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Republic of Bulgaria

National Climate Change Adaptation Strategy and Action Plan

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Preface

The Government of Bulgaria (GoB) has requested the World Bank's assistance to provide advisory services on:

> *Strengthening strategic planning on climate change adaptation, including providing inputs for the preparation of a National Climate Change Adaptation Strategy, together with an Action Plan for the Ministry of Environment and Water (MoEW)*

The development objectives of this project are to:

- Assess options to address climate risks across the economy;
- Formulate a National Climate Change Adaptation Strategy and Action Plan, which shall cover the period to 2030; and
- Strengthen capacity for implementation and cross-sector coordination on climate change adaptation.

This final draft National Climate Change Adaptation Strategy and Action Plan for the Republic of Bulgaria is intended to serve as a reference document, setting a framework for climate change adaptation (CCA) action and priority directions up to 2030, identifying and confirming the need for climate adaptation action both at economy-wide and sectoral levels, while highlighting the consequences of no action.

The development of this Strategy and Action Plan has followed, to the extent possible, the principles and methodology for strategic planning in the Republic of Bulgaria (Council for Administrative Reform 2010). This includes the steps, methods, and content in developing strategic documents and adherence to the principle of public partnership between state institutions and citizens and their organizations. The Strategy and Action Plan also draws on available resources for developing CCA strategies and action plans including the European Commission's Guidelines on developing adaptation strategies (EC 2013b) and the European Climate Adaptation Platform (Climate-ADAPT).[1]

This document builds on the National Climate Change Risk and Vulnerability Assessment of the Bulgarian Economic Sectors (MoEW 2014) and draws extensively on the information, analyses, and recommendations of the nine sector assessment reports, the Disaster Risk Management Assessment report, and the report on the 'Macroeconomic Implications of Climate Change' (as listed in ***Annex 4***).

The structure of the document is as follows: ***Chapter 1*** outlines climate change risks and vulnerabilities for economic sectors (agriculture, forestry, biodiversity and ecosystems [BD&ES], water, energy, transport, urban environment, human health, tourism, and disaster risk management [DRM] considered as a cross-sectoral topic) as well as sector interrelationships in relation to these risks and vulnerabilities and macroeconomic consequences of climate change. In ***Chapter 2***, the policy and institutional context of CCA is discussed in terms of stakeholder awareness and knowledge, legal and institutional frameworks,

[1] European Climate Adaptation Platform (Climate-ADAPT): http://climate-adapt.eea.europa.eu/

ongoing actions and gaps, and barriers hindering CCA response. As a basis for development of CCA strategic objectives and actions, ***Chapter 3*** presents Political, Economic, Social, and Technical (PEST) and Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analyses and guiding principles for strategy implementation. ***Chapter 4*** develops strategic objectives and adaptation options and priorities, along with presenting key findings of the Cost-Benefit Analysis of implementing adaptation measures, and discussion of cross-cutting issues and financial resources. The National Programme and Action Plan is elaborated in ***Chapter 5*** including operational objectives and specific actions. ***Chapter 6*** presents conclusions on the way forward for the Strategy and Action plan including proposed arrangements for monitoring and reporting.

A number of annexes provide further details on specific subjects. ***Annex 1*** explains climate scenarios in the Bulgarian context. ***Annex 2*** gives more analysis of sector interrelationships in relation to climate change risks and vulnerabilities. Full tables of Action Plans per sector, including details of proposed responsible institutions, resources, timelines, targets, and monitoring indicators are given in ***Annex 3***. ***Annex 4*** provides a list of sector assessment reports.

Finally, the nine sector assessment reports, the Disaster Risk Management Assessment Report and the Macroeconomic Implications of Climate Change Analysis Report are presented as appendices to this report. The reader is directed to these assessment reports for more detailed and consolidated sector information and analysis than the overview given in this Strategy and Action Plan document.

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Abbreviations and Acronyms

ABTTA	Association of Bulgarian Tour Operators and Travel Agents
AR5	Assessment Report 5
BAAT	Bulgarian Association for Alternative Tourism
BAS	Bulgarian Academy of Sciences
BATA	Bulgarian Association of Travel Agents
BCC	Bulgarian Construction Chamber
BCCI	Bulgarian Chamber of Commerce and Industry
BCWFI	Branch Chamber of Woodworking and Furniture Industry
BD	Biodiversity
BEH EAD	Bulgarian Energy Holding EAD
BFSA	Bulgarian Food Safety Agency
BHRA	Bulgarian Hotelier and Restaurant Association
BPI	Bulgarian Ports Infrastructure Company
BTCH	Bulgarian Tourist Chamber
CAA	Civil Aviation Administration
CAB	Chamber of Architects in Bulgaria
CAP	Common Agricultural Policy
CBA	Cost-Benefit Analysis
CBD	Convention for Biodiversity
CCA	Climate Change Adaptation
CCHH	Climate Change and Human Health
CCMA	Climate Change Mitigation Act
CEF	Connecting Europe Facility
CEIB	Confederation of Employers and Industrialists in Bulgaria
CEID	Chamber of Engineers in the Investment Desigh
CFP	Common Fisheries Policy
CGE	Computable General Equilibrium
Climate-ADAPT	European Climate Adaptation Platform
CO2	Carbon Dioxide
CoM	Council of Ministers
COP 21	21st Conference of the Parties
DFRMP	Danube Flood Risk Management Plan
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction

EAFA	Executive Agency for Fisheries and Aquaculture
EAP	Environment Action Programme
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EE	Energy Efficiency
EFA	Executive Forest Agency
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EMEPA	Enterprise for Management of Environmental Protection Activities
EPA	Environment Protection Act
ERDF	European Regional Development Fund
ES	Ecosystems
ESCOs	Energy Service Companies
ESIF	European Structural and Investment Funds
ESS	Ecosystem Services
ETS	Emission Trading Scheme
EU ETS	European Union Emissions Trading System
EU	European Union
EUSF	European Union Solidarity Fund
EWRC	Energy and Water Regulatory Commission
ExAAA	Executive Agency Automobile Administration
ExAEMDR	Executive Agency "Exploration and Maintenance of the Danube River"
ExAMA	Executive Agency Maritime Administration
ExARA	Executive Agency Railway Administration
ExEA	Executive Environment Agency
ExFA	Executive Forest Agency
FA	Forest Act
FRI	Forest Research Institute to the Bulgarian Academy of Sciences
FRMP	Flood Risk Management Plan
FSCPDG	Fire Safety and Civil Protection Directorate General at the Ministry of Interior
GCI	Global Competitiveness Index
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GoB	Government of Bulgaria

GTAP	Global Trade Analysis Project
GVA	Gross Value Added
HPP	Hydroelectric Power Plant
IAS	Invasive Alien Species
IBER	Institute of Biodiversity and Ecosystem Research to the Bulgarian Academy of Sciences
ICT	Information and Communication Technology
IFI	International Financial Institution
INDC	Intended Nationally Determined Contribution
INTERREG	Interregional Cooperation Programme
IPA	Institute of Public Administration
IPCC	Intergovernmental Panel on Climate Change
KP	Kyoto Protocol
M&E	Monitoring and Evaluation
MAFF	Ministry of Agriculture, Food, and Forestry
MC	Ministry of Culture
MCA	Multicriteria Analysis
MEc	Ministry of Economy
MEn	Ministry of Energy
MES	Ministry of Education and Science
MEx	Ministry of Exterior
MF	Ministry of Finance
MFF	Multiannual Financial Framework
MH	Ministry of Health
MI	Ministry of Interior
MLSP	Ministry of Labor and Social Policy
MoEW	Ministry of Environment and Water
MRDPW	Ministry of Regional Development and Public Works
MT	Ministry of Tourism
MTITC	Ministry of Transport, Information Technology, and Communications
NA	National Assembly
NAAS	National Agricultural Advisory Services
NAFA	National Agency for Fisheries and Aquaculture
NAMRB	National Association of Municipalities in Republic of Bulgaria
NAPCC	National Action Plan on Climate Change

NAS	National Adaptation Strategy
NCEQEMS	National Center for Education and Qualification in the EMS System
NCPHA	National Center for Public Health and Analysis
NCRD	National Centre for Regional Development
NCSD	National Concept for Spatial Development
NDP BG2020	National Development Program: Bulgaria 2020
NDP	National Development Plan
NECCC	National Expert Council on Climate Change
NEK	Natsionalna Elektricheska Kompania (National Electricity Company)
NFI	National Forest Inventory
NGO	Nongovernmental Organization
NIMH	National Institute for Meteorology and Hydrology
NPP	Nuclear Power Plant
NPV	Net Present Value
NRA	Nuclear Regulatory Agency
NRIC	National Railway Infrastructure Company
NRN	National Rural Network
NSDFSRB	National Strategy for Development of the Forest Sector in the Republic of Bulgaria 2013 - 2020
NSEM	National System for Environmental Monitoring
NSI	National Statistical Institute
NTC	National Tourist Council
NUTS	Nomenclature of Territorial Units for Statistics
OP	Operational Programme
OPTTI	Operational Programme Transport and Transport Infrastructure 2014 - 2020
OTRM	Organization for Tourism Regions Management
PEST	Political, Economic, Social, and Technical
PTSD	Post-Traumatic Stress Disorder
R&D	Research and Development
RBD	River Basin Directorate
RBMP	River Basin Management Plan
RCP	Representative Concentration Pathway
RDP	Rural Development Programme
RES	Renewable Energy Sources
RHI	Regional Health Inspectorate

RIA	Road Infrastructure Agency
SCD	Systematic Country Diagnostic
SDG	Sustainable Development Goal
SEA	Strategic Environmental Assessment
SEDA	Sustainable Energy Development Agency
SEEA	System of Environmental-Economic Accounting
SFA	State Fund for Agriculture
SME	Small and Medium Enterprises
SU	Sofia University
SWOT	Strengths, Weaknesses, Opportunities, and Threats
T&D	Transmission and Distribution
TEN-E	Trans-European Networks for Energy
TPP	Thermal Power Plant
TSO	Transmission System Operator
UAB	Union of Architects in Bulgaria
UACEG	University of Architecture, Civil Engineering and Geodesy
UBA	Union of Bulgarian Architects
UF	University of Forestry – Sofia
UKCIP	U.K. Climate Impacts Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNWE	University of National and World Economy
UPB	Union of Planners in Bulgaria
UV	Ultraviolet
WFD	Water Framework Directive
WG	Working Group

Glossary[2]

Climate change refers to a change in climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.
Global warming refers to the gradual increase, observed or projected, in global surface temperature, as one of the consequences of radiative forcing caused by anthropogenic emissions.
Adaptation is the process of adjustment to actual or expected adverse effects of climate change and taking appropriate action to prevent or minimize the damage they can cause. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.
Mitigation (of climate change) is a human intervention to reduce the sources or enhance the sinks of greenhouse gases (GHGs).
Vulnerability to climate change is the degree to which any system is susceptible to, and unable to cope with, the negative impacts that climate change imposes upon it. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.
Resilience is the opposite of vulnerability and is defined as the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, capacity for self-organization, and capacity to adapt to stress and change.
Risk is the potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as the probability or likelihood of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur.

[2] Definitions are based on WGII AR5 (IPCC 2014).

Executive Summary

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

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

3. All sectors of the economy are expected to be affected by the anticipated changes. These changes would furthermore affect society and its citizens as well as the economy as a whole. The general conclusions from the Macro-economic Implications of Climate Change report underline the costs of no action on adaptation. Climate change impacts do not affect all people and territories equally due to different levels of exposure, existing vulnerabilities, and adaptive capacities to cope. The risk is greater for the segments of the society and businesses that are less prepared and more vulnerable.

4. For all sectors, there are considerable uncertainties in assessing the nature and scale of climate change vulnerabilities. However, key common themes in the assessment of climate risks and vulnerabilities across all sectors in the country are the potential impacts, both from increased frequency of climate change-related extreme events and gradual changes in temperature and rainfall patterns, on infrastructures, production, human health, and ecosystems services, with resulting consequences for economic growth and livelihoods. The economic analysis undertaken for this strategy estimates a cumulative loss in real gross domestic product (GDP) in 2050 at between 1 percent and 3.5 percent, compared with the baseline scenario.

5. These risks and vulnerabilities should also be understood in terms of the complex interrelationships and interdependencies between economic sectors. In particular, specific risks may create cascading impacts across different sectors. There is also a spatial dimension to these interrelationships because climate change impacts and consequences affect different parts of the country in a different manner. Thus, understanding the spatial distribution of climate change risks is important in developing appropriate and effective local adaptation strategies.

6. In general, in Bulgaria, there is increasing awareness on climate change but more limited awareness of specific adaptation issues, both among the public and some other stakeholders. At the political and policy-making level, a high general awareness of potential future consequences of climate change exists. However, there is considerable uncertainty on how this might be

manifested across different sectors. Policy making has so far mainly concerned the identification and implementation of climate change mitigation measures and not adaptation.

7. The legal framework and policies for CCA in Bulgaria should be understood in the context of its commitments under international conventions and EU legislation. At the national level, a number of key strategies and programs provide a foundation for legislation on climate change in general (in particular, Third National Action Plan on Climate Change [NAPCC]) but up to now the focus has been on mitigation, and there are no explicit adaptation strategies developed at the national or sector level in Bulgaria. Similarly, the climate change-related institutional framework in Bulgaria has, over recent years, focused mainly on mitigation. The institutional framework related to CCA is an element of the overall climate change institutional framework set out in the Climate Change Mitigation Act (CCMA).

8. The overall conclusion from the review of current ongoing actions on CCA is that this is rather limited in some sectors, and there is a need for fresh impetus and that should be provided by a national strategy. However, there are several gaps and barriers hindering CCA responses in general, which are also very relevant for Bulgaria and need to be taken into account in designing the strategy. These include the need to address awareness-raising and communication, institutional capacity, knowledge and data gaps, the policy and legal framework, and limitations in financial and human resources. The role of education and information is seen as a key pre-condition to allow for successful implementation of other adaptation actions. The Strengths, Weaknesses, Opportunities, and Threats (SWOT) and Political, Economic, Social, and Technical (PEST) analyses undertaken for this strategy analyze such issues in the Bulgarian context and provide a basis for setting out general strategic objectives for CCA for the country. These are proposed as follows:

- **Mainstream and integrate CCA.** This includes strengthening the policy and legal framework for adaptation and the integration of adaptation considerations into existing national and sectoral plans and programs.
- **Build institutional capacity for CCA.** This includes building expertise, training, the knowledge base, monitoring, and research to enable and support adaptation actions.
- **Raise awareness on CCA.** This includes enhancing education and public awareness about CCA issues and the need for adaptation actions to be implemented in Bulgaria to build public acceptance and participation of adaptation-related policies and actions.
- **Build climate change resilience.** This includes strengthening infrastructure and asset management and the protection of natural capital and covers water system infrastructure, energy supply infrastructure, and protecting and enhancing ecosystems services (including those provided by forest resources).

9. A set of strategic objectives for each sector have also been developed to address the adaptation needs in specific sectors. These address common themes to the general strategic objectives given earlier. A set of operational objectives and proposed adaptation activities, related to the specific strategic objectives of each sector, have also been developed. Selection of adaptation activities is based on the range of adaptation options identified in the sector assessment reports written for this strategy and have been informed by a priority setting exercise

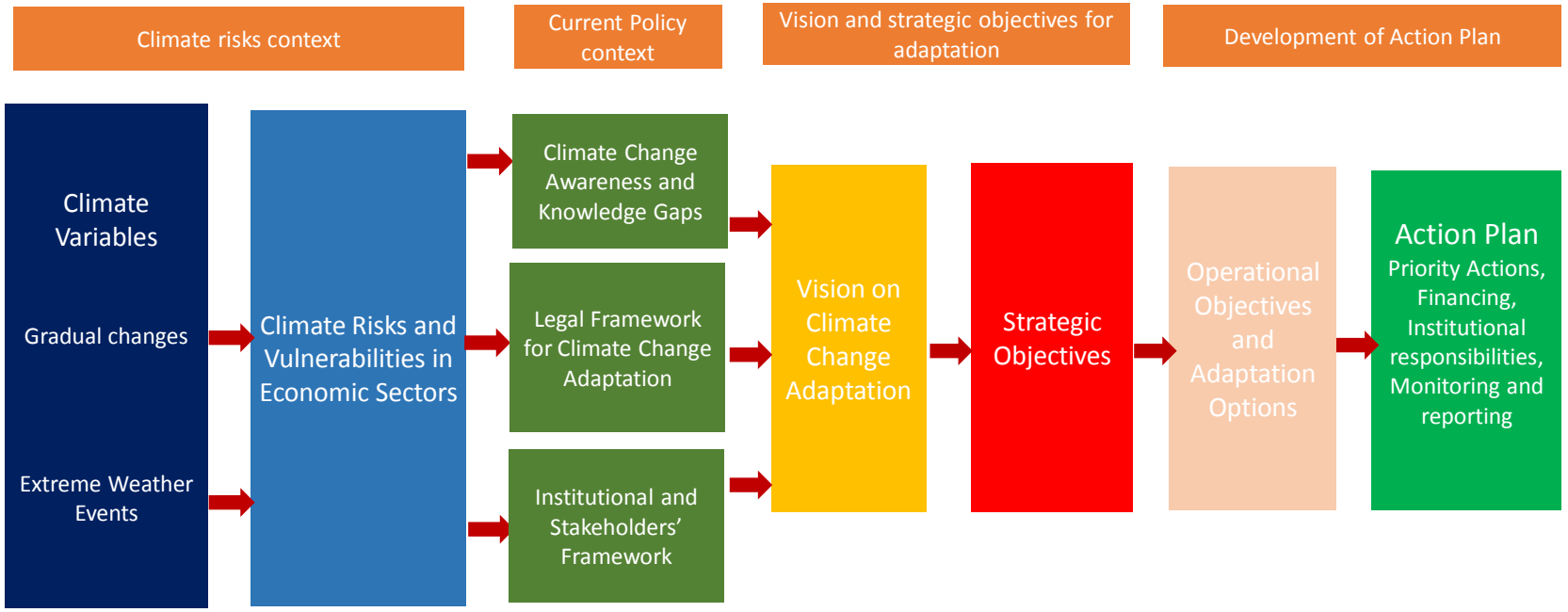
for the identified adaptation options in which stakeholders were consulted using a multicriteria analysis (MCA) approach.

10. The list of proposed adaptation activities to be included in the Action Plan, for the period up to 2030, for all strategic objectives and operational objectives per sector has, therefore, been developed for this strategy document. This includes indicative details for each adaptation activity of budget amounts and sources, priorities (in short, medium, and long term), duration, expected results, monitoring indicators, and responsible institutions. A shorter list of short-term highest priority actions for each sector has also been developed. The general conclusions from the Cost Benefit Analyses (CBA) undertaken on adaptation options focusing on soft measures (summarized in the Sector Assessment Reports) demonstrate the cost savings that can result from the decrease of potential damage caused by climate change and show that investments in these measures are economically efficient.

11. Activities which are assessed as priorities to start in the short term will be, in many cases, measures which enable and support following adaptation actions. This means that many of these priority actions across all sectors are soft measures (assessed as no cost or low cost) supporting the strategic and operational objectives related to (a) building institutional capacity (including through addressing knowledge gaps), (b) mainstreaming and integrating CCA into existing national and sectoral plans and programs, and (c) raising awareness. These will provide the foundation for medium- and longer-term practical actions for building climate change resilience including through the management of infrastructure and assets, and the protection and enhancement of natural capital. Underpinning sector-based activities, a number of general coordinating and facilitating activities for the strategy and action plan are necessary to focus on delivering the general strategic objectives. In particular, the process of monitoring and reporting of progress in the implementation of the measures set out in the Action Plan is proposed.

12. ***Figure 1*** provides a simplified framework for the structure of this report showing how the climate change adaptation vision, strategy and action plan have been developed from the assessment of climate risks and vulnerabilities for each sector.

Figure 1. Simplified illustration of framework of National Climate Change Adaptation Strategy and Action Plan Report



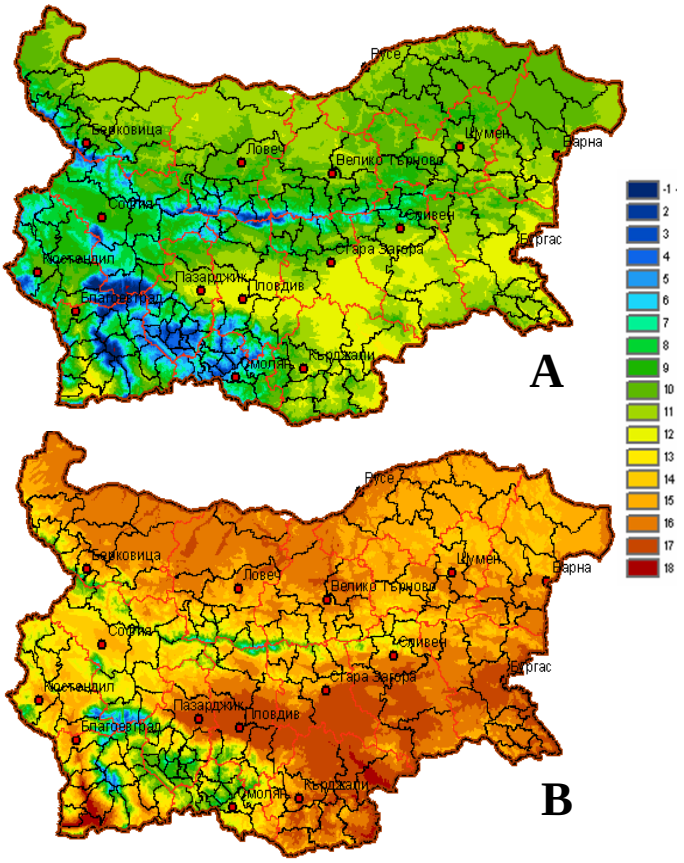
Chapter 1. Climate Change Adaptation - Risks and Vulnerabilities

1.1. Climate Change in Bulgaria

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

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

Figure 2. Average Year Temperature for 1961–1990 (A); Pessimistic Climate Scenario for Average Year Temperature for 2080 (B)



Source: NIMH.

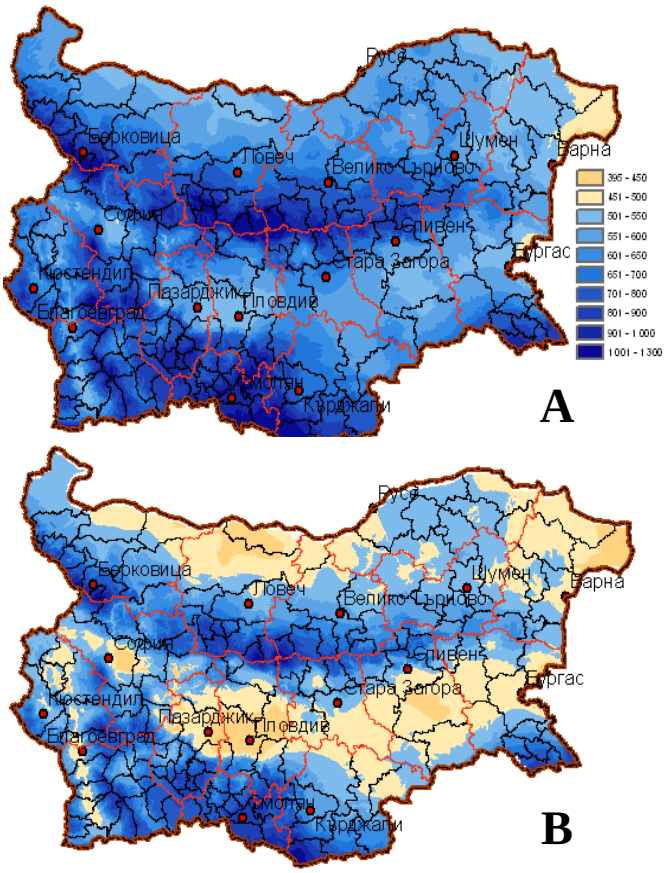
15. Scientific projections indicate that global temperature will rise between 1.8°C and 4°C by 2100, with the temperature increase in Europe expected to be even higher than the estimated global average.

16. **Research** conducted by the Department of Meteorology, National Institute of Meteorology and Hydrology at the Bulgarian Academy of Sciences (NIMH-BAS), projects an **increase in annual air temperature in Bulgaria of 0.7°C to 1.8°C by 2020**. Even warmer temperatures are expected by 2050 and 2080, with projected increases of 1.6°C to 3.1°C and 2.9°C to 4.1°C, respectively (***Figure 2***). Generally, the temperature increase is expected to be more significant during the summer season (from July to September).

17. In terms of the **expected changes in rainfall patterns**, a reduction in precipitation is likely, leading to a significant reduction of the total water reserves in the country. In this regard, projections suggest a decrease in precipitation by approximately 10 percent by 2020, 15 percent by 2050, and up to 30 percent to 40 percent by 2080 (***Figure 3***). In most climate change scenarios, rainfall during the winter months is likely to increase by the end of the century, but significant decrease in rainfall during the summer months is expected to offset this increase.

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

Figure 3. Precipitation per Year for 1961–1990 (A); Precipitation per Year for 2080, According to the Pessimistic Scenario (B)



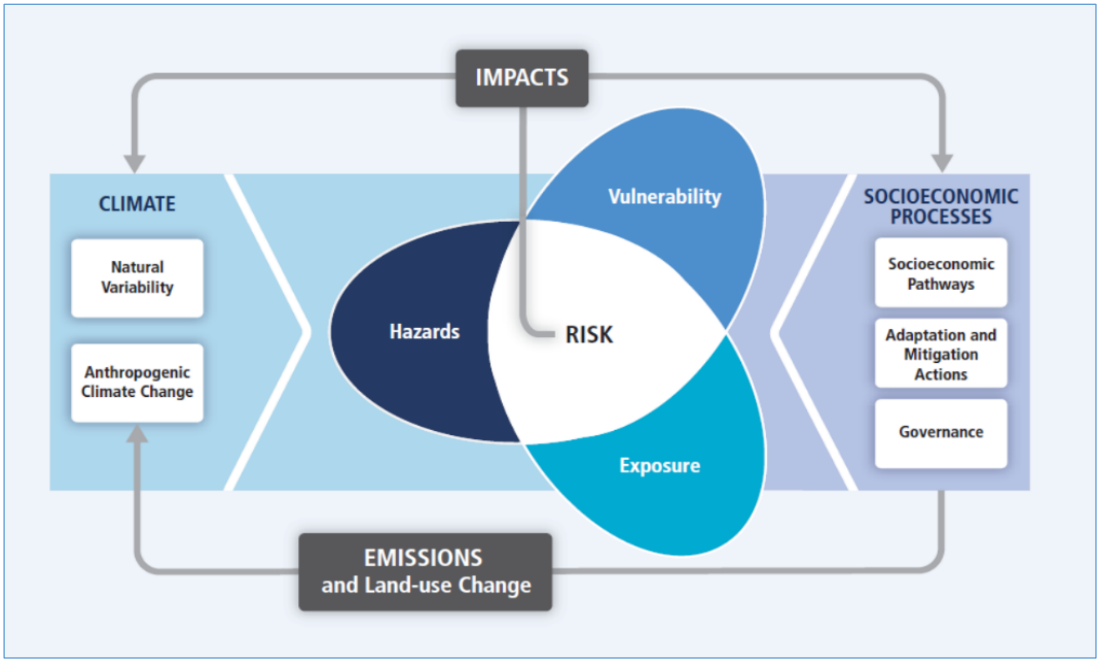
Source: NIMH.

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

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

21. The specific challenges due to climate change faced by sectors in Bulgaria are analyzed in detail in Bulgaria's sector assessment reports (available separately as appendices to this strategy) that were developed in 2017 for agriculture, biodiversity, and ecosystems (BD&ES), energy, forestry, human health, transport, tourism, urban environment, and water management. These reports use the terms and definitions of risk, vulnerability, and adaptation options as introduced by WGII Assessment Report 5 (AR5) (IPCC 2014). Risk of climate-related impacts results from the interaction of climate-related hazards with the vulnerability and exposure. Changes in both the climate system (left side in ***Figure 4***) and socioeconomic processes including adaptation and mitigation (right side of ***Figure 4***) are drivers of hazards, exposure, and vulnerability. This understanding reveals the importance of the adaptation options. Vulnerability, hazard, and/or exposure will be reduced, and thus the risk will be mitigated when adaptation options are properly identified and timely implemented.

Figure 4. General Concept of WGII AR5



Source: IPCC 2014.

1.2. Climate Risks and Vulnerabilities in Economic Sectors

22. This section summarizes key climate risks and vulnerabilities in nine economic sectors of Bulgaria based on the conclusions from nine sector assessment reports (under separate cover as appendices to this strategy), which also draw on the *National Climate Change Risk and Vulnerability Assessment for the Sectors of the Bulgarian Economy* (MoEW 2014). The potential opportunities from climate change are also outlined where these have been identified in sector assessment reports.

23. For all sectors, there are considerable uncertainties in assessing the nature and scale of climate change vulnerabilities. This is due to the complexity of taking into account multiple factors including future environmental, economic, and social changes. A major source of uncertainty relates to the degree to which future emissions of greenhouse gases (GHGs) will change radiative forcing over the coming century. GHG emissions are driven by complex factors such as population growth, economic growth, and energy policy.

1.2.1. Agriculture

24. **Agriculture plays a key yet disproportionate role in the socioeconomic fabric of rural Bulgaria.** The agricultural sector generated 4.4 percent of the country's total gross value added (GVA) and provided employment to 5.8 percent of the labor force (second highest rate in EU-28) in 2015[3]. More generally, the country remains predominantly rural, and while the rural space is richly endowed with natural resources, it is marked by lower incomes, limited job opportunities, an aging farm population, higher rates of poverty (the majority of the rural population is at risk of poverty or social exclusion), and an ensuing urban-rural divide in social and living standards.

[3] NSI Eurostat

25. **Climate change will be a significant factor in the future development of Bulgarian agriculture; the first negative impacts are already a reality.** The frequency and intensity of adverse climatic events have increased during the last decades—three distinct periods of droughts have been experienced and more frequent floods caused by prolonged and intense rainfalls are being regularly encountered, yet difficult to predict. Temperature increases from 2°C to 5°C and significant changes in precipitation patterns are projected by the end of this century. Climate change scenarios for Bulgaria indicate an increased frequency of climatic adverse events, such as longer droughts, heat waves, heavy rainfalls, and floods.

26. **The agriculture sector is highly vulnerable to the impacts of climate change**, as a provider of adequate food, pillar for economic growth, deliverer of ecosystem services, and provider of livelihoods for the rural population. However, the risk of the impacts of climate change is not equally distributed with regional differences in the likelihood of negative impacts from droughts and floods, as well as differences in the vulnerability, resilience, and adaptive capacity of rural dwellers to climate change. These differences are further accentuated by the pronounced dual farm structures and uneven land distribution that characterize the agriculture sector in Bulgaria. This engenders substantial differences in resilience and adaptive capacity between (a) *large-scale commercial farms*, which are economically highly vulnerable to the impact of drought and floods on crop yields and farm profits but are better resourced to invest in adaptation measures; and (b) *smallholders practicing (semi-)subsistence farming* who are also socially and economically vulnerable to adverse climate events, but tend to have more intrinsic resilience due to their more diversified production, stronger social relations, and off-farm income diversification.

27. **Extreme weather events and gradual climate changes may have a strong impact on yields and quality of output.** Specific climate change risks and vulnerabilities in the agricultural sector in Bulgaria are as follows:

- **Changes in length of growing season.** A longer growing season would allow better distribution of individual species and improve opportunities for growing new, more thermophilic species or secondary crops.
- **Agro-phenology.** In Bulgaria, earlier flowering of trees, a longer season for vines, and changes in the other natural crop cycles are expected, thus affecting final yields. In the case of cereals, further contractions of inter-phase periods from flowering to ripening are expected. A shorter reproductive period would also mean less time for grain filling, which would have a negative impact on yields.
- **Crop yields.** Yields depend on a number of factors including the length of the growing season and other crop productivity factors. Changes in yield volumes for major crops (winter wheat, corn, and sunflower) are forecasted due to projected temperature rises and reduced rainfall**.** Rising concentration of carbon dioxide (CO_2) in the future might also create conditions to improve the yields of some crops.
- **Increased risk of spread of pests, diseases, and weeds.** Changes in temperature, moisture, and concentration of atmospheric gases could not only stimulate growth and the generation of plants, fungi, and insects, but also change interactions between pests and their natural enemies and hosts. Pests and diseases often lead to harvest losses and

an increased use of pesticides and veterinary drugs. A longer growing season would also affect the spread of a number of weeds, diseases, and pests.

- **Adverse effects on livestock production.** Livestock will be adversely affected by greater heat stress from increases in air temperature and humidity which affects animal production health and well-being. Changes in temperature and precipitation may affect livestock breeding in terms of reproduction, metabolism, and health. Changes in temperature and precipitation may also result in the spread of pathogens, and parasites may influence the distribution of diseases with concomitant decrease in animal productivity and increase in mortality. Climate change may also affect the availability and quality of fodder and grazing resources.
- **Increased risk of soil aridity, erosion, desertification, and salinization.** More frequent and intense droughts will likely increase soil aridity, which combined with hot winds will increase the risk of wind erosion and soil degradation. These factors increase the risk of triggering desertification, marginalization, and abandonment of agricultural land in the areas where soils are lighter and more vulnerable to erosion.
- **Risk of water shortage.** A combination of factors may lead to water shortages in some regions of the country, leading to increased irrigation requirements. Higher temperatures and lower relative humidity will increase water needs due to evapotranspiration in agricultural plantations, although increased CO_2 levels in the atmosphere will result in higher water-use efficiency due to reduced transpiration and an increased rate of photosynthesis. Reduced precipitation levels may cause a reduction in water reserves and lower accumulation of water in irrigation reservoirs. Increased droughts and growing water need of industrial and urban water users may lead to increased competition with agriculture for water resources.
- **Adverse impacts on fisheries and aquaculture.** Droughts may lead to reduced water levels that pose a serious threat to fish farming systems and may also decrease the smaller mountain river and stream water levels, and may leading to loss of species. Higher temperatures also lead to changes in the spawning period of species. For open-basin rivers, this might cause migration to deeper, colder waters. Increased water level may affect dikes and river embankments and may lead to the destruction of valuable spawning, nursery, or feeding habitats.

28. It is evident that a combination of the above climate change risks and vulnerabilities in the agricultural sector will have an impact on aggregate and individual households' production levels and living standards. Droughts and floods are one of the most important manifestations of climate change in agriculture and cause significant variability of yields. With the farming sector contributing significantly to the Bulgarian economy and growing agricultural vulnerability to adverse climatic events, it is expected that the livelihoods of many Bulgarians will be increasingly affected.

1.2.2. Biodiversity and ecosystem services

29. **Bulgaria is a country of rich biodiversity.** Its diverse physical geography and location on the border of different climatic and vegetation regions creates favorable conditions for the existence of nearly 41,493 plant and animal species—26 percent of European species, including

25 percent of those in the Red Book of Europe. NATURA 2000 sites, which occupy 34.4 percent of the territory, and protected areas with a range of 584,569.19 ha or 5.3 percent of the country's area, are dedicated for their conservation.

30. **Projections for gradual climate changes and extreme climate events are expected to have effects at all levels of BD&ES.** Manifestations of climate change are expected to have different impacts on different types of ecosystems and affect biodiversity and ecosystem services in a range of ways including in an abrupt and even catastrophic manner. On the other hand, the projected annual increase in average temperatures may help adaptation by extending the vegetation periods and allowing for the migration of species in natural ecosystems or the controlled introduction of species for agriculture, green infrastructure, or other adaptation purposes.

31. The main vulnerabilities to climate change at the different levels of BD&ES in Bulgaria are summarized as follows:

- **Loss of genetic diversity.** Genetic diversity is subject to threats posed directly by climate change on vulnerable/endangered species (including endemic species with a limited range and opportunities for migration) that may be lost forever. There are also indirect climate change induced effects due to competition for resources between biodiversity and human activities that cause an increase of other pressures (such as water extraction, overexploitation of rare species by vulnerable population groups, land-use change, and fragmentation by infrastructure).
- **Disruption of species lifecycles and phenological phases.** Climate change can affect the life cycles and breeding periods of species, within ecosystems, to affect populations and processes in the ecosystem (food chains and competition for resources), including by invasion of invasive species which compete with native species and replace them from traditional niches, therefore, changing the ecosystem's integrity. Invasive species may also bring opportunities for climate change adaptation (CCA) if used as an indicator in an early warning mechanism or if they are commercially important and contribute to providing ecosystem services.
- **Deterioration of habitats.** The possible consequence of climate change is the deterioration of habitats in the categories of critically endangered, endangered, vulnerable, and nearly threatened as included in the Red Data Book of the Republic of Bulgaria, Habitats (BAS 2011). In particular, high-altitude habitats are vulnerable to these changes.
- **Impacts on the provision of ecosystems services.** A key risk is the regime shifts in the long term that may occur in the provision of ecosystem services. Regime shifts could be in both directions:
    - Positive impacts: increased length of the growing period could lead to increasing productivity of terrestrial ecosystems, including crop yield and timber harvesting. Increasing temperature could also change the water condition of water bodies, resulting in changes in fish composition and structures. Disturbances in ecosystems caused by extreme events may also lead to the emergence of new species composition conductive to improved provision of ecosystem services.

- Negative impacts: periods of drought could change the composition of producers in the terrestrial ecosystems causing changes in their functioning and resulting in reduced provision of ecosystem services. Increasing floods, fires, windthrows, and bark beetle outbreaks in forests will cause tree mortality and replacement by more adaptive species, changing the ecosystem integrity and potentially reducing the provision of ecosystem services both in the short – to mid-term (until the systems adapt and productivity is restored) or permanently (if the new equilibrium state involves reduced production of ecosystem services). The most vulnerable ecosystems are the southern border forestry area as well as the other lowland areas of the country. The inland wetlands ecosystems, heathland and shrub ecosystems (especially in the alpine zone in mountains), and coastal zone ecosystems are also the most sensitive to climate change.

32. Gradual climate changes and extreme weather events are, therefore, likely to affect all levels of biodiversity: genetic, species and ecosystems. However, the vulnerability and adaptive capacity assessment of BD&ES services to climate change is very complex and includes large levels of uncertainty within scientific information, system understanding, and expert knowledge. Furthermore, the climate change impacts on ecosystem integrity characteristics are insufficiently studied due to a lack of data time series with suitable quality and the complexity of interactions in the system.

1.2.3. Energy

33. The energy sector in Bulgaria is highly important in terms of its economic contribution, with the industry and energy sectors accounting for around 20 percent of gross domestic product (GDP). Energy generation is heavily dependent on local coal production, which contributes over half of the primary energy supply, followed by nuclear energy at 34 percent. However, Bulgaria is also highly dependent on imported energy resources (natural gas, crude oil, and nuclear fuel). In the medium term, thermal power, both from Thermal Power Plants (TPP) and Nuclear Power Plants (NPP), is expected to be the main contributor to electricity generation in Bulgaria and despite rapid growth rates of renewable energy, it is expected to account for around 80 percent of electricity generation in Bulgaria in 2024.

34. The energy sector will be among the sectors in Bulgaria that will be affected by climate change. Bulgaria is already exposed to a variety of natural hazards, including floods, droughts, forest fires, earthquakes, and landslides. Increased temperatures, reduced precipitation, changes in river flows and ecosystems and extreme events have caused some damage and disruption to the energy sector. In recent years, extreme weather events have caused some damage and disruption to the energy sector, which has knock-on consequences for other sectors. However, these events have not significantly affected energy infrastructure to date and have mostly led to damages in the electricity grid and temporary power cuts. An increase in the frequency and intensity of such weather events is likely to pose challenges to the sector in the future.

35. Energy infrastructure is vulnerable to a range of climate stressors, including temperature, precipitation, sea-level rise, and extreme events. Specifically, climate change is expected to change the intensity, frequency, and distribution of extreme heat, precipitation, and storms, exacerbating the vulnerability of energy infrastructure. Climate change risks and

vulnerabilities for each of the elements of the energy system in Bulgaria are identified in the energy sector assessment report as follows:

Primary energy supply

- Coal production
  - **Damage to infrastructure and equipment.** Heavy precipitation may present risks to operations and damage infrastructure and equipment that result in interruption to production. Mine site conditions can be affected through increased risk of flooding, subsidence, landslides, soil erosion, and changing groundwater levels.
  - **Reduced coal quality.** Precipitation increases, and flooding may lead to reduced coal quality through higher moisture content of opencast mining.
  - **Increased risk of heat stress for outdoor workers.** With predicted increasing frequency and intensity of heat waves, weather-related heat exposure is presenting a growing challenge to occupational health and safety.
- Extraction and supply of natural gas:

- In recent years climate change, has increase the fire risk, especially in periods with high temperatures and summer droughts in croplands, semi-mountainous and mountainous regions, which increases the external risks to the gas transmission system. There is a risk of a possible interruption of natural gas supplies indefinitely, with an expected impact on neighboring countries, especially if the transmission infrastructure to third countries is affected.
- Floods can also cause significant disturbances in the gas and gas distribution infrastructure and their components: pipelines, compressor stations, gas distribution stations.

Electricity generation

- Nuclear and thermal power plants
  - **Reduced efficiency of power plants.** Power plants will experience some reduction in output as higher air and water temperatures affect the efficiency of their cooling systems. An increase in ambient temperature results in a decrease in the difference between ambient and combustion temperature, reducing the efficiency of gensets, boilers, and turbines.
  - **Availability of water for cooling.** Due to increased drought risk and greater competition for water resources, some power plants may face reduced ability to abstract and discharge cooling water.
  - **Damage to infrastructure.** Warming temperatures may create favorable conditions for some invasive species that can damage energy infrastructure. Rozov Kladenets and Ovcharitsa lakes (the cooling lakes of the three largest TPPs in Bulgaria) offer highly suitable conditions for eutrophication and development of invasive species, and climate change may aggravate these problems.
- Renewable energy

- **Uncertainty of power generation.** Hydropower generation is likely to suffer from reduced precipitation, particularly in the summer season. River flow will change because of changes in precipitation patterns and the reduced snow and ice cover in mountainous regions.
- **Decreased efficiency of solar and wind power generation.** In general, solar power generation can be vulnerable to increased cloud cover associated with increased rainfall. For wind power systems, changes in wind patterns and intensity due to climate change could affect the productivity of existing wind farms. In addition, extreme stormy conditions can damage wind turbines and potentially cause shut down.

- Supply/demand balance
  - **Shift in energy demand.** Climate change may change energy requirements for residential and industrial cooling and heating, the timing and magnitude of peak demand, and adjustments in energy consumption for transportation, construction, and agricultural activities.
- Electricity transmission and distribution
  - **Damage to infrastructure and disruptions.** This includes (a) likelihood of more damage and disruptions to transmission lines from extreme precipitation, floods, and winter storms; (b) increasing threats to functioning of infrastructure in mountainous areas by an increased frequency and intensity of natural hazards (such as landslides, rock falls, or floods) mostly linked to increasing ambient temperature; (c) effects on efficiency of electricity transmission from increased frequency of heat waves; and (d) higher likelihood of power lines hanging below the minimum distance from the ground required by law, caused by warmer temperatures.
- Heating production and distribution
  - **Reduced need for heating.** Increasing temperatures due to climate change may gradually reduce the need for heating.

36. In conclusion, changes in climate and weather extremes will affect the energy sector both positively and negatively, though negative impacts prevail. This means that climate change is a substantial energy security concern not only due to direct impacts on infrastructure and distribution but also because of consequent impacts on other sectors and issues including food security and health. However, it should also be noted that a conclusion of the Climate Change Vulnerability and Risk Analysis and Assessment of Bulgaria's Economic Sectors (MoEW 2014) is that the energy sector is 'extremely resilient' to expected impacts in the period until 2035. The high resilience of the energy infrastructure to climate change is because it is relatively well-planned and maintained.

1.2.4. Forestry

37. Forested areas in Bulgaria occupy about one-third of the country territory, amounting to 4.230 million ha, of which 3.864 million ha are forests. The standing wood volume of forests in Bulgaria has almost tripled from the 1960s and now amounts to about 680 million m^3. Bulgarian forests have outstanding biodiversity with the vascular flora alone consisting of 4,102 species. In economic terms, the annual contribution by forestry, logging, and furniture production is approximately €500 million (EUROSTAT and European Sector Monitor of Wood Processing and Furniture Industry). About 43,000 people are employed in the forestry sector and in some rural areas, it is the main driver of economic output.

38. Climate change projections for increases in temperature, warmer winters, and more summer droughts along with greater number and magnitude of extreme climate events, such as heat waves and cold spells, severe storms, wet snow, and ice accumulation, will reduce forest health and tree growth, increase attacks from insects and fungi, including invasive species and cause serious losses due to fires and storm-related damages. There is already evidence of impacts on the forestry sector in Bulgaria from these types of climate events. In future these

could contribute to very high economic losses, degradation of the ability of forests to sequester carbon and affect the quality of life in Bulgaria by reducing the delivery of valued ecosystem services.

39. According to one study, wood growth could be reduced by 3.5 million m^3 per year (Kostov and Raffailova 2009). This is equivalent to 42 percent of the annual harvest and would have a devastating effect on the primary production of forest products and the rural economy. Impact of a similar scale could be expected on the forests' ability to protect drinking water supplies, attenuate extreme rainfall and flooding, stabilize vulnerable soils and slopes, facilitate a growing recreation and tourism sector, capture carbon, and support a rich resource of natural biodiversity.

40. Climate change is a potential driver of significant changes in the forests of Bulgaria and while their interactions and combined effects are complex, the main vulnerabilities include the following:

- **Species-specific physiological responses** to modified temperature and precipitation regime and inability to respond to changing climatic conditions. Some species may lack the adaptability to cope with new climate conditions and thus, become locally or globally extinct or suffer serious growth and health problems.
- **Uncertainties for the interaction between species.** Related to species-specific responses are the uncertainties for the interaction between species such as competition for resources, which is one of the main drivers of forest dynamics and composition in conditions of modified climate. There is high probability that some species may lose their growth advantage compared to other species which in turn may seriously modify forest composition and, in the long-term, productivity and other related ecosystem services served by the specific forests.
- **Large areas with coniferous plantations at too low elevations** and related to this, the potential for growth decline and various health problems. This vulnerability is an effect of the large-scale afforestation in the 20th century. While the plantations often served their primary goal to help in the control of erosion processes, in the last decades, there were numerous mortality waves, which were attributed to the combined negative effects of drought, aging, and lack of possibilities for regular thinning.
- **Increased probabilities of large fires and other disturbances** such as windthrows, damages from wet snow and ice, attacks from insects. This is potentially the most important factor for forests given the fact that natural disturbances often lead to dramatic changes in forest structure and environment. While in natural conditions, such temporal dynamics in forest composition and structure are often a part of the overall forest dynamics, new climatic conditions may lead to completely different species compositions and, therefore, ecosystems over a relatively short time period. In addition to the general environmental impact, natural disturbances often cause huge losses due to loss of wood, high cost of recovery measures, or the need to sell salvaged wood at very low prices.
- **Improved conditions for invasive species** with high potential for considerable damages to forests. Future climate changes may provide better opportunity for these

species to migrate and increase their distribution and thus, hinder local species. This is potentially a very high risk for habitats which are rare and in marginal locations.

- **High prevalence of firewood as a timber product** that contributes little economic value to the economic sustainability of the sector and its ability to self-fund resilience actions and sequester carbon.

41. Bulgarian forest ecosystems are very important for the country and well-being of the society. They are highly diverse and productive. However, despite the serious efforts already undertaken to prepare for CCA, there are several groups of vulnerabilities of the forestry sector that are priorities for action, as listed earlier.

1.2.5. Human health

42. Human health can be influenced by a great number of weather-related manifestations linked to climate change. Climate change in Bulgaria is manifested by an increase in the average annual air and water temperatures, an increase in heatwaves and cold spells, a change in the annual rainfall, an increase in heavy rainfalls, increases in extreme weather events (windstorms, cyclones, floods, and droughts), and changes in intensity of ultraviolet (UV) radiation. All these changes affect health in a complex and individual way, depending on various socioeconomic, health, personal, and other factors.

43. In general, the health effects can be differentiated as primary and secondary. Primary effects directly affect human health, for example, through heat waves and cold spells, UV radiation, and floods. Secondary effects indirectly affect human health through other climate-influenced factors such as pollen, vector-borne diseases, fires, contaminated food, water, and air, and compromised crops. The primary and secondary health effects of climate change can be differentiated into the following groups: heat-related morbidity and mortality, extreme weather-related morbidity and mortality, cardiovascular diseases, including strokes, asthma, respiratory allergies and airway diseases, cancer, vector-borne and zoonotic diseases, foodborne diseases and nutrition factors, waterborne diseases, mental health and stress-related disorders, and neurological diseases and disorders.

44. Key future vulnerabilities for Bulgaria outlined in the sector assessment report are as follows:

- **Temperature- and humidity-related health effects.** These include expected increases in number of deaths from cardiovascular diseases and strokes in the big cities in summer due to heatwaves and the urban heat island effect; vector-borne morbidity; and Campylobacteriosis infections; respiratory diseases due to the higher impact of CO_2, dust, and PM in the warmer air; and allergic diseases due to earlier flowering and increased concentration of pollen, spores, and other allergens in the air (based on the study by Mihaylova 2014).
- **Emergency weather-related health effects.** These include expected increases in mortality due to extreme weather events and fires, with that increase being higher among vulnerable groups, waterborne and foodborne morbidity due to damaged infrastructure, and post-traumatic stress disorder (PTSD) (based on the study by Mihaylova 2014).

- **Change in precipitation-related health effects.** These include expected increases in incidence of Cryptosporidiosis and Campylobacteriosis due to a combination of more frequent precipitation and higher annual average temperatures, and diarrheal infections caused by non-cholera vibrio due to more abundant precipitation and higher levels of humidity, as well as of the higher water temperature of the Black Sea.

45. It is stressed, however, that assessing health outcomes in relation to climate change is a complex task that must accommodate the multiple types of **uncertainty** including those related to GHG emissions scenarios, data limitation, and models of the relationships between climate and health. Thus, it is necessary to deepen the knowledge and assessment of the manifestations of climate change in Bulgaria, and the mechanisms of their impact on human health.

