SECOND NATIONAL COMMUNICATION OF BOSNIA AND HERZEGOVINA UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

June 2013

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Second National Communication of Bosnia and Herzegovina under the United Nations Framework Convention on Climate Change was adopted by the Council of Ministers of Bosnia and Herzegovina on 08 Oct 2013.

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EXECUTIVE SUMMARY

National circumstances

Geography:	Bosnia and Herzegovina (BiH) has a total surface area of 51,209.2 km^2, consisting of 51,197 km^2 of land and 12.2 km^2 of sea. Of the total land area, 5% is lowlands, 24% hills, 42% mountains, and 29% karst regions. BiH has common borders with the Republic of Croatia (931 km), the Republic of Serbia (375 km) and the Republic of Montenegro (249 km).
Climate:	The climate varies from a temperate continental climate in the northern Pannonian lowlands along the Sava River and in the foothill zone, to an alpine climate in the mountain regions, and a Mediterranean climate in the coastal and lowland area of the Herzegovina region in the south and southeast.
Institutional framework:	BiH is a sovereign state with a decentralized political and administrative structure. It consists of two Entities: the Federation of Bosnia and Herzegovina (FBiH) and the Republic of Srpska (RS) and Brčko District. The Federation of Bosnia and Herzegovina is sub-divided into 10 Cantons. Decision-making involves the Council of Ministers, the two Entities and Brčko District.
Population:	Estimated BiH population size is 3,839,737 (2011), with approximately 37% in the Republic of Srpska, 61% in the Federation of Bosnia and Herzegovina and 2% in Brčko District.
Economy:	GDP – KM 24,584 million; GDP per capita – 6,397 KM[1] (2010)
Industry	Processing industries are prevalent in BiH, producing 78.3% of the total value of industrial product sales (2011)
Energy	Total electricity generation in BiH in 2011 was 14,049 GWh
Transport:	BiH has 22,744.30 km of roads; 1,031 km of railways; 4 international airports; and no seaport. The Sava River is the main navigable river.
Agriculture:	2.3 million ha (46% of the territory) is suitable for agriculture, which comprises 6.25% of GDP (2010) and more than 19% of the employed workforce.
Forestry:	2.7 million ha (53% of the territory) is occupied by forests and forest land, with approximately 1.3 million ha of forests that can be managed economically
Waste management:	68% of the population utilises municipal waste disposal services; the average amount of municipal waste generated is 1.08 kg per capita per day (2010)
Water management:	BiH has two main river basins: the Sava River basin (38,719 km^2), with average annual discharge of 722 m^3/s; and the Adriatic Sea basin (12,410 km^2) with discharge of 433 m^3/s. Water intake totals 329,954,000 m^3 (2011)
Health:	The leading cause of death is cardiovascular disease (2011)
International cooperation:	Ratified conventions: UNFCCC, the UN Convention of Biological Diversity, the UN Convention to Combat Desertification, the Vienna Convention for the Protection of the Ozone Layer, the Convention on Long-range Transboundary Air Pollution Potential candidate for EU membership (Stabilisation and Association Agreement signed in 2008)

