures. Bulgaria is required to integrate

updated data into its strategic documents, such as the National Adaptation Strategy and Action Plan, in line with EU requirements and the UNFCCC.

A precise risk and vulnerability assessment is critical for developing effective policies and adaptation measures at both national and sectoral levels. The absence of such an assessment limits the ability to allocate resources and investments effectively to the most vulnerable sectors. Advances in programs like Copernicus and Climate-ADAPT provide new data, tools, and models that can improve the accuracy of the analysis. Incorporating georeferenced maps will facilitate risk and vulnerability visualization, offering a valuable planning tool.

The growing frequency and intensity of climate risks, such as extreme weather events, droughts, floods, and heatwaves, underscore the urgency of updating the assessment to address their impacts on key sectors. The updated analysis, planned for 2025 will also serve as the scientific basis for revising the National Adaptation Strategy and Action Plan. This will ensure that adaptation policies are evidence-based, effective, and aligned with European and international standards.

5. Information on financial, technology development and transfer and capacity-building support provided and mobilized under Articles 9–11 of the Paris Agreement

Pursuant to Article 13, paragraph 9, of the Paris Agreement in accordance with the relevant modalities, procedures and guidelines (MPGs), in this chapter, we provided information on financial, technology development and transfer and capacity-building support provided and mobilized under Articles 9–11 of the Paris Agreement.

In order to provide this information in a clear and consistent manner, this chapter is structured along the lines of the relevant MPGs (decision 18/CMA.1, para. 118 - 129).

5.1. National circumstances and institutional arrangements

The Republic of Bulgaria provided national and international sources for financing of environmental policy, including climate change mitigation and adaptation measures.

The main national and international sources for financing are:

- National: State budget; National Trust Eco Fund
- EU Environmental Funds: "Operational Programme Environment 2021-2027" ,
- Other EU Funds, Programs and Initiatives

National Trust Eco 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, climate change mitigation and adaptation.

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 2014-2020" and „Operational Programme Environment 2021-2027" (OPE) sets the country strategic objectives and priorities in environment sector including climate mitigation and adaptation measures. 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.

5.2. Information on financial support provided and mobilized under Article 9 of the Paris Agreement

Bulgaria contributes annually to the general core budget of the UNFCCC and the Kyoto protocol. Part of this contribution is meant for support to developing countries, including Protection and rehabilitation of in Africa, affected by drought and desertification.

In 2022, Bulgaria's Ministry of Foreign Affairs agreed a ponce for a grant contribution of 50 000 euros, to the Green Climate Fund which have been released in 2023.

In 2022, the project “Strengthening the institutional and administrative capacity for negotiations under Chapter 27 ‘Environment’ of the Ministry of Environment and Spatial Planning of the Republic of North Macedonia and its regional structures in the process of accession to the EU” was fudned under the program “International Cooperation for development” of the Bulgarian Ministry of Foreign Affairs. Its implementation contributes to achieving EU goals in the Western Balkans in the short and long term.

Part of the project have been dedicated to climate change policy and the challenges associated with achieving climate neutrality. The process of transposing European legislation into national legislation in this important area for the EU, the strategic documents at the national level and the sub-normative framework have been presented in detail. Specific cases of implementation of the European Emissions Trading Scheme, issuance of greenhouse gas permits and the challenges associated with reducing the impact of the human factor on climate change, as well as adaptation to it, have been discussed.

6. IMPROVEMENTS IN REPORTING

As per the modalities, procedure and guidelines, each Party should, to the extent possible, identify, regularly update and include as part of its biennial transparency report information on areas of improvement in relation to its reporting. Bulgaria will improve its biennial transparency report continuously.

As this BTR is the first report under the Paris Agreement, Bulgaria is planning to further improve its reporting in subsequent BTRs according to the technical expert review team´s recommendations.

7. ANNEXES TO THE BIENNIAL TRANSPARENCY REPORT

The following annexes are available as separate submissions on the UNFCCC website:

- Common reporting tables for GHG emissions and removals
- Common tabular formats for information necessary to track progress
- Common tabular formats for information on support provided and mobilised

The National Inventory document is submitted as a stand-alone document.

References

Chapter 2 National Inventory Report

https://unfccc.int/ghg-inventories-annex-i-parties/2024

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Chapter 4 Climate change impacts and adaptation

National Climate Adaptation Strategy