46. It is further noted that climate-related health impacts disproportionately affect the more vulnerable groups of the population, in particular, children and adults, people with chronic illnesses, people with a low socioeconomic status, those living in poverty and those with harmful personal habits (use of alcohol, drugs, and tobacco). Indicators of the most vulnerable groups over recent decades show that the country is in a less favorable position than many other EU countries.

47. Health vulnerability to climate change may also be exacerbated as a consequence of some features of the health sector including infrastructure and structure, and the understanding and competencies of health personnel on the impact of climate change on human health. Therefore, the severity of healthy impacts resulting from the risks outlined earlier will depend on the capacity of the public health sector to address these conditions and prepare for them, as well as on factors such as individuals' behavior, age, gender and socioeconomic status, and location.

1.2.6. Tourism

48. International tourism in Bulgaria generates an estimated US$2.4 billion, and the tourism sector employs 11.1 percent of the national workforce (in 2015)[4]. The major market for tourism is the EU, and the main tourism product is coastal summer tourism in the Dobrich, Burgas and Varna regions of the Black Sea. An estimated 95 percent of all revenues from international tourism originate from seaside resorts, where arrivals peak in July and August. Winter tourism is less relevant for the national economy and caters mostly to domestic tourism.

49. Weather and climate have considerable importance for tourism. Climate is a key factor defining a destination's attractiveness, also influencing the timing of holidays, as well as tourist activity choices and expenditures. On holidays, weather conditions in the destination determine trip satisfaction. Adverse weather experiences, including heat waves, cold spells, heavy rainfall, storms, or changes in natural tourism assets, such as lack of snow, can all have negative repercussions for tourist perceptions of a destination and willingness to return.

50. Due to its spatially concentrated, weather-dependent, and highly seasonal character, tourism in Bulgaria is vulnerable to climate change. Extreme events that have been observed in the past are expected to become more frequent under scenarios of climate change, including heat waves, intense rainfall events, coastal flooding, and storms. Winter tourism is already

[4] World Travel and Tourism Council

suffering from higher temperatures and in the short- to medium-term future, ski areas are likely to become increasingly economically unviable; in the long-term future, summer temperatures are expected to exceed biophysically acceptable threshold levels, while sea-level rise and flooding will cause the loss of coastal areas. Climate change may also become indirectly relevant for tourism, in particular, through increased resource scarcity (in particular, fresh water) and a growing energy demand, for example, for air-conditioning.

51. Climate change thus poses various short- and longer-term threats to tourism in Bulgaria, even though warmer temperatures earlier and later in the year may make the country more attractive in the shoulder season (between high and low season). The main risks related to expected climate change and extreme weather events faced by the Bulgarian tourism sector can be summarized as follows:

- **Lower number of tourists.** A combination of climate change-related trends, including higher temperatures, more frequent heat waves, and increased precipitation and humidity may cause lower number of tourists.
- **Shorter winter season.** Winter season can be expected to continue to shrink due to shorter snow cover period as well as other factors such as higher risks of avalanches.
- **Shorter average stay.** This may result from a combination of factors including higher temperatures, more frequent heat waves, and increased precipitation and humidity.
- **Health problems with tourists.** This particularly refers to the summer season when there will be more risk of heat and sun strokes, high blood pressure issues, and so on.
- **Poorer conditions for outdoor recreation.** This is related to higher precipitation and humidity as well as extreme weather events.
- **Damage of tourist infrastructure and superstructure.** This is particularly resulting from extreme weather events including increasing winds and storms, floods, avalanches, and landslides.
- **Poorer access to tourist destinations.** This is particularly resulting from extreme weather events including floods, avalanches, and landslides.
- **Water shortages.** Tourism contributes to high water demand in water scarce areas, which will further aggravate the problem. Higher temperatures and increased drought frequency will contribute to increasing water needs in tourist areas and may impact the tourism experience and deter visitors.

52. The opportunities can be seen in the following:

- **Longer summer and shoulder seasons.** In particular, prolonged summer season for seaside tourism and shoulder seasons for all tourism types may result from higher temperatures.
- **Development of new tourism products.** Among these are various types of cultural tourism (historic, archaeological, special route tourism); wine and culinary tourism; and special events (for example, festivals).
- **Attracting new perspective tourism markets.** For example, this may include developing the market segment of elderly and retired people visiting outside the peak tourist seasons and developing new destinations.
- **Less need for heating energy in winter and shoulder seasons.** This is linked to higher temperature trends but needs to be balanced with need for higher energy for cooling systems in summer.

53. It should also be noted that the vulnerability of tourism to climate change has considerable uncertainties. For instance, there is inadequate understanding of how travelers react to extreme events such as heat waves, storms, or heavy rainfall events, and longer-term changes in average temperatures, and how these climate factors may impact choices of tourism activities, or cause demand shifts to different destinations or changes in the timing of holidays.

1.2.7. Transport

54. The main transport modes, in terms of infrastructure and services, in Bulgaria are road and railway, followed by water and air transport. Road transport is by far the most important mode of passenger transport with cars and buses having a total share of 96 percent in 2015, followed by railway transport, which has a share of only 3.6 percent (in terms of number of passenger trips).

55. The most significant past impacts on the infrastructure from weather-related events in Bulgaria have come from floods and landslides. The most vulnerable infrastructure is the national road network, including the municipal transport infrastructure (streets and roads), and public transport services. Although no comprehensive data exist for all transport subsectors, it is estimated that annual average costs for damaged transport infrastructure, due to climate-related catastrophic events, are in the range of BGN 115–135 million. This does not include social costs, such as loss of human life, or impacts on the wider economy caused by these damages.

56. In the medium to long term, the most important risks for the Bulgarian transport system expected as a result of anticipated climate change are concluded to be the following in the sector assessment report:

- **Floods.** The frequency and impact of floods are expected to increase under all climate change scenarios. Floods cause heavy damage to road and railway infrastructure by deteriorating the subbase layers of the road or railway structures. Water may undermine the subbase leading to catastrophic failure of the engineering structures.
- **Landslides.** Precipitation is a major factor in the development of landslides and although the total annual volumes of precipitation are projected to decrease, landslides

will continue to be a serious problem due to expected higher frequency of extreme precipitations. Landslides cause heavy damage to road and railway infrastructure and river banks. These may be the reason for long-lasting disruption of operation and restricted accessibility to specific population and/or economic areas.

- **Blizzards and snowfall.** In the long term, the annual volumes of snowfall are projected to decrease, but in the short-term and midterm perspective, blizzards and intense snowfall will continue to be a major source of disruptions to the services of all modes of transport. The northern and northeastern regions are particularly prone to winter traffic disruptions due to high speed winds and snowfall.
- **Extreme heat.** Extreme heat affects roads' asphalt concrete pavements by softening their binding component—bitumen. This decreases the bearing capacity of the pavement and combined with the traffic load, leads to its deformation and to formation of ruts, which increases road accident risks. Furthermore, the combination of high heat and sunlight is the reason for surface cracks and reduces road pavement life. Regarding the railway infrastructure, extreme heat may cause rail buckling, which at its turn, leads to the need of reduction of the maximum admissible operational speed or even disruption of operation and reduces the life of the rails. Extreme heat combined with more expected droughts will further harm the Danube River navigability, which already faces serious deficiencies.

57. Climate change related events are expected to negatively impact all transport sector stakeholders including:

- **Infrastructure managers** due to deterioration, damage, and even temporary closures of infrastructure sections and/or nodes;
- **Transport operators** due to higher operation costs and possible disruption of operations;
- **Transport users** due to delays, longer transit times, and discomfort during the trip; and
- **End consumers/society** due to higher costs for the transport infrastructure and operations. This also includes potential losses of business, contracts, and customers due to supply chain disruptions.

58. It should be noted, however, that the *National Climate Change Risk and Vulnerability Assessment for the Sectors of the Bulgarian Economy* (MoEW 2014) evaluates the transport sector as extremely resilient for the period up to 2035. This is due firstly, to the expected moderate climate change to 2035 and secondly, to the transport system being designed and constructed with consideration of the local climate conditions. Nevertheless, the adaptive capacity of the sector is assessed as insufficient.

1.2.8. Urban environment

59. In 2017, the urban population in Bulgaria was 5,181,755 or 73.5 percent of the total with about 45.6 percent of the urban population concentrated in six big cities. Despite projections for overall population decline, the urban population is expected to reach 81 percent of total population by 2050. This urban concentration creates pressure on land, infrastructure, and

services and exposes more people to disaster risks due to greater concentration of vulnerable groups.

60. The analysis of past and present weather events shows that the Bulgarian cities have experienced temperature average annual temperature increase and increased number of days with intensive precipitation, often accompanied by wind storms or hail and associated with a growing number of floods which have caused considerable damage over the recent years. Among extreme weather events, floods and landslides have caused the highest financial damages during the period 2010–2015.

61. **Method for assessing future risks.** Considering the complexity of urban environment and the variety of urban settings in the current analysis, cities are systematized into three groups according to their population— big, medium, and small—and into four groups, according to their location—coastal (on Danube River and Black Sea coast), plain areas, mountainous, and semi-mountainous areas. The vulnerability of the urban environment is also considered according to their development pattern, zoning, and specific land use.

62. There are a wide range of likely interlinked impacts in urban areas from future climate events. These include damage to buildings and urban infrastructures, health effects, endangered key services including food supply and electricity, reduced mobility and accessibility and water stress, as well as increased financial pressures on municipalities for maintenance of infrastructure and on emergency aid facilities and staff. Overall, climate change will have a larger-scale impact in big cities. More vulnerable to extreme weather events will be their central urban areas with higher density, intensive traffic, reduced green and open spaces, and old infrastructure with limited capacity. Extreme weather events will also affect more significantly vulnerable groups including those living below the poverty line, in poor standard housing, the homeless, the elderly, and the sick.

63. The main findings of the analysis and assessment of climate change risks and vulnerability given in the sector assessment report are as follows:

Extreme temperatures

- **Higher temperatures leading to the formation of heat islands,** which will occur more often and will last longer, will have the greatest impact on big cities with increased density and intensity of construction.
- **Extremely low temperatures and cold waves** are not expected to occur frequently but can last for several consecutive days and affect life in both big and small mountain cities. When combined with abundant snowfall, they can endanger vital services, including food supply.

Intense precipitation

- **Flooding will increase in frequency** and affect all settlements and cause damages in both big cities and small towns. The most vulnerable will be those housing areas located near watercourses and the neighborhoods of large cities, built illegally on their periphery in flood-prone zones.
- **Hailstorms**, which are often combined with intensive precipitations, will also cause floods in cities and damage buildings, cars, public transport, and infrastructure.

- **Prolonged precipitation**, combined with a rise in groundwater levels or wastewater seepage and some additional human factors, will trigger **landslides**, especially those in the most sensitive areas of the Black Sea and Danube cities. Additional aggravating factors in this respect include abrasion and erosion.
- **Landslides** can also be provoked by earthquakes, typical of the country. Although earthquakes are not related to climate change, their large impact on the urban environment and people's lives should be considered in the adaptation process.

Water resource scarcity

- **High temperatures combined with droughts will increase water stress** in settlements where there is water scarcity and obsolete networks that lose large amounts of water.

64. The above conclusions demonstrate that the urban environment in Bulgaria is vulnerable and at considerable risk from future climate change. These risks are exacerbated by the obsolete and often inadequate infrastructure in big and small settlements alike and the large proportion of aging population, predominantly with low-income and below the poverty line. This vulnerability is increased by a poor level of awareness of the problems, their causes, and possible prevention and management, among both decision makers and the general public.

1.2.9. Water

65. The water sector as defined here includes both managed water systems (water supply and sanitation, hydro-melioration,[5] hydropower, and industrial use) and natural water systems. Bulgaria's total long-term annual renewable water resources amount to 21.3 km^3, of which 20.4 km^3 is accounted for as surface water and 0.9 km^3 as net groundwater resources. The area covered by surface freshwater bodies accounts proximately 2,000 km^2, which is less than 2 percent of the country's territory. While Bulgaria has relatively significant freshwater resources compared to other European countries, water resources are unevenly distributed throughout the country and by season.

66. Climate change is expected to have a significant effect on the hydrology of rivers. For some river basin management regions, total annual discharge rates are projected to drop by approximately 10 percent over a period of 30 years in comparison to the reference period 1976–2005. Significant shifts are expected in the seasonal distribution of rivers' runoff. While in winter and spring there will be an increase, summer and autumn river discharge rates are expected to decline. Groundwater availability is not expected to change significantly. Past and present weather events and trends including serious droughts and floods since 2000 have already impacted the water sector with physical evidence of the impairment of water sector infrastructure due to floods (2004 to 2008) given in the sector assessment report.

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

- **Flood and drought hazards** are identified as most relevant to the water sector. Higher flood risks concern the entire country, while higher droughts risk concern regions with projected water scarcity. Based on projections that climate change will not affect

[5] Hydro-melioration includes irrigation of agricultural crops, drainage of agricultural land, and flood protection of agricultural land.

groundwater availability and projected decline of Bulgaria's population and slow growth of industrial and agricultural activities, there is a lower scarcity risk in regions which use groundwater. High scarcity risk is likely in regions supplied with surface water and having high tourism activities, which are projected to increase.

- **The Black Sea region appears to be the most vulnerable to scarcity risk** because it uses surface water and is the most visited by tourists. Poor condition of the infrastructure in this region adds another dimension toward increasing the risk.
- **Key vulnerabilities to these climate hazards** (and their effect on water scarcity) are:
  - **State and preparedness of the infrastructure -** Overwhelmed, aging, poorly maintained infrastructure, and therefore, highly vulnerable and most probably inadequate to cope with climate change.
  - **Preparedness of the human factor, operator, or user -** Population and operators of infrastructure lack historical experience and good practices with floods and droughts, and therefore, are highly vulnerable.
  - **Hydropower production systems** – vulnerable to operation during droughts
  - **Water services** (water supply, sanitation, melioration) - vulnerable during droughts
- **Major risks to managed systems** are therefore
  - Risks to infrastructure and services: damage, improper operation, and low-level or insufficient services
  - Risks to hydroelectric-generation from low or high river flows
- **Major risks to natural systems** are to impaired biodiversity resulting from both floods and droughts.

1.3. Climate Risk and Vulnerability Interrelationships Between Economic Sectors

68. As outlined in Section 1.2, climate change risks and vulnerabilities affect a wide range of economic sectors. These risks and vulnerabilities should also be understood in terms of the complex interrelationships and interdependencies between economic sectors. In particular, specific risks may create cascading impacts across different sectors. For example, a major flood can cause direct damages to crop, transportation, energy, and other infrastructure, which may then affect other sectors such as tourism and contribute to an increase of food and transportation prices.

69. There is also a spatial dimension to these interrelationships since climate change impacts and consequences affect different parts of the country in a different manner. Thus, understanding the spatial distribution of climate change risks is important in developing appropriate and effective local adaptation strategies. Moreover, climate change also affects people differently depending on their social, cultural, and economic background, for example, agricultural sector workers and vulnerable groups, such as the elderly and low-income people, are more likely to feel the effects of climate change.

70. Key interrelationships of climate change risks and vulnerabilities between sectors are outlined in the following paragraphs (rather than sector linkages in context of adaptation

options). These include both the possible consequent impacts on other sectors from the risks and vulnerabilities of a particular sector and impacts from other sectors on that sector. A key cross-cutting issue for all sectors is the vulnerability to extreme weather events and the need to develop resilience and preparedness through disaster risk management (DRM).

71. Cross-cutting issues, tradeoffs, and synergies of adaptation options between economic sectors are discussed in more detail in Section 4.3. Further detailed analysis of sector interdependencies in the context of climate change vulnerabilities, opportunities, and adaptation options is given in the sector assessment reports (***Annex 2***).

1.3.1. Agriculture

72. Climate change vulnerability and risk in the agricultural sector encompasses a wide range of cross-sectoral issues related to water and energy supply, air and soil quality, land use, biodiversity, and forestry. These include the consequences for other sectors of direct damages to crops and livestock production from extreme weather events and gradual changes in climate. For example, these impacts may contribute to an increase in food prices that then affects both on the macro-economy and on specific sectors such as public health and tourism. There may also be effects on the demand for other sector goods and services, for example, higher temperatures that cause stress to animals would increase the need for energy for cooling. Fisheries are closely related to tourism through recreational activities linked to water and fishing. The climate change impacts on fisheries will affect the activities concerning the tourism, including provision of additional jobs and income for local fishermen.

73. Impacts on the agricultural sector resulting from climate change impacts on other sectors include damage from extreme weather events to transportation, energy, and water infrastructure resulting in disruption of supply for agricultural production. Loss of biodiversity and changes in ecosystems may have direct effects on crop and animal breeding.

74. Specific threats are also interlinked across sectors and require coordinated actions to manage and protect farmlands, as well as forests and ecosystems. For example, pests and diseases pose a significant risk to the agriculture, forestry, and biodiversity sectors. Soil degradation also has negative impacts on both agriculture and forestry.

1.3.2. Biodiversity and ecosystem services

75. BD&ES are strongly linked to vulnerability and risk assessments in other sectors. due to the universal nature of ecosystem services that are being used in all sectors. The majority of regulating services act as significant final ecosystem services - climate regulation, flood regulation, erosion regulation, hazard regulation, or contribute to other final ecosystem services - water quantity and quality, purification (air, water and soil quality). Some regulating services are also intermediate ecosystem services - pollination and regulation of pests and diseases, for example, are essential for the provision of crops, medicinal plants and livestock. Key threats to other sectors from loss of biodiversity and deterioration of ecosystems services include **loss of crop yield in agriculture**, due to declines in pollination, reduced pest and disease control and soil formation, less genetic diversity, and loss of regulating ecosystem services. Any decline or

loss of these services is likely to result in additional costs for irrigation, fertilization of soils, and possibly for crop and cultivated tree species.

76. DRM and transport are also affected by loss of regulating ecosystem services, which leads to reduced disaster resilience and may cause additional costs for protection from wind, avalanches, landslides, floods, and other extreme events. The water and energy sectors are likely to be mainly affected by the decline or loss in provisioning services related to water production and regulating services related to purification (related to forest and other ecosystems).

77. Forests are an important ecosystem type due to their rich biodiversity and are of great importance to society not only from an environmental perspective, but also from a social and economic one. Forests are home to the very large number of vertebrates, and are habitat for many different plants, insects, and invertebrates species. Forests provide important regulating ecosystem services such as water supply regulation, soils protection, erosion prevention and climate regulation. They are also a very important basis for provisioning ecosystem services such as wood, medicinal plants and game. Forests also provide important social and cultural services, including recreation and tourism. Because forests are an important ecosystem type, the risks of loss of biodiversity in the forestry sector are strongly related to risks to biodiversity in general. Loss of biodiversity in other related ecosystems, such as freshwater and wetlands, may also negatively affect the forests. Tourism may also be negatively influenced by the loss of cultural ecosystem services.

78. The urban environment and human health sectors are likely to be affected by the loss of a wide range of regulating ecosystem services and recreational cultural services. Particularly, the decline in microclimate regulation[6] to mitigate heat waves and alleviate smog and reduced recreation options are likely to negatively affect both general well-being and health of urban population. In addition, the regulating services for protection from floods and other disaster protection are relevant for the urban sector as well as the rural population.

1.3.3. Energy

79. The energy sector also has strong interdependencies with other sectors, due to their reliance on energy supply and the various resource requirements from other sectors of the energy sector.

80. Disruption of power supply from extreme events may impact all sectors including transport services, urban environment, and health. Damaged energy infrastructure can also cause damage to other infrastructures including transport. Gradual climate changes will also impact seasonal demand for energy for heating and cooling, with supply costs consequences for all sectors.

81. In terms of resource requirements, the energy sector is in competition for water resources with other sectors (as outlined earlier). Use of fuelwood as a cheap energy source is also vulnerable to climate change impacts in forests. Any such disruption in energy source supply caused by climate factors may impact electricity costs for all sectors.

[6] Ecosystems change the microclimate in their location through the processes of evapotranspiration, mediation of smells and air purification. These regulating services are used, for example, for reducing the heat island effect and improving the living environment in the urban green infrastructure.

82. Opportunities for the energy sector from climate change also exist in particular, for increased use of solar and wind sources with consequent environmental benefits as well as potential cost benefits for consumers.

1.3.4. Forestry

83. Interlinkages between forestry and other sectors relate in particular to the ecosystem services provided by forests. These include maintaining biodiversity and genetic diversity, and thus, the integrity and resilience of ecosystems and provision of drinking water which highly depends on the condition of forests. Positive effects for the agriculture sector come from forest shelterbelts which decrease wind erosion and help uniform snow deposition, and thus increase crop productivity, contributing to the maintenance of biodiversity. Forests provide a source of renewable energy (although fuelwood contributes to air pollution) and have an important carbon sequestration function. Other cross-sectoral links include positive human health effects from ecosystem services as well as negative health effects through air pollution from forest fires. Provision of forest landscapes is also beneficial for tourism. Thus, any change or disruption in these forest ecosystem services and the health status of forest tree species resulting from climate change will affect a number of sectors.

1.3.5. Human health

84. Other sectors play an important role in determining the risks of disease and injury resulting from climate change. These can be risks of primary health effects from extreme weather events, such as from storms and floods, which are influenced by preparedness of infrastructure of other sectors including water supply and sanitation, agriculture, energy, and transport. The risks can also be from secondary effects through other climatic-influenced factors such as vector-borne diseases, contaminated food, and water and air quality. For example, water pollution may be influenced by reduced water levels.

85. There may also be implications for other sectors resulting from climate change effect on health and well-being. Workers' productivity may decrease in higher temperatures and there may be increased heat-related health and safety risks for workers in the energy, transport, agriculture, and other sectors. Effects on tourism may be negative due to increased heat-related health risks but a longer summer season may have health benefits through providing more options for outside activities. A combination of such health effects may also put more pressure on urban health and social services.

1.3.6. Tourism

86. Tourism sector interdependencies concern the reliance on infrastructure and services of other sectors, and the competition for resources with other sectors. Extreme weather events that damage infrastructure and disrupt services of transport, water, and energy sectors will also affect tourism. Additionally, extreme weather events and gradual climatic changes that affect forest landscapes, biodiversity, and agriculture will also influence the demand for different types of tourism and tourist destinations in Bulgaria. Increased risks of damage to cultural and heritage sites from extreme weather events may affect tourism, especially in the urban environment.

87. Gradual climatic changes, particularly higher temperatures, may result in longer seasons, more visitors and higher revenues in some locations. However, such changes in tourism numbers may then lead to increased demand for transport, water and energy, more competition for water resources with other sectors, and increased pressure on infrastructures including wastewater collection. Moreover, any increase in unsustainable forms of tourism can contribute to overexploitation of ecosystem services in tourist/recreation sites.

1.3.7. Transport

88. The transport sector interdependencies concern the reliance of other sectors on transport infrastructure and services, the resource requirements of the transport sector and other functions and impacts of transport infrastructure.

89. All sectors depend on transport systems to carry workforce, while agricultural and other produce distribution and tourism is also highly dependent on transport. Therefore, any damage to transport infrastructure from extreme weather events may hinder these activities as well as hamper access to other infrastructure in emergencies. Specific impacts may include lower river levels due to more frequent/severe drought that will affect river transport.

90. The transport sector is dependent on the energy infrastructure for fuel and electricity supply. It also depends on information and communication technology (ICT) networks for the management of services and transport infrastructure.

91. Transport infrastructure also performs other functions, such as access and monitoring of fire events and limitation of erosion and landslides, which may be of increased benefit for protection against future climate change vulnerabilities. It is also linked to BD&ES in both positive (for example, creating migration routes) and negative ways (for example, ecosystem fragmentation and spread of invasive alien species [IAS]). The link to human health can also be positive (for example, more potential for healthier mobility options such as walking and cycling in warmer seasons) or negative (for example, deteriorated air quality due to transport emissions under changed thermal and humidity conditions).

1.3.8. Urban environment

92. The urban environment has complex interdependencies with other sectors due to the cross-cutting nature of this sector, its reliance on key infrastructure and services for its efficient functioning, and the wide impact on other sectors of urban environment functioning.

93. Extreme weather events may damage infrastructure and disrupt services of urban transport, water, and energy sectors. This may also result in higher construction and maintenance costs for these infrastructures. Tourism would also be affected by these weather events including by the endangerment of cultural attractions in cities. Higher temperatures and increased dry spells will also lead to increased water consumption in urban areas and, therefore, increased competition for water resources with other sectors. Temperature increases in summer would increase demand for energy for cooling systems and warmer winter temperatures would reduce demand for energy for heating. These climatic changes may also provide incentives for sustainable urban transport modes, for example, cycling, walking, and boost city tourism. Health implications from climate change in cities arise from the increased intensity of heat islands and increased air pollution at higher temperature.

94. Other linkages of the urban environment include that to biodiversity, in its role as a habitat for a variety of species, and to agricultural due to the extension of urbanized areas envisaged in Spatial Development Plans and the move toward urban agriculture. Thus, the climate change vulnerabilities of these sectors also need to be taken into account in future urban planning.

1.3.9. Water

95. The water sector has strong interdependencies with other sectors, in particular, regarding water supply to these sectors. Reduced water availability from extreme weather events and gradual climate changes can cause competition between sectors such as urban environment (drinking water), agriculture (irrigation), energy (power generation), and tourism (drinking water and activities requiring water). Competition for water resources with irrigation infrastructure can also decrease the resilience of ecosystems services including in forests.

96. Failures in water infrastructures (supply and sewerage systems, irrigation) may also damage other sector infrastructure, such as transport and disrupt services including in urban environments. Health impacts can also occur due to insufficient water supply, water pollution from heavy rains, and invasion of harmful water species.

1.4. Macroeconomic Consequences of Climate Change: The Costs of Inaction and Action

97. The Macro-Economic Implications of Climate Change Analysis Report (as listed in ***Annex 4***) evaluates the economic implications of climate change impacts in Bulgaria and highlights the costs of inaction and economic aspects of the choice of adaptation options. The analysis estimates overall economic activity (that is, GDP), economic welfare, sectoral output, and employment levels, with and without climate adaptation. This was achieved by developing the first integrated assessment model on climate change adaptation in Bulgaria. This model explicitly links a Computable General Equilibrium (CGE) model with several environmental modules[7] that represent climate change impacts on land, and water resources (for methodological details and assumptions, see the Macro-Economic Implications of Climate Change Analysis Report, ***Appendix 11*** to this strategy).

98. The CGE model simulations included development of (a) an economic baseline to 2050 that does not account for climate change and its impacts, (b) adjustments to these baseline projections for the estimated impacts of climate change, and (c) additional scenarios to illustrate potential net gains from CCA.

99. **The economic baseline without climate change** was developed based on the observed economic trends as well as demographic projections and migration trends for the country and assumes the Bulgarian economy will grow 1.3 times by 2050, or an annual average growth rate of around 1.7 percent per year. It is important to note that the economic baseline does not integrate existing or planned sectoral strategies or reforms; it simply translates the growth potential based on the demand and supply projections for various sectors and sub-regions.

[7] The CGE model was developed using the Global Trade Analysis Project (GTAP) modelling framework and database. It was further tailored to the Bulgarian context by developing a water- and land-use module to allow estimation of the impact from climate change at a granular level, both from a sectoral point of view and from a geographic point of view (that is, based on Bulgaria's four water basins).

100. **The baseline growth with climate change scenario** was developed with a focus on those areas where climate change is expected to have the most significant impacts.[8] The macroeconomic analysis was developed on the basis of two climate scenarios—a 2°C (optimistic) and 4°C (pessimistic) temperature change over Bulgaria by 2050. Each climate scenario was also tested for high and low vulnerability assumptions in each sector (in terms of sensitivity to climate change and ability to adapt). Climate change can directly (or indirectly) affect the cost and availability of economic outputs and inputs, which influences the level and structure of overall economic activity. The loss in real GDP growth in 2050, compared with the baseline scenario, was estimated at around 1 percent under the optimistic climate scenario and 3.5 percent under the pessimistic climate scenario. This would mean that the projected GDP annual growth rate of about 1.7 percent by 2050 would be completely cancelled out if Bulgaria faces the full impact of a 2°C rise in temperature by 2050.

101. Considering sector-wide impacts of climate change scenarios in Bulgaria by 2050, the economic analysis concluded that

- Climate change induces a direct negative productivity shock on the agricultural sector (represented by crop production) and hence, a decline in output across all scenarios. The output of wheat, grains, and other crops experience the highest negative impacts across all the four river basin management regions in Bulgaria. The Danube River basin, where agricultural productivity is the highest, is the sub region that suffers the most from climate change.
- There would be a decline in output of the energy sector in all scenarios considered. This is explained by decreased demand from a contracting economy, reflected as reduced production.
- The transport sector also experiences a negative outcome, with overall decline in economic activity (negative GDP changes) accounting for the decline in demand for output for these sectors.
- Energy-intensive sectors including chemicals, steel, aluminum, cement, and ceramics have a positive output response driven by positive terms of trade change that helps to drive up export demand which helps to mitigate declining domestic demand.

102. General conclusions for other macroeconomic and social parameters were the following:

- Following the impact of climate change in Bulgaria, jobs will move out of those sectors that are negatively impacted.
- Climate change will change the overall trade structure of Bulgaria. Thus, there will be an increase in imports of goods whose domestic production is heavily affected by climate change.
- Under all climate impact scenarios considered, there would be an economy-wide increase in domestic real prices. Moreover, rising prices for commodities may result in a substantial reduction in real income and an increase in poverty, for households

[8] The model represents climate change impacts in the sectors considered the most vulnerable to climate change as per the *2014 Vulnerability Assessment of the Bulgarian Economy*: water (modelled offline), agriculture (modelled through damage functions), and tourism (modelled through damage functions).

spending a large share of their income on commodities whose prices rise substantially (including food staples).

- In general, earnings from both skilled and unskilled labor will decline in all scenarios. Thus, combined with rising real prices and declining earnings from labor, more people are expected to fall below the poverty line. Under these climate scenarios, it is very likely that there will be more poor people living in Bulgaria by 2050. It is also widely accepted that the impacts of climate change, including from extreme weather-related events, fall disproportionately upon lower-income and more vulnerable groups thus, compounding impacts on these groups from rising prices and declining earnings.

103. The Macro-Economic Implications of Climate Change Analysis Report also took a welfare approach to help gauge the economic impact of climate change. The welfare approach differs from GDP as it includes private consumption involving goods, services, government purchases, and other variables. Welfare impacts of climate shocks can be further divided into three components—direct impacts, efficiency changes, and terms of trade effects. Welfare losses were estimated for the two core climate scenarios (2°C and 4°C temperature rise by 2050) along with both sets of vulnerability assumptions. The key conclusions from the analysis were the following:

- In general, the results suggested that the market effects of climate change will have similar implications for economic welfare and for overall income, spending, and production (GDP).
- Direct impact of climate shocks was negative in all scenarios, reflecting the general worsening of production conditions in Bulgaria. The projections suggest that the loss to economic welfare from this direct component will dominate the other two components if temperature rises by 4°C by 2050.
- Climate change leads to loss of economic efficiency but this loss is overshadowed by the other two components of welfare.
- The impact of climate change on terms of trade and its contribution to national welfare was assessed as not strong enough to outweigh the direct impacts but nonetheless contributing to mitigating some of the welfare losses arising from climate change.
- In general, it was concluded that there will be modest structural change following the impact of climate change but that the Bulgarian economy would still be mainly service based.

104. **CCA** was also explored in the Macro-Economic Implications of Climate Change Analysis Report. This focused mainly on the appropriate adaptation level to be targeted, overall funding needs, and possible financing mechanisms for Bulgaria that would generate the maximum benefit for society. It did not analyze the details of specific investment projects for adaptation. The analysis used the Bulgaria CGE model and macroeconomic results were given for adaptation to the 2^{o}C (optimistic scenario) and 4^{o}C (pessimistic scenario) to 2050.

105. The emerging messages of the analysis of CCA are summarized as follows:

- There are potentially large benefits from adaptation, especially for higher levels of climate change.

- In terms of resource mobilization, it is possible to finance adaptation domestically via fiscal measures, at little to no costs to the economy. The analysis considers the hypothetical case of a 2 percent contribution levied on consumption goods and finds that it can generate a major part of necessary adaptation funding without hampering the prospects for growth.
- External resources, such as structural funds from the European Union, or their successors, or other bi- or multi-lateral mechanisms focused on climate finance, can also be used towards adaptation, in complement of domestic resources.
- In terms of allocating adaptation funding, the analysis concludes that orienting adaptation resources across sectors (and not only to the most vulnerable sectors) yields more benefits to the Bulgarian economy and citizens, since it increases availability of capital in productive sectors, with expansion in output and value added, partly outweighing the negative impacts from climate change.

Chapter 2. Policy and Institutional Context

2.1. Climate Change Awareness and Knowledge Gaps

106. This section presents general conclusions on the state of awareness and understanding of the future consequences of climate change, along with knowledge gaps focusing on research needs in sectors. In general, in Bulgaria, there is increasing awareness on climate change but more limited awareness of specific CCA issues, both among the public and some other stakeholders. At the political and policy making level, a high general awareness of potential future consequences of climate change exists. However, there is considerable uncertainty on how this might be manifested across different sectors. Policy making has been so far mainly concerned with the identification and implementation of climate change mitigation measures and not CCA. The Third NAPCC 2013–2020 outlines a framework for action which is focused on mitigation measures rather than actions for adapting to climate change. Climate change has, so far, received modest attention on the public agenda.

107. In terms of awareness-raising activities, the Ministry of Environment and Water (MoEW), together with its subsidiaries, has a dedicated policy to improve public awareness on environmental issues and ensure public participation in decision-making processes. It also disseminates information on environmental matters to inform decisions and actions. There are several mechanisms for involvement and awareness raising of nongovernmental organizations (NGOs), academia, business, and other stakeholders, such as the National Expert Council on Climate Change to the MoEW, created in 2013. A number of initiatives have been developed to raise awareness and public participation during preparation of the National Adaptation Strategy (NAS), including workshops with public authorities, academia, NGOs, and other stakeholders.

2.1.1. Agriculture

108. At present, there is no specific program or initiative on CCA in the agricultural sector. Although climate change in general and its impacts on the agriculture sector is the subject of research of various scientific and research institutes—including the NIMH, the Agricultural Academy, the BAS, and the Institute of Soil Science and Agroecology—there is a lack of systematic studies on the impact of climate change in the Bulgarian agriculture and fisheries sector. The farming community also lacks sufficient information on CCA. Although agricultural associations represent the interests of agricultural businesses and farmers and participate in expert groups and commissions dealing with policy development, specific discussions on climate change effects and CCA are not widespread and many stakeholders are not familiar with climate change impacts on agriculture and have limited knowledge of CCA options and measures. Consequently, farmers lack sufficient information and knowledge about the vulnerabilities of the agricultural sector and the opportunities for changing crops in response to climate trends.

2.1.2. Biodiversity and ecosystem services

109. There is limited awareness of the increasing environmental threats arising from biodiversity loss and the resulting decline in climate change resilience of ecosystems and societal systems relying on ecosystem services. Information about both climate change and

ecosystems as a complex system is not communicated easily. Furthermore, data gaps in climate and biodiversity models mean that national projections are not sufficiently detailed. Such data gaps inhibit the elaboration of spatially explicit policy recommendations for CCA. As it is cross-sectoral in nature, concerted action is needed to set up consistent monitoring and protect the critical natural capital that provides ecosystem services for CCA. It has to be enacted and implemented consistently in all ecosystems, including those regulated by agricultural, fishery and aquaculture, and forestry legislation.

2.1.3. Energy

110. Both internationally and in Bulgaria, emphasis has been typically placed on the role of the energy sector in mitigating human-induced climate change, with comparatively little attention paid to the impacts of climate change on the energy sector. This has begun to change in the recent years with increased recognition that mitigation and adaptation must be undertaken in tandem.

2.1.4. Forestry

111. Forestry specialists and the higher level of management of the forestry sector in Bulgaria are aware that climate changes are a likely contributing factor to many of the growth and health problems in forests and that future climate changes may cause further problems. At the same time, there is high uncertainty, about what might be the possible consequences for the forestry sector. There is also a general lack of public awareness on the potential deterioration of certain ecosystem services in forests.

112. Key knowledge gaps identified are (a) possible consequences of climate change on the most important tree species, forest types, and priority tree species and habitats for protection; (b) lack of adequate modeling at the country level of potential changes in forests and what actions will improve their ability to adapt; and (c) lack of adequate knowledge and modeling at the country and district levels of the potential biotic and abiotic disturbances and their effects on forests.

2.1.5. Human Health

113. Although, the Bulgarian health sector stakeholders (public, private, and civil society) are aware of climate change and the related human health problems, there is a need for further effective communication on these issues. Moreover, such awareness is not yet very apparent at policy level as, for example, the latest National Action Plan (MoEW 2012) on Climate Change does not cover human health.

114. There is a range of gaps in research of climate change-related diseases including asthma, respiratory allergies and airway diseases, cancer, cardiovascular diseases and strokes, food-borne diseases and nutrition, heat-related morbidity and mortality, human development effects, mental health and stress-related disorders, neurological diseases and disorders, vector-borne and zoonotic diseases, waterborne diseases, and weather-related morbidity and mortality. Additionally, cross-cutting and transdisciplinary issues relevant to potential health impacts of climate change include identifying susceptible, vulnerable, and displaced populations; enhancing public health and health care infrastructure; developing capacities and skills in modeling and prediction; and improving risk communication and public health education. Such

research will lead to more effective early warning systems and greater public awareness of health risks from climate change, which should translate into more successful mitigation and adaptation strategies.

2.1.6. Tourism

115. There is now a wide international recognition of the urgent need for the tourism industry, national governments, and international organizations to develop and implement strategies on CCA. However, in Bulgaria, there is low awareness of the specific negative impacts and opportunities for the sector resulting from climate change. This is true for almost all stakeholders—public authorities at national, regional, and local levels; tourism NGOs (except for Bulgarian Association for Alternative Tourism [BAAT]); and the private tourist sector. For example, municipalities are investing large sums into building more winter ski infrastructure in low altitude areas, apparently without awareness of projections of future climate conditions.

116. Despite the significant growth of publications on tourism and climate change globally, there are considerable knowledge gaps on climate change adaptation and mitigation. Key general CCA knowledge gaps include climate change science, roles and responsibilities for implementation of adaptation activities, and priorities for action as well as their financing. In Bulgaria, there is also a lack of information and little or sporadic academic research about the impact of climate change on tourism.

2.1.7. Transport

117. Awareness of the need for a systematic approach regarding CCA has started to grow among stakeholders in the transport sector in recent years. An example of this is the increasing coverage of CCA in environmental assessments of strategic documents in the transport sector. The environmental assessment of the Integrated Transport Strategy for the period until 2030, produced in 2017, includes extensive discussion of CCA (MTITC 2017). There have also been isolated initiatives in various subsectors to address specific climate change-related issues, for example, the increased use of polymer modified bitumen in road pavements. However, much remains to be done in pursuing a more systematic approach and in understanding the issues and their importance by the stakeholders in the various subsectors.

118. To review the level of awareness and the adaptive capacity of the stakeholders in the Bulgarian transport sector, the sector assessment prepared a questionnaire and distributed it among all major public-sector entities that have duties and responsibilities related to transport. A key finding was that about half of the stakeholders declared they have knowledge and understanding of CCA.

119. Regarding knowledge gaps, there is a lack of systematic studies of the longer-term impact of climate change on the transport sector in Bulgaria. Also, the definition of specific CCA actions and their effects need more attention and research.

2.1.8. Urban environment

120. Over the last decade, the country's EU commitments on climate change have required increased awareness among policy makers for all sectors in the economy, including urban environment. At the municipal level, concerns in Bulgaria about the consequences of climate change are related to responsibilities to prevent and respond to a number of cross-cutting issues

such as floods, water and air pollution, drinking water shortages, and destruction of green areas. At present, the only practical measures related to climate change are limited to the preparation of documents at the national level and sparingly at the municipal level because of EU requirements. A comprehensive and long-term vision on the urban environment and its problems, including the risks from expected climate change is lacking.

121. Regarding research and education, climate change impacts on the urban environment are not sufficiently presented in the urban planning curriculum, thus reflecting the overall limited academic and professional capacity for promotion of issues of CCA. There are, therefore, considerable needs for further capacity building and increasing understanding and awareness of CCA through public engagement, communication access, and education.

122. Key knowledge gaps on CCA in the urban environment in Bulgaria are identified across a number of subjects including gaps in methodologies, information, financial analysis (cost of damage and cost-benefit analysis [CBA] of actions), implementation, and governance. Generating knowledge and information at the local level will require additional data collection and research and longer-term observations. The most important challenge for Bulgaria is seen in the sector report as information exchange and knowledge communication if the required synergy in climate change mitigation and adaptation is to be achieved.

2.1.9. Water

123. Public awareness on climate change in the context of water is mainly limited to experience of and media information on flood events. Due to the significant impacts of recent floods in terms of human victims and damage costs, there is a broad social consensus regarding the urgent necessity of defining and implementing DRM measures, mainly relating to the water sector.

124. At the policy level, in line with the requirements of the Water Framework Directive (WFD) and the Floods Directive, public participation procedures were carried out in the preparation of the Bulgarian River Basin Management Plans (RBMPs) and Flood Risk Management Plans (FRMPs). These two strategic planning documents are targeted to a wide range of stakeholders—society, business (industries and other water users), and municipalities, through information and consultation activities and active participation.

2.2. Legal Framework for Climate Change Adaptation

125. The legal framework and policies for CCA in Bulgaria should be understood in the context of its commitments under international conventions and EU legislation. This section gives an overview of this legal framework including relevant documents at the international, EU, and national level and a brief outline of sector-level frameworks. Further information on relevant legal framework and policies for each sector (including relevant EU Directives and Strategies) is given in the sector assessment reports that come as appendices to this strategy.

2.2.1. International framework

126. Bulgaria has been a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) since June 1992 and a party to it after ratification by the Bulgarian Parliament in 1995. It is also a signatory of the Kyoto Protocol (KP). More recently, the Paris

Agreement of the 21st Conference of the Parties (COP 21) to the UNFCCC was adopted on October 5, 2016, providing a framework for global actions to address climate change after 2020. The Paris Agreement establishes "a global goal on adaptation: enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change" and urges a significant increase in financial assistance for adaptation in developing countries. Through their Intended Nationally Determined Contributions (INDCs), the EU and its Member States have committed to a binding target of at least 40 percent domestic reduction in GHG emissions by 2030 compared to 1990.

127. Bulgaria is further a party to numerous other conventions relevant to CCA in different sectors, such as the Convention for Biodiversity (CBD), the Convention for the Protection of the Architectural Heritage of Europe, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, and the Convention on Cooperation for the Protection and Sustainable Use of the Danube River.

2.2.2. EU framework

128. A number of EU strategic, legislative, and implementation-related documents underpin the Bulgarian national legal framework for CCA. The main elements are as follows:

129. Key strategies and programs:

- **The Europe 2020 Strategy.** This sets the scene toward smart, sustainable, and inclusive growth actions across the EU. The strategy defines three mutually reinforcing priorities for each Member State: (a) smart growth—developing an economy based on knowledge and innovation; (b) sustainable growth—promoting a more resource-efficient, greener, and more competitive economy; and (c) inclusive growth—fostering a high-employment economy delivering social and territorial cohesion. The 2020 package, part of the strategy, is a set of binding legislation to ensure the EU meets its climate and energy targets for the year 2020.
- **The EU Strategy on Adaptation to Climate Change (**EC 2013a) provides a framework and mechanisms to improve the preparedness of Member States for current and future impacts of climate change. The strategy helps enhance the capacity to respond to the impacts of climate change at the local, regional, national, and European level and supports the development of a coherent approach and improved coordination at the EU level. Key objectives include provision of funding to help Member States build up adaptation capacities, addressing gaps in knowledge about adaptation, and mainstreaming adaptation measures into EU policies and programs.
- **7th Environment Action Programme (EAP) to 2020** 'Living well, within the limits of our planet'. The 7th EAP is an overarching document that creates the links between single environmental policies at the EU level. It explicitly links to CCA by stating that "Action to mitigate and adapt to climate change will increase the resilience of the Union's economy and society, while stimulating innovation and protecting the Union's natural resources" (EC 2013c).

- **Other sectoral strategies.** A range of EU sectoral strategies link to national CCA legal frameworks for sectors, for example, the Biodiversity Strategy to 2020, EU Forest Strategy 2013, and the EU Strategy for the Danube Region.
- **Common Provisions Regulation (EU) No. 1303/2013 and the regulations governing the European Structural and Investment Funds (ESIF) 2014–2020.** These reflect the increased importance that climate change risks and the need for adaptation have gained in the EU policy agenda. The regulations explicitly mention climate change adaptation as part of the horizontal principle on sustainable development, and a 20 percent overall EU budget spending on climate change has been promoted, which includes spending on adaptation.

130. EU legislation provides a framework for Bulgaria's policy development and national legislation to achieve the interlinked goals of the EU strategies and programs outlined earlier. In particular, this provides a basis for mainstreaming CCA into national sector policies. Several EU Directives, setting out required outcomes for Member States, without stipulating the means of implementation, underpin national legislation, for example, the Birds Directive and Habitats Directive in the context of biodiversity and ecosystem services. As well as strategic and legislative documents, the EU provides practical guidance documents and policy implementation tools. These include the information and tools in the European Climate Adaptation Platform (Climate–ADAPT).

2.2.3. National framework

131. At the national level, key strategies and programs that provide a foundation for legislation in general, including for CCA, are as follows:

- **The National Development Program Bulgaria 2020 (NDP BG2020).** This details the objectives of the development policies of the country until 2020. This is an integrated document focusing on the social and economic development of Bulgaria until 2020, linking the EU priorities in the context of the Europe 2020 Strategy and the national priorities of Bulgaria.
- **The Partnership Agreement (PA) for 2014–2020.** This is the national strategic document outlining the framework for the management of EU structural and investment funds. The adverse impacts of CCA measures for negative effects are explicitly addressed under the third strategic priority 'Connectivity and Green Economy for Sustainable Growth', and its sub-priority 'Climate and Climate Change, Prevention and Risk Management'. European Council states that climate action objectives will represent at least 20 percent of EU spending in the 2014–2020 period and the ESIF are a key contributor to achieving this target.
- **Guidelines on Mainstreaming of Environmental Policy and Climate Change Policy into the ESIF.** The need to mainstream environment and climate change into other sectoral policies is a basic principle for the 2014–2020 programming period. Moreover, the Common Provisions Regulation requires Member States to provide information on the support relating to climate change, in line with the aim to allocate at least 20 percent of the EU budget for this purpose. To meet these requirements, the MoEW coordinated the development of a guidelines package in two phases—respectively for the

programming and implementation stages of Operational Programmes (OPs) under the Partnership Agreement. The guidelines proved to be an important tool for planning of interventions in the field of environment and climate change through all programs co-financed by the ESIF in 2014–2020 though adaptation aspect has not been explored enough.

- **The Third NAPCC** outlines the framework for action on climate change for 2013–2020 in accordance with the EU policy and international agreements. The document also defines the duties of the relevant entities (ministries, agencies, and local authorities) and is mainly focused on climate change mitigation.
- **Sector strategies** also provide some elements of climate change-related policy and action as outlined in the following paragraphs and with greater details in the sector assessment reports. However, they conclude that CCA is not well-mainstreamed in sector policy documents.

132. Key legislation currently in place is as follows:

- **Environment Protection Act** (EPA) is a sector overarching act that regulates the strategic process in all areas of environmental protection, monitoring, and management. It mentions but does not go into specifics on CCA. The EPA states the principle of mainstreaming of environmental policies (including climate and biodiversity policies) across other sectors.
- **CCMA.** This is main piece of national legislation related to climate change. It describes and regulates the state policy on the mitigation of climate change and the implementation of the mechanisms for fulfillment of the obligations of Bulgaria related to the UNFCCC and the KP. It outlines the institutional responsibilities and stakeholder involvement mechanisms. The act contains some adaptation aspects and aims to guarantee the long-term planning of measures for CCA. Article 9 explicitly provides for the development of a NAS outlining the key measures to be undertaken with this respect on horizontal and sectoral levels.

2.2.4. Sector level

133. At the sector level there are, in general, no specific current legal acts in Bulgaria that deal solely with CCA. Instead, aspects of adaptation can be found in a broad range of sector and cross-sector documents including strategies, laws, and guidance documents. A summary of the legal framework for each sector is given in the following paragraphs.

Agriculture

134. Agriculture and fisheries sectors have no specific legal acts (at the national level) that deal exclusively with CCA. In the EU Strategy on Adaptation to Climate Change, both agriculture and fisheries are defined as key vulnerable sectors, dependent on the impact of climate change. The EU Common Agricultural Policy (CAP) addresses the challenges of climate change with nearly one third of Bulgaria's overall financial allocation under CAP 2014–2020 earmarked for mainstreaming CCA and mitigation activities. The EU Rural Development Policy also aims at mainstreaming climate change mitigation and adaptation activities. The Bulgarian Rural Development

Programme (RDP) addresses climate change mitigation and adaptation more directly in three out of the six rural development priorities, with total indicative amount allocated to objectives affecting CCA and mitigation 44.6 percent of the total RDP budget. The Common Fisheries Policy (CFP) aims to ensure that fishing and aquaculture are environmentally, economically, and socially sustainable. The Maritime and Fisheries Program 2014-2020 is a financial instrument for implementing the Common Fisheries Policy. The Multiannual National Strategic Plan for Aquaculture in Bulgaria (2014–2020) has been prepared in accordance with the Strategic Guidelines for the Sustainable Development of EU Aquaculture of the European Commission (EC). However, the plan lacks any assessment of the sector vulnerabilities in relation to climate change and does not prescribe any specific actions for mitigation or adaptation to the impacts of climate change.

Biodiversity and ecosystem services

135. At EU level, the key strategy documents are the EAP to 2020, the Biodiversity Strategy to 2020, the Action Plan for Nature, People, and the Economy Communication (which summarizes the findings of the 'Fitness Check' evaluation of the Birds and Habitats Directives), the Forest Strategy 2013, and the Communication on Green Infrastructure - Enhancing Europe's Natural Capital. EU policies span various aspects of biodiversity, including specific targets for biodiversity conservation with legislative protection for key habitats and species (key directives are the Birds Directive[9] and Habitats Directive[10]), and other sectoral legislation, such as on agriculture and forestry, fisheries, environment pollution, and climate change.