1 EUR equals 1.95583 KM, BiH Central Bank, Jun 2013

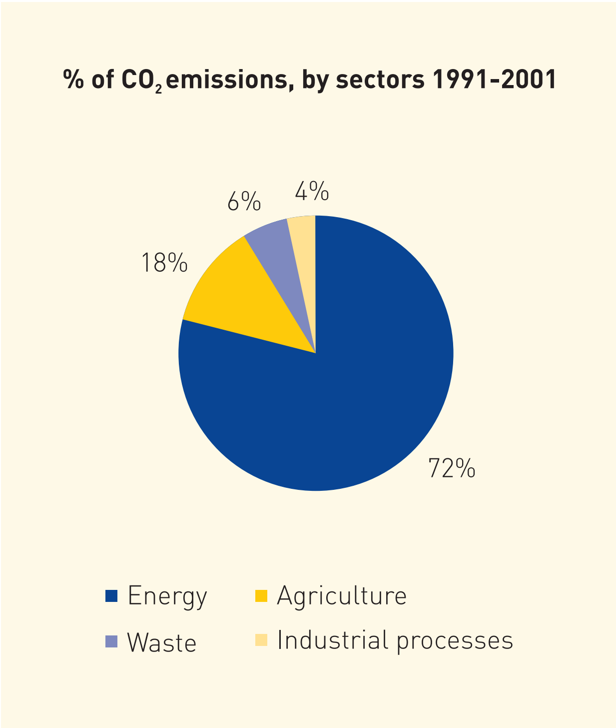
Calculation of greenhouse gas emissions

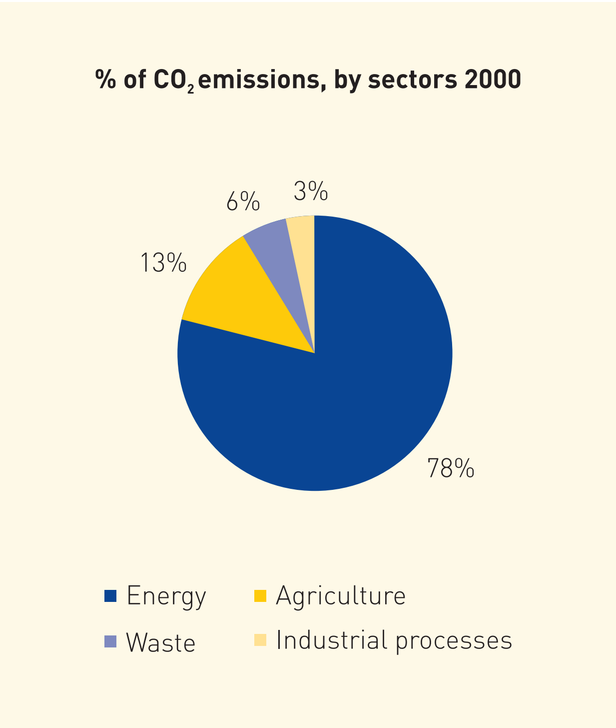
The inventory of greenhouse gases in this Communication covers a ten-year period, 1991 to 2001. It has been compiled in line with the inventory development recommendations – UNFCCC Reporting Guidelines as per Decisions 3/CP.5 and 17/CP.8, including the common reporting format (CRF) and the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, which specify reporting requirements under Articles 4 and 12 of the UNFCCC (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories). The inventory is based on the CORINAIR (CORe INventory of AIR emissions) system created by ETC/AE (European Topic Centre on Air Emissions).

It is necessary to emphasize the increased uncertainty of data for emissions calculated for the wartime period (1992 – 1996) and immediate post-war period (until the year 1998), due to lack of and/or poor quality of input data.

Total emissions in the inventory period vary from a low of 4,010 GgCO_2e in 1993 (only 12% of emissions for the base year of 1990), followed by a recorded increase in emissions that in the year 2000 reached 15,249 GgCO_2e, and in 2001 totalled 16,118 GgCO_2e; i.e., 47% of the level of emissions recorded in 1990.

The most significant source of CO_2 emissions is certainly the energy sector, which in this ten-year period contributed 72.3% of total CO_2 emissions, followed by agriculture (18.1%), waste (6.2%), and industrial processes (3.5%).





Share of CO_2 emissions by sectors (%), 1991-2001 and for the year 2000.

Vulnerability assessment and adaptation to climate change

Observed climate change

Based on the comparative analysis for the period of 1981-2010, with respect to the reference period of 1961-1990, increases in annual air temperature in the range of 0.4 to 0.8°C were identified, whereas temperature increases during vegetation periods were up to 1.0°C.

Significant variability in precipitation has not been noted during the same period, but a decrease in the number of days with rainfall exceeding 1.0 mm and an increase in the number of days with intensive rainfall caused disruptions in the pluviometric regime. Pronounced change in annual rainfall patterns, coupled with temperature increases, are one of the key factors causing more frequent and intensive occurrences of draught and floods on the territory of Bosnia and Herzegovina.

Over the past several decades, increased climate variability has been noted in all seasons and across the entire territory of Bosnia and Herzegovina: five of the past 12 years were very dry to extremely dry, and four of these years were characterised by extreme flood events. The past four years (2009-2012) have all been characterised by extreme events: flooding in 2009 and 2010, drought and high heat in 2011 and 2012, cold in early 2012, and strong wind in mid-2012.

Projections of future climate change

This report presents the results of the coupled regional climate model EBU-POM for future climate change scenarios, obtained by the method of dynamic scaling of results from two global climate models of atmosphere and ocean - SINTEX-G and ECHAM5. We focus on the results from the IPCC SRES scenarios A1B and A2.

Model results were analyzed for two intervals: 2001-2030 and 2071-2100. The Communication focuses on changes in two basic meteorological parameters: air temperature at 2m and accumulated precipitation. Changes in these parameters are shown with reference to the mean values from the so-called base (standard) period of 1961-1990.

Results from two global climate models- SINTEX-G and ECHAM5 indicate the mean seasonal temperature increase of average +1°C till 2030, comparing to the base period 1961 – 1990 over the whole Bosnia and Herzegovina. The largest increase of +1.4°C is expected during summer time (June – August). For the A2 scenario (2071-2100), the rapid temperature increase of +4°C yearly average is expected, while the expected increase in temperature during summer time will go up to +4.8°C. Models indicate uneven precipitation changes. Slight increase in precipitation in mountain and central areas is expected, while negative precipitation anomalies are projected for the other areas. According to the A2 scenario for the period 2071-2100, negative precipitations are expected at the whole BiH territory. The largest precipitation deficit of up to 50% comparing to the base period 1961-1990 is expected during summer time.

SINTEX-5		A1B 2001-2030	A1B 2071-2100	A2 2071-2100
	DJF	0.6 – 0.9	1.8 – 2.4	2.4 – 3.6
	MAM	0.8 – 0.9	2.4 – 2.6	3.4 – 3.8
	JJA	1.1 – 1.4	3.4 – 3.6	4.6 – >4.8
	SON	0.5 – 0.9	2.0 – 2.4	2.8 – 3.2
	YEAR	0.8 – 1.0	2.4 – 2.8	3.4 – 3.8

ECHAM5		A1B 2001-2030	A1B 2071-2100	A2 2071-2100
	DJF	0.2 – 0.5	3 – 3.8	3.2 – 4
	MAM	< 0.2	2.2 – 2.6	2.6 – 3.2
	JJA	0.5 – 0.8	4 – 4.2	4.4 – 4.8
	SON	0.9 – 1.1	3.4 – 3.8	3.8 – 4.2
	YEAR	0.4 – 0.6	3.2 – 3.6	3.6 – 4.0

Comparative overview of temperature changes in °C

SINTEX-5		A1B 2001-2030	A1B 2071-2100	A2 2071-2100
	DJF	-15 – -5	-50 – -10	-5 – 30
	MAM	-10 – 5	-15 – 0	-30 – 0
	JJA	-5 – 15	-30 – 0	-50 – 0
	SON	-10 – 20	-50 – -15	-30 – 0
	YEAR	-20 – 10	-30 – -10	-15 – 0

ECHAM5		A1B 2001-2030	A1B 2071-2100	A2 2071-2100
	DJF	0 – 10	-15 – 5	-30 – 15
	MAM	0 – 15	-5 – 15	-10 – 10
	JJA	-10 – 10	-50 – -20	-50 – -20
	SON	-10 – 5	-30 – -5	-20 – 0
	YEAR	-5 – 10	-15 – -5	-20 – -5

Comparative overview of precipitation changes in %

Sector analysis and adaptation measures

Sectors that are most vulnerable to climate change in Bosnia and Herzegovina are as follows: agriculture, water resources, human health, forestry and biodiversity, as well as the vulnerable ecosystems. Detailed analyses were conducted of long-term climate change vulnerability and impacts in these sectors based on the SRES climate scenarios A1B and A2 discussed above.

Climate Changes Impact

In agriculture, climate change impacts include reduced yields as a result of reduced rainfall and increased evaporation; a potential decrease in livestock productivity; increased incidence of agricultural pests and crop disease; and increased food insecurity. Potential positive impacts include an extended growing season and greater potential for growing Mediterranean crops in Herzegovina.

In water management, climate change impacts include more frequent droughts (in Western BiH), a reduction in summer river flows and more frequent floods.

In the health sector, potential negative impacts include an increase in the frequency and magnitude of epidemics/pandemics due to warmer winters; increased mortality due to heat waves; the possible spread of the Asian tiger mosquito (Aedes albopictus); and an increase in tick-borne diseases (Lyme borelliosis and tick-borne encephalitis). Potential positive impacts could include cold-related deaths.

In the forestry sector, potential negative impacts include increased frequency and extent of forest fires; increased risks to rare and endangered forest communities; increased bark beetles and gypsy moths (North Atlantic oscillation [NAO] index); and a risk of the transformation of forest ecosystems, resulting in large-scale tree mortality. Potential positive impacts include faster growth rates and the emergence of new species with economic potential.

In the area of biodiversity and sensitive ecosystems, potential negative impacts include the loss of existing habitats; habitat fragmentation; species extinction; rapid temperature and/or precipitation changes, affecting ecosystem functions. Potential positive impacts in the sector include the emergency of new habitats.