136. The main national legislative act in the area of BD&ES services is the Biodiversity Act. It defines a National Ecological Network, regulates the protection of species in situ or ex situ, as well as the designation and management of protected zones and areas and stipulates the process of preparation and approval of the National Biodiversity Strategy and Action Plan.

137. Adaptation to climate change related to BD&ES is currently not the main focus of local and regional adaptation policies, which are, in many cases, focused on responses to disasters.

Energy

138. The EC aims to increase the climate resilience of infrastructure, including energy, by providing strategic frameworks, such as the working document on 'Adapting Infrastructure to Climate Change' (2013) and the 'Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy' (2015). Infrastructure projects that receive EU funding should also take climate-proofing into account, based on methodologies to be developed and incorporated into the Trans-European Networks for Energy (TEN-E) guidelines and EU Cohesion Policy.

139. Key national documents are the Energy Act and the Energy Strategy of the Republic of Bulgaria until 2020, although the Energy Strategy has no provisions for CCA. Other key documents are the Energy from Renewable Sources Act and the National Action Plan on Energy from Renewable Sources, the Energy Efficiency Act,

[9] Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Birds Directive).
[10] Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)

the National Energy Efficiency Action Plan 2014–2020, and the Program for Accelerated Gasification of the Republic of Bulgaria till 2020. The Ministry of Energy has developed in cooperation with other responsible departments an Integrated Plan for Energy and Climate of the Republic of Bulgaria until 2030 in accordance with the requirements of Regulation (EC) 2018/1999[11] The Integrated Plan project is in line with the EC guidelines. The document was presented to the EC in January 2019.

140. Forestry

141. The EU Forest Strategy (2013) sets the agenda for sustainable forest management and includes among its priorities 'forests in a changing climate', which covers mainstreaming adaptation action in forest policies (Priority Area 3). The national forest legislative framework to a large extent reflects the requirements of the environment protection legislation, including those related to climate change. The National Strategy for Development of the Forest Sector in the Republic of Bulgaria (NSDFSRB) 2013–2020 defines national priorities, in line with the European framework for planning in the sector. Priorities of the strategy include 'sustaining vital, productive and multifunctional forest ecosystems, contributing to the mitigation of the effects of the climatic changes' (Measure 1.4 – 'Increasing the resilience of the forest ecosystems to and their ability for climate change adaptation'). The strategic plan for the development of the forest sector for the period 2014–2023 has 20 operational targets corresponding with the NSDFSRB and 102 activities for their achievement. All these targets are related to CCA. The Forest Act (FA) (2011) and a number of other items of legislation govern environment protection and management of the forest territories in Bulgaria. In addition, there is a specific "*Programme of measures for adaptation of the forests in Republic of Bulgaria and mitigation of the negative effects of climate change on them.*" This outlines the most problematic areas under different climate change scenarios and measures to adapt forests to climate change.

Human health

142. The EU Health Strategy 'Together for Health' supports the overall Europe 2020 Strategy and the EU Climate Change Adaptation Strategy. The third EU Health Programme is the main instrument the EC uses to implement the EU Health Strategy.

143. The basic legal document of the health sector in Bulgaria is the Health Act (last amended on October 24, 2017). This act aims at providing a healthy living environment, protection from harmful impacts, including climatic impacts, and taking measures for their reduction. The act does not explicitly refer to any CCA issues. Other legal acts such as the Medical Institutions Act (published in 1999, last amended on October 24, 2017), the Foods Act (published in 1999, last amended on August 4, 2017), the Healthy and Safe Labor Conditions Act (published in 1997, last amended on November 1, 2015), the Health Insurance Act (published in 1998, last amended on October 24, 2017), and the Bulgarian Red Cross Act (published in 1995, last amended on October 14, 2011)—all regard environmental conditions, including climatic, as a factor of health, but none of them is directly related to the CCA for human health. The National

[11] Regulation (EC) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the management of the Energy Union and Climate Action, published in the Official Journal of the European Union on 21.12.2018.

Strategy for Disaster Risk Reduction is also closely related to health risk and adaptation to extreme weather events.

Tourism

144. The tourism sector is not among the main priorities of the EU CCA legal framework and policies, although directions and initiatives relevant to tourism can be found in various documents related to GHG emissions, transport, agriculture, water supply, and other sectors.

145. There is no explicit CCA policy or strategy developed for the tourism sector in Bulgaria. The key tourism development strategies and plans are the Tourism Act, the National Strategy for Sustainable Tourism Development 2014–2030, and the Strategic Plan for the Development of Cultural Tourism in Bulgaria. The Tourism Act does not envisage any regulations or other administrative measures concerning climate change impacts on tourism or any relevant adaptation actions. The National Strategy for Sustainable Tourism Development 2014–2030 is the only strategy that gives considerable attention to climate change and its potential impact on tourism.

Transport

146. The most important EU-level legal and policy documents with relevance to the transport sector are the EU Strategy on Adaptation to Climate Change (which includes specific action to 'ensuring more resilient infrastructure'), the Common Provisions Regulation (which includes the development of sustainable transport, and climate change adaptation and mitigation in its thematic objectives), and the EU Strategy for the Danube Region.

147. The key national documents in the development of the transport system are the Strategy for the Development of the Transport System of the Republic of Bulgaria until 2020 (2010) and the Integrated Transport Strategy for the Period until 2030 (2017). In general, both strategies are more concerned with climate change mitigation, than with adaptation. Other documents with relevance to CCA in the transport sector are the National Programme for Disaster Protection 2014–2018 and the National Programme for Prevention and Mitigation of Landslides on the Territory of the Republic of Bulgaria, Erosion and Abrasion on the Danube and Black Sea Shores 2015–2020. These documents prescribe specific CCA actions to be taken by various entities in the transport sector. A number of transport infrastructure design norms are also of relevance to CCA.

Urban environment

148. There is no EU Directive for the urban environment or urban sector CCA although a range of directives and initiatives are relevant for the implementation of adaptation measures in spatial and urban planning. A key initiative in this context is the Covenant of Mayors Initiative for Climate and Energy that assumed the former Mayors Adapt Initiative which was set up to engage cities in acting to adapt to climate change. Cities signing up for the adaptation initiative commit to contributing to the overall aim of the EU Adaptation Strategy by developing a comprehensive local adaptation strategy and/or integrating adaptation to climate change into relevant existing plans.[12] Adaptation plans for climate change prepared in Bulgaria under the

[12] In October 2015, the Mayors Adapt Initiative was officially merged with the Covenant of Mayors to create the new Covenant of Mayors for Climate and Energy. The new covenant addresses both mitigation and adaptation.

Covenant of Mayors Initiative for Climate and Energy include those for the cities of Sofia, Burgas, and Dimitrovgrad.

149. Legislation and regulations in Bulgaria relevant to CCA for the urban environment include (a) acts and regulations directly connected to climate change, (b) urban and spatial planning and design acts and regulations, and (c) acts and regulations in other sectors, indirectly connected to the urban environment. The Spatial Planning Act is the main act, which regulates urban environment development and ensures its quality and sustainability in relation to climate challenges. The Black Sea Coast Spatial Planning Act determines the specialized norms and regulation for spatial development and construction on the coast. The Sofia Municipality Territorial Planning and Building Act is also of relevance to CCA of the urban environment. The Regional Development Act defines the system of hierarchically related documents for regional and spatial development, at the national, regional, district, municipal, and city administrative levels. The above acts also link to many other sector and issue specific strategies and legislation that directly or indirectly affect the urban environment, including for energy, building codes, transport, land use, water supply, and DRM.

Water

150. Key EU water sector policy documents that provide the context for the national legal framework include the WFD, Floods Directive, and the EC Communication 'A Blueprint to Safeguard Europe's Water Resources'.

151. Long-term strategic objectives for the water sector in Bulgaria are formulated in the Water Sector Strategy which includes CCA related objectives to (a) guaranteed provision of water to the population and businesses in times of climate change leading to drought, and (b) reduce the risk of flood damage.

152. A number of laws and ordinances provide the legal framework for water in Bulgaria. The Water Act is the major water-related legal document and transposes the requirements of the WFD and the Floods Directive into national legislation as well as specifying other aspects, such as ownership of waters and water infrastructure, water use, and management of water supply and sanitation systems. The Spatial Development Act also includes provisions related to the water supply and sanitation subsector. The Water Supply and Sewerage Services Regulation Act aims to create a legal framework to ensure better services to the clients, as well as better operation and maintenance of the infrastructure. The main legal act in the field of hydro-melioration is the Irrigation Associations Act.[13] Hydropower generation is also governed by several acts including the Energy Act. Finally, in compliance with the requirements of the WFD and the Floods Directive, as well as of the Water Act, Bulgaria develops and implements RBMPs and FRMPs for each of the four river basin management regions.

Disaster risk management

153. The lead policy document on DRM is the National Strategy for Disaster Risk Reduction 2014–2020. The strategy is developed in line with the provisions of the Law on Protection from

[13] The Common Strategy for Management and Development of Hydro-melioration and Protection against Harmful Effects of Water establishes a new framework for legal and institutional reforms and it outlines how the hydro-melioration sector should manage the infrastructure.

Disasters (2011),[14] the Hyogo Framework for Action and EU policies and decisions. The strategy aims to identify the strategic priorities for disaster risk reduction (DRR) and support their implementation on the national, regional, municipal, and specific-object level. It supports identification and prioritization of concrete areas for transboundary and transregional cooperation as well as long term coordination of DRR. The National Programme for Protection from Disasters 2014–2018 sets out the objectives and tasks for disaster protection.

154. The above National DRM Strategy and Programme are linked to a number of specific programs and plans such as the National Programme for Prevention and Limitation of Landslides on the Territory of the Republic of Bulgaria, the Erosion and Abrasion along the Danube and Black Sea Coast 2015–2020, and the FRMPs.

2.3. Institutional and Stakeholders' Framework

155. The climate change-related institutional framework in Bulgaria has, over recent years, focused mainly on mitigation. The institutional framework related to CCA is an element of the overall climate change institutional framework set out in the CCMA and the related sub-legislation. The structure and main actors in implementing the Bulgarian climate change policy is outlined in ***Figure 5***. The areas that are not yet legally mandated or sufficiently detailed are marked in red.

156. The Bulgarian Parliament is responsible for decisions on legislating climate change policy and financial allocations for their implementation. The Council of Ministers (CoM) is the implementing body responsible for approving the national climate change policy, approving the staff allocations through the statutes of bodies responsible for climate policy implementation, and drafting the financial resource allocations.

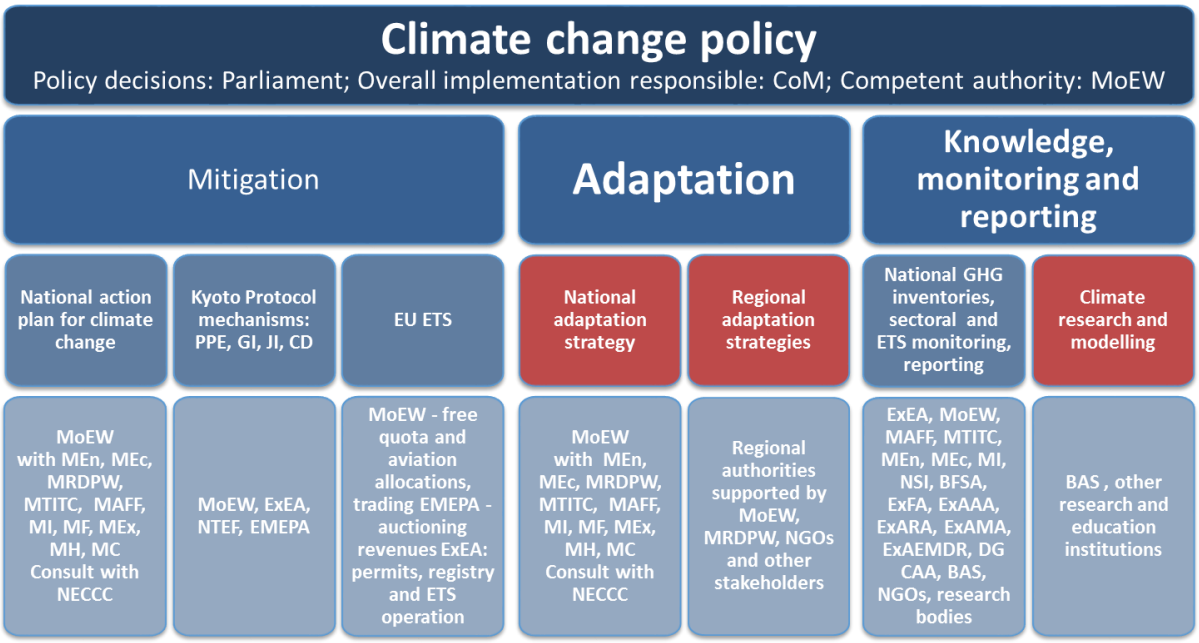
157. The MoEW is responsible for coordinating the policy-making process in relation to CCA. The work in the area of climate change is done within the specialized Directorate for Climate Change Policy. The National Coordination Council on Climate Change led by the MoEW and involving representatives of all ministries and agencies is fostering strategy development. The MoEW is also assisted by the National Expert Council on Climate Change, established under the CCMA, which includes representatives of the ministries, the executive agencies, the BAS, the National Association of Municipalities, and non-profit organizations with an interest in climate change.

158. The ministries are responsible for mainstreaming climate policies in their respective sectors and for developing and implementing adaptation measures for climate change, in coordination with the MoEW and in consultation with the National Expert Council. Responsible ministries and governmental agencies include the Ministry of Agriculture, Food and Forestry (MAFF); Ministry of Economy (MEc); Ministry of Transport, Information Technology and Communications (MTITC); Ministry of Finance (MF); Ministry of Interior (MI); Ministry of Energy (MEn); Ministry of Exterior (MEx); Ministry of Health (MH); Ministry of Education

[14] The Law on Protection from Disasters (2011) concerns the protection of lives and health of the population, the environment, and property. The act lays down provisions related to the prevention activities, actions in situation of disaster, support and recovery actions, financial and technical insurance for protection from disasters, and functions of the executive authorities.

and Science; Ministry of Labor and Social Policy (MLSP); and Executive Environment Agency (ExEA).

Figure 5. Structure and main actors in implementing the Bulgarian climate change policy



Note: All abbreviations used in this figure could be found within the Abbreviations and Acronyms section.

Source: World Bank design.

159. A brief outline of institutional and stakeholder frameworks by sector, with specific reference to CCA where possible, is given in the following paragraphs.

2.3.1. Agriculture

160. The MAFF is responsible for the programming of the RDP and operates various schemes supporting agriculture. The MAFF is also responsible for the development programs and strategies in the fishery and aquaculture sectors. The State Fund for Agriculture (SFA) deals with administration and controls of direct payments to farmers, payment for projects within the RDP, and the national state aid program in agriculture. The Directorate for Rural Development is acting as the managing authority for the RDP and is responsible for the efficient programming, management, and implementation of the program. Various administrative units, such as the directorate for livestock, have activities and policy that is partly related to climate change. The Maritime and Fisheries Program 2014-2020 is a instrument for implementing the Common Fisheries Policy. The main issue is coordination of climate change policy across different directorates.

161. The farm advisory services in Bulgaria are currently delivered by the National Agricultural Advisory Services (NAAS) and private advisory organizations. The Bulgarian National Rural Network (NRN), part of the European Network for Rural Development, aims to promote the exchange of information and knowledge among network members to support cooperation activities and strengthen the capacity of local action groups. The NRN's activities are coordinated by the Rural Development Directorate, part of the MAFF. The National Agency

for Fisheries and Aquaculture (NAFA) manages fisheries and aquaculture and provides monitoring and control of fishing, and aquaculture.

162. The BAS is the leading scientific institution in the country carrying out research and development activities on climate change, examining fluctuations, adaptation of the individual sectors, and so on. The Agricultural Academy of Bulgaria is a public research organization, responsible for conducting scientific and applied research in the fields of agriculture, fisheries and aquacultures, as well as the food industry. Trakia University and Agrarian University - Plovdiv are leading universities in agriculture and agrarian economics and carry out research in agricultural sector development.

163. Several NGOs have had a direct input on developing the policy in agricultural sectors, such as the National Grain Producers Association, Association of Agricultural Producers in Bulgaria, Bulgarian Association of Organic Products and Bulgarian Association for Dairy Processors. Two of the largest fisheries associations in Bulgaria are the Association of Fish Products Producers BG Fish and the National Association of Fish Producers.

2.3.2. Biodiversity and ecosystem services

164. BD&ES is a cross-cutting policy area which needs to be mainstreamed across sectors. Hence, the institutional framework on strategic and legislative levels spans a range of institutions. The overall responsibility of the MoEW as a policy-making body for environmental issues includes the requirement for the respective units to achieve a cross-sectoral harmonization for mainstreaming CCA within policy related to BD&ES services. The newly created Environment Impact Assessment Directorate (operational since October 2017) should also be closely involved in operationalization of the ecosystem approach.

165. As a focal point for environmental data collection and reporting (National Environmental Monitoring System), the ExEA is expected to play a key role in provision of data on CCA and biodiversity and in introducing ecosystems-based monitoring.

166. Other line ministries, agencies, and government-appointed bodies include policy making and implementing authorities across sectors affected by or affecting biodiversity. These include the Ministers of MEc, Ministry of Energy (MEn), MTITC, MAFF, MI, Ministry of Regional Development and Public Works (MRDPW), MH, Ministries of Education, and Sciences, Labor and Social Policy, and Culture, as well as the State Agency for National Security, the Executive Forest Agency, Bulgarian Food Safety Agency, Executive Agency Automobile Administration, Executive Agency Railway Administration, Executive Agency Maritime Administration, Executive Agency for Exploration and Maintenance of the Danube River, Directorate General Civil Aviation Administration, BAS, National Trust Ecofund, and Enterprise for Management of Environmental Protection Activities (EMEPA). Bodies with horizontal functions include the Minister of the MF and the National Statistical Institute (NSI).

167. Other bodies with responsibilities relevant for BD& ES include the following:

- **Regional Inspectorates of Environment and Water and local authorities**, which implement environmental policies at the regional and local levels including those related to biodiversity and some related sectors under the Minister of Environment and Water.

- **The National Park Directorates and Nature Park Directorates.** Due to the importance of forests for climate change resilience, they have a role in setting up and implementing ecosystems-based monitoring and management plans that maximize the resilience of valuable ecosystems.
- **Basin Directorates.** These are in charge of water management policies in the four basin territories of Bulgaria.
- **Governors.** These are in charge of implementing environmental policies at a district level across a number of municipalities.
- **Mayors.** Their decisions on selection of adaptation options for a given territory will mean that they are instrumental in recognizing and communicating the importance of ecosystem services and their benefits for CCA.

168. Biodiversity has many stakeholders spread across different institutions. This can make policy coordination and implementation difficult for organizational reasons and due to the potential for conflicting interests represented by different stakeholders. Key stakeholders directly related to biodiversity policies are the expert councils being created under the EPA (for example, Expert Ecological Councils, the Basin Councils, and the National Council of Experts on Biodiversity); regional and branch associations (for example, National Associations of Municipalities of the Republic of Bulgaria, Regional Municipal Associations, Regional Initiative Groups, and the Bulgarian Association of Municipal Ecologists); and NGOs (for example, World Wide Fund for Nature - WWF, the Bulgarian Society for the Protection of Birds, Green Balkans, and BlueLink). Bulgarian business is also likely to follow the lead of its Western counterparts and take an active interest in CCA, even more so in the BD&ES sector where ecosystem restoration and other forms of 'green businesses' are likely to increase resilience, therefore, directly affecting other sectors such as the insurance industry.

2.3.3. Energy

169. The energy policy in Bulgaria is implemented by the MEn, which defines the strategic objectives and priorities in the sector and implements the country's energy policy. The main role of the MEn, in cooperation with the MoEW and other related institutions, organizations and entities in the area of CCA, lies with the Strategies and Policies for Sustainable Energy Development Directorate; the Energy Security and Crises Management Directorate; Natural Resources, Concessions, and Control Directorate; and the Energy Projects and International Cooperation Directorate. The MEn does not have a specific unit responsible for CCA. Experts of the ministry participate in the Inter-ministerial Committee on Climate Change and the Inter-ministerial Working Group for Development of the National Allocation Plan. The remit of groups, which were established in 2000 and 2005 respectively, is to coordinate climate measures in key sectoral policies.

170. Other institutions with CCA-related responsibilities and interests are as follow:

- **Sustainable Energy Development Agency is** responsible for the implementation of national policies in the area of energy efficiency, renewable sources, and biofuels utilization. As such, the agency contributes to implementing the national policy on climate change mitigation and adaptation.

- **The Energy and Water Regulatory Commission (EWRC),** an independent specialized state body, is responsible for the regulation of the activities in the energy sector and water supply and sewerage.
- **The Nuclear Regulatory Agency (NRA)** has as the main responsibility to guarantee nuclear safety and radiation protection in the country. Certain responsibilities and obligations overlap with CCA in relation to preparedness, protection, and monitoring for extreme events.
- **Municipalities** are responsible for efficient production, supply, and use of energy (for example, energy savings through buildings renovation, energy-efficient street lighting). They can also develop their own CCA strategy and action plans, including those related to the energy sector. For example, in 2016, Sofia municipality adopted an adaptation strategy to climate change that contained adaptation measures in the energy sector.

171. Key stakeholders for the energy sector are as follows:

- **Energy companies.** Key among these is the Bulgarian Energy Holding EAD (BEH EAD), a company wholly owned by the Bulgarian state with rights of ownership exercised by the Minister of the MEn.
- **Bulgarian Academy of Sciences.** The BAS carries out research and development activities on climate change including adaptation of sectors.
- **Private sector organizations.** The most notable are the Confederation of Employers and Industrialists in Bulgaria (CEIB), represented by its Environmental Protection Directorate and the Bulgarian Chamber of Commerce and Industry (BCCI).
- **NGOs.** The Bulgaria Climate Coalition spans over 100 organizations including WWF, Greenpeace Bulgaria, Borrowed Nature Association, Green Policy Institute, Regional Ecologic Centre-Sofia, and EU for the Earth.

2.3.4. Forestry

172. The MAFF is responsible for the sustainable development of agriculture and forestry. The vulnerability of the forestry sector to climate change is addressed mainly by the Commercial Companies and State Forest Enterprises Directorate, Land Use and Land Consolidation Directorate, , the Executive Forest Agency, and the State Enterprises under the FA. The ministry does not have a specific unit responsible for CCA.

173. Other institutions and stakeholders with CCA-related responsibilities and interests are as follows:

- **Key NGOs and professional organizations** with direct relationships with the forestry sector are the Association 'Municipal Forests' which represents municipalities owning forests in Bulgaria, the National Association of Non-State Forest Owners 'Gorovladelets', and The Union of Bulgarian Foresters. There are also several active NGOs that work on topics related to the management of forest resources and climate change, such as the World Wildlife Fund-Bulgaria, the Bulgarian Society for Protection of Birds, the Association of Parks in Bulgaria, the Bulgarian 'Biodiversity' Foundation, 'Za Zemiata (For the Nature)' Association, and 'Green Balkans' Federation.

- **Entities developing forest management plans and inventories** are companies registered in the public register under Article 241 of the FA.
- **The hunters and fishermen** in Bulgaria are represented by the nonprofit organization the 'National Hunting-Fishing Association' (a Union of Hunters and Fishermen in Bulgaria and Bulgarian Hunting-Fishing Association).
- **Forest harvesting contractors and timber processors** (including the Branch Chamber of Woodworking and Furniture Industry [BCWFI]).
- **Academic institutions.** University of Forestry – Sofia (UF), the Forest Research Institute (FRI) to the BAS, and the Institute on Biodiversity and Ecosystem Research (IBER) to the BAS.
- Branch Chambers are BULPROFOR – the Union of Practicing Foresters and Forest Entrepreneurs in Bulgaria;

174. It is noted that CCA-related activities are in most cases not addressed by specialized units in many of the interested organizations of the forestry sector. This is of particular relevance to local authorities and businesses as many of the CCA policies and measures for forestry are to be implemented at the local level.

2.3.5. Human health

175. The decision-making mechanisms for the development and implementation of health promotion and primary prevention-related policies in Bulgaria are initialized, developed, and approved by the MH. The MH is therefore the key institution with responsibilities for integration of climate change policy with regard to human health. However, the sector assessment report finds that, at present, there is a lack of activity related to CCA by MH units. There is also no dedicated climate- and health-related structure involved in the adaptation policy making process. The National Expert Council on Climate Change includes representatives of the MH and other health stakeholders such as the Red Cross, although the council's activities have not to date included human health aspects of CCA.

176. Key stakeholders include the following:

- **Actors in the insurance system.** The Health Insurance Act of 1998 (last amended on October 4, 2017) reformed the Bulgarian health system into a health insurance system with compulsory health insurance and voluntary health insurance. The key players in the insurance system are the insured individuals, health care providers, and third-party payers, comprising the National Health Insurance Fund (the single payer in the social health insurance system) and voluntary health insurance companies.
- **The private sector** stakeholders encompass all primary medical, dental, and pharmaceutical care, most of the specialized outpatient care and some hospitals. Institutions at the regional and local levels are Regional Health Inspectorates and regional and municipal bodies responsible for healthcare, disease prevention, and social protection.
- **Organizations in the context of health impacts of extreme weather events**, including the Bulgarian Red Cross, together with the Youth Red Cross, the Mountain Rescue

Service, the Water Life-Saving Service, and the Fire Safety and Civil Protection Directorate General (FSCPDG).

177. There are a large number of other health-related organizations in Bulgaria. Although not many of them deal explicitly with CCA at present, many could develop activities in this area. These include professional organizations (for example, the Bulgarian Union of Medical Doctors and the Bulgarian Association of Health Care Professionals), medical universities and schools, research institutes (for example, the Institute of Molecular Biology, the Institute of Microbiology), scientific societies (for example, the Bulgarian cardiological society and the Bulgarian society of infectious diseases), and NGOs (for example, the National Association of Urgent Medical Support Staff).

2.3.6. Tourism

178. The major institution responsible for tourism development in Bulgaria is the Ministry of Tourism (MT). The ministry is responsible for any new documents (plans, strategies, and so on) concerning tourism development in general, including CCA actions in the sector. The National Tourist Council (NTC) is a consultative body at the Minister of MT which aims to assist in the implementation of the national tourism policy. The members of the NTC are representatives of the tourism-related ministries and institutions, regional, local, and branch tourist associations, associations of air, land, and water carriers, and nationally represented associations of consumers in the Republic of Bulgaria.

179. Key tourism related NGOs are the National Tourism Board (NTB), BAAT, the Association of Bulgarian Tour Operators and Travel Agents (ABTTA), the Bulgarian Hotelier and Restaurant Association (BHRA), the Bulgarian Balneological and SPA Tourism Union, the Bulgarian Association of Travel Agents (BATA), the Bulgarian Tourist Chamber (BTCH). There are also several regional tourism associations and regional tourism councils in Bulgaria. Other stakeholders in Bulgaria are all municipalities in which tourism is or can be developed. A new tourism stakeholder is the network of the Organizations for Tourism Regions Management (OTRMs), which is currently being established.

180. The sector assessment report concludes that important institutions and stakeholders which can have a substantial impact on the approval and the adoption of CCA actions in the tourism sector in Bulgaria, are as follows:

- **At the national level.** The MT, BAAT, and the national intermediaries' (mainly tour operators') associations (ABTTA and BATA).
- **At the regional level.** The OTRMs, regional tourism associations, and municipalities.

2.3.7. Transport

181. The institutional framework for the transport sector in Bulgaria at the policy-making level includes two main entities—the MTITC and the MRDPW. Neither ministry has a dedicated unit specifically responsible for climate change adaptation.

182. In the MTITC, the Safety, Technical Supervision and Crises Management Directorate, the National Transport Policy Directorate, the Coordination of Programmes and Projects Directorate and the European Coordination and International Cooperation Directorate are

involved in the subject as part of their general duties. The ministry has inspectors in charge of monitoring the safety of all modes of transport. They also register events such as catastrophes, infrastructure failures, and obstructions to services.

183. In the MRDPW, a unit with a potential role in CCA is the Technical Rules and Regulations Department. The Department is responsible for developing the draft regulations in the area of design and construction of roads, streets, transport networks and facilities. The Geo-protection and Public Works Directorate is responsible for registration and monitoring of landslides. In case of unfavorable geodynamic events, MRDPW provides support and specialized assistance through one company for geo-protection, located in Varna, with brunches in Pleven and Pernik.

184. At the implementation level, an extremely important role is played by the various agencies, state companies and trade enterprises under the two ministries. The most important such entities are the Road Infrastructure Agency (RIA), the National Railway Infrastructure Company (NRIC), the Bulgarian Ports Infrastructure Company (BPI), the Executive Agency for Exploration and Maintenance of the Danube River, and the Directorate General of Civil Aviation Administration (CAA).

185. Regarding transport in urban areas, the most important entities are the municipalities and the public transport operators. The municipalities are responsible for the preparation of general and transport masterplans and are in charge of employing and controlling the operators, as well having a significant role in building and maintaining the municipal transport infrastructure. Several Bulgarian municipalities are members of the Covenant of Mayors Initiative for Climate and Energy, the largest of them being the municipalities of Sofia, Burgas, and Varna. Most of the municipalities participating in the initiative have developed CCA strategies and action plans and have units with duties and responsibilities related to CCA.

186. NGOs in the transport sector include the Bulgarian Construction Chamber, Bulgarian Road Safety Branch Chamber, National Association of the Municipalities in the Republic of Bulgaria, National Association of the Bulgarian Road Carriers, Union of International Haulers, Association of the Bulgarian Enterprises for International Road Transport and the Roads, Bulgarian Association of Road Transport Organizations, and Association of Bulgarian Railway Carriers.

2.3.8. Urban environment

187. Ministries and organizations with responsibilities and interests in the urban environment sector cut across a number of other sectors. The regional policy in Bulgaria, part of which is the urban development policy, is governed by the MRDPW. It sets the legal framework for regional development, spatial planning, investment projects, construction, and construction supervision. The Minister of the MRDPW carries overall responsibility for the development of the road infrastructure together with the MTITC, the former supported by the RIA. The development and management of the water supply and sewerage sector and the activities for prevention of the harmful effects of waters within the settlements are carried out with the help of the Water Supply and Sewerage Directorate, which plans and coordinates the water supply and sewerage sector at the national level. The public works and geo-protection are managed by the respective

specialized directorate. On the territory of the country, there is one state company for geo-protection, in Varna, with brunches in Pleven and Pernik.

188. The Minister of the MRDPW also carries out the state policy on the development of legislation in the field of design and construction and on their harmonization with EU law. The state policy on water management in Bulgaria is carried out by the MoEW and its Water Management Directorate. This ministry is assisted by four River Basin Directorates (RBDs) and 16 Regional Inspectorates for Environment and Water, which along with the rest of their activities carry out control over wastewaters.

189. Urban environment-related institutions with respect to CCA are all ministries with their respective units and state agencies, which in some way are responsible for management of different risks. The MRDPW has a leading role, because of the wide range of activities, related to spatial and regional development policy, development and implementation of government housing policy, water supply, landslides, and construction.

190. Other stakeholders in the sector are the following:

- **Professional communities and bodies** involved in transposition of the international standards and codes in Bulgarian spatial and urban planning and in the construction sector, such as the Union of Bulgarian Architects, Chamber of the Bulgarian Architects, Union of Planners in Bulgaria, and Bulgarian Construction Chamber.
- **Research organizations.** Key stakeholders in the process of research, planning, implementation, and evaluation of adaptation options include a number of academic organizations, such as the specialist institutes at the BAS and the University of Architecture, Civil Engineering and Geodesy (UACEG).
- In the **private sector,** there are many small consulting companies in this field, which however, have very limited capacity to deal with CCA plans and programs.
- **NGOs.** The main actor among the NGOs in Bulgaria is the National Association of Municipalities in the Republic of Bulgaria (NAMRB), which works mainly with mayors and chief architects of the municipalities, supports their initiatives, and represents them in the governmental structures, in the EU and in the Assembly of the European Regions. The specific issues on CCA are within the scope of regional organizations, such as the Association of Danube Municipalities, Association of Black Sea Municipalities, and Association of the Mountainous Municipalities. The establishment of the network of Black Sea NGO is an attempt at better cooperation and capacity building. The representatives of the NGO sector in the country are also active on issues related to environment quality, air pollution, and drinking water, energy and green infrastructure. They actively participate as consultants during municipal Spatial Development Plans elaboration and their assessment of strategic documents (for example, SEAs), in public consultations and expert councils.

2.3.9. Water

191. Several institutions have responsibilities for the management and development of the water sector, which necessitates good coordination. The MoEW is responsible for the formulation and implementation of the policies and measures to climate change mitigation and

adaptation and implementation of the national water management policy. To support the activity, a Higher Advisory Council on Waters has been set up with the Minister of the MoEW. This council includes representatives of ministries with functions and responsibilities in water management and conservation, the BAS, municipalities, non-profit legal entities with a direct relation to water, and others.

192. The MoEW interacts with a number of institutions in the implementation of water management policy, including the MRDPW, MAFF, MI (General Directorate Civil Defense), the District Governors, the mayors of municipalities, and the NIMH. Other key organizations with water management-related responsibilities are the Executive Environmental Agency, RBDs, Regional Inspectorates for Environment and Water, MEn, MEc, and EWRC.

2.3.10. Disaster risk management

193. The activities for population protection in case of emergency or disasters are carried out by the Unified Rescue System according to Disaster Protection Plans. The Unified Rescue System includes ministries and agencies, municipalities, commercial companies and sole entrepreneurs, emergency medical care centers, other medical and health care establishments, nonprofit organizations, including voluntary formations under Article 41 of the Disaster Protection Act, and armed forces. The coordination of the components of the Unified Rescue System is carried out by the operational centers of the FSCPDG.

194. A Disaster Risk Reduction Council was created as a permanent body to the CoM to ensure coordination and cooperation in the implementation of state policy in the field of disaster protection. The Council performs the functions of a national DRR platform in implementation of the Hyogo Framework for Action 2005–2015 and Sendai Framework for Disaster Risk Reduction 2015–2030.

2.4. Ongoing and Foreseen CCA Actions

195. This section briefly outlines ongoing and foreseen priority actions on CCA at the sector level as identified in the sector assessment reports. This illustrates the rather limited action currently being taken on CCA in some sectors and the need for impetus on CCA that should be provided by the NAS.

2.4.1. Agriculture

196. Recommendations for priority foreseen actions are the following:

- **Water management and the development of good irrigation practices** are recommended for immediate attention. In particular, promotion of sustainable use of natural resources and arable land and reduction of the vulnerability of agricultural crops to climate change impacts that may lead to decrease in crop yields, loss of profits, and loss of competitiveness. Recommendations also include improving soil structure maintenance and restoration and increasing the soil's infiltration capacity to minimize erosion.
- Adjusting livestock breeding to address the adverse effect of climate change on livestock production. The efforts could be to adapt farms and facilities, diversify livestock farming and improve existing pastures for grazing.

- **Investment in CCA measures and risk management tools** by the private sector, NGOs, and government and local communities. Farmers usually have limited resources and they are insured at low premium, which does not cover the losses for climate change extreme events. Therefore, farmers need investments to ensure they can cover the costs of adapting to climate change and appropriate risk management tools.
- **Targeting eco-innovations and the development and introduction of more selective fishing equipment, facilities, and resource-efficient technologies.** The changes in the fisheries and aquaculture sectors caused by climate change will require enhanced adaptability and flexibility in fisheries and aquaculture policies. The uncertainty associated with the interactions between climate change and fisheries and aquaculture in the long term require further research and studies to enable policy makers to develop and implement CCA strategies in these fields.
- **Information dissemination.** Develop a database of information and online portal for exchange of information. Availability of innovation research will allow its use by different stakeholders including farmers and public institution. Online platforms can be established for agriculture, aquaculture, and fishery.

2.4.2. Biodiversity and ecosystem services

197. Ongoing actions on CCA are cited as follows:

- **Development of guidelines for the integration of environmental policy and climate change policy in the EU Funds programming**, on the initiative of the MoEW for the current programming period 2014–2020. These guidelines contain general provisions on mainstreaming and environmental and climate-related criteria and requirements to be used in the assessment of project proposals and their subsequent implementation.
- **Progress on important environmental data that could be used for sectoral CCA[15].** In particular, European Economic Area Financial Mechanism 2009–2014 programs BG02 integrated management of marine and inland water and BG03 biodiversity and ecosystem services have laid the methodological foundation and compiled a mapping and assessment outside NATURA 2000, whereas OP-Environment has planned for performing the mapping and assessment within NATURA.
- Bulgaria also participates in international activities related to BD&ES and exploring the relationship with climate change, such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), International Long-Term Ecosystem Research (ILTER) and Network and the Ecosystem Services Partnership (ESP).

2.4.3. Energy

198. Bulgaria is currently not implementing any energy measures/actions explicitly targeted at CCA. However, a number of activities and initiatives in the sector mainly dealing with mitigation efforts provide synergies with adaptation. These include the following:

- **Integrated Plan for Energy and Climate of R of Bulgaria 2030**

[15] By September 2018, Bulgaria is determined as the country with the biggest progress in EU and the mapping of ecosystems.

- **National Investment Plan 2020** (with a main objective to ensure a sustainable transition to a low-carbon economy)
- **Diversification of energy sources** (in particular, development of the gas network) and energy efficiency

2.4.4. Forestry

199. Key ongoing actions are given as follows:

- **Program of Measures to Adapt Forests in the Republic of Bulgaria and Mitigate the Negative Impact of Climate Change on them 2012–2020,** adopted by the Executive Forest Agency (EFA) under the MAFF (UNECE 2017).
- **The Third National Climate Change Action Plan 2013–2020** defines a small number of adaptation measures in the agriculture and forestry sectors.
- **National Forest Inventory (NFI).** Ongoing implementation of a full NFI is of critical importance to collect reliable data on the status of forest resources.

2.4.5. Human health

200. As outlined earlier, there is a lack of activity related to CCA in the health sector as a whole. However, individually, the sector representatives take part in a number of activities at the local, national, and international level, relevant to CCA. This includes participation in the process of policy making, educational activity, research activity, information provision, and public communication. It is recommended in the sector assessment report that the existence of such actions is further identified, and steps are taken to develop an official sector framework for CCA actions.

2.4.6. Tourism

201. There is very limited current involvement by the tourism sector on CCA activities. The only CCA-related action in which a Bulgarian tourism organization took part that is referred to in the sector assessment report was the 'Climate Change – the Challenges before Bulgarian Nature and Tourism' conference held in December 2015 and co-organized by BAAT.

2.4.7. Transport

202. To date, the approach to CCA in the Bulgarian transport sector has not been very systematic. Specific climate change-related issues have been identified by stakeholders who have sometimes attempted to resolve them on a case-by-case basis. Examples of CCA actions taken in the various transport subsectors include increased use of polymer modified bitumen, stopping of heavy vehicles during hot weather (by the Traffic Police based on an ordinance issued by the RIA), and revision of the road design norms (commissioned by the MRDPW).

203. Following EU legislation for the current programming period 2014–2020, all transport infrastructure projects applying for grant financing from the EU Cohesion and Structural Funds shall perform a CCA assessment.

2.4.8. Urban environment

204. The envisaged actions for CCA in the urban environment can be derived from the adopted Third NAPCC 2013–2020, the National Programme for Disaster Protection 2014–2018, and the Action Plan to the National Strategy for Management and Development of the Water Sector in the Republic of Bulgaria. The Third NAPCC 2013–2020 does not have an urban environment sector, so the associated measures are found in other sectors.

205. Urban environment-related specific ongoing and foreseen actions are mainly focused on the response of other sectors to the extreme weather events and their consequences. These relate to action for extreme temperatures, floods, landslides, fires, droughts (water resources), and DRM. The most important actions are connected with the monitoring and control of the implementation of the adopted strategic documents and their action plans and programs, with the provision and access to reliable information, knowledge development and communication, capacity building, and awareness raising.

206. At the municipal level, ongoing actions most directly related to adaptation of the urban environment are their CCA strategies. All municipal councils have adopted rules and procedures aimed at reducing the risk of natural disasters. However, in general, physical modifications to the environment through adaptive topography and adaptive infrastructure are still mainly aspirations and at present, are rarely used in practice.

2.4.9. Water

207. The MoEW has launched activities specifically aiming at CCA, during the preparation of the national CCA strategy. The major actions for implementation are in the framework of the programs of measures under the RBMPs and FRMPs.

208. Water utilities are participating in various projects and initiatives, including benchmarking projects. Although CCA is not directly targeted, this is an opportunity for the water utilities to increase their efficiency. This is the way to also increase their resilience, especially in terms of increasing the efficiency of water supply systems, reducing leakages, and unbilled consumption.

209. Regional feasibility studies are currently being carried out for the designated areas of the biggest 15 operators of water supply and sewerage systems that will assess the risks associated with climate change and will set up measures to adapt to future climate change and mitigate their impact as well for disaster resilience. As a result of the assessment, measures will be proposed to comply with existing national and European legislation related to climate change.

2.5. Gaps and Barriers Hindering CCA Response

210. A number of common themes emerge from the sector assessment reports in the identification of gaps and barriers hindering CCA responses in general and specifically in the Bulgarian context. Key common and interlinked themes are summarized in the following paragraphs. The categories of gaps and barriers used here link to the characterization of adaptation capacity to address vulnerability to climate change in the *National Climate Change Risk and Vulnerability Assessment for the Sectors of the Bulgarian Economy* (MoEW 2014) and other guidelines on developing adaptation strategies and options (EC 2013b and UKCIP

2007). These themes feed into the analysis on the visions of CCA and the strategic objectives and national program and action plan in the following sections of this report.

- **Awareness-raising and communication.** This refers to the need for effective communication of relevant information on CCA—and other complicated concepts such as ecosystems and their services—as well as awareness raising campaigns to create a common understanding for adaptation needs. This includes various measures such as early awareness raising in schools, public access, and dissemination of information. This facilitates preparedness to take measures to adapt to climate change and public participation in decision making on the management of risk from climate change. General current lack of awareness and understanding of specific climate change impacts and CCA needs was identified across sectors.
- **Institutional capacity.** This refers to internal organizational/administrative capacity and expert capacity among organizations responsible for CCA policy and actions. Identified specific gaps and barriers are as follows:
    - The scope and quality of coordination between institutions related to CCA (ministries, state agencies, and so on). A particular challenge arises for sectors with a greater level of cross-cutting issues (for example, health, tourism, and urban environment), where a range of sector institutions are involved in CCA policies and there is greater potential for lack of coordination and cooperation. There is also potential for disparity of capacity and involvement between central, regional, local agencies and governmental structures, which may lead to the exclusion or limited attention to climate change policies and CCA priorities at the local and regional level.
    - Insufficient professional training, including specialized occupational training and knowledge-sharing activities related to CCA, as well as dedicated university programs.
    - The level of awareness among some decision makers and preparedness of staff to integrate this knowledge into the planning and management process. This should be addressed by specialized capacity-building courses for policy makers and creating of skills and tools for informed decision making.
    - *Data collection and monitoring.* This refers to the extent to which relevant information is available and used for informed decision making regarding CCA at all levels. For example, the need for a more unified and systematic basis for collecting and processing information and data is recommended in the agricultural sector report and the lack of availability and quality of statistical data required to support the planning process is identified as a barrier for the transport sector.
    - *Monitoring and evaluation (M&E) capacity.* Effective implementation of CCA polices requires a process of M&E to be put in place. For example, the health sector is at an early stage of policy development and requires further development of appropriate tools and mechanisms for this.
- **Knowledge and data gaps.** This refers to uncertainty and gaps in information and dedicated research that hinders the adaptation policy process. This includes uncertainties

with climate projections and associated risks, costs and benefits of adaptation, vulnerabilities at the local level, and the availability of data for M&E purposes (including the need for greater inter-operability between databases and data access, as well as the need for local-level projections of CCA impact on ecosystems, as highlighted for the BD&ES sector). A number of these knowledge and data gaps feed into institutional capacity and policy and legal framework issues identified in the following paragraph (for example, a number of research and methodological issues were identified as a barrier for health sector CCA policy development). Moreover, such gaps may inhibit some sectors' stakeholders from taking action, for example, a major barrier preventing energy companies from taking action on risks of extreme weather events was identified as the uncertainty and lack of tools to incorporate these risks into their corporate decision making.

- **Policy and legal framework.** This refers in particular to changing or developing regulations, standards, codes, plans, policy or programs to integrate, and risks from climate change, and mainstream CCA responses. Key specific issues are the following:
  - The need for improved policy coherence and coordination of CCA initiatives across sectors. This is a recurring issue in sector assessments including, for example, in the forestry and health reports. The urban environment report outlines the issue of various diverging strategies (such as for green infrastructure, natural disasters and energy efficiency), developed at the municipal level, overlapping in content but poorly coordinated. The water sector report also highlights lack of synchronization between different legal acts. The BD&ES report highlights the spread of institutional capacities between different institutions whose mandates do not include the protection and building up of ecosystem services important for adaptation and may even lead to the decline in such services.
  - The need for implementation arrangements to have clear allocation of responsibilities and mandates to different entities.
  - A specific gap (outlined in the context of BD&ES and linked to knowledge and data gaps) is the need to simplify and accelerate decision making by implementing to the extent possible a single pool of environmental data for the use of decision makers and developing tools for analyzing tradeoffs in decisions.
  - The need for CCA to be better incorporated in sector-specific legislation and other documents. In the case of transport, specific gaps are identified in the rules and regulations, for example, for design of road and railway bridges, culverts and other drainage structures, and so on. There is also a focus on improving such infrastructure performance issues on a case-by-case basis and not as structured and planned efforts to address the effects of climate change. In the case of the water sector, there are gaps in legislation (for example, rainwater harvesting and reclaimed water use) and design norms. Also, the need for using the co-benefits and assessing tradeoffs in a resource-effective approach when deciding on the mix of solutions on the regional and local level requires a better coordination across all policies.
- **Limitation in financial and human resources.** Lack of financial resources for CCA actions is a common theme across sectors. Currently, there is high dependence on EU

funding, especially for large investment projects. Key issues are the following:

- *Competing priorities.* Priorities other than climate change mitigation and adaptation often have greater short-term benefits, for example, in the tourist sector and energy sectors, where investment in building resilience competes for resources with other objectives, many of which are more immediate and tangible. In the forestry sector, there is a need for funding of strategic programs with very long duration, where shorter-term project funding is not an appropriate solution.
- Lack of information on the financial resources necessary for adaptation to climate change, such as in the case of buildings and facilities in the urban environment.
- Limited CCA dedicated human resources both in number and in expertise in key institutions are identified by a number of sector assessments (for example, energy, health, tourism, and water).

Chapter 3. Vision on Climate Change Adaptation

3.1. PEST and SWOT Analyses

3.1.1. Political, economic, social and technological (PEST) context

211. In 2017, Bulgaria marked its 10-year membership of the EU with a real GDP growth of 3.6 percent and projected to reach 3.8 percent in 2018 (DG ECFIN forecast, spring 2018). This is a real boost compared to the modest average growth rate of around 1 percent during the global crisis from 2009 to 2014. The main driver of this GDP growth is the capital expenditure by the government due to the uptake of EU funds under the 2014–2020 programming period.

212. Political stability after 2014 helped reduce fiscal pressures and government debt. The country's government debt declined from 28.2 percent of GDP in 2015 to 25.4 percent in 2017 and is still one of the lowest in the EU. The labor market recovery also continued in 2017, with employment growth rising by 1.8 percent and the employment rate returning to its pre-crisis level of 64.3 percent.

213. The Global Competitiveness Report 2017–2018, published by the World Economic Forum, shows that Bulgaria has moved up from 50th to 49th place among 137 economies included in the Global Competitiveness Index (GCI). Back in 2011, the country was ranked 74th and it should be acknowledged that the main pillars driving Bulgaria forward were the macroeconomic environment (25th place) and technological readiness (39th place).

214. Technological readiness includes a number of quantitative indicators such as the share of individual Internet users, the share of broadband Internet subscribers and high Internet speed. According to Eurostat data, in 2016 the share of households with access to internet in Bulgaria was 64 percent. Although it remains among the lowest in the EU, the increase of nearly 30 percentage points in the period 2010–2016 brought the country higher up in the GCI ranking.

215. Despite this positive change in the macroeconomic and technological environment, Bulgaria's income per capita remains the lowest in the EU (47 percent of the EU average) and the negative population growth rate (−0.61 percent) considerably impacts future prospects. The Systematic Country Diagnostic (SCD) performed by the World Bank Group in 2015 highlights two major challenges facing Bulgaria. The first is rapid population aging and a decline in the working age force. The second is low productivity growth of around 3 percent per capita. Consequently, the country received relatively poor scores on the respective indicators in the Global Competitiveness Report. With regard to the labor market, Bulgaria has slipped from the 54th to the 67th place, with very low marks for labor-employer relations, capacity to attract and retain talent, and labor productivity.

216. There is a continuing process of population aging, which results in reduction of the share of the population of ages below 15 and increase of the share of ages 65 and above. According to recent United Nations projections, by 2050, one in three Bulgarians is projected to be older than 65 and only one in two Bulgarians will be of working age. Because the proportion of the population that works is a key determinant of a country's income level, its decline is likely to depress growth. The higher productivity grows, the easier it will be for Bulgaria to manage this demographic challenge. The World Bank Group estimations show that productivity will need

to grow by at least 4 percent per year over the next 25 years for Bulgaria to catch up with average EU income levels and thus, boost prosperity.

217. In 2017, Bulgaria's population was 7,050,034 with people over 65 years accounting for 21 percent of the total. A recent EuroStat survey found that, in 2017, 35 percent of the population (2.5 million Bulgarians, mainly aged below 15 and over 65) is living in poverty. Thus, a serious challenge to the social development of the country is the risk of poverty and social exclusion, which is above the EU average. This unfavorable demographic situation is not only affecting economic development but is also placing a high burden to the national health system threatening its financial stability.

218. Currently, 73.2 percent of the total population lives in urban areas, 46 percent out of which is concentrated in six big cities, including the capital Sofia. This concentration places considerable pressure on the urban infrastructure, environment, and natural resources. The condition of technical infrastructure networks and amenities do not adequately meet urban needs and obstructs the proper functioning of cities. The physical environment and the buildings are worn out, while facilities like roads, pedestrian areas, landscaping, urban centers, and so on, are in poor condition.

219. Almost 99 percent of the population are supplied with drinking water, but the supply systems within settlements is physically and morally outdated with frequent failures, low efficiency of operation and high losses (of over 60 percent). The availability of sewerage networks and wastewater treatment plants are much less developed than water supply systems. According to Eurostat data from 2016, the share of towns and cities with sewerage systems is 67 percent and rural areas is 3.2 percent.

220. Another major challenge facing the country's economy is low energy efficiency, which has a negative impact on competitiveness. This is due to the outdated energy infrastructure, leading to significant losses in energy transmission. The use of outdated technologies in production processes also accounts for the low productivity and the high energy intensity of the economy. In addition, the energy sector is challenged by its significant dependence on imported energy resources and rising energy prices. More than 70 percent of its gross consumption of natural gas, crude oil, and nuclear fuel comes from imports, primarily from Russia.

221. The instrument for overcoming these gaps in technology—investing in new equipment, technology and know-how—is not sufficiently intensive in Bulgaria. Both the state and private sectors allocate very little financial resources to research and development, which deepens the problem of technological backwardness. According to the national statistics data, the expenditure on research and development (R&D) in 2016 amounted to BGN 734 million (€375 million) which, in terms of R&D intensity, represents 0.78 percent of GDP. This is a considerable decrease compared to 2015 when R&D expenditure showed a relative peak of 0.96 percent of GDP. In 2010, Bulgaria adopted, for the first time, a national target to spend up to 1.5 percent of GDP on R&D by 2020. It is still below the current EU average of 2.03 percent, and far from the EU 2020 standards, under which total expenditure on R&D is to reach at least 3 percent of GDP.

222. From a regional development perspective, large disparities still exist between urban and rural areas, and between the development regions in Bulgaria. Problems such as negative natural

population growth, migration, poor age structure, low level of employment, and poor infrastructure need to be urgently addressed especially in the northwestern region NUTS 2 level and in smaller settlements. The intra-regional disparities are a major problem to achieving sustainable regional development. The development of key economic sectors like tourism, agriculture, and urban development are hindered by these disparities, and these are also designated among the most vulnerable to climate change.

3.1.2. Climate change context

223. As already acknowledged in Chapter 1 of this Strategy, Bulgaria is situated in one of the regions that are particularly vulnerable to climate change (mainly through temperature increase and extreme precipitation) and to the increased frequency of climate change-related extreme events, such as droughts and floods. The risks will not affect all people and territories equally due to different levels of exposure, existing vulnerabilities, and adaptive capacities.

224. Biodiversity, land, and aquatic ecosystems, as well as water and forest resources, are expected to be affected by the anticipated changes. In a domino effect, important sectors of the national economy, such as agriculture and tourism, will also be affected. According to the Macro-Economic Implications of Climate Change Analysis Bulgaria will face climate-induced changes in three main areas: agricultural productivity, which is projected to decrease; energy demand that is expected to fall due to warming temperatures; and in both domestic and international tourism activities.

225. Cities and climate are co-evolving in a manner that is expected to amplify both the health effects of heat and the vulnerability of urban populations. In urban areas, extreme temperatures create greater health hazards for the elderly, especially for the poor and those living in low standard housing or the homeless. There is a risk for outdoor workers, employed in the construction sector or in public utilities maintenance. Extreme temperatures also put pressure on water supply systems in summer and on electricity supply systems for heating and cooling. In periods with extreme low temperatures, there is a risk for traffic and mobility due to icing and/or snowfall.

226. Among the more vulnerable groups of people are the elderly of ages over 65 and small children, as well as the poor concentrated mainly in the national periphery and in the northwestern region. Given the country's demographic situation outlined in the previous section, it is to be expected that a considerable part of the population in Bulgaria is likely to be at high risk of climate change impacts.

227. The Macro-Economic Implications of Climate Change Analysis finds that economic growth can be fully wiped out if Bulgaria faces the full impact of a 2°C rise in temperature by 2050, unless timely and effective measures are taken to make the economy more resilient. At the same time the analysis finds that with the development and implementation of an Adaptation Strategy 33 percent of the gross damages can be reduced at "no/low cost" to the economy. The sectoral risk assessment reports highlight key priority areas for action, summarized in the Action Plan to this Strategy.

228. Opportunities provided by the climate change are also identified in the sector reports and outlined in Section 1.2. of this Strategy, as well as in the SWOT analysis in Section 3.1.3.

They are however conditional upon deliberate and planned adaptation actions, provision of which is the main goal of the Strategy and its Action Plan.

3.1.3. SWOT analysis

229. The following SWOT analysis identifies the main **strengths** and **weaknesses** of the current CCA framework in Bulgaria. It also outlines **threats** deriving from a changing climate, as well as **opportunities** conditional upon the implementation of a targeted strategy with clearly defined adaptation options for key sectors of the economy likely to be most affected by climate change. The analysis reflects both general and sector-specific aspects, while sector interrelations with respect to impacts of climate change are summarized in ***Annex 2***. Policy responses are outlined in the following sections and a vision for the National Climate Change Adaptation Strategy is built upon this analysis.

Table 1. SWOT analysis

	STRENGTHS	WEAKNESSES
INTERNAL	• Stable political and microeconomic environment with a reasonable and predictable fiscal policy • Well-developed national transmission and transborder electricity grid • Nearly 100 percent of the population covered by centralized water supply, with a growing rate of connections to sewerage systems • Significant stock of hydraulic storage capacity ensured by 216 multipurpose large dams • Rich nature and biodiversity benefitting both tourism and agriculture development • Comprehensive strategic, legal, and institutional framework addressing climate change in line with the EU approach • General awareness of potential consequences of climate change exists at the policy-making level • Well-developed framework for action focused on mitigation measures, in line with the EU policy agenda • Broad social consensus regarding the urgent necessity of defining and implementing DRM measures (mainly relating to the water sector) • Broad understanding of the need to take adaptation measures in some sectors of the economy (especially agriculture, water management, tourism) • Increasing coverage of CCA in environmental impact assessments of strategic documents (SEA) and of infrastructure projects (EIA) • Adopted guidelines on mainstreaming environmental and climate change policies into the OPs co-financed by the ESIF in the period 2014–2020	• Low productivity and low efficiency of the economy resulting in low incomes of the population • Unfavorable demographic trends with large proportion of aging population • Low energy efficiency of the economy and high dependence on imported energy resources • Urban areas with high and growing density, intensive traffic, reduced green and open spaces • Obsolete and often inadequate social, health, and educational infrastructure • Unsatisfactory condition and maintenance of the existing transport infrastructure • High amortization rate of the water supply networks causing considerable water loss • Depreciated energy infrastructure causing energy losses in the grid • Low research and development investments in the economy in general and in CCA in particular • General lack of awareness and understanding of specific climate change impacts and CCA needs, both among the public and specific stakeholders • Lack of systematic studies of the longer-term impact of climate change and insufficient knowledge about sectors' vulnerabilities and the opportunities deriving from climate trends • Limited human resources and insufficient professional training dedicated to CCA issues, coupled by poor coordination between the responsible institutions with respect to CCA mainstreaming • Insufficient allocation of financial resources to CCA actions

	OPPORTUNITIES	THREATS
EXTERNAL	• Better governance through mainstreaming climate change adaptation into key sectoral policies • Increased resilience of key sectors likely to be most affected by climate change • Increased possibility for EU funds absorption by mainstreaming climate change considerations into the OPs co-financed by ESIF • Simplified and accelerated decision making by implementing a single pool of environmental data for the use of decision makers • Establishment of more effective early warning systems and greater public awareness of health risks from climate change • Development and introduction of more selective equipment, facilities, and resource-efficient technologies in the sectors likely to be most affected by climate change • Prolonged summer season for seaside tourism and shoulder seasons for all tourism types • Development of new and alternative tourism products and destinations • Development and introduction of new crop species requiring less water and promotion of good irrigation practices • Development of new forest shelterbelts, thus increasing forest territories and ecosystems • Increased potential for renewable energy development (solar, biomass) and bioenergy production through capture and conversion to biogas, with consequent environmental benefits and potential cost benefits for consumers • Development of urban/rural green infrastructure, thus supporting the decrease in air pollution and heat-related conditions	• Increased frequency of adverse climatic events, such as longer droughts, heat waves, heavy rainfalls, floods • Increased economic losses from climate- and weather-related disasters • Damage to buildings, transport and urban infrastructures such as road, energy, and water networks • Endangered key services including food supply and electricity, reduced mobility (or at higher costs) and accessibility • Increased intensity of heat islands with consequent negative health effects • Decrease in precipitation leading to a reduction of the total water reserves in the country • Water shortages and stress leading to competition for water resources between sectors • Increase of invasive species leading to disturbed ecological balance • Health impacts of floods, insufficient water supply, water pollution from heavy rains, or invasion of harmful water species • Expected increase in mortality due to extreme weather events, summer heats, floods, and fires • Shrunk winter tourist season due to shorter snow cover period and other factors such as higher risks of avalanches • Worsen conditions for outdoor recreation, related to higher precipitation and humidity as well as extreme weather events

3.1.4. Policy response

230. The NDP BG2020 is the Government's medium-term strategy document and shows the link between the priorities of the EU in the context of the Europe 2020 Strategy and the national priorities of Bulgaria. It is promoting the Government's policies to address the gap between Bulgaria and the EU with respect to incomes, institutions, and service delivery. The program includes goals to improve the competitiveness of the Bulgarian economy, the physical and institutional infrastructure, and the quality of human capital.

231. Moving toward a more sustainable economy is acknowledged as a priority, which is consistent with the Europe 2020 and commitments made with the ratification of the Paris Agreement. This includes binding commitments on both the use of EU funds (more than 20 percent of resources should be used for climate change-related activities) and policies of climate change mitigation and adaptation. Sub-priority 3.5 of the program emphasizes in particular that the *"national policy in the field of climate change should be directed toward adaptation of the most vulnerable sectors (agriculture, tourism, water resources, and forestry management, and so on) since the failure to act in this direction may lead to adverse economic consequences for our country in a longer term."*

232. Given the global nature of the processes, climate action in Bulgaria has been driven mainly by the country's international (UNFCCC) and EU commitments. These include GHG reduction (mitigation), as well as improving resilience to climate change and natural disasters (adaptation). However, the policy and legal framework (the CCMA and the NAPCC) so far has covered mainly the mitigation aspect. Since 2007, Bulgaria is contributing to the EU common targets of 20 percent GHG reduction, 20 percent renewable energy in the final consumption and 20 percent increase in energy efficiency to be reached by 2020. The country is on track with the achievement of its individual share of these targets and has also committed to the EU GHG common reduction target of 40 percent by 2030, following the adoption of the new climate and energy package.

233. This National Climate Change Adaptation Strategy is intended to fill in the gap, taking into account that adaptation and mitigation are in principle closely linked and that prevention of climate change impacts is the reason for action in both cases. Thus, action in favor of adaptation in the sectoral policies must also consider mitigation (*and vice versa*) to exploit synergies, to resolve possible contradictions and to ensure good readability of the activities targeting both mitigation and adaptation. Bulgaria is already implementing its Third NAPCC, which could be a good basis for identifying potential synergies with the adaptation actions proposed in this Strategy.

234. By definition adaptation is not only about "*anticipating the adverse effects of climate change and taking appropriate action to prevent or minimize the damage they can cause*", but also about "*taking advantage of opportunities that may arise*". One of the main purposes of this Strategy is to inform the decision-making process of future sectoral policies development by identifying such opportunities and formulating appropriate actions to enable them.

235. CBAs have been performed for all sectors (as summarized in Section 4.3 and the Sector Assessment reports appended to this Strategy) and the overarching conclusion is that the effects of adaptation measures will be cost savings because of a decrease of potential damage caused

by climate change. The net present value (NPV) calculations show that investments in adaptation measures are economically efficient in all sectors assessed. Moreover, combining measures intended for various sectors, or for climate change mitigation will generate synergic effects, thus spreading the benefits while lowering the costs.

3.2. Vision for Development of Adaptation Action

236. Moving toward a more sustainable economy is an important government priority laid down in the NDP BG2020. **Building resilience and adapting the key sectors of the national economy to a changing climate is acknowledged as an indispensable part of its sustainable growth**.

237. This National Climate Change Adaptation Strategy fills in a gap in the Bulgarian climate change policy by mapping out the country's approach for adapting key sectors of the economy to a changing climate. It is the reference document outlining the strategic framework and priorities with regard to climate change adaptation up to 2030. The Strategy is supported by in-depth vulnerability and risk assessments and highlights key priority areas for action on this basis. It is complemented by an Action Plan setting goals and priorities for improving capacity to adapt, formulating climate change adaptation measures per sector, providing a timeline for implementation of these measures, and pointing out the necessary resources and responsible institutions.

238. By adopting the Strategy, Bulgaria is taking the first step in meeting its obligations under Article 4 of the United Nations Framework Convention on Climate Change which stipulated that the parties "*shall formulate, implement, and regularly update national and, where appropriate, regional programmes to facilitate adequate adaptation to climate change*." This is based on and in line with the main principles of the EU Adaptation Strategy.

3.2.1. Vision statement and long-term objective

239. The Bulgarian Government's vision regarding climate change adaptation is as follows:

> ***'To develop the country's highest possible level of resilience against climate change, by taking any measures needed and feasible, thus securing the undisturbed functioning of the country's economic sectors, safeguarding its population's health and well-being, and preserving its rich natural assets'***

240. The ultimate goal is the natural environment, buildings and infrastructures, health and emergency services, as well as the key economic sectors to become not only resilient to the risks, but also ready to maximize opportunities.

241. **To achieve this goal, the MoEW will lead and coordinate action at the national level to reduce the vulnerability of natural, social, and economic systems in Bulgaria and to maintain and improve their capacity to adapt to the inevitable impacts of global climate change**.

242. The adaptation action will aim at building resilience of the society and businesses which are able to make timely and well-informed decisions to address challenges and opportunities presented by a changing climate. The vision for such a society has driven the set of general

objectives in the Strategy and the choice of adaptation actions related to awareness rising, institutional and capacity building, and mainstreaming of climate change adaptation into the sectoral policies.

243. Building on this mission and vision, mainstreaming of climate change adaptation action in the existing and upcoming policy cycles and action planning, developed under the responsibility of involved ministries and local authorities shall be ensured, in line with this Strategy and Action Plan. All involved institutions will respect internationally agreed directions, principles of transparent organization, free information sharing, and practicing open in- and external communication.

244. The overall strategy of the climate change adaptation process follows and accepts the mission statements of all involved ministries. The long-term objective of the NAS is as follows:

> ***'To proactively pursue long-term high-impact economic, social, and ecological resilience and sustainability, to allow Bulgaria's citizens, private sector, and public institutions to adequately prepare and protect themselves against vulnerabilities deriving from climate change'***

Information and data sharing

245. **Raising awareness and general education on climate change** is, among others, an essential pre-condition for good adaptation. The sectoral analyses performed showed that in Bulgaria the degree of awareness and its implications on the economy is still very low. Overall, people recognize that adaptation to climate change is an urgent matter. However, they have very little knowledge on the implications of changing local microclimates and the measures that could be taken. Generally, local citizens are not aware of what is climate adaptation and why is it so important for the economy and for their cities in the longer term. They also do not have a clear view of how they are contributing to the problem and what they can do to reduce their own impact on the living environment. Therefore, further efforts are needed to improve the degree of awareness among local communities. This is closely linked to the need of providing better education in natural sciences, as well as introducing climate change issues in the curricula at all scholar levels.

246. **Sharing information is an essential tool for building adaptation awareness**. Information on climate change, impacts, and possible adaptation actions should be formulated in a user-oriented way to reach different audiences. Various formats for communication exist and have proven to be useful in other countries, such as personal consultations, Internet communication/platforms, and mass media to spread information on climate change, impacts, and possible adaptation actions.

247. **A national web portal gathering tailored information on climate change**, including on adaptation of various sectors, could be an excellent tool for disseminating relevant information. Such platform should be connected with other existing portals on sectoral policies (for example, water, biodiversity, forestry) and disaster risk prevention/management. A **public repository of data, tools and analyses** developed for this Strategy (MCA, CBA, and so on) could be created to serve both the decision-making process and further capacity building in climate change adaptation.

248. This approach would be fully in line with one of the main priority pillars of the NDP BG2020 which outlines a broad package of measures for the development of e-governance (including achieving an "inter-connected administration", optimization of information and communication resources through remote access to shared sources, building and maintenance of a National Information Centre, public repositories and so on).

Secured co-financing

249. **Streamlining climate change considerations into the sectoral policies is the instrument to secure allocation of financial resources** to both mitigation and adaptation measures, thus respecting the commitment of 20 percent climate-related investments during the current programming period. The present strategy and its action plan will play an important role in planning and prioritizing respective adaptation activities. **It will also provide a valuable tool to support the mainstreaming exercise for the next programming period, including integration of climate change adaptation measures into the EU financing beyond 2020.**

250. The Macro-Economic Implications of Climate Change Analysis Report suggests that allocating foreign funds equally across sectors is the optimal approach to achieve a 30 percent reduction in climate change damage and improved welfare of the citizens.

251. For the programing period 2014–2020, Bulgaria benefits from nearly €16 billion from ESIF, allocated as follows: €7.5 billion under nine OPs, €2.3 billion under RDP, and €5.3 billion for direct payments in agriculture. The OPs are co-financed by the state budget and support activities under topics such as good governance, transport, environment, innovation and competitiveness, regional development, human resources development, and science and education. Other EU instruments (such as LIFE+, Horizon 2020) and bilateral donor programs (EEA/Swiss and Norway Financial Mechanisms) are also available to support directly or indirectly climate adaptation actions.

252. Section 4.4. provides more detailed information on available and potential financial resources to support CCA actions per sector. It should be acknowledged that considerable resources are available to Bulgaria by 2020 from the ESIF, and that investments in large infrastructure are in general highly dependent on the availability (and absorption) of EU Funds. This trend is expected to continue in the next programming period as well. The Multiannual Financial Framework (MFF) Mid Term Review, the European Court of Auditors' special report 31/2016 on progress towards integrating climate in the EU Budget[16] and the related Council Conclusions (7495/17, ECOFIN),[17] all point toward the current approach to **mainstreaming as being broadly successful and should be strengthened.**

253. The **EU Budget proposal for the new programming period 2021-2027** envisages an increase of 5 percent (to 25 percent) of climate-related spending, as well as considerable increase (by 60 percent) of the LIFE Programme. As outlined in Section 4.4., options for further improvements in climate change financing are explored in a report for DG CLIMA published in 2017 – 'Climate mainstreaming in the EU budget: Preparing for the next MFF'.[18] It is therein

[16] https://www.eca.europa.eu/en/Pages/DocItem.aspx?did=39853
[17] http://data.consilium.europa.eu/doc/document/ST-7495-2017-INIT/en/pdf
[18] https://publications.europa.eu/en/publication-detail/-/publication/1df19257-aef9-11e7-837e-01aa75ed71a1

proposed, among other improvements, to strengthen streamlining of the adaptation pillar, as well as to strengthen the reporting and assessment mechanism.

254. Considering the substantial financial needs to support adequate adaptation measures (especially in infrastructure investments), additional sources should be explored at the national level for the period beyond 2020 - subject to respective regulatory and economic impact assessments, which are not the purpose of this Strategy.

255. A 2-percent contribution levied on consumption goods to generate a major part of necessary adaptation funds is suggested in the Macro-Economic Implications of Climate Change Analysis. Another viable option would be to allocate part of the revenues (for example, 2 percent) deriving from the EU Emission Trading System (ETS) or from the instruments to be launched under the new Effort Sharing Regulation after 2020. Part of the revenues deriving from application of the *polluter pays principle* (for example charges related to the vehicle fleet or to various water uses) could also be considered for allocation to CCA action in the respective vulnerable sectors. Thus, mitigation and adaptation measures would be bound by ensuring that valuable resources for adaptation actions are coming from mitigation mechanisms (such as the ETS or the vehicle fleet related taxation). Such approach would be a matter of shifting priorities within existing financing allocations, without additional burden to the budget.

256. Attracting private investments and larger application of blended financial instruments through the international financial institutions (EIB, EBRD, WB) should also be considered, in line with their increased use in the ESIF allocation policy. In addition, insurance options should be explored further as it provides a valuable tool for adaptation in three ways: helping to manage climate change risks; providing incentives for risk prevention; and providing information on potential risks.

257. The experience so far has proved that a changing climate represents not only a *threat* to the economic activities, but also an *opportunity* for new businesses and investments. A fresh approach and paradigm shift are necessary to unlock the potential for *value creation*, which can additionally foster the country's economic growth. Investment in 'smart' and innovative solutions is one of the opportunities that needs to be encouraged with this respect.

Inter-institutional coordination

258. Currently in Bulgaria, in addition to the MoEW, a large number of ministries and other institutions, and municipalities, have responsibilities in relation to climate change adaptation. Respective capacity building measures should be envisaged to enable effective communication throughout the Strategy implementation process. Establishing a national portal with reliable climate-related data and information, as well as a repository of tools, analyses and reports developed under this Strategy would in this respect be instrumental

259. The complexity and cross-cutting nature of climate change adaptation requires that continued and enhanced attention is paid to ensuring efficient communication and coordination within and between the organizations involved if adaptation is to be carried out as effectively as possible. According to the CCMA, the MoEW is responsible for the facilitation of coordinative action, with other public institutions responsible for full and constructive cooperation in this adaptation coordination process.

260. The MoEW will be supported in this endeavor by the National Expert Council on Climate Change. Sector-specific working groups (WGs) may be established to coordinate implementation of concrete adaptation actions. The Coordination Council on Climate Change is the best placed platform to build on cooperation at the decision-making level.

3.2.2. Timeframe for the Strategy

261. The implementation of this NAS is seen as a medium-term process which will progressively ascertain action needs and develop and implement adaptation measures in conjunction with the relevant stakeholders.

262. Article 9 of the CCMA sets a deadline of 2030 for the period of duration of the National Climate Change Adaptation Strategy. It is obvious that the effects of climate change will come gradually, many of them expected to speed up after the expiry date of this strategy. The period until 2030 will therefore be used to timely and properly prepare the country for what is likely to come mostly after 2030.

263. Various deadlines for adaptation action are set in the action plan that comes with this strategy. The plan recognizes the need of sequencing actions, where some of them precede the possibility to (effectively) carry out other actions. Therefore, all actions are indicated as short, medium, or long term. Further explanation on this is provided in Chapter 5 of this strategy.

264. A mechanism for reporting on implementation of adaptation actions envisaged in the sectoral action plans is proposed in Chapter 6 to be coordinated by the MoEW. Biannual reporting will be performed in accordance with the Regulation on the Governance of the Energy Union, as recently approved in a co-decision procedure by the European Parliament and the Council. Two official reports – in 2025 and 2031 are envisaged, subject to adoption by the Coordination Council on Climate Change. One initial report will be developed in 2021 to assess the implementation of short-term measures of highest priority as identified in Chapter 5.3. A mid-term update of the strategy will be initiated as a check on the direction that has been taken, together with a review of the actions that are being implemented and a revision of the adaptation action plan as appropriate.

3.3. Guiding Principles in Strategy Implementation

265. To achieve an adequate level of adaptation to climate change, the Bulgarian Government will apply a number of leading and overarching guiding principles in the implementation of this adaptation strategy. These principles are straightforward and will provide clear direction and benefits to the country. They are inspired by and highly coincide with those included in the EC's 'Guidelines on developing adaptation strategies'.[19]

266. The EU Climate Change Adaptation Strategy rightfully sets out that "adjustments in natural and human systems in response to actual or expected climate change impacts, which moderate, harm, or exploit beneficial opportunities," are at the roots of climate change adaptation (Adger et al. 2007). It further shows that "adaptation affects all levels of decision making, all regions as well as most sectors, so that it needs to be structured as a cross-sectoral,

[19] Commission Staff working document (SWD 2013) 134 final of 16 April 2013

multilevel, and inter-regional activity bringing together actors with different knowledge, interests, and values" (Grothmann 2011; Lebel, Grothmann, and Siebenhüner 2010).

267. Principles (based on Adger and Vincent 2005; Brown et al. 2011; Prutsch et al. 2010; UKCIP 2005) that have internationally been recognized as key factors for good adaptation and that the Government of Bulgaria (GoB) herewith makes her own, are the following:

(a) Any adaptation action undertaken should be **sustainable.** Responses to adaptation should not go against climate change mitigation efforts and should not block the carrying out of adaptation elsewhere. Article 7 of the Paris Agreement states that the goal of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, has a view to contribute to sustainable development. Thus, there is a clear linkage between climate change adaptation and Sustainable Development Goals (as outlined in Section 4.3).

(b) Carry out adaptation in **partnership.** All stakeholders like from public institutions, civil society, and private sector, at all levels, should be identified and engaged. It should be ensured that they are well-informed and encouraged to work on adaptation.

(c) **Evidence-based** adaptation is the preferred approach. Latest research, data, and practical experience should be applied in support of robust decision making. Closing of data gaps is a priority.

(d) Apply a **balanced approach**. Social, natural, and economic development are influenced by a variety of stresses, of which climate change is one aspect. Thus, adaptation must take a holistic approach managing both, climate and non-climate risks.

(e) Address risks associated with past and current **climate variability** and **weather extremes.** This forms the starting point for anticipatory action addressing longer-term climate change related risks and opportunities. Coordination and **close synergies with DRM** should be secured.

(f) Adaptive action should be **prioritized**. Giving more attention to most affected sectors, to situations with long-term lifetimes or implications, to significant investment needs or high value stakes, or in case of critical national infrastructure, are examples.

(g) Adaptation must be **tailored** to the scale required by the climate change challenge. Solutions need to be adjusted to individual situations, also addressing responsibilities and financing.

(h) Adaptation should be **flexible**. A level of uncertainty over future climate will always remain. Adaptation options should be considered in certain fields (for example, horizontal and soft options with relatively low costs, and/or vertical options in sectors with long-term planning horizons). This creates decisions that can be adjusted easily.

(i) Adaptation needs to be **transparent.** The effects of various adaptation options, both in the near and long term, should be communicated in full, providing as much detail as possible which, among others, include the level of risk to be accepted, as well as to agree on solutions that are fair and balanced.

(j) Continuously review the **effectiveness, efficiency, equity, and legitimacy** of adaptation decisions. This will allow for their gradual improvement in line with the evolution of evidence and knowledge on climate change impacts.

Chapter 4. Strategic Objectives

268. This section summarizes strategic objectives that have been developed by this project for adaptation to climate change in Bulgaria. These include both general strategic objectives and for each sector. It then outlines the types of adaptation options available for addressing these strategic objectives for each sector. Cross-cutting issues, tradeoffs, and synergies between sectors in relation to climate change adaptation are then addressed. Finally, the financial resources available for funding adaptation options to support the strategic objectives for each sector are summarized.

269. The strategic objectives outlined in this chapter are the foundation for the further development of operational objectives and proposed activities in the Action Plan as presented in Chapter 5 and ***Annex 3***.

4.1. Strategic Objectives

4.1.1. General strategic objectives

270. Based on the conclusions and guiding principles given in Chapter 3 and following general guidance documents (including EC 2013b), a number of general strategic objectives for this climate change adaptation strategy have been developed. This has also considered the main common themes for adaptation options arising from the sector assessment reports. These general strategic objectives should be seen as common objectives guiding the overall cohesion and coordination of the Strategy and Action Plan. The proposed general strategic objectives are as follows:

- **Mainstream and integrate climate change adaptation.** This includes strengthening the policy and legal framework for adaptation and the integration of adaptation considerations into existing national and sectoral plans and programs.
- **Build institutional capacity for climate change adaptation.** This includes building expertise, training, the knowledge base, monitoring and research to enable and support adaptation actions.
- **Raise awareness on climate change adaptation.** This includes enhancing education and public awareness about climate change adaptation issues and the need for adaptation actions to be implemented in Bulgaria to build public acceptance and participation of adaptation-related policies and actions.
- **Build climate change resilience.** This includes strengthening infrastructure and asset management and the protection of natural capital and covers water system infrastructure, energy supply infrastructure, and protecting and enhancing ecosystem services including those provided by forest resources).

4.1.2. Strategic objectives for sectors

271. The following strategic objectives for each sector are derived from specific sectoral context and adaptation needs as addressed in the sector assessment reports and have been developed in consultation with the expert authors. They also link to the general strategic objectives given earlier. Operational objectives and adaptation options related to each of these strategic objectives are outlined in more detail in Section 5.1 and ***Annex 3***.

Agriculture

- Sustainably manage agricultural practices for adaptation to climate change
- Promote adaptive capacity and awareness in agricultural sector
- Promote research and innovation for climate change adaptation
- Strengthen policy and legal framework for adaptation in the agricultural sector

Biodiversity and ecosystem services

- Enhance ecosystem governance
- Enhance knowledge management and stakeholder communication for adaptation
- Create space for BD&ES services
- Increase climate change resilience by reducing pressures not related to climate change
- Sustainable use of regulating and cultural ecosystem services for adaptation

Energy

- Build institutional capacity, knowledge, and use of data for adaptation
- Mainstream climate change considerations into energy sector policies, plans, and financial mechanisms
- Incorporate climate resilience into design and engineering
- Increase resilience of energy supply

Forestry

- Enhance knowledge base and awareness for climate change adaptation
- Enhance and protect the forest resources
- Improve potential for sustainable use of forest resource

Human health

- Enhance governance for adaptation
- Build knowledge base and awareness for adaptation
- Adapt external environment to reduce health impacts of climate change

Tourism

- Mainstream climate change adaptation into policy development and legal framework for tourism sector
- Enhance awareness and knowledge base for climate change adaptation in tourist sector
- Build adaptive capacity in tourism sector
- Develop specific adaptation actions for the tourism sector

Transport

- Build institutional capacity and knowledge base of the transport sector
- Mainstream climate change adaptation considerations into key planning and decision-making processes

Urban environment

- Strengthen policy and legal framework to mainstream adaptation to climate change
- Build adaptive capacity
- Develop financial, social, and risk management policies for adaptation to climate change
- Enhance knowledge management, research, education, and stakeholder communication for adaptation

Water

- Enhance adaptive governance
- Strengthen knowledge base and awareness for adaptation
- Enhance adaptive management of water system infrastructure

272. To ensure effective and efficient progress for all the above general and sectoral strategic objectives and the associated adaptation action plans, strong coordination is required between relevant ministries and agencies across all sectors. This is particularly required to promote mainstreaming and integration of climate change adaptation considerations into existing national and sectoral plans and programs.

273. It is proposed that the MoEW is best placed to perform a coordinating and facilitating role for the Climate Change Adaptation Strategy and Action Plan. This would require working in partnership with other ministries and responsible agencies for implementing CCA actions. A reporting and coordination mechanism is proposed in Chapter 6, to be further operationalized by the MoEW with the support of the National Expert Council on Climate Change or respective working groups, as needed.

4.2. Adaptation Options

274. This section briefly outlines adaptation options available for each sector. It should be noted that the term adaptation options in this context means a range of actions that may be undertaken in combination rather than mutually exclusive alternatives. The categorization of adaptation options (for example, according to mainstreaming CCA into the policy and legal framework, building institutional capacity, developing the knowledge base, awareness raising, and so on) is consistent with guidelines on developing adaptation strategies and options (for example, EC 2013b; UKCIP 2007) and links to the strategic objectives for each sector given in Section 4.1.

275. For each sector, a range of adaptation options have been identified in the Sector Assessment Reports. The options can be identified for 'horizontal' (covering the whole sector) and 'vertical' (addressing specific subsectors) levels and further grouped according to the type of option. It should be noted that horizontal options can support vertical options by enabling specific subsector actions. Types of options together with examples of specific options for each type are given in the following sector summaries. Note that further in-depth explanation of the rationale for the adaptation options given and lists of the full range of specific options identified for each sector are given in the Sector Assessment Reports. The selection of activities in the Action Plan, explained in Section 5.3 and given in full in the Action Plan (***Annex 3***), is based

on expert assessment of the full range of adaptation options given in the Sector Assessment Reports.

276. It is noted that climate adaptation actions can include both (a) ex ante actions that reduce the potential impact of future climate change or extreme events, and (b) actions that support ex post risk recovery after the climate impact has been observed (for example, insurance and emergency response DRM actions). The identified adaptation options include both these two types of actions, although most options identified and prioritized focus on ex ante risk reduction, which in general is lower cost than disaster recovery.

4.2.1. Agriculture

277. Adaptation actions need to be undertaken at both the national and farm levels, with the engagement of regional/local administration and communities. The responsibility of developing sectoral climate change policies and drafting guidelines and other regulatory documents should be undertaken by the MAFF in collaboration with all other relevant ministries, government organizations, and main stakeholders. At the same time, the policy should be consistent with EU and international policies and commitments. Local authorities, business companies, and society as a whole, should also have a role to play. For example, some adaptation actions (such as introducing innovations in the farms, growing new plants adaptive to climate change) would require the direct participation of agricultural holders and farmers

278. Adaptation options have been identified and grouped into horizontal and vertical levels (also see the Sector Assessment Report – ***Appendix 1***). Vertical adaptation options are grouped into agricultural productivity (crops); livestock production; and natural resources (soil erosion and desertification, water shortage and irrigation, fisheries and aquaculture). Horizontal adaptation options are grouped into building adaptive capacity; improving awareness; strengthening research, technology development, and innovation; risk management; and legal framework. ***Table 2*** summaries these with examples.

Table 2. Summary of agricultural adaptation options

Strategic Objective	Type of Option	Examples
Vertical Options		
Sustainable management of agricultural practices for adaptation to climate change	Agricultural productivity (crops)	Adjust timing of farm operations; grow thermophilic crops; and develop suitable irrigation systems.
	Livestock production	Develop systems and mechanisms for storing water on farms; diversify livestock farming; and save existing pastures for grazing.
	Natural resources management (soil, water, fisheries, and aquaculture)	Increase the use of perennial crops; improve water management practices; and maintain and improve existing aquaculture habitats.

Strategic Objective	Type of Option	Examples
Horizontal Options		
Promote adaptive capacity and awareness in agricultural sector	Building adaptive capacity	Develop climate change training; and develop knowledge dissemination actions.
	Improving awareness	Engage in wider dissemination of CCA knowledge to reach local farmers; and establish a formal platform for aquaculture.
Promote research and innovation for climate change adaptation	Research, technology development, and innovation	Develop research on new crop varieties; and develop farm-level resource management innovations.
Strengthen policy and legal framework for adaptation in the agricultural sector	Risk management	Develop insurance and risk management programs
	Legal framework	Update and amend the legislation affecting fisheries and aquaculture

4.2.2. Biodiversity and ecosystem services

279. The approach to identifying adaptation options uses an ecosystems-based approach to CCA. The grouping of adaptation options is based on the target groups and types of measures. The first two groups are mainly related to the national-level coordination and national and local action. The last three groups are options for operationalizing ecosystems-based adaptation at the local level and summarize the key themes identified during informal consultations with stakeholders.

280. It is noted that legal and methodological gaps for BD&ES outlined in the Sector Assessment Report (see ***Appendix 2***) contribute to a higher level of uncertainty than other sectors. To reduce this uncertainty and the related societal risks, it is important to implement adaptation options from all five groups of action outlined in ***Table 3*** to take into account their mutual links.

Table 3. Summary of biodiversity and ecosystems services adaptation options

Strategic Objective	Type of Option	Examples
Enhance ecosystem governance	Strategic planning and implementation legislation	Develop and adopt the new Biodiversity Strategy and Action Plan and a new Green Infrastructure Strategy with regard to CCA
	Adjusting sectoral legislation to climate legislation	Revise the CCMA and sectoral strategies/ legislation to include provisions of CCA Strategy
	Linking emissions statistics to new environmental accounts	Create carbon environmental accounts
	Education for ecosystem thinking	Create specialized education courses for administrations responsible for implementing CCA and biodiversity legislation

Strategic Objective	Type of Option	Examples
Enhance knowledge management and stakeholder communication for adaptation	Open and reuse data	Ecosystem data interoperability between authorities and other actors
	Communication and understanding of ecosystem processes and climate change as pressure	Communication and tools for informed prioritization of research and practical action
	Use of local biodiversity knowledge	Targeted collection of folk customs and traditional knowledge
	Use of citizen science	Promote ecosystem thinking among volunteers
Create space for BD&ES	Reclaim space from grey infrastructure	Regional/local 'red lines' to prevent loss of ecosystem services vital for CCA
	Create refugia, reduce fragmentation	
Increase climate change resilience by reducing pressures not related to climate change	Reduce pollution and disturbance	Estimate carrying capacity for vital ecosystems and production capacity for their services
	Reduce overexploitation	
Sustainable use of regulating and cultural ecosystem services for adaptation	Optimal use of existing ecosystem services	Use genetic resources for resilience
	Ecosystem services for CCA as new opportunity for business and society	Ecosystem restoration—a long-term business opportunity

4.2.3. Energy

281. A set of adaptation options is proposed in the Sector Assessment Report (see ***Appendix 3***) that can help increase the climate resilience of Bulgaria's energy sector. The measures that are the focus of the report are those specifically addressing near- and long-term climate risks of high magnitude, as presented in Chapter 1. Given that the energy sector in Bulgaria is facing climate-related challenges, and as there are uncertainties over future climate change, these measures have been selected because they will help improve the resilience of the sector today, as well as in the future. These are summarized in ***Table 4***.

Table 4. Summary of energy sector adaptation options

Strategic Objective	Type of Option	Examples
Build institutional capacity, knowledge, and use of data for adaptation	Institutional capacity and knowledge networks	Provide training to the MEn, regulator, and wider energy sector decision makers/ operators on CCA
	Translate monitoring, forecasting, and weather data for the energy sector	Meetings with the NIMH to define needs for climate services and centralized agreement for provision of climate services

Strategic Objective	Type of Option	Examples
Mainstream climate change considerations into energy sector policies, plans, and financial mechanisms	Mainstream climate change considerations within energy sector policies and plans	Undertake an inventory of strategies, policies, plans, standards, and so on, to identify where climate resilience should be incorporated
	Financial mechanisms to build resilience	Review existing mechanisms for financial protection in other countries and evaluate potential for implementation
Incorporate climate resilience into design and engineering	Climate resilience in power plants and mines	Ensure climate resilience is integrated into water resources management affecting the operation of large hydro power plants
	Climate resilience in transmission and distribution (T&D) infrastructure	Develop maps showing climate risk zones for climatic parameters relevant to T&D infrastructure
Increase resilience of energy supply	Diversify supply to increase overall energy system resilience	Continue to develop regional electricity trading and interconnections
	Energy efficiency in buildings and industry systems	Advance efforts to motivate end users to implement energy saving measures

4.2.4. Forestry

282. The adaptation options included here (also see the Sector Assessment Report – ***Appendix 4***) will help safeguard the sector so that its many services will continue to be delivered for society. These include options to enhance knowledge base and awareness, enhance and protect the forest resources for climate change adaptation, and improve potential for sustainable use of forest resource. Many of the options are envisaged in the 'Strategic Plan for the Development of the Forestry Sector in the Republic of Bulgaria 2014–2023' and the further development of these adaptation options should be in coordination with the delivery of this plan. A summary of forestry adaptation option is given in ***Table 5***.

Table 5. Summary of forestry sector adaptation options

Strategic Objective	Type of Option	Examples
Enhance knowledge base and awareness for climate change adaptation	Research, education, and extension	Create a National Forestry Extension Service and a system for dissemination of results
	Research to support adaptation	Model potential performance of important tree species under different climate change scenarios and timescales
Enhance and protect the forest resources	Resilience in regenerating, expanding, and strengthening the forest resource	Enhance Bulgaria's forest nursery capacity and system for seed collection and storage

Strategic Objective	Type of Option	Examples
	Maintenance of biodiversity, genetic diversity, and forest resilience	Measures to limit potential of invasive species to enter forest ecosystems
	Management of forest resources	Build national system for rapid fire detection and response to this and other natural calamities
Improving potential for sustainable use of forest resource	Improving the potential for long-term use of higher-valued wood products	Review and expand current building standards to improve the position of wood as a material
	Improving potential for sustainable and more environmentally friendly use of wood biomass for production of energy	Establish a program to promote the installation of modern energy and heat production systems for households, businesses, and small communities

4.2.5. Human health

283. Planned adaptation to the health impacts of climate change comprises a broad range of public health interventions (also see Sector Assessment Report – ***Appendix 5***). Successful planned adaptation depends on an awareness of and information about the problem, on the existence of effective response strategies, and on the availability of the resources, information, and incentives to implement them. The main challenges in developing adaptation strategies for human health are to account for the diversity of health impairments, regional conditions, and adaptation actors, and for the large uncertainty about future changes in most climate-sensitive health risks. Adaptation options outlined in ***Table 6*** include those for enhancing governance, building the knowledge base and awareness, and adapting the external environment to reduce health impacts of climate change.

Table 6. Summary of human health adaptation options

Strategic Objective	Type of Option	Examples
Enhance governance for adaptation	Policy, legal, and institutional framework	Development of National Strategy and Action Plan on health and climate change
	Administrative, infrastructure, communication, financial, and technical capacity	Establishment of inter-disciplinary climate change and human health (CCHH) WG to provide communication, coordination, initiation, control, updating, and so on.
	Professional capacity	Thematic workshops, lectures, and training on the health effects from climate change for all professionals and stakeholders
Build knowledge base and awareness for adaptation	Public education and awareness on adaptation	Multimedia campaign on CCHH
	Monitoring, data collecting, and early warning	Build national monitoring and early warning system for CCHH

Strategic Objective	Type of Option	Examples
	Research and knowledge base	Assessing health vulnerability at the national and local level
Adapt external environment to reduce health impacts of climate change	Adapting built and natural environment to reduce health impact of climate change	Development of concept and guidelines for adjustment of public built environment to climate change.
	Socioeconomic capacity	Development register of groups vulnerable to climate change at the national and local level and special program for work with these groups

4.2.6. Tourism

284. Adaptation options proposed for tourism are based on the assessment of risk and vulnerability and the policy context as presented in the Sector Assessment Report (see ***Appendix 6***) and outlined in Chapters 1 and 2. These are summarized in ***Table 7*** and cover options for mainstreaming CCA into policy development and the legal framework related to the tourism sector, enhancing awareness and knowledge base for climate change adaptation in the sector, building adaptive capacity, and developing of specific adaptation actions for existing and new tourism.

Table 7. Summary of tourism sector adaptation options

Strategic Objective	Type of Option	Examples
Mainstream climate change adaptation into policy development and legal framework for tourism sector	Development of a Sectoral Climate Change Policy	Development of NAS and Action Plan for CCA in the tourism sector
	Comprehensive legal framework	Develop insurance and risk management programs
Enhance awareness and knowledge base for climate change adaptation in tourist sector	Awareness-raising measures on climate change and its impacts on the sector	Develop a national database (online portal) containing CCA specific information
	Strengthening the sector knowledge base	Develop research projects and programs for climate change impacts on tourism development
Build adaptive capacity in tourism sector	Regional and sub sectoral assessment of adaptive capacity	Conduct adaptive capacity assessments in nine tourist regions
	Capacity building	Develop climate change training
Development of specific adaptation actions for the tourism sector	Adapting existing tourism sectors	Develop and implement adaptation measures for summer and winter tourism
	Developing new tourism and management solutions	Develop new tourism types/products and/or destinations

4.2.7. Transport

285. There are several areas where adaptation options with relevance to transport infrastructure can be identified, as shown in ***Table 8*** (also see Sector Assessment Report – ***Appendix 7***). These include those related to building institutional capacity and the knowledge base regarding CCA to support the formulation and implementation of policies. They also focus on mainstream CCA considerations into the planning and decision-making processes. This includes through project preparation, operation and maintenance (including in relation to extreme weather-related events) and updating design norms to account of climate change.

Table 8. Summary of transport sector adaptation options

Strategic Objective	Type of Option	Examples
Build institutional capacity and knowledge base of the transport sector	Building institutional capacity	Training needs assessment and implementation of training programs
	Building knowledge base	Introduce and/or improve CCA relevant data collection practice and perform dedicated studies
Mainstream climate change adaptation considerations into key planning and decision-making processes	Reviewing and enhancing project preparation procedures	Development of guidelines for considering CCA issues in the project management cycle
	Reviewing and improving operation and maintenance	Develop and implement program for strengthening road network resilience to extreme weather events
	Reviewing and updating design norms	Update of guidelines for design of roads' culverts and bridges

4.2.8. Urban environment

286. The range of adaptation options for the urban environment sector (see Sector Assessment Report – ***Appendix 8***) reflects the scope and complexity of climate change impacts in this context. These are focused on strengthening the policy and legal framework to mainstream adaptation to climate change, building adaptive capacity, developing financial, social, and risk management policies, and enhancing knowledge management, research, education, and stakeholder communication (as shown in ***Table 9***). Identified adaptation options include those directly or indirectly targeted toward DRM. The interdependence of these adaptation options means that their effectiveness depends on their appropriate combination.

Table 9. Summary of urban environment adaptation options

Strategic Objective	Type of Option	Examples
Strengthen policy and legal framework to mainstream adaptation to climate change	Mainstream CCA in regional and urban development	Incorporate CCA into the new National Housing Strategy
	Revising and amending legislative documents to transpose CCA issues after a Regulatory Impact Assessment	Mainstream CCA requirements in all legislative documents related to regional and spatial/urban planning

Strategic Objective	Type of Option	Examples
	Technology/construction - implementing new Eurocodes and technical norms in planning, design, construction technologies, and building materials	Promote green, smart, and innovative cities, buildings and technologies planning, design, and certification
Build adaptive capacity	Developing sustainable institutions capable of providing CCA policy at all administrative levels	Organize horizontal coordination between MRDPW, MoEW, MEn, MAFF, MF, and MI
	Institutional, administrative, and expert capacity	Build emergency and DRM units' capacity, provide sufficient and modern equipment, and financial support
Develop financial, social and risk management policies for adaptation to climate-change	Financial, social, and insurance policies	Revise existing financial instruments and design new ones for CCA and DRM, including for energy efficiency and construction renovation of buildings
Enhance knowledge management, research, education and stakeholder communication for adaptation	Information—securing institutionally regulated exchange of information and data according to INSPIRE Directive obligations	Create common standards for the type, structure, scope, and format of metadata and data, harmonized with EU at the city level
	Research—provide common long-term vision and objectives in urban environment CCA research	Identify priority scientific topics, linked with the city, open and green spaces, buildings, infrastructure, construction materials and human health, and their risk resilience assessment
	Education— 'Train the trainers' on CCA	Establish joint multidisciplinary courses at different educational levels
	Partnership—work in partnership and communicate knowledge	Organize a social network for support of vulnerable groups

4.2.9. Water

287. The suggested adaptation options (also see Sector Assessment Report – ***Appendix 9***) are grouped according to three strategic objectives. These refer to enhancing adaptive governance, strengthening the knowledge base and awareness for adaptation, and enhancing adaptive management of water system infrastructure (including design, construction, and operation). Such options also link to water-related DRM in particular for floods and droughts. Types of adaptation options with examples are given in ***Table 10***.

Table 10. Summary of water sector adaptation options

Strategic Objective	Type of Option	Examples
Enhance adaptive governance	Adaptation of legal framework to make it instrumental for addressing climate change impacts	Clarify roles and responsibilities for CCA
Strengthen knowledge base and awareness for adaptation	Use of research and education institutions	Provide research support to RBDs through framework agreements
	Awareness, education, and training	CCA training of public administration and water operators
	Monitoring and flexibility	Extend and upgrade CCA related monitoring networks of precipitation, water resources, and water use
Enhance adaptive management of water system infrastructure	Adapting design and construction	Revise and update design and construction norms
	Adapting operations	Develop methodology and assess adaptive capacity of significant water infrastructure

4.3. Cost-benefit Analysis

288. Benefits for adaptation actions in the all sectors can be viewed temporally, as either offering short-term or long-term benefits. Actions that offer short-term benefits are those that improve resilience to extreme events or those that improve the enabling environment and governance framework to facilitate more effective adaptation in the future (for example mainstreaming climate change within sector policies and plans and building institutional capacity and knowledge networks). Actions offering longer-term benefits are linked to sectoral assets, which frequently have long life spans, and include amendments to existing or planned assets to ensure climate resilience (for instance, water and energy infrastructure).

289. Benefits can also be viewed in terms of the wider socioeconomic or environmental benefits they offer. For example, developing better and improved early warning systems would contribute to businesses being able to respond in an efficient manner to unfavourable climatic events, thus reducing the losses from extreme weather events.

290. A CBA has been undertaken for each sector (explained in more detail in the Sector Appendices, with methodological details and assumptions given in the Annexes of the Sector Appendices) and focus mainly on the assessment of soft adaptation measures. The benefits gained as a result of their implementation are best exemplified through the quantification of saved costs in main performance indicators (for example, in the case of agriculture: crop output, crop yield and livestock production). Considering the complex impact of the adaptation options on each sector, these were not separately quantified in the current CBAs. For each sector net present values (NPV) have been calculated to illustrate the monetary value of avoided losses as

a result of implementing adaptation measures, and cost effectiveness estimates (benefit/cost ratios) are given to illustrate the benefits achieved in relation to the required investments/costs[20].

291. An overview of the results for the NPVs and cost effectiveness for each sector is given in ***Table 11***. This shows the benefits of the adaptation measures included in the CBA in each sector under different climate scenarios until 2050. The overall conclusions from these results are that in almost all scenarios the NPV is positive, showing that investments in adaptation measures are economically efficient.

292. Sector conclusions are given in more detail in the Sector Appendices. However, ***Table 11*** illustrates that in all sectors the implementation of adaptation measures will have a positive impact on the sector and that in some sectors, such as forestry, investments in adaptation measures can have very high potential effects. This is illustrated by the high benefit/cost ratios which indicate that investments are relatively small compared with potential benefits.