Adaptive Capacity

In agriculture, adaptive capacity to climate change is low. There is a lack of crop modelling and a lack of climate data necessary for Early Warning Systems. Farmers need to be trained in less labor-intensive methods of cultivation, and they lack knowledge about hail protection techniques. Farm equipment is often obsolete, and there is a lack of rainwater collection. Finally, climate issues are not mainstreamed into sectoral policies on agriculture.

In the water sector, there is a critical lack of hydrological modelling and detailed vulnerability assessments, maps, and risk charts. There is a lack of investment in water supply systems, resulting in high levels of leaks and losses. There is a lack of flood protection measures, and more generally, climate change issues are not integrated into water sector policies and programs.

In the health sector, adaptive capacity is constrained by a lack of acute and chronic disease monitoring. There is low awareness among health care providers and their patients about climate-health linkages. There is a lack of financing for health-related adaptation measures, and difficulties in accessing primary care in rural regions do not allow health care providers and public health authorities to manage potential climate-sensitive chronic and infectious diseases.

Adaptive capacity to climate change in the forestry sector is very low. The most vulnerable regions have not been defined. There is no detailed analysis on how climate change affects forest systems and communities. Fire protection technique is obsolete and insufficient. As in the other sectors, there is a lack of integration of climate change issues into sectoral policies and strategies.

Although some of the species have already been affected by temperature increase and precipitation decrease, the most vulnerable areas and flora and fauna species have not been defined, which reduces adaptive capacity in biodiversity and sensitive ecosystems.

For each sector, proposed adaptation measures were identified using expert consensus, stakeholder consultation, and a review of relevant research.

Estimating the potential for mitigating climate change

The section on climate change mitigation focuses on sectors where the greatest potential for reduction of greenhouse gas emissions was identified: electricity generation, district heating, buildings, transport, waste management, agriculture, and forestry. Scenarios were developed for each of those sectors, modelling possible pathways of GHG emissions until 2025, along with proposed mitigation measures. Specific modelling involved a quantitative evaluation of time-series GHG emissions and considered three development scenarios: S1 – a baseline scenario ("business as usual"); and two mitigation scenarios. Scenario S2 assumed partial implementation of mitigation measures, and S3 – the advanced scenario -- assumed implementation of a comprehensive set of mitigation measures.

Initial data considered in the three scenarios were taken from the year 2010, and calculations of greenhouse gas emissions were made in five-year increments: i.e., for 2015, 2020 and 2025.

Energy sector

The energy sector is responsible for more than 70% of total CO_2 emissions in BiH; therefore, the potential for reducing GHG emissions is greatest in this sector.

Analyses were completed of all three GHG emission reduction scenarios, each of which assumed an increase in energy efficiency as the result of the draft National Energy Efficiency Action Plan (NEEAP):

- Scenario 1 (S1) assumes that greenhouse gas emissions shall increase proportionally to increases in energy consumption. Since greenhouse gases emissions are directly dependent on energy generation, this scenario assumes the same percentage of energy needs covered from domestic sources;
- Scenario 2 (S2) assumes the construction of generation plants in accordance with the relevant entity strategies and other data collected on planned activities;
- Scenario 3 (S3) assumes the intensive use of renewable energy sources (RES) and energy efficiency (EE) following the entry of BiH into the European Union Emissions Trading Scheme (EU ETS), which would require purchasing GHG emission allowances for the energy sector.

S1 and S2 assume that CO_2 emissions from the BiH energy sector will increase in the period 2010–2025, as opposed to S3, which assumes a significant reduction (over 20%) of emissions with respect to 2010.

District heating systems

Three scenarios were developed for this sector, at the level of end-use energy consumption, and all three assume heating systems for remote city districts and an expansion of heating system networks:

- S1 assumes energy consumption without investments into new technologies and without the introduction of additional measures;
- S2 assumes energy consumption with EE measures to reduce consumption;
- S3 is an advanced scenario for energy consumption, assuming intensive economic development and investments into new technologies.

In view of the fact that the advanced scenario assumes intensive network expansion, it also entails an increase in emissions from this sector in 2025 of approximately 10% compared to 2010, whereas S2 assumes an approximate decrease of 5% by 2025.

Buildings

Buildings are responsible for the highest share of end consumption of energy in Bosnia and Herzegovina. The age of buildings and their inadequate energy efficiency provide great potentials for savings, i.e. reductions in consumption of energy-generating fuels and reductions in CO_2 emissions.

- S1 assumes a slight increase in GDP and energy consumption, entailing an increase in population size, construction of buildings and energy consumption, which would increase almost linearly, without energy efficiency measures;
- S2 assumes a moderately rapid increase in GDP and energy consumption without additional energy efficiency measures;
- S3 assumes a moderately rapid increase of GDP with implementation of energy efficiency measures that result in significant savings.

Emission reductions in the building sector are reflected in decreased and/or more efficient use of electricity and thermal energy.

Transport

The basis for the development of scenarios for the reduction of greenhouse gas emissions from the transport sector is found in the fact that road transport in BiH, compared to railway transport, is responsible for 90% of the total annual energy consumption (diesel and petrol) in this sector:

- S1 is based on previously established trends of an increasing number of motor vehicles at the average annual rate of approximately 5.8%, an average age of vehicles of between 12 and 15 years, no implementation of emission controls, and an average annual rate of increase in the consumption of diesel and petrol fuels by 3.7%;
- S2 assumes the introduction of additional technical measures for road motor vehicles supporting improved motor energy efficiency and reductions in fuel consumption; it assumes the same rate of increase in the number of motor vehicles as in S1, but with assumed improvements in the quality of fuels and in the quality of road infrastructure;
- S3 is based on the assumption that by 2025 BiH will become an EU member, implying the compulsory implementation of EU Directives regulating this field.

Scenario S1 envisages an increase in emissions from this sector of approximately 92%; S2 envisages an increase of 57% in the year 2025 compared to 2010, and scenario S3 envisages a reduction in emissions of approximately 8%.

Forestry

The sink potential of BiH forest soil in 2010 was estimated at 7327.5 $GgCO_2$.

- S1 is based on the established trend of reductions in forest areas that began in the post-war period, and it does not assume any additional measures intended to affect this trend;
- S2 is based on the implementation of certain measures intended to preserve existing afforested areas;
- S3 – the advanced scenario – is based on the assumption that by 2025 BiH will become EU member, implying the compulsory implementation of directives regulating the forestry sector.

According to the first scenario, S1, average annual sink capacity of BiH forests would be reduced by approximately 257 $GgCO_2$ by 2025, while in S3 it would increase by approximately 285 $GgCO_2$.

Agriculture

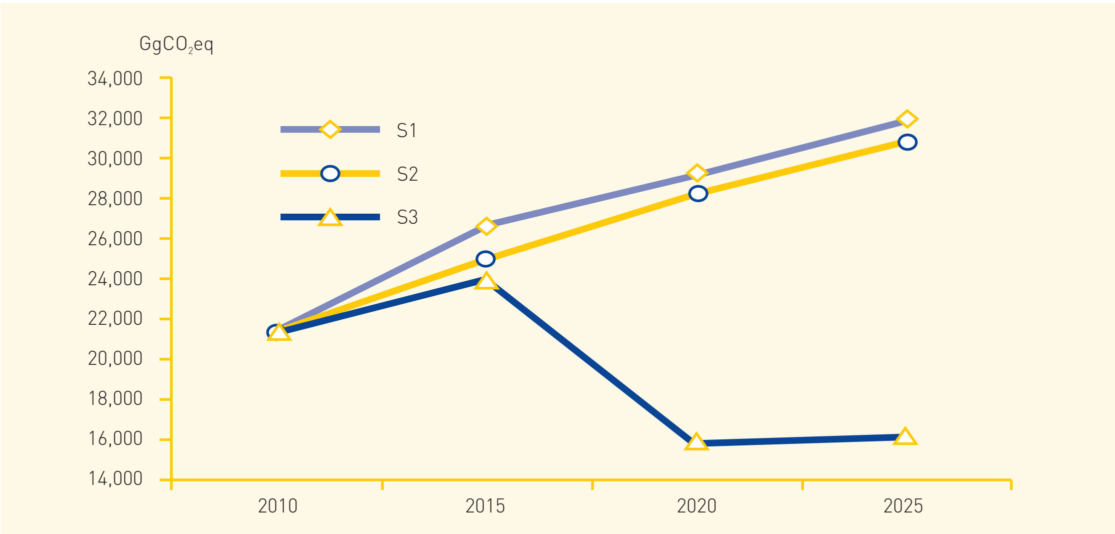
Potentials for climate change mitigation in the agriculture sector of BiH can be observed in two ways: 1) as sink potentials; and 2) as sources of greenhouse gas emissions.

- S1 is based on the trend of post-war reduction in arable land and land use change (most frequently into construction plots), and it does not entail any additional measures for land preservation.
- S2 assumes positive experiences and good production practices in the field of agriculture that are characteristic of economically developed, agricultural European countries.
- S3, as in other sectors, is based on the expectations that by 2025 BiH will become an EU member.