[20] The NPV of an adaptation option is given by the present value of the estimated benefits and costs. If NPV is more than zero, this indicates that the investment is efficient and incremental benefits of adaptation exceed the incremental resource costs. If NPV is <0 or B/C is <1, then the adaptation measures add no net benefit to the Urban Environment sector. If NPV is >0 or B/C is >1, then it adds positive benefits. The positive value of NPV confirms that investments for adaptation are efficient. The benefit-cost ratio (B/C) is the ratio of the present value of benefits to the present value of costs. When the B/C ratio is more than one, the present value of the option's benefits is larger than the present value of its costs.

	Agriculture		Biodiversity & Ecosystems		Energy		Forestry		Human Health		Tourism		Transport		Urban Environment		Water	
Climate scenarios	NPV (€ mln.)	Cost-eff. (Benefit/ Cost ratio)	NPV (€ mln.)	Cost-eff. (Benefit/ Cost ratio)	NPV (€ mln.)	Cost-eff. (Benefit/ Cost ratio)	NPV (€ mln.)	Cost-eff. (Benefit/ Cost ratio)	NPV (€ mln.)	Cost-eff. (Benefit/ Cost ratio)	NPV (€ mln.)	Cost-eff. (Benefit/ Cost ratio)	NPV (€ mln.)	Cost-eff. (Benefit/ Cost ratio)	NPV (€ mln.)	Cost-eff. (Benefit/ Cost ratio)	NPV (€ mln.)	Cost-eff. (Benefit/ Cost ratio)
Realistic scenario +2°C	2	1.0	7,056	140.4	67	1.1	22,324	435.9	5	1.1	108	16.5	683	2.0	8,786	1.6	74	29.2
Optimistic scenario +2°C	26	1.3	8,946	177.8	115	1.1	38,177	744.7	9	1.2	135	20.3	735	2.1	13,285	1.9	86	33.9
Pessimistic scenario +2°C	-23	0.8	5,165	103.1	19	1.0	6,470	127.0	1	1.0	81	12.6	633	2.0	4,287	1.3	62	24.5
Realistic scenario +4°C	292	3.9	7,202	143.3	476	1.3	37,240	726.3	107	3.2	144	21.6	1,420	3.2	20,523	2.3	99	38.7
Optimistic scenario +4°C	386	4.9	9,247	183.7	548	1.4	53,093	1,035.1	119	3.4	179	26.7	1,502	3.3	29,741	2.9	115	44.9
Pessimistic scenario +4°C	198	3.0	5,158	102.9	403	1.3	21,387	417.7	96	2.9	109	16.6	1,344	3.0	11,304	1.7	83	32.5

Table 11. Benefits of adaptation measures in sectors under different climate scenarios until 2050 (in €, million)

4.4. Cross-Cutting Issues, Tradeoffs, and Synergies

293. This section briefly outlines the nature of cross-cutting issues, tradeoffs, and synergies in relation to CCA in Bulgaria. The focus here is on the interrelationships in the context of adaptation strategy and actions (interdependencies in the context of risks and vulnerabilities are addressed in Section 1.3 and ***Annex 2***.) More detailed assessment of specific cross-cutting issues, tradeoffs, and synergies can be found in the sector assessment reports.

294. Due to strong interdependencies between sectors, the process of adaptation cannot be undertaken in isolation and needs to be placed within the broader context of a country's sustainable development policies and strategies and consider impacts and adaptations across all sectors. In addition, further knowledge is needed on spillover effects of impacts and adaptation at the regional and global levels.

295. The wider linkage between climate change adaptation and Sustainable Development Goals (SDG) is emphasized (UNCCS 2017). Adaptation is linked in particular to SDG 13 which aims to 'take urgent action to combat climate change and its impacts' and has specific targets that include to (a) Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters; (b) Integrate climate change measures into national policies, strategies and planning; and (c) Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning. However, adaptation is also strongly interlinked with a number of other SDGs. For example, progress toward increased resilience to climate change is also likely to contribute to SDG 3 (Good Health and Well-Being for People), SDG 4 (Quality Education), SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation, and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 15 (Life on Land – related to sustainable use of biodiversity and ecosystem services).

296. As noted in Section 3.2.1, inter-institutional coordination is needed to address cross-sectoral climate change adaptation issues. This requires the development of coordination mechanisms for the ministries and other institutions, and municipalities, with responsibilities in relation to climate change adaptation. The MoEW is responsible for the facilitation of coordinative action with support from the National Expert Council on Climate Change.

297. A number of key emerging themes across the sector assessment reports are summarized in the following paragraphs with some sector examples given:

- **Sector interdependencies may be positive and negative** (as illustrated by the positive and negative interdependences tables for risks and vulnerabilities in ***Annex 2***). For example, an increase of 'green agriculture' may support cropland ecosystem resilience and raise crop yield but intensification of agriculture can come at the expense of biodiversity through pollution, land grabbing, and diversion of water for irrigation. In the case of tourism, adaptation activities in several sectors (forestry, urban environment, BD&ES services, human health, and agriculture) are identified as having the potential for positive synergies.
- **Adaptation measures in one sector may impact a number of other sectors**. Therefore, the analysis of tradeoffs and synergies should be considered in a holistic

manner. For example, creating green belts between croplands and roads (for BD&ES services) can have adaptation benefits for agriculture due to the potential for water filtration, microclimate regulation functions, and pollination benefits, as well as for protecting the transport infrastructure from the wind and snow.

- **Possible measures for a sector to adapt to climate change can lie outside the direct control of that sector.** This is particularly the case for the health sector for which key actions affecting human health are rooted in areas such as sanitation and water supply, education, agriculture, trade, tourism, transport, development, and housing. For example, a review of public health responses to extreme heat in Europe identified transport policies, building design, and urban land use as important elements of national and municipal heat waves and health action plans (WHO 2009). This highlights the need for cross-sectoral understanding of the adaptation measures that potentially impact human health.
- **Relationships between adaptation options also include intra-sectoral synergies and tradeoffs**, for example, within the biodiversity and ecosystem services sector there are tradeoffs typically between provisioning and regulating/cultural services.
- **Management of water resources.** Key inter-sector tradeoffs and synergies concern the effect of adaptation measures on the management of resources. Management of water resources is a major cross-cutting issue, affecting the energy sector, the water sector, agriculture, BD&ES, urban environment, and tourism. Adaptation measures and associated actions within the energy sector could have positive and negative consequences for stakeholders in other water using sectors. In particular, the energy sector's use of water for cooling processes will need to be made considering other users. Within the context of the Danube River Basin, the International Commission for the Protection of the Danube River provides a key forum for coordinated action and the Danube RBMP (2015) provides a framework for collaboration.
- **There are strong sector interdependencies with regard to infrastructure services.** All sectors depend on the efficient working of infrastructure for energy, transport, water, and information and communication technology networks. Thus, any climate-related impact affecting these infrastructures will have wide consequences for other sectors. Furthermore, there are interdependencies between infrastructures which can result in cascade failure, whereby the failure of one type of infrastructure leads to the failure of another. Adaptation actions to address such climate risks and vulnerabilities therefore bring benefits to all sectors. In the case of the urban environment sector, its efficient functioning depends on all these infrastructures and requires their appropriate combination and coordination in urban planning.
- **Cross-cutting macroeconomic and social issues.** In the selection and design of appropriate and effective adaptation policy responses it is important to understand the cross-cutting demographic, social, and economic issues and policies that also affect the risks and vulnerabilities to climate change. For example, a major cross-cutting issue with a strong effect on tourism is the aging population in all EU countries which impacts the type of tourist demand. Social policy interventions in low-income urban settings have the potential to reduce the harmful effects of climate extremes on health and

therefore, have a role in DRM. The macroeconomic analysis outlined in Section 1.4 demonstrates the costs of inaction and the potential benefit to the economy of adaptation actions across all sectors.

- **DRM** is a key cross-cutting issue. Adaptation options in all sector assessment reports include coverage of this issue and this highlights the requirement for a coordinated response. In the case of flooding, the Danube Flood Risk Management Plan (DFRMP) provides a useful framework for collaboration.

298. It is necessary also to understand and **promote synergies between adaptation and mitigation** to ensure more effective and efficient policies within and across sectors. Intra-sectorial synergies should be considered at various levels (local, regional and national). This is especially highlighted in the case of agriculture for which many adaptation options have positive impacts on mitigation of climate change. Other sectors for which adaptation actions will have key implications for mitigation (GHG emissions) include energy, urban environment, transport, tourism, and forestry.

299. Non-exhaustive examples are summarized in the following paragraphs for reference. These are identified in a 2017 *Report on Mitigation & Adaptation Synergies in the NDCs* of the Nordic Council of Ministers and considered sector-relevant in any country.

Agriculture

- Examples of measures that can contribute to both adaptation and mitigation include measures that reduce soil erosion and improve soil health, measures for conserving soil moisture, and improving and optimizing crop rotations by choices of species or varieties.
- Actions to sequester carbon in the soil contribute to restoring degraded land and mitigating climate change, but also help preserve ecosystems and water resources, which will bring adaptation benefits.
- Improving ecosystem health by incorporating practices such as organic farming and sustainable land management, which increase resilience while lowering emissions.
- In the area of livestock, there is a focus on enhancing adaptive capacity through both breeding and water management, while improving production practices that all can lead to reducing emissions from livestock, improved income of farmers, and greater food security.

Forestry

- Synergies within forestry mean carbon sequestration and prevention of soil degradation, increased biodiversity preservation, increased resource productivity, as well as forestry as an economic activity and potentially important source of income.
- Afforestation and reforestation programmes make it possible to preserve one of the world's most important GHG sinks but will also prevent soil erosion and therefore reduce the risk of floods and landslides.
- Agroforestry is an integrated system combining agriculture and forestry to create productive and sustainable land-use systems by growing trees and shrubs around or among pastures or fields. When correctly implemented, agroforestry systems bring

adaptation benefits, including protection against floods, increased water retention capacity, while simultaneously generating benefits from mitigation actions such as carbon storage and decrease in loss of soil organic matter.

Energy

- Identified synergies are related to renewable energy, mostly in terms of bioenergy, but also solar and water, in terms of income and energy security, as well as energy efficiency both in end-user, transmission, and conversion perspectives.
- Improved energy access and decreased energy poverty hold important mitigation and adaptation possibilities. Energy development and access to energy, especially bioenergy, can be seen as a mitigation action, but bring the added benefit of increasing people's adaptive capacity.
- Mitigation options in the energy sector are expected to have co-benefits, such as improved air quality from increased renewables and improved access to energy, for example from localized biogas production.
- Increased use of biogas systems has the added benefit of providing organic fertilizers, which will boost food production.

Urban environment / Transport

- Examples of potential synergies in urban policies include building urban micro grids and distributed renewables that provide local low-carbon solutions, thus increasing the resilience of the power system.
- Increasing urban green areas provides several synergies, such as reducing urban heat islands, storm water capacity, urban ecosystem services, improved air quality and recreation.
- Adopting effective waste management practices provides potential for biogas production and fertilizers, where the latter can increase agricultural yields, as well as reducing methane emissions in the atmosphere. Better waste management also results in improved resource efficiency with broad positive effects on material flows.
- Improved transportation systems that allow low-carbon, energy efficient, low-congestion and mass transport, creates mitigation possibilities while also improving mobility and access to jobs.

300. Bulgaria is already implementing its 3rd National Action Plan on Climate Change and the present Strategy is providing an additional tool to create synergies between adaptation and mitigation actions on national level. By identifying and integrating the relevant adaptation and mitigation aspects at all levels of respective sectoral planning, budgeting, program and project cycles, there is a tangible potential to scale up and mainstream more synergy into the climate policies, including streamlining into the available funding.

4.5. Financial Resources

301. The financing of CCA measures requires considerable mobilization of funds. In preparing the EU Strategy on Adaptation to Climate Change, the EC made certain cost estimates. According to these estimates, the cost of not adapting to climate change could reach

at least €100 billion a year by 2020, rising to €250 billion a year by 2050. Improved access to funding will be a key factor in strengthening resilience to climate change.

302. Given the magnitude of funding needs, both public and private resources will be required and will play a complementary role in effective adaptation. Public intervention will in particular support a policy environment that is conducive to effective private adaptation (for example, pricing on water use), provide climate-resilient public goods (for example, climate proof key infrastructure or early warning systems), and assist vulnerable groups that cannot adapt sufficiently themselves. The focus of this section is on public sources, that can be used to address funding gaps (for example, additional costs of adapting to emerging climate risks) or mitigate risks (for example, support contingency funds) with a view to mobilizing and leveraging a larger amount of private resources.

303. The main public sources for adaptation financing are EU funds (grants, subsidies) or national sources (State budget). In a context of fiscal tightening, EU financing appears as one of the most readily available sources to Bulgaria. This is in line with current discussions on strengthening the climate relevance of the EU budget. With respect to State budget, while additional or increased taxation could be considered in future, a portion of the revenues from the sale of EU Allowances could be oriented towards financing adaptation.

4.5.1. EU and international funding

304. In the current programming period from 2014 to 2020, the EC has allocated over 20 percent of EU structural funds budget to action on climate change, including adaptation measures.

305. The EU Cohesion Policy provides funding for EU Member States and regions to help them achieve the EU's strategic goals. The EC has stressed the potential for regions to use the funds to support the sustainable growth priority of the Europe 2020 Strategy, in particular, to contribute to a resource-efficient, low-carbon, and climate-resilient economy. The proposed regulations for the EU Cohesion Policy for 2014–2020 place greater emphasis on the challenge of climate change than in the past. Member States and regions can target funds specifically for the transition to a low-carbon economy (Thematic Objective 4) and for adaptation to climate change (Thematic Objective 5). The total amount of available funds for Bulgaria under Thematic Objective 5 exceeds €66.7 million.

306. Priority Axis 4 'Flood and Landslides Risk Prevention and Management' of OP 'Environment' is aimed at the implementation of Thematic Objective 5 of the General Regulation: 'Promoting climate change adaptation, risk prevention and management.' Priority Axis 4 is co-financed by the Cohesion Fund with a budget of €78.5 million. The measures provided under Priority Axis 4 aim to provide resistance to disasters, prevent risks to human health and the environment, and mitigate the consequences of floods.

307. In addition to providing funds for adaptation from structural funds, the EU budget provides support for adaptation programs and projects within the Horizon 2020 and LIFE programs. Horizon 2020 is the EU Framework Programme for Research and Innovation and aims to dedicate 35 percent of funds to climate-related research, including adaptation. The program addresses knowledge gaps such as those identified in the EU Adaptation Strategy,

including the development and testing of decision-making support tools, monitoring systems for adaptation, resilient infrastructures, and the integration of CCA in sectoral research. LIFE Climate Action is a new subprogram of the LIFE Program for the Environment and Climate Action 2014–2020 and among grants for project activities it includes CCA. Adaptation measures are also supported by several other EU funds and international financial institutions (IFIs). These include the European Investment Bank (EIB), the European Bank for Reconstruction and Development (EBRD), and the World Bank.

308. The EU budget remains an important source of funds for areas from low carbon development to clean infrastructure and sustainable regional development. In the **EU budget proposal for 2021–2027,**[21] **presented in June 2018, the European Commission suggests an increase in the proportion of climate-related spending from 20 to 25 percent**. In numbers it would mean spending on climate in the range of €16 billion per year. According to the proposal, increase in climate spending in areas such as research and innovation, economic development and agriculture is expected to be even more pronounced than it is in the current MFF. For the next long-term EU budget, the Commission proposes also to increase funding by 60% for LIFE, the EU program for the environment and climate action.

309. Although this increase accounts for only a portion of the €170 billion yearly gap needed to meet the EU's climate and energy targets, it will be a strong leverage for triggering climate investments. Moreover, it should be noted that on EU level a number of stakeholders are pushing for considerably higher expenditures on climate action. The European Parliament insists on climate spending increase to 30 percent, while the Greens in the Parliament want 50 percent to be devoted to climate. Thus, some upwards pressure on the climate earmark could be expected with the progress of negotiations.

310. It's also important to remember that a bigger envisaged number in the budget doesn't necessarily mean better climate spending. In its special report on progress towards integrating climate in the EU Budget (31/2016), the European Court of Auditors has assessed the current climate earmarking as insufficiently targeted and recommended better tracking methodologies to be introduced. Options for improvements in climate change financing are proposed in a recent report for DG CLIMA on mainstreaming of climate considerations into the EU financing ('Climate mainstreaming in the EU budget: Preparing for the next MFF'[22]). Here below the key proposals for improvement are outlined, to be considered by the Commission in preparation of the future MFF.

311. The recent DG CLIMA report evaluates the options for further improvements in mainstreaming and one of its main conclusions is that **climate change adaptation actions should be brought up in the focus of the next MFF** – in terms of programming of actions and respective financial resources, through broader use of blended financial mechanisms, to tracking progress on spending and implementation (see ***Box 1***). These and other aspects would be considered in preparing the Commission proposal for the next MFF. With this respect the **CCA strategies and action plans developed by the Member States (including Bulgaria)**

[21] https://ec.europa.eu/commission/news/long-term-eu-budget-2021-2027-2018-jun-01_en
[22] https://publications.europa.eu/en/publication-detail/-/publication/1df19257-aef9-11e7-837e-01aa75ed71a1

provide a good tool for negotiating future integration of climate change adaptation measures into the EU financing beyond 2020.

Box 1. Main recommendations to the new MFF with respect to climate financing

- Introduction of *sector investment guidelines and standards* for the post-2020 EU budget, which establish rules and identify those areas where EU funding should not be provided.
- Establishment of a set of key climate-relevant *ex ante conditionalities* for broader use within the post-2020 MFF. These conditionalities should be made relevant for the improved use of green public procurement as well.
- More extensive use of climate considerations in CBA for EU investment decisions should be *considered together with vulnerability and risk assessments*.

And in a longer term:

- The establishment of *minimum spending requirements on climate objectives* or earmarking of climate resources should be considered more extensively in the future MFF funding programmes on a case-by-case basis.
- Drawing a *closer link between EU climate allocations and EU and MS climate policies*. The report identifies three options to do this:
  - Creating a link to the National Energy and Climate Plans (NECPs) under the currently negotiated Regulation on the Governance of the Energy Union;
  - Establishing a *stronger link between allocations for mitigation actions and their contributions to the overall delivery* of EU and MS climate objectives (in the case of ESIF, these could be linked to the national GHG emission reduction targets);
  - Greater use of vulnerability and risk assessments and in particular *creating a closer link between National Adaptation Strategies and EU allocations* to adaptation objectives.
- Consider the **establishment of separate climate mitigation and adaptation mainstreaming targets** in order to ensure that attention is paid to both objectives. As a first step towards this long-term goal, the Commission could identify those EU funds which would benefit of having separate mitigation and adaptation targets (e.g. *if a fund is found to focus largely on mitigation actions and does not exploit its potential in adaptation separate targets could reduce these imbalances*).

For more details see the report '*Climate mainstreaming in the EU budget: Preparing for the next MFF', Directorate General Climate Action - DG CLIMA, October 2017.*

4.5.2. Funding sources by Sector

Role of State budget

312. The role of the national budget and the budgets of local communities is to co-finance the aforementioned European and international sources and to independently finance measures. Because CCA measures often overlap with climate change mitigation measures, sustainable energy and transport policy measures, and policy measures aimed at improving the quality of the environment, it is necessary to identify areas of commonality, which may facilitate the mobilization of funds. Non-exhaustive examples of synergies in mitigation and adaptation are given in Section 4.3.

313. Specific national and EU financial resources for sectors, as identified in Sector Assessment Reports, are summarized in the following paragraphs.

Agriculture

314. Over the past 10 years, the main sources of funding within the agriculture and rural development sector have been the CAP payments. Under the new CAP for 2014–2020, Bulgaria has been allocated significant inflows of EU funds for the farming sector and rural areas, totaling around €7.4 billion. The total planned public expenditure (European Network for Rural Development 2015) for the RDP 2014–2020 is nearly €3 billion, including EU and national co-financing. The total public expenditure for the Bulgarian Rural Network (Rural Development program 2014–2020) is € 2,062,130 (EU and national-co-financing). The Maritime and Fisheries Program 2014-2020 is a financial instrument for implementing the Common Fisheries Policy.

315. Several priorities and measures of the government policy program are funded by the state budget of the MAFF. The budget expenditures are allocated across various programs, plans, and policies. Budgetary allocation is linked to carrying out specific commitments, some of which are directly or indirectly related to climate change mitigation or adaptation.

316. State aid policy in the agriculture sector is aimed at solving specific problems for farmers by applying both compensatory and preventive measures, as well as measures to promote the competitiveness of the sector. The State Fund Agriculture provides financial support to agricultural producers under state aid programs. The state aid is intended to compensate damage caused by natural disasters, to prevent plant and animal diseases, to encourage farmers to insure their assets, and to support farmers' production, which is vulnerable to climate change impacts.

317. The RDP provides a framework to help encourage adaptation in the agricultural sector. Agri-environmental and climatic schemes have the potential to offer support for many adaptation options.

Biodiversity and ecosystem services

318. Bulgarian budget funding on environment (including biodiversity, ecosystems, and CCA) is limited. Actions where national and private funding is needed are identified in the Action Plan table in ***Annex 3***. Funding for both biodiversity and CCA is available from numerous other sources and Annex 6 of the Sector Assessment Report on Biodiversity and Ecosystems gives detailed information on these funding opportunities. These include OP-Environment 2014–2020, the European Economic Area Financial Mechanism 2014–2021, the Program for the Environment and Climate Action (LIFE), the Interregional Cooperation Programme (INTERREG), ESPON 2020, the Black Sea Basin ENI CBC Program 2014– 2020, and the Advisory Assistance Programme of the German Federal Government.

Energy

319. The 'Connecting Europe Facility' (CEF) finances the development, construction, and improvement of infrastructure projects in the transport, energy, and digital sectors as a part of the EU's Trans-European Networks policy. Climate change objectives and targets are effectively mainstreamed into the CEF instrument. CEF grants only support projects of common interest, which under the TEN-E Regulation go through rigorous assessment and selection procedures that include assessment of GHG emissions and vulnerability to climate change

impacts. There are real opportunities to use the CEF funding for further climate mainstreaming goals in such a way that it would also improve the robust delivery of the infrastructure projects.

320. The largest share of the funding under the Horizon 2020 Programme was spent on 'Secure, Clean, and Efficient Energy' in 2017. Adaptation measures are also supported by several other EU funds and IFIs. These include the EIB, EBRD, and World Bank. To date, these have largely focused on the implementation of energy efficiency measures and renewable energy in Bulgaria, for instance, the Energy Efficiency and Renewable Sources Fund, the Kozloduy International Decommissioning Support Fund, and the European Economic Area Financial Mechanism 2009–2014 (Programme BG04 'Energy Efficiency and Renewable Energy').

321. Other potential sources of funding for CCA measures are corporate financing from energy private and state energy companies, and loans from IFIs and commercial banks.

Forestry

322. Climate change mitigation and activities are supported by the budget and the RDP, OP-Environment, , OP-Administrative Capacity, and other operational programs for transboundary, transnational, and interregional cooperation for 2014–2020. Other potential sources are the European Fund Solidarity, Framework Program for Scientific Research and Innovations Horizon 2020, LIFE Programme for Environment and Climate Action, and INTERREG Europe. Donor countries' programs are also a source of financing different climate change/CCA activities and projects.

Human health

323. Bulgaria has a mixed public-private health care financing system. Health care is financed from compulsory health insurance contributions, taxes, out-of-pocket payments, voluntary health insurance premiums, corporate payments, donations, and external funding. Some policies which concern indirectly the adaptation of the human health sector to climate change are directly funded by the state budget (for example, Better Healthcare Concept and National Program for Prevention of Chronic Non-Communicable Diseases).

324. Since the mid-1990s, the Bulgarian health system has received substantial foreign assistance, including governmental loans, international projects, and grants from various governments, institutions, and organizations. Some of the priority axes of the financial mechanism of the European Economic Area provide a budget for development of projects with a favorable effect on human health and adaptation to extreme climate change events. Among several such projects are the FRMPs and RBMPs.

Tourism

325. It is concluded in the Tourism Sector Assessment Report that there are insufficient financial resources allocated to the MT in Bulgaria for funds to be allocated for research into climate change and its impact on tourism or for the development and implementation of adaptation measures. Therefore, financial resources for CCA in the tourism sector in Bulgaria can be found mainly from external sources—the EU-funded OPs and other related projects.

326. Several OPs in the period 2014–2020 could potentially finance climate change research and adaptation in the tourism sector. In the OP-Regions in Growth, the sixth priority axis is

'regional tourism' which focuses mainly on the unexplored potential of cultural tourism. It is suggested that the development of this type of tourism can help to adapt the highly seasonal and climate-sensitive nature of Bulgarian tourism, and therefore contribute to CCA. Another OP which could address the impacts of extreme weather events on tourism is the OP-Environment, Priority Axis 4 'Flood and Landslides Risk Prevention and Management'. In the OP text, an explicit connection with the EU Strategy on Adaptation to Climate Change is made. The OP-Rural Development may also offer funding opportunities. Although this program is mostly oriented toward agriculture and forestry, it can be used to develop new tourism products and destinations which may be less sensitive to climate changes, for example, wine and culinary tourism. In addition, opportunities for financing CCA research, development, and application can be found in the transborder cooperation programs 2014–2020 funded by the EU.

Transport

327. During recent decades, financing the development of the transport infrastructure has been mainly achieved by national co-financing for programs with funding from external sources. The main sources of funding have been EU co-financed programs and, to a lesser extent, loans from the IFIs.

328. Operational Programme Transport and Transport Infrastructure (OPTTI) 2014–2020 is a possible source of funding for CCA measures in the transport sector. The best option for this would be the 'smart mobility' axis of the program: Priority Axis 4 'Innovations in management and services – establishment of modern infrastructure for traffic management and transport safety improvement'. Eligible for funding would be activities such as the development of transport plans and strategies related to CCA, as well as the implementation of some CCA measures (for example, information systems, navigation, and emergency systems).

329. OP-Regions in Growth 2014–2020 contributes to CCA in a direct way with support for the development of public transport information systems. As with the OPTTI, consideration of CCA is made at all steps of the project preparation and implementation process. CCA is also explicitly discussed in the applications for funding of major projects. The implementation of CCA measures in the transport sector should be possible under OP-Regions in growth if the measures are included in the integrated plans for urban reconstruction and development, needed as a precondition to fund urban projects.

Urban environment

330. The main sources of funding for adaptation to climate change and for dealing with emerging disasters in the urban environment are the state budget, municipal budgets, and the EU's structural funds, and private funding from financial institutions. The financing of actions related to disasters is explained under DRM in this section.

331. A number of EU funding sources are identified in the sector assessment report for their relevance to urban environment. Among the ESIF, the European Regional Development Fund (ERDF) and the Cohesion Fund can finance activities related to reduced risk of landslides, floods, and droughts and capacity building for effective and efficient climate adaptation, prevention, and risk management.

332. The OP-Regions in Growth (2014–2020) directs funds for the renovation of cities under Priority Axis 1 - 'Sustainable and Integrated Urban Development' and allocates it to cities, approved for support by the National Concept for Spatial Development (NCSD). Priority Axis 1 stipulates financing of integrated urban transport projects, which should aim at improving urban mobility and reducing environmental pollution. In addition to the renovation of residential areas and buildings, important cultural assets and economic zones with potential and investment interest can be renovated.

333. The other priority axes related to regional educational, health, and social infrastructure, will also be implemented in settlements that need to update these important sites and buildings and adapt them to climate change. The energy efficiency of buildings is a horizontal priority for which 20 percent of the program's financial resources are allocated. Financial priority 1 is related to 'providing support for energy efficiency and the use of renewable energy in public infrastructures, including public buildings and the residential sector'. Other funding opportunities are offered by the LIFE and Horizon 2020 programs.

Water

334. The elaboration and implementation of CCA measures in the water sector is closely linked with the maintenance and management of the water infrastructure and resources. The sources of funding can be divided into the following main categories: the business sector, public financing, loans, and grants.

335. Financial resources of the business sector include the funds allocated for investment and maintenance carried out by the water operators, the National Electricity Company, the Irrigation Systems Company, Zeminvest, and private associations for irrigation, other companies (including operators of industrial wastewater treatment plants and those using circulating water supply and integrated water technologies), private operators of water bodies, and small hydroelectric power plants (HPP).

336. Public financing of the water sector consists of subsidies from the state budget for municipal water projects and municipal contributions, transfers for national public co-financing of EU projects, the state budget for public hydro-melioration services, government subsidies for flood protection activities, and the state budget for administrative staff (the MoEW, MRDPW, and other institutions).

337. The EMEPA is a state-owned enterprise which provides funding for the implementation of environmental projects and activities identified in the national and municipal strategies and programs. The EMEPA provides grants and interest-free or low interest loans for environmental projects of municipalities, individuals, and legal entities and subsidies to cover part or the total amount of interest due on bank loans for the implementation of environmental projects. Projects in the water sector have the largest share (varying between 80 and 90 percent) in the total amount of grants for investment projects.

338. The Fund for Local Authorities and Governments is structured as a revolving mechanism for financing the development and implementation of economically and financially viable municipal infrastructure projects and for supporting the administrative capacity of municipalities to absorb the structural and cohesion funds proceeds. A Financing Agreement is

to be signed between the Managing Authority of the Operational Program Environment 2014–2020 and the Fund Manager of Financial Instruments in Bulgaria on providing support through financial instruments in the field of water, with a budget of BGN 234 million.

339. Other potential sources identified for grants are the OP-Environment 2014–2020, the RDP 2014–2020, the Financial Mechanism of European Economic Area, and Norwegian financial mechanism, and the European territorial cooperation financed by the ERDF and the European Union Solidarity Fund (EUSF). The EUSF was set up to respond to major natural disasters and express European solidarity to disaster-stricken regions within Europe.

Disaster risk management

340. According to the Disaster Protection Act, the financial resources for the implementation of the National Programme for Disaster Protection 2014–2018 are being provided through the budgets of the respective ministries and government departments and through budgetary relations of the municipalities with the central budget, stipulated by the State Budget of the Republic of Bulgaria Act for the respective year.

341. Each ministry and local government authorities responsible for a specific activity under the program must have up-to-date estimates of the necessary costs for activities in the field of their commitments to program implementation. Each institution is expected to specify which policy and program-related activities will receive financial support.

342. The funds for the implementation of the program need to be budgeted by the respective budget spenders. They must be declared by ministries and agencies each year during the budgetary procedure for the year in question. Pursuant to Article 56 of the Disaster Protection Act, the Interdepartmental Commission for Restoration and Assistance to the Council of Ministers adopts a decision to provide funds from the reserve for contingencies and/or emergency expenditures in the part for prevention, containment, and overcoming of consequences of disasters and controls their target spending. The decision of the commission is approved by the CoM.

343. The Council of Ministers sets a limit - at least 15 percent of the funds under the contingency and/or urgent expenditures for prevention, containment, and overcoming of consequences of disasters - to finance: disaster risk reduction activities – preventive activities and preparedness response activities as complementary funding to the approved budget of the relevant competent authority and/or to funds from other sources. The financial, material and technical support for disaster protection is provided by the budgets of ministries and state bodies, municipal budgets, commercial companies and sole entrepreneurs - for their properties, the structural funds of the EU, and other sources.

Chapter 5. National Programme and Action Plan

344. The development of the Action Plan has used an iterative process to identify and select operational objectives and specify the actions to address these objectives, in support of the sector strategic objectives. This is founded in the process of developing the sector assessment reports for the nine key sectors and has been informed by the DRM and macroeconomic analysis reports. This process has involved a series of consultations with stakeholders, including relevant government agencies. On finalization of the Sector Assessment Reports, further development of draft operational objectives and priority activities for these objectives (with associated implementation details) took place in consultations between sector experts and the Adaptation Strategy and Action Plan report authors. This section outlines the key outcomes from the development of the Action Plan including operational objectives and priority options, as well as an explanation of proposed activities and expected results.

5.1. Operational Objectives

345. Operational objectives related to strategic objectives (as outlined in Section 4.1) are summarized in the following paragraphs for each sector. In consultations with sector experts it was concluded that, in many cases, the categorization of adaptation options given in the sector assessment reports links directly to operational objectives. Therefore, the operational objectives listed here are significantly based on this categorization of adaptation options for each sector, with some aggregation, disaggregation, and reordering to enhance the cohesion of the framework. These objectives also largely correspond with the 'types of options' columns of the sector adaptation options tables given in Section 4.2.

Table 12. Operational Objectives: Agriculture

Strategic Objective	Operational Objective
Sustainable management of agricultural practices for adaptation to climate change	Adapt agricultural productivity (crops)
	Adapt livestock production
	Adapt natural resources management (soil, water, fisheries, and aquaculture)
Promote adaptive capacity and awareness in agricultural sector	Build adaptive capacity
	Improve awareness
Promote research and innovation for climate change adaptation	Strengthen research, technology development, and innovation
Strengthen policy and legal framework for adaptation in the agricultural sector	Strengthen legal framework
	Strengthen risk management and other policy development

Table 13. Operational Objectives: Biodiversity and ecosystems services

Strategic Objective	Operational Objective
Enhance ecosystem governance	Align strategic planning and implementation legislation
	Adjust sectoral legislation to climate legislation
	Link emissions statistics to new environmental accounts
Enhance knowledge management and stakeholder communication for adaptation	Promote open and reuse of data
	Improve communication and understanding of ecosystem processes and climate change as pressure
	Restore, enhance, and use local biodiversity knowledge
	Maximize the use of citizen science
	Educate for ecosystem thinking
Create space for BD&ES	Reclaim space from grey infrastructure and create refugia, reduce fragmentation
Increase climate change resilience by reducing pressures not related to climate change	Reduce pollution, disturbance, and overexploitation.
Sustainable use of regulating and cultural ecosystem services for adaptation	Sustainable use of existing ecosystem services

Table 14. Operational Objectives: Energy

Strategic Objective	Operational Objective
Build institutional capacity, knowledge, and use of data for adaptation	Build institutional capacity and knowledge networks
	Translate monitoring, forecasting, and weather data for the energy sector
Mainstream climate change considerations into energy sector policies, plans, and financial mechanisms	Mainstream climate change considerations within energy sector policies and plans
	Develop financial mechanisms to build resilience
Incorporate climate resilience into design and engineering	Incorporate climate resilience in power plants and mines
	Incorporate climate resilience in T&D infrastructure
Increase resilience of energy supply	Diversify supply to increase overall energy system resilience
	Improve energy efficiency in buildings and industry systems

Table 15. Operational Objectives: Forestry

Strategic Objective	Operational Objective
Enhance knowledge base and awareness for climate change adaptation	Build capacity for research, education, and extension
	Develop research to support adaptation
Enhance and protect the forest resources	Build resilience in regenerating, expanding, and strengthening the forest resource
	Maintenance of biodiversity, genetic diversity, and forest resilience
	Enhance management of forest resources
Improving potential for sustainable use of forest resource	Improving the potential for long-term use of higher-valued wood products
	Improving potential for sustainable and more environmentally friendly use of wood biomass for production of energy

Table 16. Operational Objectives: Human Health

Strategic Objective	Operational Objective
Enhance governance for adaptation	Strengthen policy, legal, and institutional framework
	Develop administrative, infrastructure, financial, communication, and technical capacity
	Build professional capacity
Build knowledge base and awareness for adaptation	Develop public education and awareness on adaptation
	Develop monitoring, data collection, and early warning
	Develop research and knowledge base
Adapt external environment to reduce health impacts of climate change	Adapt built and natural environment to reduce health impact of climate change
	Develop socioeconomic capacity

Table 17. Operational Objectives: Tourism

Strategic Objective	Operational Objective
Mainstream climate change adaptation into policy development and legal framework for tourism sector	Development of a sectoral climate change policy
	Provision of comprehensive legal framework, risk management, and incentives
Enhance awareness and knowledge base for climate change adaptation in tourist sector	Awareness-raising measures on climate change and its impacts on the sector
	Strengthening the sector knowledge base
Build adaptive capacity in Tourism Sector	Regional and sub-sectoral assessment of adaptive capacity
	Capacity building
Development of specific adaptation actions for the tourism sector	Adapt existing tourism sectors
	Develop new tourism and management solutions

Table 18. Operational Objectives: Transport

Strategic Objective	Operational Objective
Build institutional capacity and knowledge base of the transport sector	Building institutional capacity
	Building knowledge base
Mainstream climate change adaptation considerations into key planning and decision-making processes	Review and enhance project preparation procedures
	Review and improve operation and maintenance
	Review and update design norms

Table 19. Operational Objectives: Urban Environment

Strategic Objective	Operational Objective
Strengthen policy and legal framework to mainstream adaptation to climate change	Mainstream CCA in regional and urban development
	Revise and amend all types of legislative documents to transpose CCA issues after a Regulatory Impact Assessment
	Technology/construction - implement new Eurocodes and technical norms in planning, design, construction technologies, and building materials
Build adaptive capacity	Develop sustainable institutions capable of providing CCA policy at all administrative levels
	Develop and upscale institutional, administrative, and expert capacity
Develop financial, social and risk management policies for adaptation to climate change	Change financial, social, and insurance policies
Enhance knowledge management, research, education, and stakeholder communication for adaptation	Information—secure institutionally regulated exchange of information and data according to INSPIRE directive obligations
	Research—provide common long-term vision and objectives in urban environment CCA research through amendment of the National Scientific Research Development
	Education — 'Train the trainers' on CCA
	Partnership—work in partnership and communicate knowledge

Table 20. Operational Objectives: Water

Strategic Objective	Operational Objective
Enhance adaptive governance	Adaptation of legal framework to make it instrumental for addressing climate change impacts
Strengthen knowledge base and awareness for adaptation	Maximize the use of research and education institutions
	Enhance awareness, education, and training
	Enhance monitoring and flexibility
Enhance adaptive management of water system infrastructure	Adapt design and construction
	Adapt operation

5.2. Priority Options

346. In support of priority setting for the identified adaptation options (as outlined in Section 4.2), each sector undertook a prioritization exercise. This included organizing stakeholder meetings at which an MCA approach was used, following Climate-ADAPT guidance.[23] MCA is an approach, as well as a set of techniques, that aims at providing an overall ordering of options, ranging from the most preferred to the least preferred. It represents a way of looking at complex problems that are characterized by a mix of monetary and non-monetary objectives. MCA breaks down options into more manageable pieces by using a set of criteria. The two groups of criteria used for the analysis were those of 'Net Benefits', further broken down into economic, social, and environmental benefits, and 'Implementation Risks', further broken down into financial, social, institutional, technical, and technological risks. This approach allows data and judgements to focus on the separate pieces that are then reassembled to present a coherent overall picture. Further details of the criteria used are given in the Sector Assessment Reports (see ***Appendices 1 to 9***). This approach produced a tentative short list of priority actions for each sector. Some sectors (including BD&ES services, tourism, water) also provide additional assessment/ranking of priority options based on expert judgment and/or additional feedback from stakeholders.

347. The results of the prioritization assessments are given in the following paragraphs for each sector. These results served as an initial contribution to inform the development of the draft Action Plan. However, caveats are needed on the direct implementation of a limited selection of top-ranked options. The interlinked nature of CCA policy means that, to be effective, actions need to be implemented in coordination with associated actions to maximize benefits and according to a logical sequence.

348. Prioritization of adaptation options is also informed by the CBAs that have been undertaken for sectors, as summarized in the Sector Assessment Reports that come as appendices to this strategy. The general conclusion from the CBAs is that the overall effects of adaptation measures will be cost savings as a result of the decrease of potential damage caused by climate change, compared with the no action scenario (see Section 4.3). For some sectors the CBA identifies the most economically efficient adaptation actions and allows for their ranking. These rankings are given in the sector sub sections given below (after the MCA prioritization results), for each sector where they are available in the Sector Assessment Reports, illustrating the assessed adaptation measures for which benefits most exceeded costs.

349. It should be noted that an essential element of prioritization of adaptation actions is addressing uncertainty in climate planning. Therefore, among priorities identified there is a particular focus on building capacity and addressing knowledge gaps and in selection of 'no-regrets' actions (that is, measures for which benefits will still occur under differing climate change scenarios). The importance of measures addressing knowledge gaps and undertaking monitoring and reporting of progress on the Adaptation Strategy and Action Plan is that it will allow actions to be adapted to the latest knowledge on climate change scenarios and impacts.

[23] http://climate-adapt.eea.europa.eu/knowledge/tools/adaptation-support-tool/step-4/prioritise-and-select

5.2.1. Agriculture

350. The initial results indicate that the development of water management innovations and improvement of water management practices are top priorities, together with increased research development, training on climate change, and active engagement in the wider dissemination of CCA knowledge to local farmers. The development of insurance and risk management programs has also been identified as a top priority.

351. The main priority adaptation options that were tentatively identified for the agriculture sector are listed in the following paragraphs:

Horizontal adaptation options

- Develop climate change training
- Develop knowledge dissemination actions
- Develop insurance and risk management programs
- Develop water management innovations
- Improve the CCA legal framework

Vertical adaptation options

- Improve water management practices
- Adjust the timing of farm operations
- Improve the soil structure maintenance and increase the soil's organic matter reserves and soil cultivation technologies
- Eliminate secondary salinization conditions and conditions for anthropogenic soil acidification
- Maintain and improve existing aquaculture habitat

The CBA identifies and ranks the most economically efficient adaptation actions as follows:

- Developing a suitable irrigation system
- Adjusting time farming operations
- Diversifying livestock farming, improving soil structure
- Improving water management practices, and others

5.2.2. Biodiversity and ecosystem services

352. The prioritization recommendations for BD&ES services took account of the stakeholder MCA and further assessment by sector experts. These propose the following prioritization of options with (a) the highest priority. Note that options ranked of equal importance are listed as (i), (ii) and (iii).

(a) (i) Develop and adopt the new Biodiversity Strategy and Action Plan and a new Green Infrastructure Strategy with regard to ecosystem-based management, conservation, restoration and CCA

(ii) Review and amend legislation and secondary legislation in the environment sector and related sectors to reflect the new Biodiversity Strategy and Green Infrastructure Strategy

(b) Set up interdisciplinary teams and centers of excellence

(c) Operationalize ecosystem-based monitoring and strategic/environment impact assessment

(d) (i) Open data for public use

(ii) Establish communication and provide tools for informed prioritization of research and practical action

(iii) Enable volunteer sharing

(e) (i) Adjust regional and local adaptation strategies to the amended CCMA and the strategic documents and legislation on BD&ES services

(ii) Stimulate local development and equitable access to ecosystems services

(f) Link decision making, resources, and funding to efficient assessment of improved ecosystem conditions

(g) (i) Identify regional/local 'red lines' to prevent decrease or irreversible loss of ecosystem services vital for CCA

(ii) Develop regional/local programs to conserve and restore biodiversity to increase the delivery of ecosystems services

(h) (i) Carry out ecosystems restoration—a long-term business opportunity

(ii) Implement new training programs at all educational levels and in informal/non-formal education

(iii) Create carbon environmental accounts

(i) (i) Develop cultural ecosystems services for recreation and education

(ii) Use genetic resources for resilience

(j) Collection folk customs and traditional knowledge in a targeted manner

5.2.3. Energy

353. The five main priority adaptation options that were tentatively identified based on the stakeholder consultation using the MCA for the energy sector were as follows:

(a) Advance efforts to motivate end users of energy to implement energy-saving measures, especially in households

(b) Review costs and benefits of incorporating climate resilience into the design of new power plants

(c) The MoEW is to ensure that climate resilience is integrated into water resources management and associated decisions affecting the operation of large HPPs

(d) Undertake an inventory of strategies, policies, plans, standards, site selection, energy infrastructure design norms and other, to identify those where climate resilience should be incorporated

(e) When the new Energy Strategy is developed, ensure climate resilience is mainstreamed into it

354. The CBA identifies and ranks the most economically efficient adaptation actions as follows:

- Financial support for gasification of households
- Continued development of regional interconnections
- Soft adaptation measures
- Implementation of energy saving measures

5.2.4. Forestry

355. A prioritization exercise was conducted by combining the results of the MCA analysis with the national and international experience of the report authors. Actions were categorized in the descending order of priority from 1 to 3. The actions listed as the highest priority (1) were as follows:

(a) Establish a research and development coordination body

(b) Design and implement a research program

(c) Promote management strategies, which ensure high species and structural diversity and natural regeneration

(d) Execute the NFI

(e) Establish a national system for early warning and awareness at regional and local level

(f) Establish and maintain a national disturbance monitoring system

(g) Develop a wood specifiers guide and promote wood use

5.2.5. Human health

356. The five main priority adaptation options that were tentatively identified for the human health sector from the MCA exercise were as follows:

(a) Monitor and collect data; develop warning system about dangerous for health climate change phenomena

(b) Carry out public education and awareness outreach

(c) Work in partnership and cooperation: intra- and intersectoral (local, national, and international)

(d) Carry out research/raise knowledge-base

5.2.6. Tourism

357. Building on the stakeholders' MCA prioritization contributions, the experts responsible for the sector assessment report assessed the proposed adaption options for the tourism sector and, using their professional judgement, suggested the following prioritization of CCA options.

Vertical options

(a) Develop a NAS for CCA in the Tourism Sector

(b) Develop a system of monitoring indicators and indicators monitoring

(c) Raise and develop the tourism industry's adaptive capacity and awareness

(d) Develop four seasons' tourism across the country

(e) Develop and implement new market segmentation and new marketing strategies

Horizontal options

(a) Improve the CCA legal framework

(b) Develop and improve an M&E system

(c) Develop a national database (online portal) containing CCA-specific information

(d) Create cross-sectoral policy frameworks and improve coordination among responsible government and public institution

(e) Introduce subsidies, grants, and other financial programs

358. In summary, the adaptation options identified for the Bulgarian tourism sector mainly encompass soft and foundation measures for the development of future, more specific and more detailed adaptation options.

5.2.7. Transport

359. The main priority adaptation options that were tentatively identified for the transport sector based on the MCA were the following:

(a) Review the institutional settings

(b) Assign CCA responsibilities in the statute and internal procedures of the relevant stakeholders and train the staff

(c) Introduce and/or improve CCA relevant data collection practices

(d) Update the design norms (with specific focus on road and railway bridges and culverts) and continue the updating of these codes

(e) Develop a common guideline for all beneficiaries to take CCA into consideration and embed it in the project preparation process

360. The CBA identifies and ranks the most economically efficient adaptation actions as follows:

- Review and enhance project preparation procedures
- Review and improve operation and maintenance
- Review and update of design codes

5.2.8. Urban environment

361. The main priority adaptation options, tentatively identified for the urban environment sector, were as follows:

(a) **Policy** - Mainstream CCA into the policy of regional and urban development, including housing and construction; *Adaptation option* - incorporate CCA into the National Housing Strategy (2017–2030);

(b) **Legislation** - Revise and amend legislative documents to transpose CCA issues (after RIA when applicable and necessary); *Adaptation option* - mainstream CCA requirements in all related legislative documents, relevant to regional and spatial/urban planning and environmental protection (Spatial Planning Act, Regional Development Act, Regulations No. 4, 7, and, 8, Regulation for Spatial Development Documents for EIA and SEA);

(c) **Information** - Secure institutionally regulated exchange of information and data according to INSPIRE Directive obligations; *Adaptation option* - create common standards for the type, structure, scope, and format of metadata and data, harmonized with the EU at the city level;

(d) **Research** - Provide a common long-term vision and objectives in the urban environment CCA research through amendment of the National Scientific Research Development Strategy 2020; *Adaptation option* - identify priority scientific topics, linked with the city, open and green spaces, buildings, infrastructure, construction materials, and human health;

(e) **Education** - 'Train the trainers' for CCA; *Adaptation option* - organize appropriate education and training formats for all levels—from politicians to the general public

(f) **Finance** - Change financial, social, and insurance policy; *Adaptation option* - revise the existing financial instruments and design new ones for CCA and DRM, including for energy renovation.

362. The CBA identifies and ranks the most economically efficient adaptation actions as follows:

- Housing energy efficiency renovation
- Identify priority scientific topics
- Mainstream CCA into policies of regional and urban development
- Promote partnership, networking, and collaboration, and others

5.2.9. Water

363. The suggested top five adaptation options for the water sector were selected based on the prioritization session with stakeholders, additional feedback from stakeholders, and expert judgment. These were as follows:

(a) Adapt the legal framework to make it instrumental for addressing climate change impacts

(b) Establish dynamic publicly available GIS database supporting climate change decision making

(c) Maximize the use of research and education institutions

(d) Operate water infrastructure to increase resilience to climate change for all users and sectors

(e) Strengthen adaptation capacity: CCA awareness raising campaigns, education, and training

364. The CBA identifies and ranks the most economically efficient adaptation actions as follows:

- Secure funds for CCA research and implementation of CCA-related innovations
- Introduce economic incentives for behavioral change
- Include CCA measures in the infrastructure operational plans

5.3. Activities

365. A full list of proposed adaptation activities to be included in the Action Plan, for the period up to 2030, for all strategic objectives and operational objectives per sector is given in ***Annex 3***. For each adaptation activity this includes indicative details of the following:

- Budget amount (ranked as negligible/low, medium, and high for this draft). Cost rankings are based on the experts' experience and comparison with analogous projects. Where available the Action Plan tables include the tentative budget estimates for specific actions that were used in the CBAs for each sector (as reported in Sector Assessment reports). Both the cost rankings and the selected budget estimates should be seen as only indicative. Part of the process of the implementation of the action plan is to assess more accurately the funding requirements.
- Budget source (EU, State, private). The stated sources are indicative only. Part of the process of the Action Plan implementation is to identify and develop potential sources of funding.
- Priority (defined as short term (within 5 years), medium term (5 to 10 years), or long term (after 10 years). Those activities which have been assessed as the highest priority for implementation are shown in green highlight in the priority column.
- Duration (defined as short (<5 years), medium (5 to 10 years), or long (>10 years)
- Expected results. These are summarized per sector in the section below.
- Monitoring indicators (parameters are defined and, to the extent possible, targets are also given). These are indicative suggestions and, therefore, the most appropriate and practical indicators should be further developed during the process of implementing the Action Plan.
- Responsible institutions (lead and partners). The institutional responsibilities listed are tentative and to be further developed and agreed during the course of the implementation of the Action Plan.

366. It should also be noted that some of the proposed actions may be part of other programs and action plans but are also relevant for CCA. For example, several of the actions included in the Forestry Action Plan, such as under the strategic objective to build resilience in regenerating, expanding, and strengthening the forest resource, are part of existing ongoing forestry plans and activities.

367. A number of the proposed activities are addressing the same types of adaptation issues that exist in all sectors, in particular those relating to the general strategic objectives to build institutional capacity and raise awareness on climate change adaptation. Thus, it is necessary to understand synergies between adaptation actions across sectors (as discussed in Section 4.3) to ensure more effective and efficient policies. The inter-institutional coordinating and facilitating roles outlined in Chapter 6 should therefore include identifying where such synergies exist and promoting cross-sectoral cooperation on activities related to shared strategic objectives, where appropriate.

368. A set of short term highest priority activities for implementation in each sector are highlighted in green in the priority column of the Action Plan Table in ***Annex 3.*** Identification

of these highest priorities is based on an assessment by sector experts taking into account the prioritization exercise undertaken in the Sector Assessment Reports (outlined in Section 5.2). Note that these are activities which have been assessed as feasible (or preferable) to start in the short term and in many cases will enable and support following actions. Therefore, many of these actions across all sectors are soft measures (many assessed as no cost or low cost). supporting the strategic and operational objectives related to building institutional capacity (including though addressing knowledge gaps), mainstreaming and integrating CCA into existing national and sectoral plans and programs, and raising awareness and enhancing education. These will provide the foundation for medium- and longer-term practical actions for building climate change resilience including through the management of infrastructure and assets, and the protection and enhancement of natural capital. It is suggested that the identified highest priority activities should be a key focus of sector-specific working groups established to coordinate implementation of concrete adaptation actions.

369. A summary of proposed highest priority activities for each sector (based on those activities highlighted in green in ***Annex 3)*** is given below:

5.3.1. Agriculture

370. The range of highest priority actions identified for the agricultural sector cover all four strategic objectives: sustainable management of agricultural practices for CCA, promoting adaptive capacity and awareness, promoting research and innovation, and strengthening the policy and legal framework.

371. Specific high priorities include those to adapt agricultural productivity (developing suitable irrigation systems and climate-adapted crops) and livestock production (adapting farms and facilities), and to adapt natural resources management (ensuring protective cover for soil surface or plant residues, improve the soil structure maintenance and maintaining and improving existing aquaculture habitats). Other high priorities to support these actions include developing knowledge dissemination, establishing a formal platform for aquaculture and developing enhanced ecosystem observation systems.

372. High priorities for research and innovation to support CCA include developing new crop varieties and developing climate information systems and the early warning system. Priorities to strengthen the legal framework are identified as updating and amending the legislation affecting fisheries and aquaculture, and elaborating the National Strategy for Agricultural Development. Finally, the need to strengthen risk management should be addressed through prioritizing development of insurance and risk management programs.

373. All the above actions are assessed at low or medium cost except in the case of developing suitable irrigation systems and adapting livestock farms and facilities.

5.3.2. Biodiversity and ecosystem services

374. As noted in Section 4.2.2 the legal and methodological gaps for BD&ES contribute to a higher level of uncertainty regarding CCA than for other sectors and to reduce this uncertainty requires implementation of adaptation options addressing a range of strategic objectives. Therefore, proposed highest priority actions are included for strategic objectives for: enhancing ecosystem governance; enhancing knowledge management, education and stakeholder

communication; creating space for biodiversity and ecosystems; and increasing climate change resilience by reducing pressures not related to climate change. It is also noted that in this sector in particular, the role of education and science is a prerequisite for developing awareness, knowledge and information, adaptive behavior and policy design.

375. Key priority actions for enhancing ecosystem governance address aligning strategic planning and implementation legislation, and include developing and adopting the new Biodiversity Strategy and Action Plan and a new Green Infrastructure Strategy with regard to ecosystem-based management, conservation, restoration and CCA. This also includes reviewing and amending legislation in the environment and related sectors to reflect implementation of ecosystem-based adaptation in line with these new strategies.

376. Proposed high priorities to enhance knowledge management, education and communication for adaptation include: to operationalize ecosystem data interoperability between authorities and other actors, encouraging participative science: via multidisciplinary research contests, targeted collection of folk customs and traditional knowledge, enabling volunteer sharing and Implementing new training programs at all educational levels.

377. Priority actions for creating space for biodiversity and ecosystems are proposed as developing regional/local 'red lines' to prevent loss of ecosystem services vital for CCA as well as regional/local BD conservation and restoration programs to boost delivery of ecosystem services.

378. Finally, high priorities to increase climate change resilience by reducing pollution, disturbance and overexploitation are: the estimation of carrying capacity for vital ecosystems and production capacity for their services; and the use self-monitoring and EIA for tracking ES exploitation, disturbance and stocks.

379. The above priority actions have been assessed as low or medium costs, except for those related to creating space for biodiversity and ecosystems, and increasing climate change resilience, which are estimated as medium to high cost.

5.3.3. Energy

380. Highest priorities identified for the energy sector include nine actions across three strategic objectives. All of these actions are essential preliminary actions for the objectives of building capacity, mainstreaming CCA and enhancing climate resilience, and all have been assessed as low or no cost measures.

381. For the strategic objective to "build institutional capacity, knowledge and use of data for adaptation" priorities are seen as expanding the work of the National Expert Council to cover climate change adaptation, providing training to the MEn, regulator and wider energy sector decision makers/operators on climate change adaptation, and undertaking meetings with NIMH to define needs for climate services and centralized agreement for provision of climate services.

382. For the strategic objective to 'mainstream climate change considerations into energy sector policies, plans and financial mechanisms' priorities include undertaking an inventory of strategies, policies, plans, standards, energy infrastructure design codes etc. to identify where

climate resilience should be incorporated, as well as ensuring outcomes of the Sector Assessment report for Energy are built into the climate-energy plan and climate resilience is mainstreamed into the new Energy Strategy.

383. Under the strategic objective to 'incorporate climate resilience into design and engineering' priorities are given as ensuring that climate resilience is integrated into water resources management and associated decisions on operation of large HPPs, developing maps of climate risk zones (to inform decisions on T&D networks in relation to climate resilience) and continuing to monitor causes of interruptions to the T&D system.

5.3.4. Forestry

384. The eight identified short term highest priorities in the Forestry Sector focus on foundation actions for building capacity for research, education and extension, maintenance of biodiversity, genetic diversity and forest resilience, and enhancing management of forest resources. These priorities have been assessed as low or medium cost with EU funding supplementing national sources.

385. For the Strategic objective to 'enhance the knowledge base and awareness for climate change adaptation' highest priorities include establishing a research and development coordination body for climate change mitigation and adaptation, and initiating a research program to support climate change adaptation of forests. For the strategic objective to 'enhance and protect the forest resources' key proposed priorities are to promote management strategies that maximize species, genetic and structural diversity, build a national system for rapid fire detection and response, as well as a national system for long-term disturbance monitoring, and undertaking a National Forest Inventory.

5.3.5. Human health

386. The present lack of activity related to CCA by health sector institutions and absence of dedicated climate and health related structure involved in the adaptation policy making process (as noted in section 2.3.5) provides the basis for selection of the priority activities for this sector. The nine short term highest priority activities are, therefore, prerequisites for subsequent activities in the action plan and support the strategic objectives to 'enhance governance for adaptation' and to 'build the knowledge base and awareness for adaptation'. All have been assessed as low or medium cost.

387. The actions identified as highest priorities to enhance governance include development of a National Strategy and Action Plan 'Climate change and Human Health' and actualization of legislation, regulations, standards etc. To facilitate these priorities, it is proposed that it will be necessary to pre-explore requirements by undertaking a critical review of all such documents relevant to CCHH to make recommendations for actualization. Further, it is proposed that a critical review of climate change related infrastructure and technological equipment needs of the health sector should be undertaken to make recommendations for priority improvements. It is also proposed to establish an inter-disciplinary CCHH Working Group to provide vertical and horizontal communication and a special national CCHH fund. The actions identified as highest priorities to build the knowledge base and awareness for adaptation include launching a multimedia campaign on CCHH to develop public awareness, developing a national early

warning system for health effects of climate change and enhancing research knowledge on CCHH.

5.3.6. Tourism

388. The highest priorities for short term are identified as those that address the current limited involvement of the tourism sector in CCA activities. These are specific measures under the strategic objectives to enhance awareness and the knowledge base for climate change adaptation and to build adaptive capacity in the tourist sector, and focus on five soft measures that provide a foundation for the development of more specific and more detailed adaptation options.

389. For awareness raising on climate change specific high priorities are seen as wider dissemination of CCA knowledge to local tourism entrepreneurs and the development of tourism indicators sensitive to climate change, as well as climate change indicators relevant to the tourism sector. In terms of building adaptive capacity in the sector, highest priorities include the development of assessment tools for adaptive capacity and carrying out climate change - related training.

5.3.7. Transport

390. High priority actions in the transport sector refer to the need to lay the foundation for a more systematic approach to understanding and addressing CCA issues by stakeholders in the various subsectors. Six specific high priority actions have been identified related to the strategic objectives to build institutional capacity and the knowledge base of the transport sector and to mainstream climate change adaptation considerations into key planning and decision-making processes.

391. Priorities for institutional capacity building include assigning CCA responsibilities in the statute and internal procedures of the relevant stakeholders per transport subsectors (based on review and gap analysis), undertaking a training needs assessment and implementing training programs. For building the knowledge base a priority is to introduce and/or improve CCA relevant data collection practice and gradually build data base/s for dedicated studies. Most of the stakeholders collect statistical data about the impact of climate events due to their operational and financial obligations and responsibilities. Combining available information and linking it to the common meteorological data base, that is suggested to be established, will bring high benefits for the transport sector knowledge base at negligible costs.

392. Priorities for mainstreaming climate change adaptation are the development of guidelines for considering CCA issues in the project management cycle as well as a review and update of design codes. In particular, this refers to an update of guidelines for design of roads and railways culverts and bridges in order to improved resilience of newly built infrastructure.

5.3.8. Urban environment

393. The range of actions identified as high priority in the urban environment sector reflects the scope and complexity of climate change impacts in this context. These priority actions therefore address adaptation needs across number of fronts including foundation actions to support the strategic objectives to strengthen the policy and legal framework to mainstream

adaptation to climate change; build adaptive capacity; and enhance knowledge management, research, education and stakeholder communication for adaptation.

394. Mainstreaming CCA at the policy level in regional and urban development requires prioritizing organizing a discussion forum to agree on a common vision and develop common understanding on CCA policy and strategy; revising the Spatial Planning Act; and incorporating CCA into the new National Housing Strategy. A priority for adaptive capacity is identified as building the capacity of emergency and DRM units' capacity to allow for more appropriate reaction to crises. High priority actions also cover information (creating common standards for metadata and data, harmonized with EU at city level), research (identifying priority scientific topics for CCA of urban environment), education (organizing appropriate format education and training for all levels based on CCA educational needs assessment) and partnership (promoting partnership, networking, and collaboration among different groups).

5.3.9. Water

395. Highest priority options identified for the water sector include five prerequisite actions for supporting all three strategic objectives. To enhance adaptive governance the initial priority is to clarify roles and responsibilities for CCA to improve coordination among institutions. For strengthening the knowledge base and awareness for adaptation, the first priorities are to prepare and distribute CCA materials to raise public awareness, as well as to extend and upgrade CCA related monitoring networks of precipitation, water resources and water use and establish a dynamic, publicly available GIS database to improved decision making. To enhance adaptive management of water system infrastructure a key priority action is to revise and update design and construction norms.

5.4. Expected Results

396. General expected results are summarized in the following paragraphs for each sector. Note that ***Annex 3*** provides more detailed information on expected results for each proposed activity.

5.4.1. Agriculture

397. Adaptation actions in the agriculture sector can be viewed as either offering short-term or long-term benefits. Actions that offer short-term benefits are those that improve resilience to extreme events or those that improve the enabling environment and governance framework to facilitate more effective adaptation in the future. Actions offering longer-term benefits are linked to agricultural assets, which frequently have long life spans and include amendments to existing or planned assets to ensure climate resilience (for instance, improved water management and renovating the irrigation infrastructure, leading to efficient use of irrigation water and conservation of soil moisture).

398. Results can also be viewed in terms of the wider socioeconomic or environmental benefits that actions offer. For instance, developing better and improved early warning systems would contribute to farmers being able to foresee the costs for protecting agricultural products as well as to respond in an efficient manner to unfavorable climatic events, thus reducing the loss of crops and livestock due to droughts, floods, or other weather extreme events. Saving costs will help to stabilize the income and revenues for farmers.

5.4.2. Biodiversity and ecosystem services

399. The adaptation options identified in this strategy are seen as having cost-effective socioeconomic benefits. These are derived from the structural and functional links between the conservation and restoration of BD&ES services and the yield of ecosystem services that can be used for CCA. The feedback loop between anthropogenic pressures and benefits of the ecosystems services is key to adaptive management. Increases in pollution, fragmentation, extended changes in land use, and climate change decrease the provision of ecosystems' services and hence, also human well-being and economic development. In contrast, reduction of pressures, combined with ecosystem conservation or restoration, can support adaptation and provide for economic growth and social benefits accessible to the local communities at lower cost.

400. Key specific expected results in the short term are the adoption of the Biodiversity Strategy and Green Infrastructure Strategy, and provisions for implementation of ecosystem-based adaptation in line with these strategies included in relevant legislation. Other short term expected results include those related to activities for operationalizing ecosystem data interoperability between authorities and other actors, encouraging participative science, maximizing the use of citizen science and education for ecosystem thinking.

5.4.3. Energy

401. As is the case for other sectors, adaptation measures and actions in the energy sector that offer short-term benefits are those which improve resilience to extreme events and those that improve the enabling environment and governance framework to facilitate more effective adaptation (for example, mainstreaming climate change within sector policies and plans and building institutional capacity and knowledge networks). Actions with longer-term benefits are linked to energy assets, especially those of long duration and include upgrading of existing or planned assets to ensure climate resilience (for example, T&D infrastructure). In a broad sense, improved energy sector resilience has potentially significant short- to long-term benefits, and this underlines the existing need to respond to risks associated with climate change.

402. There are also potential associated socioeconomic or environmental benefits from energy sector CCA actions. For instance, the identified measures to improve energy efficiency in buildings has the potential to offer multiple co-benefits, namely climate change mitigation objectives, improved comfort for residents and workers, which if targeted at vulnerable groups (for example, rural and urban poor) could address social inequality. In addition, the action to review the use of water for cooling processes by TPPs and NPPs has the potential to offer environmental co-benefits through reduced abstraction of freshwater.

5.4.4. Forestry

403. Adaptation of Bulgarian forests to climate change and its potential consequences, reducing the overall vulnerability of the forestry sector, and increasing its economic viability and resilience is seen as crucial for the quality of life of the Bulgarian population. Successfully adapting the forest sector to climate change will have the added benefit of increasing its mitigation effect as more carbon will be sequestered from the atmosphere and the economic importance of the sector will grow.

404. A number of specific benefits from CCA actions are identified for the forestry sector. These include the benefits provided by applied research to support an informed response to climate change threats in forestry, the increase of forest resilience and capabilities to handle new conditions provided by the maintenance of biodiversity and genetic diversity, and the improvement in the long-term potential for sustainable use of wood biomass.

5.4.5. Human health

405. Health sector adaptation to climate change may have a wide range of favorable consequences. The overall benefits for a healthier and more economically active population will be facilitated by a number of contributing adaptation measures. These include creating awareness of CCHH issues, enhancing coordination and cooperation among different government agencies and NGOs concerned with CCA and human health, and strengthening health education and training on the impacts of climatic change on the environment and human health. These measures will all build capacity of health actors to address climate change-related health impacts.

5.4.6. Tourism

406. Overall long-term results of the proposed CCA measures for the tourist sector will be the economic benefits of exploiting the opportunities provided by a changing climate (such as developing new types of tourism and new destinations). The measures to build adaptive capacity will also increase resilience to climate change impacts in the sector. Adaptation practices should bring benefits to all tourism stakeholders both on the supply- and demand-side, as well as for the local communities and for the Bulgarian economy as a whole. The sector assessment report also identifies the potential for mitigation benefits from more sustainable resource use in the sector.

407. In the short term, key specific expected results are the development of a NAS and Action Plan for CCA in the tourism sector and better governance and coordination of adaptation actions; higher awareness, higher knowledge base and higher capacity; and the development of assessment tools for adaptive capacity and thus more adequate reaction to climate change in the sector. A further expected result from capacity building actions is better coordination, information, and communication between the responsible governmental and public institutions.

5.4.7. Transport

408. The results of the implementation of adaptation options, including the associated benefits, are difficult to evaluate with accuracy for the transport sector as they are expected to occur over a long period and depend on many external factors. However, the overall results from these activities are expected to be improved resilience to climate change for the transport infrastructure across all subsectors. This is contributed to by measures to build the institutional capacity and knowledge base of the transport sector, including through increasing CCA expertise availability across all key stakeholders, establishing and improving relevant data bases per transport sector, and improving knowledge as a basis for planning and implementing appropriate CCA measures. Mainstreaming climate change adaptation considerations into key planning and decision-making processes is also key to achieving resilience in transport infrastructure.

5.4.8. Urban environment

409. The benefits from the identified adaptation options include the expected synergistic and cumulative effect of their simultaneous or sequential implementation. Mainstreaming CCA into regional and urban development policies, including housing and construction, will increase the effectiveness of regional policies and will ensure land protection in spatial and urban planning and development.

410. Improving information provision, accelerating the implementation of the Access to Spatial Data Act, and exchanging information will facilitate the development of scientific research, will make the decision-making process for urban development and environmental protection more transparent and reliable, and will increase the capacity of scientific institutions and different experts.

411. The development of urban research will provide new arguments for protecting public interests and improve the living and recreation environment. Research on innovative building technologies, construction, and materials will help designers and builders to create intelligent buildings and facilities, which are better resistant to climate change and extreme events.

412. Institutional development, improved horizontal and vertical coordination, and integration, cooperation between national, regional, and local levels authorities will enhance the quality and effectiveness of their work, while linking sectoral policies with spatial planning. This will also contribute to the successful implementation of an integrated and more comprehensive approach to urban renewal and development.

5.4.9. Water

413. For adaptation options supporting the strategic objective to enhance adaptive governance, expected results are identified as improved coordination among institutions, effective and efficient implementation of RBMPs, and the adoption of more water-efficient and less water polluting technologies and practices.

414. Under the strategic objective to strengthen the knowledge base and awareness for adaptation, the key expected results are the availability of the latest research achievements and reliable water monitoring data, enhanced quality of plans and programs developed by RBDs, raised public awareness, and increased preparedness of stakeholders. Overall, the adaptation actions will contribute to improved decision making under uncertainty.

415. For the strategic objective to enhance adaptive management of water system infrastructure, the expected results are the adaptive design and construction of managed water systems, identification of significant water infrastructure which needs reinforcement, and adequately and safely operated water systems.

Chapter 6. The Way Forward

416. This chapter briefly outlines the way forward for the National Climate Change Adaptation Strategy and Action Plan. This includes establishing the process of monitoring and reporting of progress in the implementation of the measures set out in the Action Plan and the requirements of performance indicators. It also provides some concluding comments on next steps in the implementation of priority actions in the Strategy and Action Plan.

6.1. Monitoring and Reporting

417. Monitoring and Reporting under the National Climate Change Adaptation Strategy 2019-2030 (NAS) and its Action Plan should be a participatory process, which enables capacity building and understanding, as well as applying lessons learned from the activities' experience. It will be performed in accordance with the recently approved Regulation on the Governance of the Energy Union[24], which incorporates the respective provisions of the existing Climate Monitoring Mechanism Regulation[25] and harmonizes them with those of the Paris Climate Agreement.

418. The monitoring and reporting process shall serve several purposes, as follows:

- ✓ Facilitating timely identification and resolution of problems;
- ✓ Enhancing the performance of the planned activities;
- ✓ Providing the basis for technical and financial accountability;
- ✓ Building institutional and local capacity to implement and manage the planned actions successfully; and
- ✓ Promoting the identification and dissemination of lessons learned by participants themselves.

419. **Monitoring** involves the collection and analysis of data about implemented activities. The data should be easy to understand and will be incorporated in the reports. The monitoring should allow stakeholders to keep track of the activities, to determine whether the objectives are being achieved and to make whatever changes are necessary to improve the performance (an outline of the requirements of performance indicators is given in Section 6.2).

420. Pursuant to the Regulation on the Governance of the Energy Union, **reporting** on the national adaptation actions will be performed every 2 years, starting in 2021. Progress in implementation of measures envisaged in the Action Plan under the Strategy (***Annex 3***) will be assessed in one mid-term and one final official report, to be drafted and presented to the Council of Ministers respectively in 2025 and in 2031. Implementation of the short-term measures of highest priority, as identified in Chapter 5.3 of this Strategy and highlighted in green in the sectoral Action Plans, will be assessed in the initial report to be developed in 2021. The performance will be strengthened and further refined on the basis of experience gained from implemented activities.

[24] Final compromise text of the Regulation on the Governance of the Energy Union was approved by the European Parliament, Council and Commission in a trialogue on 20 June 2018, pending formal adoption by the co-legislators (the Parliament and the Council). Once formally adopted, the Regulation will be published in the EU Official Journal and will enter into force 20 days after its publication.
[25] Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change.

421. All reports will be submitted to the Coordination Council on Climate Change for approval. Based on the mid-term official report in 2025 the Coordination Council will assess the need for revision/update of the Strategy, and if needed will make appropriate recommendations for updating (along with specific deadlines).

***Method of reporting on the implementation of measures by sectors**:*

- The implementation of the measures by 2021/2023/2025/2027/2029/2031 is to be reported by the responsible institutions by sectors and by measures.
- By **10 January** 2021/2023/2025/2027/2029/2031 the MoEW is to send letters to the responsible institutions identified in the Action Plan requesting information on the progress of implementation of the measures within their competences.
- The responsible institutions provide the required information by **10 February** 2021/2023/2025/2027/2029/2031.
- By **1 March** 2021/2023/2025/2027/2029/2031 the MoEW is to prepare the respective report to the European Commission, on the basis of the information received, and to submit it to the Coordination Council where the respective report is to be approved or returned for revision.
- By **15 March** 2021/2023/2025/2027/2029/2031 the report is to be submitted to the European Commission according to the provisions of the Regulation on the Governance of the Energy Union.
- On the basis of the biannual reports to the European Commission the MoEW will prepare the mid-term and final official reports, respectively in 2025 and 2031.
- After adoption by the Coordination Council the official reports in 2025 and 2031 are to be submitted to the Council of Ministers by 30 June.
- In case the respective reports need to be amended and/or supplemented they are processed within 15 calendar days.
- The Coordination Council is to adopt the amendments/additions in writing, through official letters or email confirmation by the members of the Council.
- The report intended for submission to the Council of Ministers should contain the following information:
  - Brief information on the NAS;
  - Brief information about the procedure of reporting on the implementation of the measures envisaged in the Action Plan;
  - Brief assessment of the financial resources spent for implementation of the measures by sources;
  - Brief analysis of the implementation of the measures themselves – whether there are problematic sectors where measures were not implemented, or the performance is significantly below the expected level and the reasons for this, as well as whether there is overachievement of measures;
  - Assessment whether changes in the process of reporting or update of the measures by sectors are needed with respect to various reports to the European Commission, new EU requirements or expected new legislation;

  - Brief information on the implementation of measures with indirect effect, including in the field of education and science and of administrative measures.
- The reports are prepared in a table format predefined by the MoEW, which includes the following columns:
  - Description of the measure;
  - Responsible institution;
  - Utilized financial resources by sources of funding;
  - Indicator for implementation of the measure;
  - Target value in 2021/2025/2031;
  - Reported value in 2021/2025/2031;
  - Difference between target value and reported value for each year.

Main tasks of the Coordination Council on Climate Change (in the context of the NAS):

- Review of the reports under NAS within the relevant time limits and the approved format;
- In case of non-performance of the interim objectives – provide recommendations for further actions/measures to achieve the ultimate goals of the Strategy;
- Assessment of the need for revision/update of the NAS and preparation of relevant recommendations for updating (with specific deadlines);
- Provide opinions on various issues related to the national policy on climate change, including on draft legislation discussed at EU and national level, on elaborated national reports, plans, etc.
- Opinions on other issues/materials sent by the Secretariat or provided during meetings of the Coordination Council.

6.2. Performance Indicators

422. Monitoring and Evaluation (M&E) of the Action Plan requires deciding which information provides the best measure of progress and performance. Guidance on M&E is given in a number of sources including EC (2013b). Arrangements to monitor and evaluate progress can focus on processes and outcomes of implemented actions in meeting objectives and should also be able to capture unintended maladaptive consequences.

423. Identifying appropriate indicators should take account of the following:

- Existing indicators and datasets, which may already measure the required outcomes or can be adjusted for the purposes of the action plan. To the extent feasible, indicators from the Eurostat database[26] should be used, as well as from the information system for monitoring the government program and for implementation of the annual objectives of the administration of the CoM (Council for Administrative Reform 2010).

[26] http://ec.europa.eu/eurostat/portal/page/portal/eurostat/home

- Other influences on the indicator parameters, which may partly account for progress (or lack of progress) toward objectives. This includes autonomous adaptation which may occur alongside planned actions.
- The cost of collecting the information for the indicator which should not be more than the value of the information for M&E purposes.

424. Each of the activities listed in the Action Plan includes a proposed indicator or set of indicators for monitoring performance (see ***Annex 3***). To the extent possible, current and expected outcomes have been given. Further agreement and development of these indicators will be needed in consultation with implementing institutions.

6.3. Concluding Comments

425. The range of actions for each sector set out in this Action Plan provides a firm basis for implementation of the Climate Change Adaptation Strategy in the period up to 2030. The Action Plan should, however, be treated as an evolving document in that the range and detail of actions supporting each strategic objective will need to be fine-tuned and improved over time, as envisaged in the Monitoring and Reporting arrangements outlined above. A key role is to be played by the MoEW in leading and coordinating adaptation actions at the national level in cooperation with involved ministries and other institutions in line with this Strategy and Action Plan.

426. A number of high priority actions have been identified (as outlined in Section 5.3) that should be the focus of implementation in the short term, since they provide an essential foundation for enabling other subsequent medium and long-term actions. These priority actions focus, in particular, on soft measures to raise awareness and promote education on climate change adaptation and build adaptation capacity and knowledge. In general, these high priority short-term actions have been assessed as no cost or low cost.

427. Since mid- and long- term priorities are more investment intensive (for example, related to infrastructure improvement) this will allow time in the shorter term to assess and develop available and potential financial resources to support these actions. This should include exploring climate financing options in the post-2020 Multiannual Financial Framework. Pursuing such options, will also allow this Strategy and Action Plan to be a valuable tool in support of the mainstreaming of climate change into the EU budget for the programming period beyond 2020.

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Annex 1. Climate Change Scenarios in the Bulgarian Context

Global climate change has substantially increased the probability of various recent extreme weather and climate events in Europe. Improved climate projections provide further evidence that the frequency of such events will intensify, with significant impact on ecosystems and societies. The impacts of climate change across regions in Europe are not uniform. Climate change impacts do not affect all people and territories equally due to different levels of exposure, existing vulnerabilities, and adaptive capacities to cope. Southeastern and southern Europe are projected to be hotspot regions, having the highest numbers of severely affected sectors and domains. The risk is greater for the segments of the society and businesses that are less prepared and more vulnerable. Bulgaria is situated in one of the regions that are particularly vulnerable to climate change (mainly through temperature increase) and to the increased frequency of climate change-related extreme events, such as flash floods and droughts.

Most scientific projections indicate that global temperature will rise between 1.8°C and 4°C by 2100. The temperature increase in Europe is expected to be even higher than the estimated global average. A recent multi-hazard climate risk assessment (Forzieri et al. 2016) supported by the FP7 ENHANCE project showcased that Europe could face a consistent increase in overall climate-related hazards (heat waves, cold waves, droughts, wildfires, river floods, coastal floods, and windstorms). The results were based on a set of regional climate model simulations under the SRES A1B scenario with a reference period (1981–2010) and three projected periods (2020s, 2050s, and 2080s). According to the assessment, by 2080, vast areas in Spain, United Kingdom, Netherlands, Italy, France, the Balkan countries, as well as Bulgaria and Romania will be subject to "increases in the probability of hazard occurrence of at least 20 percent for three or even four out of the seven hazards considered" (EEA 2017). These patterns confirm the critical role of southeastern and southern Europe as hotspots of climate change impacts and vulnerabilities.

Most climate models simulate an increase in air temperature in Bulgaria from 2°C to 5°C by the end of the century. The projected changes in temperature and precipitation, as well as potential related climate extremes in AR5 (IPCC 2013) show, that depending on the scenario, the average air temperature will increase by 2081–2100, compared to the norm from 1961 to 1990 by 2°C (RCP2.6) to 7°C (RCP8.5), or by 3°C (RCP4.5) to 4°C (RCP6). 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. In 2014, the Department of Meteorology of the NIMH conducted a research that projects an increase in annual air temperature in Bulgaria of 1.6°C–3.1°C by 2050 and of 2.9°C–4.1°C by 2080. According to the research, in general, the temperature increase is expected to be more significant during the summer season (from July to September).

In most climate change scenarios, rainfall during the winter months is likely to increase by the end of the century. However, significant decrease in rainfall during the summer months is expected to offset this increase. The projected changes in precipitation in AR5 (IPCC 2013) show fluctuations in annual rainfall averages within the range of 10 percent (RCP2.6, RCP4.5, RCP6) and 10 percent to 20 percent (RCP8.5). All climate models predict that after 2065 and

until the end of the century, rainfall in the summer will decrease by 10 percent to 20 percent, and according to RCP8.5, until 2081–2100 it can reach 30 percent to 40 percent. 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 overall annual river runoff is likely to decrease during this century.

Climate change scenarios for Bulgaria indicate an increased frequency of extreme events and disasters, such as droughts, heat waves, heavy rainfalls, and floods. The analysis of the expected extreme weather events, based on the use of temperature and precipitation indexes in AR5, shows that the number and intensity of dry and hot periods in the summer will increase in the country, droughts and floods will occur with greater frequency, and torrential rainfall and dangerous natural phenomena and processes associated with these changes will occur. The northeast, southeast, and Thrace regions will be the most affected by these events.

Annex 2. Sector Interrelationships in Relation to Climate Change Risks and Vulnerabilities

Table 2.1. Sector interrelationships: Negative impacts of climate change

	Potential Negative Impacts on Sector from Other Sectors								
	Agriculture	**Forestry**	**BD&ES**	**Water**	**Energy**	**Transport**	**Urban Environment**	**Human Health**	**Tourism**
Agriculture			Decline of useful insects; increase of invasive species; and disturbed ecological balance	Reduced water availability; floods; and competition for drinking water	Competition for water resources; higher electricity costs for water pumping; and higher risk of electricity grid failure	Accessibility of farm lands; and increased transport costs	Competition for water resources	Workers health and productivity may decrease	Competition for water resources
Forestry	Spread of invasive species from agriculture lands; and land-use conflicts		Use of short rotation forestry may decrease biodiversity; and trade-offs such as land-take may be harmful	Increased demand of water resources may lead to higher demand for water harvesting, thus draining certain forest ecosystems below water catchments	Use of wood as renewable energy source conflicts carbon sequestration functions of forests while providing market opportunities	Forest ecosystems' fragmentation and decrease due to development of transport infrastructure and easier spread of invasive species	Introduction of invasive species from urban territories	Forest workers' health and productivity may decrease due to increased summer temperatures; and high risk for forest workers health while coping with increased natural disturbances in forests	Increased pressure on forest ecosystems from development of tourist infrastructure at new localities due to decreased quality of older localities associated with climate change

	Potential Negative Impacts on Sector from Other Sectors								
	Agriculture	**Forestry**	**BD&ES**	**Water**	**Energy**	**Transport**	**Urban Environment**	**Human Health**	**Tourism**
BD&ES	Impacts from intensification of agriculture to meet food demands	Over-exploitation of provisioning services in forests may deplete other ecosystems (for example, rise in erosion, decreased water retention)		Decreased resilience of ecosystems by competition for water resources with irrigation infrastructure	Competition for water resources between hydropower and BD&ES services	Ecosystem fragmentation in transport corridors; and spread of IAS	Introduction of IAS through pets	Demand for water procedures may divert or pollute water resource in ecosystems	Overexploitation of ecosystem services in tourist/ recreation sites; destruction of habitats if carrying capacity is exceeded and/or insufficient EIA for building infrastructure and tourism facilities
Water	Water-intensive agricultural practices and increased temperatures may put stress on irrigation system	Deteriorated condition of forests due to storms and droughts affects water catchment and surface water quality	Pressures may be created by water scarcity and climatic changes which lead to increase of IAS resulting in improper functioning of water systems		Competition for water resources with other sectors	Damage to transport infrastructure from extreme weather events may hinder access to water infrastructure, especially in emergencies	Higher temperatures/ dry spells will lead to increased water consumption in urban areas	Less water and more concentrated pollutants might require new treatment methods for water purification and wastewater treatment	Increase in number of tourists may (a) increase water demand and (b) put stress on wastewater collection and treatment

	Potential Negative Impacts on Sector from Other Sectors								
	Agriculture	**Forestry**	**BD&ES**	**Water**	**Energy**	**Transport**	**Urban Environment**	**Human Health**	**Tourism**
Energy	Increased demand for pumped irrigation due to more frequent/ severe droughts and prolonged growing season will increase demand for energy and competition for water resources between sectors	Increased restrictions/ legislation to protect forests may affect location of energy assets	Increased restrictions/ legislation to protect natural environment may affect location of energy assets; and increased temperature with changes in precipitation may increase IAS damage to cooling systems of TPPs and NPPs	Increasing water scarcity will create tensions between different users (for example, agriculture, public supply, and ecosystems) and will affect availability of water for power generation		Lower levels of Danube River due to more frequent/ severe drought will affect river transport; and cold spells will freeze Danube River and suspend transportation	Increased demand for energy for cooling systems due to higher temperatures	Increased heat-related health and safety risks for maintenance workers	Prolonged summer season and higher summer temperatures will increase number of tourists and need for cooling systems in summer (higher energy demand)
Transport	Poorly maintained irrigation and drainage infrastructure could damage transport infrastructure	Forest damage (for example, erosion on slopes) may disrupt road and rail operation	Biodiversity protection requirements may increase transport project costs; and increased risk of IAS damage to transport infrastructure	Damage to transport infrastructure and disruption of services due to failures in hydro-melioration and hydropower; and failures in water supply and sewerage systems may	Disruption of power supply may impact transport services; and damaged energy infrastructure can cause damage to transport infrastructure		Disruption of public transport operation due to extreme weather events; and higher construction and maintenance costs of urban transport infrastructure	Increased heat-related health and safety risks for workers	Increased use of transport infrastructure may increase the maintenance costs

	Potential Negative Impacts on Sector from Other Sectors								
	Agriculture	**Forestry**	**BD&ES**	**Water**	**Energy**	**Transport**	**Urban Environment**	**Human Health**	**Tourism**
				damage transport infrastructure and disrupt services					
Urban Environment	Competition for water resources between irrigation and urban water supply; fire threat in urban areas near agricultural burning	Green corridors interruption by deforestation; water sources less protected; and fire threat to urban areas near forests	Varied impact on biodiversity in urban areas; and alien species and pest breeding; Destruction of habitats of urban species in case of improper EE renovation of buildings	Competition for water resources; water shortages and stress; poor quality drinking water; and flooding due to old sewerage infrastructure	Higher electricity supply cost in summer; and damages to supply network due to storms, icing	Effect on urban transport services in extreme weather		Pressure on health and social urban services; and more stress on urban population	Cultural and heritage site threatened by fire, floods, and so on
Human Health	Threats to food due to more extreme events (droughts, floods, high temperatures, and so on)	Air pollution from forest fires; and conditions for development of harmful species	Pollens; invasion of harmful phyto-species; and invasion of harmful zoo-species	Health impacts of: floods, insufficient water supply, water pollution from heavy rains, invasion of harmful water species	Health threats from sudden power outages due to extreme weather events	Deteriorated air quality due higher aggressiveness of to transport emissions under changed thermal and humidity conditions	Increased intensity of heat islands; higher aggressiveness of air pollution at higher temperature		Shorter winter touristic season; Health accidents during tourist activity under extreme weather conditions

	Potential Negative Impacts on Sector from Other Sectors								
	Agriculture	**Forestry**	**BD&ES**	**Water**	**Energy**	**Transport**	**Urban Environment**	**Human Health**	**Tourism**
Tourism	Food production	Negative climate effects on forest landscapes	Loss of regulating ecosystem services can lead to the loss of assets (for example, protection from erosion, avalanches)	Effects on water availability/ shortages	Supply needs for heating and cooling	Impacts on infrastructure and accessibility	Endangered cultural assets in cities	Biophysical thresholds (for example, higher temperatures; and fewer activity and sports tourism products	

Table 2.2. Sector interrelationships: Positive impacts of climate change

	Potential Positive Impacts on Sector from Other Sectors								
	Agriculture	**Forestry**	**BD&ES**	**Water**	**Energy**	**Transport**	**Urban Environment**	**Human Health**	**Tourism**
Agriculture		Shelterbelts reduce climate effects; and erosion control	Increased 'green agriculture' subsidized by EU funds may raise crop yield	Opportunities to develop new crop species requiring less water	Opportunities: Biomass as fuel; producing bio gas; and wind and solar farming	Road network improvement benefits agriculture—saving costs of transport	Opportunities for food reserves for disasters and urban agriculture	Increased demand for health food products	Development of new food types; and farm tourism
Forestry	Development of new forest shelterbelts increases forest territories and forest corridors		Building ecosystem resilience by creating migration corridors; fire detection and control; and assigning of permanent grassland	Increased importance of water-provisioning services of forests and hence, increased economic importance of forests will assist management practices, which enhance forest resilience	Opportunities to use low-value wood as renewable energy source; improved energy production facilities will generally reduce air pollution thus positively affecting forest ecosystems	Improved control of fire and other disturbing events due to better transport infrastructure; and increased funding to limit erosion and landslides close to transport infrastructure	Decrease of wood fuel use in urban environment will improve carbon sequestration functions and other ecosystem functions of forests	Increased interest in benefits for human health; forest ecosystem services, including recreation, lead to decreased pressure on forests as source, mainly of wood	Shift of demand from forests from wood source to recreation areas

	Potential Positive Impacts on Sector from Other Sectors								
	Agriculture	**Forestry**	**BD&ES**	**Water**	**Energy**	**Transport**	**Urban Environment**	**Human Health**	**Tourism**
BD&ES	Increase of 'green agriculture' subsidized by EU funds may support crop-land ecosystem resilience	Ecosystem-based forest management may enhance regulating ecosystem services		Green infrastructure for water retention; erosion and flood protection; and provides wildlife refugia	Increase of solar energy production may reduce air and water pollution	Wind protection belts on roads may decrease fragmentation and create migration routes	Green infrastructure will provide urban wildlife refugia	Development of urban/rural green infrastructure may support the decrease in pollution and heat-related conditions	Development of ecotourism may reduce impact on ecosystem
Water	Water-efficient agriculture saves water in catchment for water supply	Retention and filtration of water to underground water bodies by forest ecosystems can help mitigate water shortages	Water provision and water purification ecosystem services; and evapo-transpiration may mitigate droughts		Clean energy means clean water		Retention and filtration of water to underground water bodies by urban green infrastructure can help mitigate water shortages	Better human health may mean less medical contaminants in wastewater	Sustainable tourism—less pressure on water
Energy		Increased use of wood in construction will improve energy efficiency of housing stock	Increased biomass production due to climate change contributes to increased renewable fuel	Increase in river flow affecting the performance of hydropower (small and large)			Reduced demand for energy for heating due to warmer winter temperatures		

	Potential Positive Impacts on Sector from Other Sectors								
	Agriculture	**Forestry**	**BD&ES**	**Water**	**Energy**	**Transport**	**Urban Environment**	**Human Health**	**Tourism**
Transport	Demand for freight transport services	Protection of transport infrastructure from improved growth of tree species	Green infrastructure on transport routes can increase wind, landslide, and erosion protection; and more resilient ecosystems (improved water provision and reduced eutrophication) can benefit water transport		Freight transport demand for transporting energy resources		Incentives for sustainable urban transport modes, for example, cycling, walking.	Incentive for cleaner and sustainable transport	Demand for transport services; driver for alternative modes of transportation
Urban Environment	Alternative food production for urban population; urban agriculture development	Preservation of existing forests improves urban microclimate	Green infrastructure and preserved biodiversity improve quality of urban environment		Lower electricity supply costs in warmer winters; and more solar energy production for urban needs	Lower snow connected costs; and more mobility options in warmer seasons (pedestrian, bicycle)		Longer season for outside activities; and more options for cycling	More visitors and higher revenues for cities' tourism

	Potential Positive Impacts on Sector from Other Sectors								
	Agriculture	**Forestry**	**BD&ES**	**Water**	**Energy**	**Transport**	**Urban Environment**	**Human Health**	**Tourism**
Human Health	More and better agricultural production due to longer seasons and new species	New forests and longer vegetation period due to climate change	Improved natural environment due to increased biodiversity; and regulation of micro-climate in built environment	Longer period for watersports and outdoor recreation	Lower air pollution due to green energy due to more intensive solar radiation, increased frequency of strong winds, and better climatic conditions for some "energy" plants	More regular winter transportations due to the longer periods with dry and warmer weather	More use of green space due to longer warm season		Health benefits from new tourism opportunities, for example, longer summer season
Tourism	New food types produced and offered to tourists	New tourism products (berries, mushrooms); and forests as buffer zones (water storage, carbon sequestration)	Opportunities for new tourism products and destinations	Saving water reduces vulnerabilities, allow to cater greater number of tourists; and longer average stay	Longer average stay	Better access to (new) tourism destinations and attractions	More attractive under scenario of extreme weather events	New tourism products—Spatial Planning Act, wellness, wellbeing	

Annex 3. Climate Change Adaptation Action Plans – Per Sector

This annex presents the final draft Action Plan tables for each sector. These include information for each proposed activity on budgets, priority, duration, expected results, performance indicators, and institutional responsibilities. These proposed details for each activity are indicative and to be further consulted with stakeholders and further developed during the process of implementation of the Action Plan.

Key to abbreviations in the table:

- Priority is defined as follows: ST (within 5 years), MT (5 to 10 years), or LT (after 10 years). Those activities which have been assessed as the highest priority are shown in green highlight in the priority column.
- Duration is defined as follows: Short (<5 years), Medium (5 to 10 years), Long (>10 years).
- Each adaptation option is scored according to three cost categories (note that, where available, the tentative budget estimates used in the CBAs have been inserted instead of cost categories). These are defined as follows:
    - **Low (L)** (up to €1 million) – for measures that, for example, concern small investments related to smaller-scale research activities, governance framework, policy development, legislative activities, existing educational programs, capacity building, knowledge transfer, modification of routine operations, required new personnel, external experts, event organization running costs, and so on.
    - **Medium (M)** (€1–100 million) – for measures that require dedicated funding, either through identified line items in national/ministerial budgets or external funding. investments related to, for example, research projects and trial including information technology, new infrastructure, projects on monitoring and fast response systems, and so on.
    - **High (H)** (€100 million and more) – for major investments related to new infrastructure at a wider scale. Country-level investment programs and compensatory payments. Requiring external financial and technical support, including major retrofitting of existing assets and significant modifications to plans for new assets.