Based on these assumptions, S1 envisages that total greenhouse gas emissions in the agriculture sector will nearly double by 2025. S2 envisages a slight decrease; i.e., approximately 5% in 2025, compared to 2010. The S3 scenario shows that with strict implementation of the latest achievements in all segments of production, climate change mitigation potential in the agriculture sector of BiH is very large: a reduction of over 60% compared to 2010.

Waste management

In view of the fact that the share of greenhouse gas emissions from the waste management sector at BiH level is approximately 3% of total emissions, its total direct impact on a reduction of GHG is not considerable. However, the reduction of waste, recycling, and energy generation from waste can have a significant impact on emission reductions in general.



Total annual emissions of CO_2e from the energy sector, district heating, transport, agriculture, and waste management in BiH for the period 2010-2025, according to scenarios S1, S2 and S3

- S1 is essentially based on the long-term continuation of existing practices in production and the organization of waste collection and disposal over the long run.

- S2 assumes the realization of goals and tasks defined in the BiH Solid Waste Management Strategy from the year 2000.
- S3 assumes the implementation of existing technical achievements and legislation applied in EU countries.

While the S1 scenario envisages a 15% increase in CO_2 emissions from the waste management sector in the year 2025, the S3 scenario envisages a 20% decrease compared to 2010.

Other relevant activities

Assessment of technological needs for mitigation and adaptation

In support of climate change mitigation projects, Bosnia and Herzegovina has established a Designated National Authority (DNA) for the implementation of Clean Development Mechanism (CDM) projects under the Kyoto Protocol of the UN Framework Convention on Climate Change. To date it has approved four CDM projects that are estimated to reduce up to 3 million tons of CO_2e. While convention mechanisms are not the only means of supporting technology transfer, they are a first step.

While BiH has mostly completed the process of ownership transformation and organizational restructuring following the transition of its economy and post-war reconstruction, technology transfer has been limited to large enterprises owned by multinational companies. Little has been done to increase energy efficiency and to support the use of renewables, and there are numerous obstacles to technology transfer in general, ranging from a lack of knowledge to inadequate legal regulations.

The Initial National Communication (INC) for BiH identified numerous measures that would introduce new technologies in different sectors to reduce the impacts of climate change in BiH. However, very little has been done to implement these measures in the subsequent reporting period.

Bosnia and Herzegovina does not have a well-developed infrastructure for identification of needs, collection of information on available technologies, nor does it have a separate system of incentives. There are no special privileges introduced for importing technology into BiH, but it is possible to exempt technology (knowledge and equipment) from customs and duties if it is classified as foreign investment. Limitations due to a lack of incentives should be taken into account when developing models for technology transfer in BiH.

Systematic monitoring

Activities on creation, opening and modernization of the network of meteorological and hydrological stations in BiH are necessary for the improvement of meteorological monitoring and the climate base. In addition to modernization, there is a need to connect the meteorological stations into a system of automatic monitoring together with hydrological stations.

Education, training and awareness-raising

Until now, activities in the education sector and climate change awareness-raising have not been well organized, and the results have been quite modest. During the compilation of the

Second National Communication, a public opinion survey on climate change was conducted in Bosnia and Herzegovina. According to the survey results, a wide majority of respondents (82.8%) believe that global climate change is really happening, while nearly one half of them (44.9%) think that they are quite uninformed about climate change and its possible consequences; 12.9% of the respondents said that they knew nothing about this topic.

The survey results unequivocally show the fact that education, training and awareness-raising in all sectors concerning climate change, its possible consequences, and adaptation and mitigation measures, are and should remain one of the priorities for Bosnia and Herzegovina in the near term.

Preparation of operational programs to inform the public

Basic information that everyone should receive is as follows:

1. Bosnia and Herzegovina is vulnerable to climate change,

2. There are adaptation methods, meaning adaptation to existing changed climate conditions, and measures to decrease global GHG emissions (mitigation),

3. Developed countries are ready and have committed through international agreements to help developing countries to adapt to climate change.

Constraints and gaps

The main constraints and gaps affecting the implementation of obligations under the UNFCCC, as well as the implementation of activities in compilation of inventory of greenhouse gas emissions, reduction of greenhouse gas emission, and climate change adaptation include:

- Institutional constraints: There is an absence of both vertical and horizontal cooperation and coordination among competent institutions;

- Financial constraints: There is a lack of utilisation of financial instruments for environmental protection;

- Human resources constraints: There is a shortage of personnel educated in the field of environmental protection.

The preparation of the Second National Communication has been a means of developing important skills and capacity in BiH in key areas. The SNC project team aims to integrate all of its findings into the process of long-term development and sectoral planning. Members of the interdisciplinary expert group that conducted the research and analysis for the SNC are in constant contact, and this group represents the seed of future institutions that will be able to implement the activities defined in this report. Work on the SNC has also supported capacity building in in-country institutions so that they will be able to assume an increasing role in the preparation and management of subsequent National Communications.

1. NATIONAL CIRCUMSTANCES

1.1. Structure and institutional framework

Bosnia and Herzegovina is a sovereign state with a decentralized political and administrative structure. It comprises two entities: the Federation of Bosnia and Herzegovina (FBiH) and the Republic of Srpska (RS), and Brčko District.

Decision making involves the Council of Ministers, the two Entities (the Federation of Bosnia and Herzegovina and the Republic of Srpska) and Brčko District. The Federation of Bosnia and Herzegovina is in turn sub-divided into 10 Cantons. In the environmental sector in BiH, the Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (MOFTER) is responsible for coordinating activities and for international relations, but environmental issues in BiH are the responsibility of the entity governments. The corresponding authorities are the Ministry of Environment and Tourism of Federation of BiH (FBiH), the Ministry of Spatial Planning, Civil Engineering and Ecology of Republic of Srpska (RS) (the seat of the UNFCCC Focal Point), and the Department for Communal Works in Brčko District (BD). The Council of Ministers of Bosnia and Herzegovina is a party to a number of international environmental agreements and conventions, and it is fully committed to meeting the requirements stipulated in these agreements.

Bosnia and Herzegovina is a potential candidate for EU membership. The Stabilisation and Association Agreement (SAA) between Bosnia and Herzegovina and EU was signed in June 2008. An Interim Agreement, mainly on trade and trade-related matters under the SAA, has been in force since July 2008. However, progress towards EU reforms has been limited.

The most important international agreements ratified in the area of environment protection include the following:

United Nations Framework Convention on Climate Change (UNFCCC)

Bosnia and Herzegovina ratified the UNFCCC in 2000. Following the ratification of the UNFCCC, BiH has made a serious effort to establish appropriate political, institutional and legal frameworks to meet the commitments of the convention. Based on mutual agreement of both of the relevant entities, the BH Focal Point for the UNFCCC is the Ministry of Spatial Planning, Civil Engineering and Ecology of RS. The Kyoto Protocol was also ratified on April 16, 2007.

In 2010, BiH submitted its Initial National Communication under the United Nations Framework Convention on Climate Change to the UNFCCC Secretariat.

United Nations Convention on Biological Diversity

Bosnia and Herzegovina ratified the United Nations Convention on Biological Diversity in 2002.
The Ministry of Environment and Tourism of the Federation of BiH has, within the scope of its responsibilities as the UN Convention on Biological Diversity national Focal Point, prepared

the BiH Strategy and Action Plan for the Protection of Biological and Landscape Diversity (2008-2015) and forwarded it to Entity Governments for adoption. This document comprises a modern and comprehensive assessment of the situation and extent of biological diversity, geographic distribution of biological resources, as well as identified existing and potential negative tendencies.

United Nations Convention to Combat Desertification

Bosnia and Herzegovina ratified the United Nations Convention to Combat Desertification in 2002.

Vienna Convention for the Protection of the Ozone Layer

Bosnia and Herzegovina became a Party of the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer through succession of the former Yugoslavia. Bosnia and Herzegovina ratified the Beijing Amendment to the Montreal Protocol and thus joined the decision to begin global phasing out of hydrochlorofluorocarbons (HCFCs) and chlorofluorocarbons (CFCs).

Convention on Long-range Trans-boundary Air Pollution

Bosnia and Herzegovina became a Party to the Convention on Long-range Trans-boundary Air Pollution and to the Protocol to the Convention Financing of the Co-operative Program for Monitoring and Evaluation on the Long-range Transmission of Air Pollutants in Europe (EMEP Protocol) through succession from the former Yugoslavia.

1.1.1. Environmental responsibilities of ministries and other bodies

As defined by the Law on Ministries, the relevant authority for environmental issues at the state level is the Ministry of Foreign Trade and Economic Relations (MOFTER). More specifically, MOFTER is responsible for carrying out tasks related to defining policies and basic principles, coordinating activities, and harmonizing plans of the entity authorities and bodies at the international level for environmental protection, development and the use of natural resources.