Action Plan – Agriculture Sector

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount in mln. Euro)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
1. Sustainable management of agricultural practices for adaptation to climate change	**1.1 Adapt agricultural productivity**	1.1.1 Develop suitable irrigation systems	347.81	National, private	ST	Short	Rehabilitation of irrigated infrastructure, expected benefits include reduction in soil wetting, reduction in soil evaporation losses; reduction in losses of crop production, improvement in the irrigation system for intensive crops; achievement of efficiency in irrigation	Total irrigated area % of Utilized Agricultural Area is 3.00; irrigated areas is 100,000 ha; average investment for irrigation per ha is €1,315	Increase total irrigated area in UAA by 2.5%; increase irrigated area by 50% (45,000 ha, investments €59,170,000); increase irrigated areas of intensive crops by 20%;	MAFF, Irrigation Systems EAD, MoEW	Farmers, stakeholders
		1.1.2 Adjust the timing of farm operations	59.51	Private	MT	Medium	Adjusted the timing of farm operations, (planting or sowing dates and treatments), in response to agrophenology; improved agricultural productivity; increased agriculture productivity	Crop production of agricultural holding is €31,800	Save 10% on labor cost per ha; increase investment for irrigation per ha by 3%	Farmers	MAFF, MoEW
		1.1.3 Grow thermophilic crops within the country	6.80	Private	MT	Medium	Growth of thermophilic crops, increase in thermal resources, and explore opportunities to grow more thermophilic crops within the country; improvement in agricultural productivity and conditions for sustainable agricultural production	Crop production of agricultural holding is €31,800; total variable cost €17,391,536; average farmer net income €9,300	Save 15% variable costs; increase farmer income by 2.5%	Farmers	MAFF
		1.1.4 Develop climate-adapted crops	L	Private	MT	Medium	Develop climate-adapted crops; improvement in productivity of crop; increase in the crop yield; increase in agriculture production	Crop production of agricultural holding is €31,800; total variable cost €17,391,536	5% decrease variable costs	Farmers	MAFF, Executive Agency for Plant Variety Testing, Field Inspection, and Seed Control
		1.1.5 Improve pest and disease control	L	National, private	ST	Short	Improvement of pest management, integrated pest management actions that prevent pest and disease, decrease the risk of spread of numerous weeds, diseases, and pests in agriculture, improve quality of agricultural products, increase crop yield per ha; improved animal health protection, decrease losses caused by infections and animal diseases	Investment of agricultural holding for control protection; investment in animal health prevention	10% savings in the investment for protection; save costs by 5% for animal protection;	MAFF, Bulgarian Food Safety Agency (BFSA), farmers	Stakeholders, branch associations
	1.2 Adapt livestock production	1.2.1 Adapt farms and facilities	128.26	Private	MT	Medium	Improved well-being status of animals; increase in the rate of return on investment for facilities	Value of investments for fixed assets €51,835,195; increase in the number of well-being animals; livestock production at €873 million; variable costs amount to €20,309,490	saved variable costs by 30%	MAFF, livestock farmers	Stakeholders (associations), BFSA
		1.2.2 Diversify livestock farming	M	National, private	MT	Medium	Diversified livestock farming and introduction of more heat-tolerant livestock breeds and adapting animals to weather conditions; increase in investment for diversified livestock	Livestock production €873 million	10% rate of return of investments;	Livestock farmers	MAFF, Executive Agency for Selection and Reproduction in Livestock Breeding, stakeholders
		1.2.3 Save existing pastures for grazing	M	EU, Private	ST	Short	Achieved well-managed pastures, improvement in current practices for grassland management and encourage restoration of degraded land, produce good livestock feed from pasture; make a benefit from pastures and from using rotational grazing, improved quality of animal products (milk and meat). Environmental benefits: Well-managed pastures have several environmental advantages: decrease soil erosion potential, require minimal pesticides and fertilizers, grazing can contribute to improve fertility of the animals. Reduced production costs, increased animal output per acre, land-use efficiency.	Animal output basic prices is €990.1 million	Animal output increase by 5%	Livestock farmers	MAFF, MoEW

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount in mln. Euro)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
	1.3 Adapt natural resources management (soil erosion, desertification; water shortage and irrigation; fisheries and aquaculture)	1.3.1 Increase the use of perennial crops	M	Private	ST	Short	Increase in fruit production and yield, improvement in the quality of fruits	Perennial crop yield per hectare (kg) - 7,400; area under cultivation - 17,596 ha	Increase perennial crop yield; increase areas under cultivation	Farmers	MAFF
		1.3.2 Ensure a protective cover for the soil surface or plant residues	L	Private			Achievement of sustainable soil management and increased agricultural yields; protection of arable areas from soil erosion; introduction of agricultural and management practices against crop composition of an agricultural area	Crop production is €2.532.47 million; increase crop production by 15%	Increase farm income	Farmers	MAFF, MoEW, 'Nikola Pushkarov' Institute of Soil Science and Agroecology
		1.3.3 Improve the soil structure maintenance	M	Private	MT	Medium	Improvement in soil structure maintenance and restoration and increase the soil's infiltration capacity; introduction of agricultural and management practices against crop composition	Crop production is €2,532.47 million	Increase crop production	Farmers	MAFF, MoEW, 'Nikola Pushkarov' Institute of Soil Science and Agroecology
		1.3.4 Increase the soil's organic matter reserves	M	Private	MT	Medium	Improvement in soil structure; increase in soil organic matter, management practices including crop rotations, protection of soil organic reserves, which are the basis for productive organic farming and sustainable agricultural systems.	Total organic area (ha) 160,620	Total organic area (ha) 160,620	Farmers	MAFF, EEA, stakeholders
		1.3.5 Use soil cultivation machines and technologies	H	Private	ST	Short	Achievement of minimum pressure on the soil surface; improvement in soil capacity to retain water; increase in soil productivity	Crop production of agricultural holding is €31,800	Increase crop production of agricultural holding by 5%	Farmers	MAFF, EEA, stakeholders, 'Nikola Pushkarov' Institute of Soil Science and Agroecology
		1.3.6 Improve water management practices		National, Private	MT	Medium	Improvement in water management practices, implementation of management practices to ensure the effective use of water (reducing water losses) improving irrigation practices and efficiency, and recycling or storing water.	Average water save cost €360 per ha; current total average water cost €36,000,000	cost-savings for water per ha, 5% decrease the losses	Farmers	MAFF, Irrigation Systems EAD, MoEW
		1.3.7 Maintain and improve existing aquaculture habitats	M	EU, National, Private	MT	Medium	Maintenance and improvement of existing aquaculture habitats; achievement of sustainable cultivation of aquaculture; reduction in negative impact-of climate change on aquaculture; improvement of the efficient use of resources; and creation of new habitats in deep pools, lakes, and basins	The GVA of aquaculture is €2.5 million; total aquaculture production (feed material and fish and other aquatic organisms' consumption) amounted to 7,557.1 tons (2012)	2.5% increase the share of aquaculture in gross value; 5% increase the aquaculture production	Fish farmers	MAFF, NAFA, Agricultural Academy
2. Promote adaptive capacity and awareness in agricultural sector	**2.1 Build adaptive capacity**	2.1.1 Develop climate change training	2.58	National	ST	Short	Farmers will gain skills and information about climate change effect on agriculture; improvement in management skills	Investment for training €300,000	Forecasted number of trainees 3,500	MAFF, National Agricultural Advisory Service	Farmers, stakeholders, NRN
		2.1.2 Develop knowledge dissemination actions	L	National	ST	Short	Development of a national database (online portal) containing CCA-specific information, for raising public awareness and knowledge-sharing bringing people together for knowledge exchange		Create web platform	MAFF, MoEW	Stakeholders (sectoral associations), regional and local authorities
		2.1.3 For aquaculture, improve the knowledge of the administrative staff and stakeholders	L	National, EC	ST	Short	Enhancement in institutional adaptive capacity; improvement of the knowledge of the administrative staff and stakeholders in relation to vulnerabilities of inland water; delivery of training seminars, informed and competent civil servants and stakeholders		Number of participants in training seminars and workshops	Fisheries and aquacultural producers, stakeholders	MAFF; NAFA
		2.1.4 Development and improvement of a M&E system	0.25	National	ST	Short	Developed M&E system and M&E; created M&E indicators, developed M&E reports. Database could be used by different stakeholders, administrative staff for analysis and decision making and researchers		Number of indicators - 2 monitoring reports and 1 evaluation report , 2 guidelines - one for monitoring and other for assessment	MAFF; MoEW	Farmers, stakeholders, NAAS

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount in mln. Euro)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
	2.2 Improve awareness	2.2.1 Dissemination of CCA knowledge	L	National	ST	Short	Enhancement in dissemination of CCA knowledge to local farmers, including publication of articles, guidelines, researches, and studies; increase in the resilience of the agriculture sector to future climate uncertainty, as well as improvement of agricultural efficiency overall; development in communication plan such as delivery of information workshops, dissemination of newsletters, brochures, risk maps, delivery of training seminars for local farmers		Communication plan - 1; guidelines - 2, number of brochures - 400; number of information meetings with local farmers - 30; number of training seminars - 25	MAFF, NRN, NAAS	Farmers, stakeholders, NAAS, regional and local authorities
		2.2.2 Develop enhanced ecosystem observation systems	L	National			Creation of ecosystem observation systems, providing knowledge for trends and consequences of climate chang, mapping ecosystem degradation and resilience, and providing warning of environmental tipping points.		Publish studies and researches	MOEW	MAFF, NAFA
3. Promote research and innovation for climate change adaptation	**3.1 Strengthen research, technology development and innovation**	3.1.1 Develop research on new crop varieties	L	EU, National, Private	MT	Medium	Development of researches on new crop varieties, including hybrids, to increase the tolerance and suitability of plants to temperature, moisture, and other relevant climatic conditions; increase in number of research methods and technologies for new crop varieties and new adapted technologies; development of genetic and selective research projects to create new varieties with increased crop productivity and quality adapted to the market and climate change; decrease in the risk of losses agricultural production (crop and livestock)	Crop yield	Increase researches; increase number of research projects	MAFF, Agricultural Academy	Stakeholders (sectoral associations), NRN
		3.1.2 Develop farm-level resource management innovations	M	EU, private	MT	Medium	Introduction of innovation practice and technologies for efficient resource management; decrease in the risk of climate change	Average crop yield organic agricultural products; number of organic farms	Increase organic agricultural products; and increase number of organic farms.	MAFF,	Stakeholders, Agricultural Academy and universities (Trakia University and Agrarian University—Plovdiv)
		3.1.3 Conduct research development		EU, National, Private	MT	Medium	Conducting research development and development of additional sectoral studies to identify the nature of climate risks, vulnerabilities and opportunities associated with current climate and projected changes.	Number of researches with focus on climate change by Agricultural Academy - 70	Increase number of researches	MAFF, Agricultural Academy	Stakeholders, MAFF, Trakia University and Agrarian University—Plovdiv, NRN
		3.1.4 Improve the technologies for cultivation of fish and aquaculture and develop re-circulating systems for fish breeding	M	EU, private	MT	Medium	Improvement in technologies for cultivation of fish and aquaculture in inland water, developing artificial breeding of the fish, using selective breeding, and implementing genetic improvements for higher resistance; increase in production of organic aquaculture; and decrease in the risk of losses aquaculture production	Value of aquaculture production by weight is €22.8 million	Increase production of aquaculture	Agricultural Academy, fish and aquaculture producers	Aquaculture and fish producers, stakeholders, MAFF
		3.1.5 Develop climate information systems and the early warning system	0.35	National, Private	MT	Medium	Development of climate information system, development of early warning systems that provide daily weather predictions and seasonal forecasts; improved dissemination information for weather variability; public availability of stored data; and decrease in the risk for crop losses and yield.	Current crop output and crop yield, livestock output	Increase crop output and crop yield	MAFF, MoEW, farmers	Stakeholders, National Institute of Meteorology and Hydrology; regional and local authorities

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount in mln. Euro)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
		3.1.6 Carry out further research to better understand the interaction between climate change and fisheries and aquaculture	L	EU, private	MT	Medium	Development of researches for climate change impacts on fisheries and aquaculture; better-informed stakeholders and policy makers; decreased risk for cultivation of aquaculture and fishes in inland.	Value of aquaculture production is €22.8 million	Increase production of aquaculture; increase the research and studies	Agricultural Academy, science institutes, universities (Trakia University and Agrarian University—Plovdiv)	MAFF, stakeholders
4. Strengthen policy and legal framework for adaptation in the agricultural sector	**4.1 Strengthen legal framework**	4.1.1 Improve the legal framework	L	National	ST	Short	Improved legal framework: updating the legislation to include climate change impact policies and/or adaptation actions; introduction of better regulations to ensure better decision making		Number of updated acts	MAFF, MoEW	Stakeholders NRN
		4.1.2 Update and amend the legislation affecting inland fisheries and aquaculture	L	National			Improved legal framework: updating the legislation to include climate change impact policies and/or adaptation actions; introduction of better regulations to ensure better decision making		Number of updated acts	MAFF, MoEW, NAFA	Stakeholders
		4.1.3 Elaboration of National Strategy for Agricultural Development	L	National	ST	Short	Improved strategic planning in sector, ensured sustainable agriculture and rural development. Defined properly the path of the future reform process in agriculture. Defined strategic goals and priorities for adaptation to climate change		Adopted national strategy, increased agriculture local production, Efficiency of adaptation measures to CC, Improved the competitiveness of agriculture (crop and livestock). Sustainable use of nature resources. Gross value added of agriculture sector will increase	MAFF, MEW, branch associations	Stakeholders, regional and local authorities
	4.2 Strengthen risk management and other policy development	4.2.1 Develop insurance and risk management programs	M	National, Private	MT	Medium	Development of insurance and risk management program (management strategies with respect to climate loss of crop yields and subsidized crop insurance program); investments in insurance products to reduce the risks of climate-related income loss.	% of farmers using insurance (current 6%); current public investment is €4,500,000	Increase % of farmers using insurance by 20%; increase public investment for insurance by 10%	MAFF, MoEW, State Agricultural Fund	Stakeholders, Insurance companies

Action Plan – Biodiversity and Ecosystems Sector

								Performance Indicators*		Responsible Institutions**	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
1. Enhance ecosystem governance	**1.1 Align strategic planning and implementation legislation**	1.1.1 Develop and adopt the new Biodiversity Strategy and Action Plan and a new Green Infrastructure Strategy with regard to ecosystem-based management, conservation, restoration and CCA	L	Funding programs (that is, OP Environment) - if a suitable modification will be feasible. State budget	ST	Short (12.2021)	(1) Biodiversity strategy adopted; (2) Green infrastructure strategy adopted	No strategies being implemented. Biodiversity Strategy expired 10 years ago; Green Infrastructure Strategy has not been developed.	(1) Biodiversity Strategy developed and adopted; (2) Green Infrastructure Strategy developed and adopted	MoEW for BD strategy; MRDPW for GI strategy	MoEW, MAFF, MRDPW, MES, MTITC, MI, MEx, MEc, MC, ExEA, EFA, Executive Agency for Fisheries and Aquaculture (EAFA); BAS and its institutes related to BD&ES (IBER and FRI) as well as supporting institutes, Pushkarov Institute of Soil Science and Agroecology; support by expert councils; public consultations with national and regional authorities and their unions; employers', branch, and trade union organizations; academia; NGOs; and general public
		1.1.2 Review and amend legislation and secondary legislation in the environment sector and related sectors to reflect the new Biodiversity Strategy and Green Infrastructure Strategy	L	Funding programs (that is, OP Environment) - if a suitable modification will be feasible. State budget	ST	Short (12.2023)	Provisions for implementation of ecosystem-based adaptation in line with new Biodiversity and Green Infrastructure Strategies included in relevant legislation	Provisions only included in forestry law; missing in all other sectors	Provisions enacting ecosystem based CCA and the activities of the current strategy harmonized across sectors and included in all relevant laws and sub-legislation, in particular policies related to provisioning services—agriculture, forestry, fisheries, urban and territorial planning, water, air, soils, pollution management	MoEW for environment and biodiversity (incl. environmental assessments); MAFF for all provisioning services in agricultural, forestry, and fisheries legislation; MRDPW for territorial planning, including urban and green infrastructure	MoEW, MAFF, MRDPW, MES, MTITC, MI, MEx, MEc, MC, ExEA, EFA, EAFA; BAS and its institutes related to BD&ES (IBER, FRI) as well as supporting institutes; Pushkarov Institute of Soil Science and Agroecology; support by expert councils; public consultations with national and regional authorities and their unions; employers', branch and trade union organizations; academia; NGOs; and general public
		1.1.3 Link decision making, resource, and funding to efficient assessment of improved ecosystem condition	L	State budget	ST	Short (12.2020)	(1) Ecosystem mapping and assessment, monitoring, self-monitoring, EIA, and other available data is taken into account in all revised CCA strategies both at national and regional/local levels (2) All funding instruments for the program periods beyond 2020 to include clearly measurable, ecologically sound objectives and indicators for ecosystem conservation/ restoration, monitoring and management, and the requirement during the eligibility check that eligible projects are to contribute toward the ecosystem-based adaptation in the adaptation strategies at the national, regional, or local levels	Only provisions for management plans of protected areas, green infrastructure and eco-agriculture. No ecologically relevant indicators.	Reporting by relevant EU-level and national ecosystem-based indicators included in each funding program	Managing authorities / national partner authorities per program	CoM, managing authorities, including relevant stakeholders, BAS and its institutes related to BD&ES (IBER, FRI)

								Performance Indicators*		Responsible Institutions**	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
		1.1.4 Operationalize ecosystem-based monitoring and strategic/environment impact assessment	M	Post-2020 funding programs; State budget for co-financing and activities outside the funding programs	MT	Medium (12.2025)	(1) National System for Environmental Monitoring (NSEM) is internally integrated to use all ecosystem-related abiotic and biotic data and assessment data available at ExEA and other national data providers (2) Standards are developed within NSEM and published in terms of data and metadata requirements, collection methodologies, interoperability, monitoring indicators, and all other methodological aspects (3) NSEM architecture is compatible with EU-level Copernicus products relevant to climate change, biodiversity/ecosystems, and carbon accounts (4) NSEM architecture is extensible to import/harvest third party data and interfaces for such imports are published for reference	Monitoring of ecosystem elements rather than systems as a whole; Assessments and self-monitoring are not easily available and systematically used for gaining knowledge about ecosystems from the fieldwork and research performed to complete them; and No regulatory requirement for single format or interoperability between monitoring, self-monitoring, and assessment data	NSEM has the necessary internal links between single databases, operational standards and data processing and storage pipeline, and is interoperable with national data sources (institutional and private/voluntary) as well as EU-level data sources	ExEA	MoEW, MAFF, MRDPW, MES, MTITC, MI, NSI, EFA, EAFA, BAS and its institutes related to BD&ES (IBER, FRI) as well as supporting institutes, Pushkarov Institute of Soil Science and Agroecology, Copernicus national focal point
	1.2 Adjust sectoral legislation to climate legislation	1.2.1 Revisesectoral strategies/legislation to include the provisions of the CCA Strategy	L	State budget and post-2020 funding programs	MT	Short (12.2021)	All sector strategies related to ecosystem management (in particular those related to provisioning services) include ecosystem-based adaptation options and funding	Ecosystem-based management envisaged only in the forestry strategy; links to CCA are to be additionally elaborated	All sectoral CCA strategies clearly distinguish between mitigation and adaptation measures and aim at achieving synergies between them (that is, reforestation for carbon capture and the use of regulating, cultural, some measure of provisioning ecosystem services)	(1) MoEW (2) Lead authorities for drafting and adoption of the respective sectoral strategy	(1) MAFF, MRDPW, MES, MTITC, MI, MEx, MEc, MC, ExEA, EFA, EAFA, BAS and its institutes related to BD&ES (IBER, FRI) as well as supporting institutes, Pushkarov Institute of Soil Science and Agroecology, support by expert councils, public consultations (2) Partners and stakeholders relevant to the respective strategies
		1.2.2 Adjust regional and local adaptation strategies to the strategic documents and legislation on BD&ES	L	Post-2020 funding programs; State budget for co-financing and activities outside the funding programs	MT	Short (12.2023)	(1) Mitigation and adaptation clearly divided in local and regional strategies (2) Selection, specification, and cost estimate of adaptation options from among the options in the national strategy performed and adopted in the regional/local strategies (3) Green carbon sequestration included in local and regional strategies	No clear adaptation focus in strategies, adaptation, and mitigation are often confused	All regional and local strategies clearly distinguish between mitigation and adaptation measures, make use of the 'red line' and carrying capacity concepts, and aim at achieving synergies between BD&ES and other sectors at a regional/local level	Lead authorities for drafting and adoption of the respective regional/local strategy	Partners and stakeholders relevant to the respective regional/local strategy
	1.3 Link emissions statistics to new environmental accounts	1.3.1 Create carbon environmental accounts	L	Eurostat grants, other funding programs, State budget	MT	Medium (12.2023)	(1) Relevant scientific research and policy options adopted considering the EU-level strategies and legislative trends (2) National carbon accounts set up in terms of table composition, data sources and responsible authorities, national specifics	No accounts in place; preparation grants received by NSI	Accounts conformant to SEEA-EEA and the EU conventions/best practices are implemented in production (that is, initially balanced and updated on a regular basis)	NSI	ExEA, MoEW, MAFF, MRDPW, EFA, EAFA, BAS (BD&ES related institutes - IBER, FRI; economic institutes)

								Performance Indicators*		Responsible Institutions**	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
		1.3.2 Link carbon emission accounts and environmental accounts	L	Eurostat grants, other funding programs, State budget	LT	Long (12.2025)	(1) A single carbon account is set up and disaggregated in geocarbon and biocarbon (2) Institutional framework created for participation in 'green carbon' trade if EU legislation passed to that end	No accounts in place	(1) The national geocarbon and biocarbon are accounted for in a connected, regular, extensible, and transparent manner (2) Carbon capture by ecosystems is accounted for and can be used as source for (project) funding, that is, through Reducing Emissions from Deforestation and Degradation (REDD) schemes or other emission cutting subsidies	NSI	ExEA, MoEW, MAFF, MRDPW, EFA, EAFA, BAS (BD&ES related institutes - IBER, FRI; economic institutes)
2. Enhance knowledge management, education and stakeholder communication for adaptation	**2.1 Open and reuse data**	2.1.1 Operationalizing ecosystem data interoperability between authorities and other actors	M	Funding programs (that is, OP-Environment) - if a suitable modification will be feasible. State budget	ST	Short (12.2023)	(1) All competent authorities have created information interfaces to NSEM ensuring continuous, automated, real-time, or frequent (daily/weekly/monthly) information exchange (2) Existing tools for volunteer submission at NSEM and the use of EIA, strategic assessment and self-monitoring data are operational, and a review mechanism is established for assessing and entering volunteer/assessment/self-monitoring data into the system (3) NSEM has established data exchange with the National Statistical Institute on the reporting with regard to Natural Capital Accounting (4) Local and regional authorities and stakeholders are provided with easy and user-friendly means to submit data and combine their data with national-level datasets	Limited interoperability, some pilots on linking data between the NSEM and other authorities (such as EFA, Basin Directorates through water permitting and use information system, IBER-BAS for the ESENIAS invasive species database); Public interface to NSEM and mobile applications in place but will need update and regular procedures; No connection to NSI with regard to Natural Capital Accounting since no accounts are in place yet; and No interfaces for regional/local authorities and business stakeholders	NSEM has the necessary external links to the national- and EU-level databases: Automated data exchange in place with MAFF, MRDPW, EFA, EAFR, Basin Directorates, RIEW, Agriculture fond, Cadaster, local and municipal information systems; Public interface used by all publicly funded projects and at least 10% of the private and volunteer data providers; Interoperability between NSEM and NSI for exchanging reporting data; and Open publishing of datasets by NSEM	ExEA	NSI, MoEW, national, local, and regional data administrators collecting data on environment, MTITC, Copernicus and Horizon 2020 national focal points, business associations, NGOs
		2.1.2 Open data for public use	M	Post-2020 funding programs State budget for co-financing and activities outside the funding programs	ST to MT	(1) Short (12.2020); (2) Short (12.2023); (3) Short (12.2021); (4) Medium (12.2026); (5) Medium (12.2027)	(1) Agreements pursuant to Article 4, paragraph 4 of the Spatial Data Access Act are signed and implemented between all national, regional, and local data provider authorities creating and maintaining data relevant to ecosystem management, strategic assessments, self-monitoring and EIA; data is also submitted to NSEM pursuant to these agreements. (2) Provisions are enacted for the conditions for use of private data (self-monitoring, EIA, and so on) in assessments in terms of privacy, remuneration, business confidentiality, and so on. (3) Existing legislation on free-of-charge data provision by public authorities is enforced efficiently	(1) No specific organization on signing agreements as per SDA, NSEM has no regulated access to all relevant data (2) No provisions for use of private data for ecosystem monitoring/management purposes other than the general provisions for statistical data (3) Existing legislation is circumvented when charges are collected for "processing" the data provided free of charge (4) Not all publicly funded projects contain	Legal, organizational, and financial obstacles for the open access to publicly (EU/other donors and budget) funded data are removed. Marketplaces are created for the use of privately produced and held data Specific activities (1) to (5) are fully implemented	MoTITC	MoEW, MAFF, MRDPW, ExEA, EFA, EAFA, BAS (climate and BD related institutes - NIMH, IO, IBER, FRI), academia and NGO - beneficiaries of public funds, business, volunteer citizens

								Performance Indicators*		Responsible Institutions**	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
							(4) Derivative data products from EU and budgetary funded projects are provided openly and free of charge (5) Data is interoperable and shared in a manner allowing automated download and processing	provisions for open and free of charge publishing of derivative results (5) Published data is not always suitable for automated processing (that is, registries containing PDF and MS Word/Excel documents instead of georeferenced data or databases exposed through web services)			
	2.2 Improve communication and understanding of ecosystem processes and climate change as pressure	2.2.1 Communication and tools for informed prioritization of research and practical action	M	Post-2020 funding programs State budget for co-financing and activities outside the funding programs	MT	(1) Short (12.2021); (2) Medium (12.2025); (3) Short (12.2023)	(1) Legal and administrative provisions are made to ensure that all mandatory studies related to ecosystems (including EIA, strategic assessments, management plans for species, habitats, protected areas, and so on) assess short- and long-term impact on ecosystem condition—including critical natural capital, red lines and carrying capacity—and ecosystem services with special attention to CCA (2) All mandatory studies related to ecosystems (including EIA, strategic assessments, management plans for species, habitats, protected areas, CBA for obtaining EU funding, and so on) contain assessment of the climate projections and at least one ecosystem-based adaptation scenario calculated in terms of business plan for adaptation related activities (3) Stakeholder scenario discussions and public consultations to contain discussion on scientific findings in the reports being discussed and/or from other sources (for example, produced through Activity 2.2.3) about the impact of proposed activities on the ecosystem condition and services. The adoption of scenarios to be documented in the proceedings when such discussions and consultations have legal consequences.	(1) Legal and administrative provisions on mandatory studies exist but are insufficiently ES&CCA oriented and in some cases vaguely formulated (for example carrying capacity is required to be estimated but no definition is given) (2) No requirement is made for the mandatory inclusion of ecosystem-based scenarios (3) Public consultations and discussions often lack objective information and end up as controversy on trade-offs	Legal and operational guarantees that discussions involving trade-offs potentially harmful to BD&ES on all policy levels are informed and scientifically underpinned with regards to possible declines in climate change vulnerability, loss of regulating ecosystem services and societal costs	(1), (2) MoEW (3) Authorities responsible for the respective assessment/ study/ management plan, and so on	Stakeholders to the respective assessment/ study/ management plan as per the relevant legal framework

								Performance Indicators*		Responsible Institutions**	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
		2.2.2 Interdisciplinary teams and centers of excellence	M	High technology funding from post-2020 funding programs, including on digital economy; State budget for co-financing and activities outside the funding programs	MT	(1) Short (12.2023) (2) Medium (12.2025)	(1) Scientific center(s) integrating CCA and ecosystem research and modelling to be funded at national/regional level - calls for proposals launched and assessed (2) Funding programs/calls are planned and performed, encouraging entrepreneurs (including Small and Medium Enterprises [SME]) and start-ups to tackle the scientific aspects of ecosystem-based climate change adaptation in cooperation with the national/regional centers of excellence	No specific calls for CCA, BD, or ES related research; Enterprise funding and venture capital available for climate change action but not specifically targeting ecosystem-based adaptation	(1) At least one call for proposals per relevant program opened and selection concluded for national/regional centers of excellence focusing on assessing the CCA and BD&ES relating modelling, the extent and condition of critical natural capital and production of ecosystem services under combined CCA and other pressures, ecosystem indicators, monitoring techniques and technologies, carrying capacity in different CCA and BD&ES scenarios, long-term, and tipping points research (2) Enterprise funding schemes re-focused to include BD&ES related CCA measures as defined in this strategy (in support of Operational objectives 2.3, 2.4, 2.5, 3.1, 4.1) and at least one call for funding launched for such start-ups/existing enterprises	(1) Managing authorities of post-2020 programs (2) Business support/start-up support/venture capital organizations	(1) Academia, NGO, business organizations (2) National focal points of EU-level schemes, academia, NGO, business organizations
		2.2.3 Participative science: Encourage topical multidisciplinary research contests	M	Post-2020 funding programs; State budget for co-financing and activities outside the funding programs	ST	Short (12.2023)	(1) Post-2020 funding programs address societal challenges related to CCA in BD&ES on the fundamental, applied and policy support levels. Multiannual working plans and thematic calls for proposals developed to that end. (2) Research contests launched and projects selected on producing open access projections by combining national data with EU level VHR and potentially also daily satellite imagery, as well as derived Copernicus products form BD&ES and the Climate service domains for supporting ecosystem monitoring and red line modelling (that is, national data with Copernicus sensor and radar data and services: imperviousness, fragmentation, phenology, wetness, grasslands and other biodiversity products; atmospheric CO_2, Surface air temperature, Seasonal forecast and sectoral climate change products)	EU-level funding is used for corporate and venture capital projects	Climate research for policy purposes institutionalized: (1) Societal challenges included in the programming and funds allocation agenda of post-2020 programs and demarcation of responsibilities/funding covers all objectives in this strategy (2) At least one topical research contest in support of operational objectives 3.1 and 4.1 launched targeting centers of excellence and enterprises	(1) CoM (2) Managing/ partner authorities and national focal points of post-2020 funding programs	(1) MoEW, Managing/partner authorities and national focal points of post-2020 funding programs, Monitoring Committees and stakeholders per program (2) CoM, MoEW, Monitoring Committees, and stakeholders per program

								Performance Indicators*		Responsible Institutions**	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
	2.3 Restore, enhance, and use local biodiversity knowledge	2.3.1 Targeted collection of folk customs and traditional knowledge	L	Environmental economic instruments/ state aid; Post-2020 funding programs; State budget for co-financing and activities outside the funding programs	ST	(1) Short (12.2023); (2) Medium (12.2025)	(1) An open library of ecologically sustainable traditional practices is put in place within NSEM and available as best practice guide for voluntary standards and set of case studies for informed decision making (2) A national voluntary labeling scheme for traditional ecosystem-based management and adaptation is developed and adopted by owners of most endangered ecosystems (forest, cropland/grassland, urban, popular tourism destinations, possibly fishery)	Traditional practices are collected on a project basis and follow-up is missing	(1) At least one call for proposals with selected projects that have the obligation to submit their results to NSEM (2) A scheme developed and agreed on between owners	(1) Managing authorities/National partner authorities/national focal points of funding programs (2) Business associations	(1) Monitoring committees and stakeholder per program; consultation by scientific committees (2) National, regional, and local authorities, ecological NGOs, academia, general public
		2.3.2 Import foreign knowledge	L	Corporate funding and environmental economic instruments/ state aid; Post-2020 funding programs; State budget for co-financing and activities outside the funding programs	MT	(1) Short (12.2023); (2) Medium (12.2025)	(1) Provisions are enacted, and funding is made available to support voluntary schemes of alien species importers who commission scientific testing of their imports in isolated nurseries and publish the results, in particular warnings, with their imports (2) Peer reviewed search results are added to the IAS module within NSEM and freely shared to stakeholders (that is, the EASIN and ESENIAS networks, and so on)	No obligations for pre-import testing of alien species. Some pets and plants being imported are invasive or potentially invasive, but consumers are not being informed about this.	(1) At least one state aid/post-2020 funding call for getting information from foreign researchers and assessing the impacts of commercially interesting invasive/potentially invasive species. The call(s) to concentrate on species with high risk assessment, including pathways of introduction, patterns of spreading and impact on host ecosystems in different regions of the country. Top 10% of the highest risk commercially interesting species to be covered by selected projects. (2) A corporate scheme for IAS data exchange with NSEM and sending news to participating companies is established and functioning and datasheets prepared for each assessed species are submitted for publishing. Members have received all datasheets submitted to NSEM and publish on their websites/inform customers on the perils of releasing species in the wild.	(1) Managing/ partner authorities and national focal points of post-2020 funding programs (2) Importer and trade associations of companies trading in animals and plants	(1) MoEW, ExEA, monitoring committees and stakeholder per program; consultation by scientific committees and business associations (2) ExEA, MoEW, other national, regional, and local authorities, ecologic NGOs, academia, general public
	2.4 Maximize the use of citizen science	2.4.1 Promote ecosystem thinking among volunteers	L	Post-2020 funding programs; State budget for co-financing and activities outside the funding programs	ST	Short (12.2023)	(1) Volunteer training projects re-focused from species to ecosystems (2) Sharing volunteer data to NSEM is encouraged in all post-2020 funding programs	Predominant species and small-scale action projects; Single ecosystem-based pilots mostly focus on some services and do not include the full ecosystem assessment; Management plan/conservation funding projects are not explicitly focused on ecosystem-based management	(1) At least one call for proposals in post-2020 programs targeting volunteer training on ecosystem level activities. Selected projects to cover areas where at least 80% of the vulnerable population lives (2) All calls for proposals related to ecosystem data collection have the obligation for submitting ecosystem data to NSEM.	Managing/ partner authorities and national focal points of post-2020 funding programs	ExEA, MoEW, monitoring committees and stakeholders of relevant programs

								Performance Indicators*		Responsible Institutions**	
Strategic Objective	Operational Objective	Activities	Budget (amount)	Budget (source)	Priority	Duration	Expected Results	Current	Targeted	Lead	Partner(s)
		2.4.2 Enable volunteer sharing	L	Post-2020 funding programs; State budget for co-financing and activities outside the funding programs	ST	Short (12.2023)	NSEM has the IT and organizational capacity to accept and process scientific, volunteer, self-monitoring, and EIA data as part of environmental monitoring	Existing public interface and smartphone apps but no streamlined process for assessment and registration of data	Information technology infrastructure updated. NSEM has the necessary capacity and organization in place to collect data on a regular basis and assess it before admitting into the information system.	ExEA	MoEW, managing authorities/national partner authorities/national coordinators; program monitoring committees and stakeholders per program
	2.5 Educate for ecosystem thinking	2.1.5 Implement new training programs at all educational levels and in informal/non-formal education	L	Post-2020 funding programs; State budget; corporate funding from stakeholder businesses	ST	Short (12.2023)	(1) School programs on ecosystem awareness and specialized interest classes on ecosystem functioning implemented from grade 2 onwards (2) University programs on ecosystem management implemented (3) Restoration related vocational training program standards in place	No dedicated ecosystem management/ecosystem service related programs	All aspects of ecosystem knowledge, awareness, management, monitoring and use of ecosystem services (including ecosystem restoration for CCA) are covered by appropriate parts of the education system	(1) MES (2) Universities and research organizations (3) National Agency for Vocational Education and Training	Public, business and civic organizations—beneficiaries of the trainings; parents' associations, civil society organizations, other stakeholders relevant to the respective education path
		2.5.2 Create specialized education courses for administrations responsible for implementing CCA and BD legislation	L	Post-2020 funding program; State budget; corporate funding from stakeholder businesses	ST	Short (12.2020)	(1) The Institute of Public Administration (IPA) has included relevant courses in its catalogue and launched competitions for producing the learning content and conducting the courses (2) Private providers offer relevant courses for administration	No specialized courses available to administration	(1) At least one course level (introductory/ advanced) provided by IPA on: (a) Introduction to ecosystem services and their impact for CCA (b) DPSIR framework, indicators for ecosystem policies, management and monitoring (c) Red line/critical natural capital, carrying capacity (d) Integrated assessment (e) Ecosystem restoration and green infrastructure (2) Funding set aside by managing authorities for attending the courses from (1) or courses on the same topics provided by private providers	(1) IPA (2) Private providers	Managing authorities, national partner authorities, national focal points
		2.5.3 Develop skills for ecosystem communication and awareness raising	L	Technical aid/ program management funds of 2017–2020 and post-2020 programs; specialized calls such as LIFE communication; state budget	ST	Short (12.2020)	(1) Representatives of scientific and policy-making organizations have developed simple visualization tools/info graphs, best practice and policy guides, databases, and so on for presenting the ecosystem related problematic in climate change adaptation (2) Media representatives trained in understanding and communicating ecosystem related issues in a simple but correct manner to the public	(1) No specific and systematic efforts for communicating ecosystem services (2) Single publications in media with track record in following eco-related issues, insufficient in number and frequency for raising the public awareness for the problems caused by loss of biodiversity under climate change	(1) At least one project funded on development of tools as per Action 1) (2) At least one workshop annually for media representatives starting with the 2020 year funded by post-2020 programs as part of their publicity efforts and leading to scientifically sound publications in national media and regional/specialized media covering at least 80% of the vulnerable population	(1) National and post-2020 funding program(s) responsible for applied R&D, as assigned during programming (2) Managing authorities/ National partner authorities/national focal points of funding programs	Academia, media, regional and local authorities, NGO

								Performance Indicators*		Responsible Institutions**	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
3. Create space for Biodiversity and Ecosystems	**3.1 Reclaim space from grey infrastructure and create refugia, reduce fragmentation**	3.1.1 Regional/local 'red lines' to prevent loss of ecosystem services vital for CCA	M to H	Post-2020 funding programs State budget	Preferred ST, probably realistic MT	(1) Short (12.2023) (2) Medium (12.2025) (3) Medium (12.2027)	(1) 'Red line' assessments are commissioned to cover at least 80% of the population in the most climate vulnerable areas to define the ecosystems providing vital ecosystem services for that population (2) 'Red line' assessment for the remaining areas in the country are commissioned (3) 'Wall-to-wall' ecosystem service production scenarios for different climate change and different levels of other pressures (including ecosystem services flows beyond the national borders) are created and the corresponding 'red lines are defined	No specific studies of critical natural capital and ecosystem production/provision	(1) At least one call for proposals launched by December 2023 with project selection covering the 80% target (2) At least one call for proposals launched by December 2025 with project selection covering the remaining territory (3) NSEM has received derivative "wall-to-wall" datasets for the scenarios and projections and they are available free of charge to regional, local authorities, researchers and the general public	(1), (2) Managing authorities/ National partner authorities/ national focal points of funding programs (3) ExEA	(1), (2) Monitoring committees and relevant stakeholders per funding program; consultation by scientific committees (3) Academia, national data producers and holders, regional and local authorities, business and civic organizations, NGOs, general public
		3.1.2 Regional/local BD conservation and restoration programs to boost delivery of ecosystem services	M to H	Post-2020 funding programs, State budget corporate funding from stakeholder businesses	Preferred ST, probably realistic MT	(1) Medium (12.2025) 2) Medium (12.2027)	(1) Regional conservation and restoration programs based on the defined 'red lines' adopted for the regions where climate change related services are produced and adopted for at least 80% of the population (2) Regional conservation and restoration programs based on the defined 'red lines' adopted for the regions where climate change related services are produced on the remaining territory	No conservation/ restoration programs target ecosystem level conservation/ restoration based on critical natural capital	(1) By 2025, call(s) for proposals are conducted, projects on regional/local red line assessments covering the 80% target are selected and implementation has started (2) By 2027, call(s) for proposals are conducted, projects on regional/local red line assessments covering the entire country are selected and implementation has started	Managing authorities/ National partner authorities/ national focal points of funding programs	MoEW, ExEA, regional and local authorities; monitoring committees, local interest groups, relevant stakeholders per funding program, academia; consultation by scientific committees
4. Sustainable use of regulating and cultural ecosystem services for adaptation	**4.1 Sustainable use of ecosystem services**	4.1.1 Sustainable use of genetic resources for resilience	H	Corporate funding (including venture capital); economic instruments and environmental state aid funded by post-2020 programs and State budget	LT	Medium (12.2025)	(1) Legal framework set up and environmental state aid/funding from post-2020 programs made available for R&D on climate resilient production of provisioning services using local genetic resources (2) Improved climate resilience of at least 50% of all managed ecosystems (agriculture, fishery, forestry, urban) in the most vulnerable territories by using genetic resources for boosting biodiversity and introducing new sorts, breeds, growing practices	No specific use of local genetic resources is made for climate change resilience and sustainable agricultural practices	(1) Sectoral legislation, in line with Nagoya Protocol, to address the rights of access of farmers to genetic resources and support economic instruments/state aid for their use in CCA and food security in the areas of agriculture (including urban farming), forestry, fisheries, and aquaculture (2) Enterprise support schemes have been set up and selected enterprises/projects for funding to achieve climate resilience on at least 50% of the most vulnerable managed ecosystems in Bulgaria	Business support/ venture capital funds Managing authorities/ National partner authorities/national focal points of funding programs	Gene-bank in Sadovo, MoEW, regional and local authorities; monitoring committees, local interest groups, relevant stakeholders per funding program, academia; consultation by scientific committees
		4.1.2 Cultural ecosystem services for recreation and education	M	Corporate and SME support funding (including venture capital); economic instruments and environmental state aid funded by post-2020 programs and State budget	MT	1) Short (12.2021) 2) Medium (12.2025)	(1) Awareness of cultural ecosystem services is common among recreation professionals (2) The protection and nourishing of landscapes and ecosystems providing cultural ecosystem services is part of the corporate culture, subject to volunteer labeling scheme(s)	No specific awareness efforts and no corporate labeling schemes	(1) All recreation professionals in the CCA vulnerable areas where 80% of the population resides are aware of the potential loss of cultural ecosystem services: information published online and sent by subscription annually or quarterly, early warnings on tipping points pushed out immediately (2) At least 50% of tourism enterprises in CCA vulnerable areas participate in volunteer labeling scheme(s)	Branch associations	(1) MT, Branch associations, regional and local authorities, research organizations engaging in cultural ecosystem research, volunteers/NGO (2) MT, regional and local authorities, research organizations engaging in cultural ecosystem research, volunteers/NGO

								Performance Indicators*		Responsible Institutions**	
Strategic Objective	Operational Objective	Activities	Budget (amount)	Budget (source)	Priority	Duration	Expected Results	Current	Targeted	Lead	Partner(s)
		4.1.3 Ecosystem restoration – a long term business opportunity	H	Project funding from post-2020 programs, economic instruments and environmental state aid funded by post-2020 programs and State budget; local budgets; corporate and SME-support funding	LT	1) Medium (12.2025) 2) Medium (12.2027) 3) Medium (12.2027)	(1) Ecosystem restoration targets set and adopted on national and regional level benefiting at least 80% of the population, considering the identified red lines and overexploitation above carrying capacity (2) Ecosystem restoration targets set and adopted on national and regional level on the entire territory of the country (3) Long-term restoration projects are selected and started their activities in the most climate vulnerable locations where at least 80% of the population lives	Minimal number of small projects	20% of degraded ecosystems restored by 2030	MRDPW	MoEW, district governments, municipalities, local interest groups, national/local business associations, companies, NGO and citizen organizations
		4.1.4 Local development and equitable access to ecosystem services	L	Economic instruments and environmental state aid funded by post-2020 programs and State budget; local budgets; corporate, SME-support and social support/ human capital formation funding	MT	1) Medium (12.2028) 2) Long (12.2030)	(1) Population employed in restoration and "green industry" projects aimed at the use of ecosystem services comprise at least 5% of the employment in the most climate vulnerable regions (2) Restoration projects that were commissioned, funded and launched are expected to benefit at least 80% of vulnerable population	(1) Minimal employment and figures not known since no specific targets have been set so far for employment in restoration projects and "green industry" (2) No attention has been paid so far on vulnerable population's benefits from green infrastructure, restoration and green projects; information is not accessible since no consequent statistics on the expected impact of ongoing restoration projects on the provision of ecosystem services to vulnerable local population	(a) Targets as per activities 1) and 2) are set up, measurable and accountable, with responsibilities and actions assigned (b) Implementation of activities on track and monitoring for the overall achievement of 80% targets coordinated on a national level	(1) MoEW (2) MLSP	(1) MRDPW, MoEW, district governments, municipalities, local interest groups, national/local business associations, companies, NGO and citizen organizations (2) Managing authorities/ National partner authorities/ focal points for funding programs, district governments, municipalities, local interest groups, national/local business associations, companies, NGO and citizen organizations

Notes:
*All targets are drawn up to the best of abilities in the absence of a strategic framework for BD&ES but may need specification/quantification together with stakeholders.
** All responsible institutions and partners are drawn up to the best of abilities in the absence of a strategic framework for BD&ES but may need additions/corrections together with stakeholders.

Action Plan – Energy Sector

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Adaptation Options**	**Budget (amount in mln. Euro)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
1. Build institutional capacity, knowledge and use of data for adaptation	**1.1 Build institutional capacity and knowledge networks**	1.1.1 Undertake a review of existing levels of awareness of climate change adaptation within the MEn, regulator and wider energy sector decision makers/operators	L	Structural funds; state budget	ST	Short	Identify knowledge gaps on CCA in the sector	n.a.	Awareness raising plan with list of actions	MEn	EWRC, energy companies
		1.1.2 Provide training to the MEn, regulator and wider energy sector decision makers/operators on climate change adaptation, including information on best practice for energy sector climate resilience from other countries	0.55	Structural funds; state budget	ST	Short	Increase expertise and management skills of staff on CCA	Number of trainings; Number of experts	Number of trainings; Number of experts	MEn	EWRC, energy companies
	1.2 Translate monitoring, forecasting, and weather data for the energy sector	1.2.1 Meetings with NIMH to define needs for climate services and centralized agreement for provision of climate services from the NIMH	L	State budget	ST	Short	Centralized agreement for provision of climate services specific to the energy sector needs	No	Centralized agreement - 1	MEn, NIMH	Energy companies
2. Mainstream climate change considerations into energy sector policies, plans and financial mechanisms	**2.1 Mainstream climate change considerations within energy sector policies and plans**	2.1.1 Undertake an inventory of strategies, policies, plans, standards, site selection, energy infrastructure design norms and so on to identify those where climate resilience should be incorporated	L	State budget	ST	Short	Better governance and coordination of adaptation actions in the energy sector in Bulgaria	No of developed/ updated ordinances, regulations, instructions, orders, decrees, and so on	No of developed ordinances, regulations, instructions, orders, decrees, and so on	MEn, MRDPW	All other ministries
		2.1.2 When the new Energy Strategy is developed, ensure climate resilience is mainstreamed into it	L	State budget	ST	Short	CCA priority measures included in the Sustainable Energy Development Strategy of Bulgaria 2020 -2030	n.a.	Energy Strategy after 2020	MEn	Energy companies
		2.1.3 Mainstream climate resilience into energy sector investment plans, by defining climate risks in terms of probability and consequence	L	State budget	ST	Short	Improved investment plans taking CCA into account		Number of updated investment plans		
		2.1.4 Incorporate seasonal climate forecasts and long-term climate change projections into seasonal and long-term power demand forecasts (Electricity System Operator and MEn)	L	State budget	ST	Short	Improved accuracy of power demand forecasts and supply/demand balance		Developed mechanism for power demand forecasts taking into account seasonal climate forecasts and long-term climate change projections	Transmission System Operators (TSOs), NIMH	MEn, energy companies
		2.1.5 Incorporate climate resilience and improved contingency planning into the management of infrastructure that supports the energy sector (for example dykes and access roads for NPP)	L	State budget	ST	Short	Improved resilience of supporting infrastructure	n.a	Number of contingency plans reviewed and amended	MEn, Ministry of Interior, energy companies	Municipalities, RIA
	2.2 Develop financial mechanisms to build resilience	2.2.1 Review existing mechanisms for financial protection in other countries and evaluate the potential for implementation in the energy sector in Bulgaria	0.35	State budget	ST	Short	Analysis of potential mechanisms for financial protection in	n.a.	Number of identified mechanisms for financial protection in Bulgaria	MEn	Energy companies, Financial institutions
3. Incorporate climate resilience into design and engineering	**3.1 Incorporate climate resilience into design and engineering (power plants and mines)**	3.1.1 Climate resilience is integrated into water resources management and associated decisions affecting the operation of large HPPs	L	State budget	ST	Short	Better water resource management related to the operation of large HPPs	n.a.	Number of water resources management plans of large dams considering CCA	MoEW	MEn, National Electricity Company (NEK)
		3.1.2 Incorporating climate resilience into design of new power plants	L	Own budget	ST	Short	Cost-effective climate resilient design of new power plants	n.a.	Number of CBAs	Energy companies	

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Adaptation Options**	**Budget (amount in mln. Euro)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
	3.2 Incorporate climate resilience into design and engineering (T&D infrastructure)	3.2.1 Develop maps showing climate risk zones for climatic parameters relevant to T&D infrastructure, to inform decisions about parts of the T&D networks that require climate resilience actions	2.50	State budget	ST	Short	Informed decision making in the T&D infrastructure management	n.a.	Number of maps with climate risk zones for T&D	NIMH, Men, MES	TSO, distribution companies
		3.2.2 Continue to monitor causes of interruptions to the T&D system and to classify climate/weather-related causes, to understand weather hazards that lead to most outages and to identify any trends in their frequency	L	Own budget	ST	Short	Informed decision-making in the T&D infrastructure management	Database of causes of interruptions to the T&D system in a few distribution companies	Database of causes of interruptions to the T&D system in all distribution companies	TSO, distribution companies	
		3.2.3 Undertake CBA to evaluate whether additional sections of the distribution system should be changed to underground cables, considering changes in the frequency and severity of extreme events and consequent damages to the network	0.70	Own budget	ST	Short	Identify cost-effective investments in electricity distribution network for building climate resilience	n.a.	CBA	TSO, distribution companies	
4. Increase resilience of energy supply	**4.1 Diversify supply to increase overall energy system resilience**	4.1.1 Continue to develop regional interconnections and regional electricity trading	188.20	Equity, loans, EU funds	ST, MT	Long	Improved security of supply of energy		Number of new/ modernized interconnectors	TSO	MEn, BEH
		4.1.2 Review opportunities for improved district heating systems to contribute to meeting winter and summer energy demand. Diversify supply, including regional energy trade, district heating/ cooling, gasification of households, and small-scale renewables to increase overall energy system resilience	L	Own budget; loans; private investment	ST	Short	Improved security of supply of energy		Number of assessed district heating systems	District heating companies	MEn, EWRC
		4.1.3 Financial support for gasification of households to contribute to meeting winter energy demand	774.00	Structural funds; EBRD credit lines (targeting Energy Efficiency and RES); Kozloduy fund; private investment of citizens and businesses	ST, MT	Short	Increased gas consumption; improved supply/demand balance	% connected households % increase in gas consumption	% connected households % increase in gas consumption	MEn	
	4.2 Improve energy efficiency in buildings and industry systems	4.2.1 Provide incentives for energy suppliers to become Energy Service Companies (ESCOs)	L	State budget	ST	Short	Expanding the energy traders' activities in the field of energy savings to end customers; Improved customer satisfaction	Number of ESCO companies	Number of developed stimuli for energy suppliers to become ESCO	Sustainable Energy Development Agency (SEDA)	Energy companies
		4.2.2 Provide assistance to obliged persons to initiate the development of methodologies for evaluation of energy savings that demonstrate the fulfilment of individual energy saving targets, especially in the case of energy savings used in the industry sectors	L	Structural funds; state budget	ST	Short	Accurate calculation of energy savings in the industry sectors		Methodologies for evaluation of energy savings	SEDA	Energy companies, Energy consumers
		4.2.3 Advance efforts to motivate end users of energy to implement energy saving measures (households and industry)	760.00	Structural funds; Green Investment Scheme; ESCO	ST; MT	Short, medium	Improvement in energy characteristics of buildings;	Number of implemented energy efficiency measures	- No. of implemented energy efficiency measures; - energy savings in GWh	SEDA	End users

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Adaptation Options**	**Budget (amount in mln. Euro)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
				contracts; energy efficiency funds; state budget			Implementation of standards for sustainable buildings and energy management.		- decrease in energy intensity		
		4.2.4 Harmonize the process of regulating the prices of electricity, heat and natural gas with the policy of improving the energy efficiency in the country	L	State budget	ST	Short	Effective price regulation and EE policy		Updated methodologies for price regulation taking into account EE	EWRC, SEDA, MEn	
		4.2.5 Raise the awareness of energy traders with regard to their obligations under the Energy Efficiency Act and the possibilities for their implementation	L	State budget	ST	Short	Improved implementation of the obligations under the Energy Efficiency Act		No of awareness raising events; No of explanatory materials produced	SEDA	
		4.2.6 Work with stakeholders in the water sector to explore links between water efficiency (that is, losses from the system) and energy efficiency	L	State budget	ST	Short	Improved energy and water efficiency; Reduced water-related energy costs		No of identified measures to improve water and energy efficiency; No of applied measures	MEn, MoEW	Energy companies, companies in the water sector

Action Plan – Forestry Sector

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
1.Enhance knowledge base and awareness for climate change adaptation	**1.1 Build capacity for research, education and extension**	1.1.1 Initiate and implement Research program to support climate change adaptation of forests	M	State budget(EFA); additional from EU sources	ST	Short to long (Starting soon, but adequate if it lasts more than 5 years)	Knowledge base for successful CCA available	Research program started, activities on most important research topics started with projects	Produced research output and practical guidelines and products, which serve climate change adaptation actions	EFA	UF; FRI
		1.1.2 Create a National Forestry Extension Service and a system for dissemination of results	M	State budget (EFA):	ST	Medium to long	Continuous transfer of knowledge to leading forest practitioners at management level of forest enterprises (several thousand specialists)	(1) National extension service created; (2) Program for education actions accepted; (3) Secured funding for the operation of the Service;	(1) 2000 educated specialists in at least 5 thematic events in 5-year period; (2) Extension service operating at regular basis	EFA + close partner UF	State forest enterprises; private forest enterprises; forest enterprises, belonging to municipalities; NGOs
		1.1.3 Build capacity in government organizations, forest management structures and private companies, university and higher education staff	L	State budget; EU funding	ST	Short	Higher capacity to cope with the challenges of CCA; better coordination between institutions and stakeholders	(1) Training program established with number of planned events on different topics; (2) Number of trained people; (3) Number of public events and activities (that is, printed brochures, information campaigns, and so on) to popularize CCA in Forestry Sector	(1) Number of executed training events and trained people; (2) Number of published and distributed information brochures and guidelines; (3) Number of public events and reached audience (measurable for media campaigns such as television broadcast, internet broadcast, and so on).	EFA + close partner UF	Different owners of forests and stakeholders: associations of private owners, municipalities, NGOs; owners of companies in wood processing and furniture industries;
	1.2 Develop research to support adaptation	1.2.1 Model the potential performance of the most important tree species currently, and those species which may have potential in Bulgaria in a future changed climate, over the entire territory of the country and under different climate change scenarios and different timescales and accounting for various topographical parameters	M	State budget; EU funding	ST	Short	(1) Availability of modern models for productivity and growth of targeted tree species linked to climate parameters, soil parameters and other parameters; (2) Availability of modern models for growth and inter-species relations (that is, forest dynamics) of targeted tree species and forest ecosystems linked to climate parameters, soil parameters and other parameters and linked to climate change scenarios output	Spatially-explicit models created, verified with in-situ experimental data	Running web-based GIS model portal, which allows quick use of data from the growth models	EFA; UF; FRI; NIMH	MoEW; international research institutions with high experience in dynamic modelling of forest ecosystems

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
		1.2.2 Continue the scientific study of genotype variability and suitability for various climate conditions for the most important, endangered and highly vulnerable tree species and conduct research on production of reproductive materials from them	M	State budget; EU funding	ST	Short to long (Starting soon, but adequate if it lasts more than 5–10 years)	(1) Accumulated better knowledge on the best performing genotypes, which enables adequate production of seedling material for various plantation activities; (2) Accumulated knowledge on production of reproductive material from different species, including rare and endangered	(1) Program for studies of species and genotypes accepted (2) Program ongoing	(1) Available experimental plots and study projects (2) Available database with results from experimental work with origins from different species at various climate conditions and production of reproductive materials from them (3) Available printed guidebooks	EFA	UF; FRI; MoEW
		1.2.3 Develop spatially explicit risk models for disturbances such as windthrow, fire, insect and disease damage	L	State budget; EU funding	ST	Short, but with continuous monitoring and re-assessment	Available modern and dynamic GIS-based models for risks of various disturbances, linked to various parameters	(1) Program for studies accepted (2) GIS-based models produced and verification on-going	Available GIS-based models for risk of various disturbances linked to forest, climate and topography parameters	EFA	MAFF, MoEW
		1.2.4 Research analysis and assessment of the data from monitoring of forest ecosystems, effects of climate change, management, adaptation and mitigation measures at micro (projects) and macro scales (NFI)	L	State budget; EU funding	ST	Medium	Continuously available information for forestry resources and the on-going processes in them	(1) Running NFI - First round executed, second round in preparation (2) Project for monitoring networks for assessment of climate change adaptation actions experiments (3) Project for analysis of data from NFI going on	Working system for regular running of NFI and analysis of data	EFA	UF; FRI; MAFF
		1.2.5 Assess the impact of changing wood resources on the processing sector and support long-term resilience and value-adding potential	L	State budget - MAFF (EFA)	MT	Medium to long (should be continuous)	Timely planning of available resources and preparing the wood-processing companies to adapt	(1) Available and on-going Program for assessment of wood resources and expected resources in the following decades (2) Events to disseminate the findings to the wood-processing sector	(1) Continuous availability of data for the available wood resources; (2) Available reports and forecasts for the wood resources	EFA	MEc; Branch chamber of woodworking and furniture industry
		1.2.6 Research on additional use of wood and forest products to foster and promote diverse uses of wood and increase the potential for value addition	L	State budget - MAFF (EFA); National science fund; contracts with private companies; EU research funding	ST	Short to medium	Available new wood products and diverse uses of wood for the market	(1) Program for studies accepted (2) Studies going on according to accepted program (3) Availability of new products and research contracts between universities, research institutions and companies in the wood-processing and furniture industries	Continuous availability of contracts between universities, research institutes, and private wood processing and furniture companies	MEc; Branch chamber of woodworking and furniture industry	UF; private companies in wood processing and furniture industries
2. Enhance and protect the forest resources	**2.1 Build resilience in regenerating, expanding and strengthening the forest resource**	2.1.1 Enhance the Bulgaria's forest nursery capacity and system for seed collection and storage	M	State budget - MAFF (EFA)	MT*	Medium* (existing long-term activity)	Efficient system of forest nurseries and seed bank capable to provide timely the needed quantity and quality of reproductive materials from desired species and genotypes	(1) Available long-term program for nurseries and planning of needed reproductive material (2) Available and updated Long-term program for seed bank operation (3) Program for production of reproductive material from rare and endangered forest species accepted	(1) Available long-term program for work of nurseries and maintenance of seed bank (2) Available database and guidebooks summarizing the experience with production of reproductive materials from various species	EFA and Seed control subdivisions	UF; FRI; Institute of plant genetic resources "Konstantin Malkov"
		2.1.2 Strengthen the existing forest resource through enrichment planting and pro-active management of at-risk plantations	M	State budget - MAFF (EFA)	MT*	Long	Availability of resilient forest resource with high potential for adaptation to new climate conditions	(1) Continuously update the guidelines for management of plantations at risk (2) Hectares of pro-actively managed plantations at risk	Increasing share of pro-actively managed plantations with aim to increase their resilience to expected climate conditions	EFA	UF; FRI; forest enterprises

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
		2.1.3 Rehabilitate forest areas highly damaged by natural disturbance or die-back, and afforestation to improve water and soil protection functions	M	State budget - MAFF (EFA)	ST*	Continuous, long-term activity; routine operations, that have to be continuously improved *	Quick recovery of forest resources after disturbances; New forests with higher resilience to climate change challenges; Protection forests with high capacity to improve water and soil protection functions	(1) Available guidebooks and expert-consultation systems for forest recovery operations after disturbances (currently on EU-researchers level there is an effort to create such platform, Bulgaria could be a local focus point); An example can be seen at web site https://www.waldwissen.net/waldwirtschaft/schaden/sturm_schnee_eis/fva_sturmhandbuch/index_EN; (2) Hectares of rehabilitated forests (3) Hectares of forests in which operations were carried out to enhance their water and soil protection functions	(1) High percentage of forests with sufficient natural regeneration or artificial planting imitating natural processes after large-scale mortality due to disturbances (2) High percentage of protection forests which serve in good way water and soil protection functions	EFA	Forest enterprises; natural park administrations; UF; FRI
		2.1.4 Maintain and create new forest shelter belts in agriculture lands	M	State budget - MAFF (EFA); EU funds	MT*	Medium and long	Stable condition of existing forest shelter belts, recovery of damaged and creation of new forest shelter belts; Improved conditions to protect biodiversity of birds, animals, insects and reptiles in lowlands	(1) Availability of Spatially-explicit program for the needed Forest Shelter belts and time-frame for their creation and maintenance (2) Legislation changes to secure the creation and maintenance of Forest shelter belts (3) Secured budget or financial instruments to support the creation of Forest Shelter belts in Private, communal and state agriculture lands (4) Kilometers and area of available shelter belts	(1) Fulfilment of program for shelterbelts (2) Available database for forest shelter belts, their state and schedule for their maintenance	MAFF; EFA	Municipalities and owners of agriculture lands, where forest shelter belts are beneficial and needed; research institutions - UF; FRI; Agricultural University; Institute of soil science, agrotechnologies, and soil protection "Nikola Pushkarov"
		2.1.5 Establish short-rotation biomass plantations	M	State budget - MAFF; EU funds	MT	Long	Availability of new short-rotation plantations for wood biomass production; higher carbon sequestration for the period of use of the plantation	(1) National program for needs of wood biomass plantations based on strategy for biomass needs and production (point 3.2.2.) (2) Financial instruments to support creation of plantations;	Hectares of created plantations according to strategy for biomass plantations and national plan for needs	MAFF, EFA;	Municipalities and owners of lands
		2.1.6 Conduct an assessment of the regulatory framework and monetary aid arrangements with regard to enabling the use of agriculture lands for temporary or long-term use for forest production	L	State budget - MAFF (EFA)	ST	Short	(1) More efficient use of agriculture lands, which are currently not in active use (2) Higher Carbon sequestration by new forests (3) Less forest fires initiated in agriculture lands with self-planted forests	(1) Clear legal procedure describing the possibility to use temporary agriculture lands for forest production	Hectares of forest in currently un-used agriculture lands	EFA; MAFF	Municipalities

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
	2.2 Maintenance of biodiversity, genetic diversity and forest resilience	2.2.1 Promote management strategies that maximize species, genetic and structural diversity and limit the spatial extent of homogenous areas	M	State budget - MAFF (EFA); EU funding	ST*	Long	Higher percentage of forests with higher structural, species and genetic diversity and therefore higher resilience to various negative effects related to climate change.	(1) Updated guidelines for forest management, which clearly provide priority to management systems that maximize diversity at different levels (2) Prepared and published information materials which clarify the proper execution of such management systems and benefits from them (3) Establishment of network of demonstration sites in different forest types, which serve also for education activities	Percentage of forest area managed with management strategies maximizing species, genetic and structural diversity	EFA	UF; FRI; Forest enterprises; MoEW;
		2.2.2 Protection of sites of great biodiversity, 'old forests' and spatially aggregated habitat (biotope) trees	M	State budget - MAFF (EFA); EU funding	ST*	Long	Preserved biodiversity and genetic variability; higher forest resilience in relation to unexpected challenges related to climate conditions	(1) Strict government engagement in nature-protection policy (2) Public list of old-growth forests, including such outside national parks, nature parks, NATURA 2000 areas (3) Financial mechanism for compensatory payments for protecting old-growth forests, hot-spots of biodiversity, clusters of habitat trees (4) National system for ecosystem services evaluation and compensatory payments	(1) Working system for ecosystem services evaluation and compensatory payments (2) Stable list of old-growth forests and engagement for maintenance of their status	EFA, MAFF, MoEW	Research institutions (UF, FRI, IBER), NGOs
		2.2.3 Identify rare species with serious risk of extinction and, together with research and nursery specialists, protect their current status, but plan for their regeneration and potential migration	L	State budget - MAFF (EFA); EU funding	ST*	Long	Protected biodiversity; decreased probability of species loss and degradation of key habitats	(1) List of species and habitats at risk, which need additional research for regeneration and support (2) Program for gaining experience with regeneration of rare species	Available guidelines summarizing the available and gained knowledge	EFA, MAFF, MoEW	UF; FRI; IBER
		2.2.4 Implement measures to limit the potential of invasive species, especially insects and fungi, to enter forest ecosystems	L	State budget - MAFF (EFA); EU funding	ST	Long	Decreased risk of damages from invasive species	(1) Plan for limiting the risk of invasive species (2) System for monitoring the spread of invasive species (3) Publishing information materials for invasive species (4) Number of trainings and public events for invasive species	Available plan for limiting the potential of invasive species and monitoring system for their spread	EFA	Other ministries, responsible for transport, urban planning and constructions; municipalities; private companies working in the field of gardening
		2.2.5 Participate in the European Information System on Forest Genetic Resources	L	State budget - MAFF (EFA); EU funding	ST*	Long	Better possibilities to exchange experience and needed seedling material	Active participation in information systems for exchange of data and experience on genetic resources		EFA	Universities and research institutes in the field of genetic resources
	2.3 Enhance management of forest resources	2.3.1 Build a National system for rapid fire detection and response to this and other natural calamities	M	State budget - MAFF (EFA); EU funding	ST*	Long	Decrease the losses from forest fires	Available national centralized system in operation		EFA	MI

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
		2.3.2 Build a National system for long-term disturbance monitoring	M	State budget - MAFF (EFA); EU funding	ST	Long	Decrease the losses from disturbances by timely response and advanced pro-active management of forests at risk to make them more resilient to various disturbances	(1) Create national system (2) Monitor the effectiveness of the system to detect disturbances (3) Establishment of Research program for analysis of collected data and updating of forest risk mapping and plans	(1) Available national centralized system in operation (2) Available system for analysis of the collected data	EFA	UF; Research institutes working with remote sensing; European Earth Observation Programme COPERNICUS
		2.3.3 Execute a NFI	M	State budget - MAFF (EFA); EU funding	ST	Long	Available data on the forestry resources and on-going processes in forests	(1) NFI 1 executed; (2) NFI 2 in preparation; (3) Data from NFI in analysis	Available system for rolling annual NFI field program and permanent staffing and institutionalization.	EFA	Forest enterprises; UF; FRI;
		2.3.4 Integrate existing and novel information systems in modern National Information System for Forest Resources	M	State budget - MAFF (EFA); EU funding	MT	Medium	Availability of linked information geo-databases	Available national centralized information system for forests in operation	Available national centralized information system for forests in operation	EFA	
3. Improving potential for sustainable use of forest resource	**3.1 Improving the potential for long-term use of higher-valued wood products**	3.1.1 Expand the use of wood as a building material	L	State budget	ST	Short	Higher use of wood as a construction material			MRDPW, Bulgarian Institute for Standardization	UF; CAB; CEID; Branch chamber of woodworking and furniture industry
		3.1.2 Establish a timber marketing board	L	State budget; could be EU funding for capacity building	ST	Short	Wider use of high-quality wood and products	(1) Timber marketing board established (2) Number of public events to promote wider use of wood (3) Prepared leaflets and guidebooks	Available and working long-term activity program for promotion of wood products	MEc	Branch chamber of woodworking and furniture industry; EFA
		3.1.3 Create a wood specifiers guide to provide all the required knowledge needed by technical professionals to ease the use of this material with confidence	L	State Budget	ST	Short	Wider use of high-quality wood	(1) Wood specifiers guide published (2) Promotional events organized		MEc	UF; CAB; Branch chamber of woodworking and furniture industry
		3.1.4 Establish and promote novel wood-based EU specifications amongst municipalities as a pilot, for example for the construction of wooden bridges and small buildings	L	State budget; private companies	ST	Short	Wider use of high-quality wood and products	(1) Specifications published and distributed (2) Constructions being done as pilots (3) Media promotion events for popularizing	Regular use of wood-based constructions in urban environment	Branch chamber of woodworking and furniture industry	UF; CAB; Branch chamber of woodworking and furniture industry; municipalities
	3.2 Improving the potential for sustainable and more environmentally-friendly use of wood biomass for production of energy	3.2.1 Implementation and optimization of the "National Action Plan for Forest Biomass Energy 2018-2027"	L	State budget -EFA	ST*	Medium to long (the strategy has to be implemented and working)	Available strategy for forest biomass needs and production	Adopted "National Action Plan for Forest Biomass Energy 2018-2027"	Implementation and optimization of the "National Action Plan for Forest Biomass Energy 2018-2027"	EFA	

Action Plan – Human Health Sector

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
1. Enhance Governance for Adaptation	**1.1 Strengthen policy, legal and institutional framework**	1.1.1 Actualization of legislation, regulations, standards, codes, plans, policy, programs and all other documents relevant to CCHH	L	State budget	ST	Long	Clarity on deficiencies in regulatory documents, and preparedness to cover climate change in regulatory documents for human health		Regulatory documents - examined, deficits identified, prescriptions made.	MH	Ministry of Justice, MoEW, MAFF, MLSP, MRDPW, MES, MI, MFA, MT, NCPHA, RHI, BAS
	1.2 Build professional capacity	1.2.1 Elaboration of publication, periodical actualization and dissemination of series of thematic information materials on climate change, designed for health care professionals and stakeholders.	L	State budget	ST	Long	Enhanced professional knowledge and awareness on the CCHH matters.		Amount of CCHH professional information materials produced and disseminated.	MH	MoEW, BAS, NCPHA
		1.2.2 Critical review of climate change related infrastructure and technological equipment needs of health sector. Development of recommendations for priority improvements.	H	State budget	ST	Medium	Health sector well placed to cope with climate change via adequate infrastructure and technological conditions.		Critical review and prescriptions made.	MH	MRDPW, RHI, MTITC, Local Governments and Municipalities
		1.2.3 Development, application and periodical actualization of standards for medical treatment of each kind of climate change health effects.	L	State budget	ST	Long	Adequate healthcare ensured for impact of climate change on human health		System of standards for medical treatment of health effects of climate change developed & implemented.	MH	RHI, NCPHA
2. Build knowledge base and awareness for adaptation	**2.1. Develop public education and awareness on adaptation**	2.1.1 Introduction of CCHH theme in primary and secondary education curricula	L	L	ST	Long	Early familiarization with topic and achievement of sustainable and creative awareness of the problem.		Published materials and used in school education.	MES	BAS, MoEW
		2.1.2 Multimedia campaign on CCHH, including developing, publishing and distributing of series of promotional materials.	L	State medias (State budget) and private medias	ST	Long	Better familiarization with, greater awareness of, and more active attitude to, the impact of climate change on human health.		Established base of a rich set of cognitive materials on the subject.	MTITC	BAS, MoEW, MH
	2.2 Develop monitoring, data collecting and early warning	2.2.1 Build National monitoring system “Climate Change and Human Health”.	M	EU, State & municipal budget	ST	Short	Basis for launching a monitoring process is set up to develop a national CCHH database.		Built and equipped network	BAS	Local Governments and Municipalities, MoEW
		2.2.2 Maintain process of accurate operational monitoring; Development and permanent updating of National database "CCHH".	M	State and municipal budget	ST	Long	Specialized database is established and regularly updated.		Permanent observation process established with continuous updating of National database on CCHH	BAS	MoEW, NSI, Local Governments and municipalities
		2.2.3 Develop and launch National early warning system for health effects of climate change.	M	State and municipal budget	ST	Long	Tool available for high level protection of health.		Permanently operating national system for early warning of climate change induced health risks.	BAS	MoEW, Local Governments and municipalities
	2.3. Develop research and knowledge base	2.3.1 Enhance research knowledge on CCHH (includes: assessing health vulnerability, development of vulnerability maps, development of research base of CCHH monitoring and early warning; database development; and so on).	M	National CCHH Fund (item 1.2.6/ii)	ST	Long	Strong scientific basis supporting process of adapting health sector to climate change.		Number of CCHH research projects; CCHH research publications; CCHH research events.	BAS, Medical Universities and schools	MoEW
3. Adapt external environment to reduce health impacts of climate change	**3.1 Adapt built and natural environment to reduce health impact of climate change**	3.1.1 Development of concept and guidelines for adjustment of public built environment to climate change.	L	State budget	ST	Long	Starting process of improvement protection of built environment to climate change.		Published and disseminated concept	MRDPW, BAS	UACEG, MoEW
		3.1.2. Building and maintaining of public places with protective architecture and landscape design against extreme weather events.	M	EU OPs	MT	Long	Increased health protection in public places against extreme weather events.		Number of newly created permits and related number of created places with protective features	MRDPW	UACEG, MoEW, Local Governments and municipalities

								Performance Indicators		Responsible Institutions	
Strategic Objective	Operational Objective	Activities	Budget (amount)	Budget (source)	Priority	Duration	Expected Results	Current	Targeted	Lead	Partner(s)

Action Plan – Tourism Sector

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount in mln. Euro)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
1. Mainstream climate change adaptation into policy development and legal framework for tourism sector	**1.1 Development of a Sectoral Climate Change Policy**	1.1.1 Development of the NAS and Action Plan for CCA in the tourism sector identifying who is responsible for the actions included in it and setting feasible deadlines for their implementation	L	MT budget	ST	Short	A NAS to Climate Change for the tourism sector, An Action Plan	n.a.	n.a.	MT	MoEW
	1.2 Provision of a comprehensive legal framework, risk management and incentives	1.2.1 Improve the CCA legal framework	0.10	None or public budget	ST	Short	Better governance and coordination of all adaptation actions in Bulgaria	Number of developed ordinances, regulations, instructions, and so on.	Number of developed ordinances, regulations, instructions, and so on.	MoEW	All other ministries, including MT
		1.2.2 Develop insurance and risk management programs	L	None	MT	Long	Better risk and disaster management	Number of developed programs	Number of developed programs	MoEW	All other ministries
		1.2.3 Create cross-sectoral policy frameworks	0.10	None	MT	Short	Avoidance of overlapping activities, efforts, resource expenditure	Number of developed ordinances, regulations, instruction, and so on.	Number of developed ordinances, regulations, instructions, and so on.	MoEW	All other ministries, including MT
2. Enhance awareness and knowledge base for climate change adaptation in tourist sector	**2.1 Awareness raising on climate change and its impacts on the sector**	2.1.1 Develop a national database (online portal) containing CCA specific information	0.35	None or public budget	MT	Medium	Higher awareness, higher knowledge base, higher capacity in all sectors	Number of databases developed	Online portal in place	MoEW	All other ministries, including MT
		2.1.2 Engage in wider dissemination of CCA knowledge to reach local tourism entrepreneurs	L	Public budget/s	ST	Medium	Higher awareness, higher knowledge base, higher capacity in all sectors	Number of communication tools developed	Number of communication actions (media, publications, seminars, and so on).	MT, NGOs, professional bodies, OTRM	MoEW
		2.1.3 Introduce climate change education in schools' and universities' curricula	2.58	None	MT	Short	Higher awareness, higher knowledge base	Number of programs (courses) developed	Number of programs (courses) introduced and running	MES	MT
		2.1.4 Develop an outreach brochure and/or other materials (including internet and other media) explaining tourism business owners how climate change affects their business, and provide a checklist for planning for climate change impacts	L	Public budget/s EU programs	MT	Medium	Higher awareness, higher knowledge base	Number of materials produced; checklist developed	Number of materials produced and distributed; Checklist approved and distributed	MT, NGOs, professional bodies, municipalities, OTRM	MoEW
		2.1.5. Develop an awareness raising seminar for the tourism business (supply side) and conduct nine seminars in the nine tourist regions	M	Public budget/s EU programs	ST	Medium	Higher awareness, higher knowledge base, higher capacity in the tourism supply subsector	Training program and materials developed	Training seminars conducted, number of seminar participants	MT, NGOs, professional bodies, municipalities, OTRM	MoEW
		2.1.6 Develop an awareness raising seminar for the tourism business (intermediaries) and conduct it in key cities with a high concentration of travel agencies	M	Public budget/s EU programs	ST	Medium	Higher awareness, higher knowledge base, higher capacity in the tourism intermediary subsector	Training program and materials developed	Training seminars conducted; Number of seminar participants	MT, NGOs, professional bodies, municipalities, OTRM	MoEW
		2.1.7 Develop tourism indicators sensitive to climate change	L	Public budget/s EU programs	ST	Short	Higher knowledge base, adequate reaction to climate change in the sector	Indicators developed	Indicators included and distributed to relevant bodies in specific regulations	MT, scientific institutions	MoEW
		2.1.8 Develop climate change indicators relevant for the tourism sector	L	Public budget/s EU programs	ST	Short		Indicators developed	Indicators included and distributed to relevant bodies in specific regulations	MT, scientific institutions	MoEW

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount in mln. Euro)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
	2.2 Strengthening the sector knowledge base	2.2.1 Develop, finance and implement climate change research projects and programs related to tourism and their impacts on tourism development (supply and intermediary sectors, tourists)	M	Public budget/s EU programs	MT	Long	Higher awareness, higher knowledge base, higher capacity in the tourism sector, adequate reaction to climate change in the sector	Research project applications	Research projects approved, implemented, specific project results	NGOs, professional bodies, municipalities, scientific institutions	MT, EU, MoEW, other ministries
		2.2.2 Initiate the collection of tourism related data on climate change in the country (two sets of monitoring indicators)	M	Public budget/s EU programs	MT	Long	Higher awareness, higher knowledge base, higher capacity in the tourism sector, adequate reaction to climate change in the sector	Collected data per year	Database created and developing	MT, NGOs, professional bodies, municipalities, scientific institutions, OTRM	MoEW
		2.2.3 Initiate various types of publications with findings and results from the above activities and disseminate these among professional bodies	M	Public budget/s EU programs	MT	Long	Higher awareness, higher knowledge base, higher capacity in the tourism sector, adequate reaction to climate change in the sector	Number of publications prepared and written	Number of publications disseminated	MT, NGOs, professional bodies, municipalities, scientific institutions, OTRM	MoEW other ministries
		2.2.4 Develop and improve a M&E system	0.25	Public budget/s EU programs	MT	Short	Higher awareness, higher knowledge base, higher capacity in the tourism sector, adequate reaction to climate change in the sector	Number of sets of various M&E indicators	System in place and functioning	MT	MoEW other ministries
		2.2.5 Disseminate developed specific adaptation measures to relevant stakeholders (see Strategic Objective "Development of specific adaptation measures in the tourism sector")	M	Public budget/s EU programs	MT/LT	Long	Adequate reaction to climate change in the sector, capacity building	Number of developed specific adaptation measures	Number of successfully implemented specific adaptation measures	MT, NGOs, professional bodies, municipalities, scientific institutions, OTRM	Tourism private enterprises
3. Build adaptive capacity in Tourism Sector	**3.1 Regional and sub-sectoral assessment of adaptive capacity**	3.1.1 Develop assessment tools for adaptive capacity	L	Public budget/s EU programs	ST	Short	Methodology for capacity assessment created	Capacity indicators identified	Capacity assessment tool/s in place	MT	MoEW
		3.1.2 Conduct adaptive capacity assessments in the nine tourist regions	M	Public budget/s EU programs	MT	Medium	Capacity of the sector assessed regionally	Methodology for the assessment procedure developed	An overall regional capacity assessment of the sector	MT, municipalities, OTRM	MoEW
		3.1.3 Conduct adaptive capacity assessments for the tourism sub-sectors – supply sector (hoteliers, restaurateurs, transportation companies) and intermediary sector (travel agencies, tour operators, and travel agents)	M	Public budget/s EU programs	MT	Medium	Capacity of the sector assessed by sub-sectors and various tourism activities	Methodology for the assessment procedure developed	An overall subsector assessment of the sector	MT, NGOs, professional bodies	MoEW
	3.2 Capacity-building	3.2.1 Develop climate change training as well as innovative measures in particular in the municipalities of Sofia, Plovdiv, Varna, Burgas, Kardzhali, Ruse, Stara Zagora, Sliven	M	Public budget/s EU programs	ST	Medium	Adequate reaction to climate change in the sector, capacity building	Number of materials developed, methodology for climate change training in place, train the trainers seminars	Number of trainings conducted, No of seminar participants	MT, NGOs, professional bodies, municipalities (Sofia, Plovdiv, Varna, Burgas, Kardzhali, Ruse, Stara Zagora, Sliven), OTRM	MoEW
		3.2.2 Develop knowledge dissemination actions as well as innovative measures in particular in the	0.25	Public budget/s EU programs	MT	Medium	Adequate reaction to climate change in the sector, capacity building	Number of dissemination actions planned	Number of dissemination actions successfully implemented	MT, NGOs, professional organizations	MoEW

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount in mln. Euro)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
		municipalities of Sofia, Plovdiv, Varna, Burgas, Kardzhali, Ruse, Stara Zagora, Sliven								(Sofia, Plovdiv, Varna, Burgas, Kardzhali, Ruse, Stara Zagora, Sliven), municipalities, OTRM	
		3.2.3 Introduce special programs and courses in colleges and universities	L	None	MT	Medium	Adequate reaction to climate change in the sector, capacity building	Number of courses created and offered	Number of courses run, Number of students enrolled and graduated	MES	MT, MoEW
		3.2.4 Improve coordination, information, and communication between the responsible governmental and public institutions	0.50	Public budget/s EU programs	ST	Medium	Better coordination, information, and communication between the responsible governmental and public institutions	Number of regulations, instructions and mechanisms created	Number regulations, instructions and mechanisms enforced	MoEW	MT, all other ministries
4. Development of specific adaptation actions for the tourism sector	**4.1 Adapt existing tourism sectors**	4.1.1 Develop and implement adaptation measures for summer tourism	H	Public budget/s EU programs	MT	Long	Better adapted to climate changes summer tourism	Number of measures identified	Number of measures implemented	MT, OTRM, NGOs, professional bodies	Tourism private sector
		4.1.2 Develop and implement adaptation measures for winter tourism	H	Public budget/s EU programs	MT	Long	Better adapted to climate changes winter tourism	Number of measures identified	Number of measures implemented	MT, OTRM, NGOs, professional bodies	Tourism private sector
	4.2 Develop new tourism and management solutions	4.2.1 Develop new tourism types/ products and/or destinations	M	Public budget/s EU programs	MT	Long	Better adaptation to climate changes, reduced seasonality, four-season tourism	Number of new tourism types/products/destinations developed	Number of new tourism types/products/destinations successfully offered and sold, Number of tourists who have chosen the new types/products/destinations	MT, OTRM, tourism private sector	NGOs, professional bodies
		4.2.2 Identify new tourist sectors (segmentation)	M	Public budget/s EU programs	MT	Long	Better adaptation to climate changes, reduced seasonality, four-season tourism	Number of new segments identified	Number of new segments reached; Number of tourists from new segments	MT, OTRM, tourism private sector	NGOs, professional bodies
		4.2.3 Develop and implement new marketing strategies and approaches	M	Public budget/s EU programs	MT	Long	Better adaptation to climate changes, reduced seasonality, four-season tourism	Number of new marketing strategies and approaches developed	Number of new marketing strategies and approaches implemented, Number of tourists' dynamics	MT, OTRM, tourism private sector	NGOs, professional bodies
		4.2.4 Develop sub-sector (enterprise) – level resource management solutions	M	Public budget/s EU programs	MT	Long	Better adaptation to climate changes, increased efficiency and economic effectiveness	Number of management solutions developed	Number of management innovations implemented, private sector economic performance	NGOs, professional bodies, tourism private sector	MT, OTRM

Action Plan – Transport Sector

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
1. Build institutional capacity and knowledge base of the transport sector	**1.1 Building institutional capacity**	1.1.1 Assign CCA responsibilities in the statute and internal procedures of the relevant stakeholders per transport subsectors based on review and gap analysis	L	Budgets of respective stakeholders (MTITC)	ST	**Short**	CCA expertise available with each of the relevant stakeholders (appx. estimation 25 stakeholders)	No specific units/ experts in charge with CCA issues	Specific unit/ expert/s in charge with CCA issues at each of the stakeholders (approximate estimation 25 stakeholders)	MTITC, MRDPW	All executive agencies and state enterprises, MI
		1.1.2 Training needs assessment and implement training programs	L	Budgets of respective stakeholders (MTITC)	ST	**Short** (to initiate needs assessment and carry out first training programs) **Long** (to be repeated regularly that is, every 2–3 years)	Trained staff to properly address CCA management in the respective area of responsibility	No CCA training programs/ plans available	Training needs assessment carried out in all relevant stakeholders (approximate 25) Specific training programs developed, and first round of training courses carried out Training programs reviewed and updated, and training courses carried out periodically	MTITC, MRDPW	All executive agencies and state enterprises, MI
		1.1.3 Raising public awareness towards transport relevant climate change and CCA issues	L	Budgets of respective stakeholders (MTITC, MRDPW)	ST	**Short** (to initiate and carry out first actions) **Long/Permanent** throughout the Strategy time span	Improved awareness of the society	No awareness raising actions available or planned	Specific awareness raising plan developed and first round of actions carried out Awareness raising plan updated and actions carried out periodically	MTITC	MRDPW, MoEW, Municipalities, NGOs
	1.2 Building knowledge base	1.2.1 Introduce and/or improve CCA relevant data collection practice and gradually build data base/s for dedicated studies	L	OPTTI for introduction and/or improvement Budgets of respective stakeholders (MTITC, relevant agencies, companies & state enterprises)	ST	**Short** (to start data collection) **Long/Permanent** to collect data	Established/improved data bases per transport subsector	Available with one of the stakeholders (NRIC for railways)	Established and maintained data bases for each transport subsector (5–6)	MTITC, MRDPW NRIC	All executive agencies, state enterprises and municipalities
		1.2.2 Carry out dedicated studies to assess mode specific climate change risk and vulnerability	L	Budgets of respective stakeholders (MTITC) OPs EU/other R&D Programs	MT	**Long** (Studies should be updated based on new available data or dynamics of climate change)	Improved knowledge as a basis for planning and implementing right CCA measures	No transport specific study at national level	Specific studies carried out per transport subsectors (4–5)	MTITC MRDPW	All executive agencies and state enterprises
2. Mainstream climate change adaptation considerations into key planning and decision-making processes	**2.1 Review and enhance project preparation procedures**	2.1.1 Development of guidelines for considering CCA issues in project management cycle	L	Budgets of respective stakeholders (MTITC) OPTTI also possible	ST	**Short**	Improved climate change resilience of transport projects to be implemented in future	No national guidelines exist	Developed guidelines per transport subsectors (4)	MTITC, MRDPW	Relevant executive agencies and state enterprises per transport subsectors
		2.1.2 Enforce considering CCA issues in project management cycle	M	Depending of the financing source for project preparation	ST	**Short** to enforce **Long/ permanent** to apply guidelines	Improved climate change resilience of transport projects to be implemented in future	Addressing CCA obligatory for projects funded from EU OPs	Addressing CCA included in respective national regulation/ bylaws for project preparation per transport subsectors	MTITC MRDPW	No

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
	2.2 Review and improve operation and maintenance	2.2.1 Develop and implement program for strengthening road network resilience to extreme weather events	M	MRDPW budget	ST	**Short** to develop Program **Long/ Permanent** to implement Program	Improved resilience of critical road infrastructure and less traffic disruptions	No program for strengthening road network resilience to extreme weather events exists	Program for strengthening road network resilience to extreme weather events developed Annual budget allocated for strengthening road network resilience to extreme weather events	MRDPW	No
		2.2.2 Develop and implement program for strengthening railway network resilience to extreme weather events	M	MTITC/ NRIC budget/s	ST	**Short** to develop Program **Long/Permanent** to implement Program	Improved resilience of critical railway infrastructure and less traffic disruptions	No program for strengthening railway network resilience to extreme weather events exists	Program for strengthening railway network resilience to extreme weather events developed Annual budget allocated for strengthening railway network resilience to extreme weather events	MTITC	NRIC
	2.3 Review and update of design norms	2.3.1 Update of guidelines for design of roads' culverts and bridges	H	MRDPW/ budget/s	ST	**Short** to update guidelines **Long/Permanent** to apply updated guidelines	Improved resilience of newly built or reconstructed road infrastructure and less traffic disruptions	Outdated guidelines for design of roads' culverts and bridges	Updated guidelines for design of roads' culverts and bridges	MRDPW	RIA
		2.3.3 Update the guidelines for design of railways' culverts and bridges	H	MTITC/ NRIC budget/s	ST	**Short** to update guidelines **Long/Permanent** to apply updated guidelines	Improved resilience of newly or reconstructed railway infrastructure and less traffic disruptions	Outdated guidelines for design of rail culverts and bridges	Updated guidelines for design of railway's culverts and bridges	MTITC	NRIC
		2.3.4 Regular update of road and rail design norms	L	Not relevant	MT	**Long/ Permanent**	Provide for design norms in line with the actual climate change and for more resilient transport infrastructure	No obligation for regular review and update exists	Obligation for regular review and update embedder in the guideline	MTITC MRDPW	NRIC RIA

Action Plan – Urban Environment Sector

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount in mln. Euro)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
1. Strengthen policy and legal framework to mainstream adaptation to climate change	**1.1 Policy – Mainstream CCA in regional and urban development**	1.1.1 Organize a discussion forum to agree on a common vision and develop common understanding on CCA policy and strategy	0.003	SB	ST	<5 years	Communicated knowledge among urban planning professionals about CCA priorities and goals, and implementation in practice	Municipalities involved - 3 professionals involved	Municipalities involved - 100 Professionals involved - 100	MRDPW, MoEW	UAB, Union of Planners in Bulgaria (UPB), UACEG, Sofia University (SU)
		1.1.2 Mainstream CCA into policies of regional and urban development, including housing and construction, by revising the Spatial Planning Act	0.12	SB	ST	<5 years	More effective and integrated spatial and urban development policies	Number of Acts – 1; Number of regulations - 2	Number of Acts - 3 Number of Regulations - 3	MRDPW	MoEW
		1.1.3 Incorporate CCA into the new National Housing Strategy	H	SB, private	MT	5–10 years	Safer housing areas and more energy efficient residential buildings	Number of EE renovated multifamily buildings - 929	Completed renovated buildings until 25.05.2018 – 1230 from a total 2022 from the National Energy Efficiency Programme for multifamily building	MRDPW	Local authorities, construction companies
	1.2 Revise and amend all types of legislative documents to transpose CCA issues after a Regulatory Impact Assessment	1.2.1 Mainstream CCA requirements in all legislative documents related to regional and spatial/urban planning (Spatial Planning Act, Regional Development Act, Regulations No. 4, 7, and 8 at the Spatial Planning Act, Regulation for spatial development documents preparation, Regulations on EIA and SEA)	5.40	SB	ST	<5 years	Better regulations for regional and spatial development, more efficient land use, concentration of resources, reduced risk zones and groups	Total number of acts and regulations	Number of Acts - 2 Number of Regulations 4 Guidelines 1	MRDPW	MoEW, National Centre for Regional Development (NCRD)
		1.2.2 Revise and update the requirements for the scope and contents of main tools in the above acts and regulations (NCSD, spatial development schemes and plans, detailed plans)	M	SB, municipal budget	ST	<5 years	Development of new type of strategic documents for regional and spatial planning at all levels with integrated measures for CCA and DRM	Number of documents updated - 0	Number of documents updated: national level - 1, regional level - 5, district level – 28, and municipal level - 265	MRDPW	NCRD, local authorities and private consultancy
	1.3 Technology/ Construction - Implement new Eurocodes and technical norms in planning, design, construction technologies, and building materials	1.3.1 Improve construction and maintenance supervision and monitoring and control by the competent bodies, and Total Quality Management systems on projects and construction through sustainable building certification	L	Municipal budget, private	ST	<5 years	Better construction and maintenance supervision, monitoring and control, leading to more resilient and healthier environment	Number of Expert Councils with introduced rules for CCA measures Number of climate change resilient certified buildings	Expert councils - 200 Number of green/sustainable building certificates - 100	CAB	Local authorities, Bulgarian Green Building Council (BGBC)
		1.3.2 Stimulate creative urban design, resilient to climate change through annual competitions and awards	0.11	Professional organizations	ST	<5 years	Development of new professional culture among young architects and planners for more responsive design	Number of competitions and scholarships	Young architects and planners' competitions 1 per year and scholarships for creative design - 2 each year	UAB	UPB, universities, media
		1.3.3 Promote green, smart, and innovative cities, buildings and technologies planning, design and certification; as well as innovative measures in particular in the municipalities of Sofia, Plovdiv, Varna, Burgas, Kardzhali, Ruse, Stara Zagora, Sliven	L	Private	MT	5–10 years	Better quality of life, healthier population, reduced climate change and disaster risks, more attractive and safer urban environment, reduced health services costs, less non-renewable resources used	Number of designs, construction technologies and materials innovations registered	Registered/certified innovations in smart cities and buildings design	CAB, BCC, municipalities (Sofia, Plovdiv, Varna, Burgas, Kardzhali, Ruse, Stara Zagora, Sliven)	Other professional bodies and universities

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount in mln. Euro)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
2. Build adaptive capacity	**2.1 Develop sustainable institutions capable of providing CCA policy at all administrative levels**	2.1.1 Organize horizontal coordination between MRDPW, MoEW, ME, MAFF, MF, MI	0.80	SB	MT	5–10 years	Establishment of multisectoral consultation group for better coordinated actions for CCA of the urban environment with other sectors	Number of consultation and coordination meetings	Number of consultation and coordination meetings 2 per year	MRDPW, MoEW	MAFF, ME, MI
		2.1.2 Organize vertical and horizontal coordination between all directorates in the MRDPW, related to urban environment CCA and DRM	L	SB	ST	<5 years	Appointment of coordination experts in all spatial and urban planning related directorates of the MRDPW	Number of experts involved -2	Number of experts involved - 7	MRDPW	MRDPW Directorates
		2.1.3 Improve cooperation between national, regional, and local levels authorities in CCA policy implementation	L	SB	MT	5–10 years	Monitored CCA policy implementation at regional and local levels and proposed measures for improved integration	Number of Regional Development Councils meetings (NUTS2 and NUTS3 (district) levels) organized on CCA policy implementation	Number of Regional Development Plans (RDC) NUTS2 meetings - 1 per year and District Development Plans (DDC) NUTS3 meetings 1 per year	RDC	DDC, municipalities
		2.1.4 Develop capacity in the directorates through retraining and additional expert employment	M	SB	ST	<5 years	Improved knowledge on CCA in Urban Environment and better-informed decision-making process	Number of retraining courses – 0; Number of retrained experts - 2	Number of courses - 1 per year; Number of experts - 7 per course	MRDPW	UACEG, SU
		2.1.5 Provide guidelines and methodological support to municipalities for the development of local CCA strategies	L	SB, municipal budget	ST	<5 years	Supported municipalities for CCA local strategies development and implementation	Guidelines issued - 0, Number of local strategies developed - 3	Guidelines – 1, Number of local strategies adopted - 100	MRDHP	Local authorities
	2.2 Develop and upscale institutional, administrative, and expert capacity	2.2.1 Build DRM and emergency response capabilities, provide sufficient and modern equipment, and financial support	28.40	SB	ST	<5 years	Revised and improved capacity of the local DRM units and more appropriate reaction to crises	Number of DRM and emergency response units, trained and modern equipped	Number of trained and modern equipped DRM and emergency response units - no less than 28	District and municipal administrations	Ministries and authorities on national level
		2.2.2 Provide appropriate accurate and updated information	L	SB	ST	<5 years	Improved decision-making process due to accurate and timely information about expected weather events	Number of early warning systems in cities providing information about expected weather events - 28	Number of early warning systems in cities providing information about expected weather events in real time - 28	MI	District DRM units, Local authorities
		2.2.3 Develop awareness, commitment, CCA knowledge and culture among the general public	L	SB	ST	<5 years	Better informed and more responsible population about reduced CC risks and damages	Number of awareness raising events organized	Number of awareness raising events organized in big cities - 28	MI	Local authorities, NGOs
3. Develop financial, social and risk management policies for adaptation to climate-change	**3.1 Change financial, social, and insurance policies**	3.1.1 Revise existing financial instruments and design new ones for CCA and DRM, including for EE and construction renovation of buildings	5.60	Private	MT	5–10 years	Financial instruments innovation, better financial protection of population	Share of private funds for EE renovation of residential and non-residential buildings Number of population with insurance for DRM	Share of private funds for EE renovation of residential and non-residential buildings Number of population with insurance for DRM	MRDPW	Insurance companies
		3.1.2 Using EU funds' potential for CCA and DRM	L	EU	MT	5–10 years	Increased financial capacity for CCA and DRM Action plan implementation	Share of attracted EU funds 2014–2020	Share of attracted EU funds for CCA and DRM after 2020	MRDPW	Municipalities
4. Enhance knowledge management, research, education and stakeholder communication for adaptation	**4.1 Information – Secure institutionally regulated exchange of information and data according to INSPIRE directive obligations**	4.1.1 Create common standards for the type, structure, scope, and format of metadata and data, harmonized with EU at city level	0.50	SB	ST	<5 years	Common standards on city level introduced, thus supporting CCA research	Number of climate indicators on city level - temperature and precipitations	Number of climate indicators on city level with provided information - temperature and precipitations	ExEA	NIMH, BAS, RIEW
		4.1.2 Exchange information with European countries and international institutions	L	SB, EU programs	MT	5–10 years	More reliable data base established for climate change and disasters forecasting, reduced damages and costs for DRM and post-disaster recovery	Number of international contacts established in the country - 3	Number of new international contacts established - 2	ExEA	NIMH, BAS, RIEW
		4.1.3 Provide open access to information for the general public	L	SB	ST	<5 years	Better informed general public and higher CCA awareness, more appropriate public participation	Established open access CCA platform	Number of users per year	MoEW	MRDPW, Municipalities, IT consultant

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (amount in mln. Euro)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
	4.2 Research – Provide common long-term vision and objectives in urban environment CCA research through amendment of the National Scientific Research Development Strategy	4.2.1 Identify priority scientific topics, linked with the city, open and green spaces, buildings, infrastructure, construction materials and human health, and their risk resilience assessment	9.25	SB, EU funds	ST	<5 years	Updated National Strategy for Development of Research (2017–2030) better focused on CCA of urban environment	Number of new priorities set; Number of research projects funded	Number of new priorities set; Number of CCA research projects funded	MES	Universities
		4.2.2 Support innovations in construction, technologies and services, relevant to CCA through funded studies by construction business	M	SB, EU programs	MT	5–10 years	Established collaboration between construction business and applied science for more resilient materials and technologies	Number of commissioned studies	Number of commissioned studies	Construction Chamber	Construction companies, construction materials labs
	4.3 Education - 'Train the trainers' on CCA	4.3.1 Organize appropriate format education and training for all levels—from politicians to the public, based on the educational needs assessment	1.02	SB, EU	ST	<5 years	CCA education needs assessed, program developed (with 3 types of courses) and knowledge upgraded	Number of courses organized	Number of courses organized 3 per year for different target groups	UACEG	CAB, MRDPW, other universities
		4.3.2 Establish joint multidisciplinary courses for planners, architects, engineers, landscape architects, ecologists, economists, sociologists, and financial management professionals on master's level	M	SB, EU	ST	<5 years	Upgraded knowledge on climate change and DRM in Urban Environment in all professional fields in the Urban Environment	Number of trained students and MSc graduates	Number of trained students and MSc graduates 12 per year	UACEG	MES, UNWE, SU, UF
		4.3.3 Provide tutoring and organize thematic PhD	M	SB, EU	MT	5–10 years	Urban environment CCA priority topics explored and results applied in the sector	Number of PhD thesis on Urban Environment CCA topic	Number of PhD thesis on Urban Environment CCA topic	MES	UACEG, UNWE, SU, UF
		4.3.4 Develop interactive CCA platform for distance and open learning in support of politicians, administrators, professionals, NGOs, and the public, with special apps for the disabled	M	SB, EU	MT	5–10 years	Improved awareness about climate change in the urban environment and better decisions taken on adaptation and DRM	Reduced costs of climate change and disasters damages	Reduced costs of climate change and disasters damages - percent of the baseline year	UACEG	MES, UNWE, SU, UF
	4.4 Partnership - Work in partnership and communicate knowledge	4.4.1 Promote partnership, networking, and collaboration among different age, gender, ethnicity, professional, and social groups, including the disadvantaged ones	1.03	SB	ST	<5 years	Identified problems, needs, and stakeholders, improved cooperation, economy of scale and resources	Published report on results	Published report on results 1	MRDPW	NGOs
		4.4.2 Organize a social network for support of vulnerable groups	L	SB, ESIF, NGOs	ST	<5 years	Facilitated social support for the most vulnerable groups		Established social support group for most vulnerable	MLSP	Municipalities
		4.4.3 Realize public-private partnerships in support of DRM and Unified national system for citizens' protection	L	Municipal budget, private	ST	<5 years	Reduced financial burden on the state and municipal budgets shared responsibilities	Number of public-private partnerships established at local level	Number of public-private partnerships established at local level	District governors and municipal mayors	District and municipal councils on disasters risk reduction, private sector
		4.4.4 Work with media for promotion of the CCA system	L	SB, municipal budget	MT	5–10 years	Better informed society; CCA messages, vision, and goals clearly distributed among different public and communication channels; increased interest among business community; achieved goals for transparency, accountability, and information	Number of media campaigns, events and or publications on CCA and DRM	Number of media campaigns, events, publications on CCA and DRM	MRDPW	MoEW, Media and all partners involved in CCA of the Urban Environment

Action Plan – Water Sector

								Performance Indicators		Responsible Institutions	
Strategic Objective	**Operational Objective**	**Activities**	**Budget (in mln. Euro)**	**Budget (source)**	**Priority**	**Duration**	**Expected Results**	**Current**	**Targeted**	**Lead**	**Partner(s)**
1. Enhance Adaptive Governance	**1.1 Adapt the legal framework to make it instrumental for addressing climate change impacts**	1.1.1 Clarify roles and responsibilities for CCA	0.20	State budget	ST	2 years	Improved coordination among institutions	Some roles and responsibilities are clear	All roles and responsibilities clarified	MoEW	MRDPW, MEn, MAFF, MEn
		1.1.2 Synchronize the planning periods between water and sanitation support organizations' BPs and RBMPs/FRMPs	0.15	State budget	ST	2 years	RBMPs and BPs effectively and efficiently implemented	Different planning periods	Synchronized planning periods	MRDPW	MEW
		1.1.3 Introduce economic incentives for behavioral change	0.15	State budget	ST	5 years	Adopted more water efficient and less water polluting technologies and practices; managed flood risk	Pricing economic incentives exists (quantity-based water supply system tariffs, water-use, and pollution charges)	Introduced trading, cooperation, and risk management schemes	MoEW	MRDPW, MF, MAFF
2. Strengthen knowledge base and awareness for adaptation	**2.1 Maximize the use of research and education institutions**	2.1.1 Secure funds for CCA research and implementation of CCA-related innovations	0.25	Scientific research fund/ private sector	MT	5 years	Latest research achievements implemented in practice	Lower level of funding for CCA research in comparison to other EU countries	Level of funding increased	MES	MEc
		2.1.2 Provide research support to RBDs through framework agreements	0.13	State budget	MT	5 years	Enhanced quality of plans and programs developed by RBDs	A few framework agreements for research support of RBDs	Increased framework agreements for research support	MoEW	RBDs, research and education institutions
	2.2 Enhance awareness, education and training	2.2.1 Enhance primary and secondary education curriculums for CCA	0.05	State budget	ST	2 years	Increased effectiveness of climate change transmission to children	Existence of the subject in the current curriculums	Increased presence of the CCA in the curriculums	MES	MoEW
		2.2.2 Prepare and carry out CCA trainings of public administration and water operators	0.10	State budget	MT	5 years	Increased preparedness of the stakeholders	Some training exists	5 training modules developed, and 1,000 stakeholders trained	MoEW	MRDPW, MAFF, MEn, UACEG
	2.3. Enhance monitoring and flexibility	2.3.1 Extend and upgrade CCA related monitoring networks of precipitation, water resources and water use	0.50	State budget	MT	5 years	Obtained sufficient and reliable water monitoring data	A few monitoring stations upgraded	50% of existing monitoring stations upgraded; monitoring stations increased by 30%	MoEW	RBDs, NIMH
		2.3.2 Establish dynamic, publicly available GIS database	0.75	State budget	MT	5 years	Improved decision making under uncertainty	Does not exist	Operational publicly available geographic information system database	MoEW	RBDs, NIMH
3. Enhance adaptive management of water system infrastructure	**3.1 Adapt design and construction**	3.1.1 Revise and update design and construction norms	0.13	State budget	ST	4 years	Ensured climate change adaptive design and construction of managed water systems	Some norms are updated	All norms updated	MRDPW	MoEW
	3.2. Adapt operation	3.2.1 Develop methodology and assess adaptive capacity of significant water infrastructure[27]	1.00	Infrastructure owners	MT	1 year	Identified significant water infrastructure which needs reinforcement	Some water infrastructure is already assessed	Developed methodology and 50% of significant water infrastructure assessed	MOEW	MAFF, MEn, UACEG, ME, BAS
		3.2.2 Include CCA measures in the infrastructure operational plans	0.30	Infrastructure owners	MT	2 years	Adequately and safely operated water systems	A few operation plans include CCA consideration	Operational plans of assessed water systems include CCA measures	MEn, MRDPW, MAFF	MoEW

[27] The methodology itself should determine the threshold of significant water infrastructure.

Annex 4. List of Sector Assessment Reports

This Strategy and Action Plan builds on the following CCA reports, prepared by the World Bank as part of the project 'Advisory Services on a National Climate Change Adaptation Strategy and Action Plan'.

- Assessment of the Agriculture Sector (February 2018)
- Assessment of the Biodiversity an Ecosystems Services Sector (February 2018)
- Assessment of the Energy Sector (February 2018)
- Assessment of the Forestry Sector (February 2018)
- Assessment of the Human Health Sector (February 2018)
- Assessment of the Tourism Sector (February 2018)
- Assessment of the Transport Sector (February 2018)
- Assessment of the Urban Environment (February 2018)
- Assessment of the Water Sector (February 2018)
- Assessment of the Disaster Risk Management Sector (May 2018)

Furthermore:

- Macro-economic Implications of Climate Change – Analysis (May 2018)