Republic of Srpska (RS)

The Ministry of Spatial Planning, Civil Engineering and Ecology of RS is responsible for the overall protection of environmental quality and its improvement through research, planning, management and protection measures, including the protection of assets of general interest, natural resources, and natural and cultural heritage. The Republic Hydrometeorological Institute of RS is the governmental organization responsible for climate change monitoring, climate data exchange and database management, applied research, and climate forecasts in the framework of the various scientific and technical programs of the World Meteorological Organization (WMO).

Federation of Bosnia and Herzegovina (FBiH)

The Ministry of Environment and Tourism of FBiH is responsible for air, water and soil protection, nature protection, waste management, development of the environmental protection policy and strategy according to sustainable development principles; environmental monitoring and oversight of air, water and soil quality; and the development of periodical reports related to the state of the environment. The FBiH Institute for Meteorology is an independent agency responsible for administrative and professional duties related to meteorology, seismology, hydrology, and water resources, as well as for monitoring environmental quality, including air, water and soil quality. Furthermore, it is responsible for the collection, processing and publishing of data related to these activities.

Inter-entity environment body

Based on decisions of RS and FBiH governments, an Inter-entity environment body has been formed. This Body deals with environmental issues which require consolidated approach of both entities. It also covers any other issues delegated to this Body by entities. This Inter-entity body is in charge for development of inter-entity environment protection plan.

1.1.2. Environmental statistics

The status of the development of emissions inventories in Bosnia and Herzegovina is primarily specified by the air protection laws for FBiH and RS that are currently in effect. The following should be emphasized in these laws:

- The Ministry of Environment and Tourism of FBiH and the Ministry for Spatial Planning, Civil Engineering and Ecology of RS each release the Report on Air Pollution Emission Inventories for their respective entities in January of each year for the year two years prior.

- Cantons in FBiH release the Report on Air Pollution Emissions Inventories in April of each year (including dissemination from natural resources) for the year two years prior.

- In line with the new Republic of Srpska Law on Air Protection from 2011, an institution authorized for GHG inventory development is the republic Hydrometeorological institute.

- The reports on emission inventories have to be prepared in compliance with reporting requirements determined by the international agreements to which Bosnia and Herzegovina is a party. Emission inventories must be prepared for the following substances: SO_2, N_2O, CO_2, CO, NH_3, NO_x, CH_4, NMVOCs, C_6H_6, and PM10. The emission inventory registry is maintained by fields of activity. Emission assessments are performed in accordance with internationally approved methods and guidance. Polluters, specialized institutions, and authorized bodies are responsible for submitting the data required for dissemination, assessment, and/or monitoring to the ministries.

Although not directly involved, state and entity level statistical institutes also play a key role in environmental monitoring.

1.2. Geographical characteristics

Bosnia and Herzegovina has a total surface area of 51,209.2 km², composed of 51,197 km² of land and 12.2 km² of sea. Of the total land area, 5% is lowlands, 24% hills, 42% mountains, and

29% karst region. According to its geographical position on the Balkan Peninsula, it belongs to the Adriatic basin and the Black Sea basin.

Figure 1. Map of Bosnia and Herzegovina

Bosnia and Herzegovina has common borders with the Republic of Croatia (931 km), the Republic of Serbia (375 km) and the Republic of Montenegro (249 km). To the north, BiH has access to the Sava River, and to the south to the Adriatic Sea (23.5 km of sea border). The land is mainly hilly to mountainous, with an average altitude of 500 meters, (0 m at the seacoast and 2,387 m at the highest peak, Maglić Mountain). There are seven river basins (Una, Vrbas, Bosna, Drina, Sava, Neretva with Trebišnjica and Cetina), of which 75.5% belong to the Black Sea catchment region and 24.3% to the Adriatic Sea catchment region. Bosnia and Herzegovina is rich in thermal, mineral and thermal-mineral waters.

1.3. Population

According to the most recent census, which was conducted in 1991, total population was 4,377,033, and GDP per capita was approximately USD 2,500, placing BiH among medium-income countries. According to the estimates of the Agency for Statistics of BiH made on June 30, 2011, the population of BiH was 3,842,566. Preliminary estimates of entity-level statistical institutes, the population of the Republic of Srpska is 1,429,668 and the population of the Federation of Bosnia and Herzegovina 2,338,270. Urban population is estimated at 80% of the total population as a result of mass wartime migration from rural to urban areas. There has been an observable rise in the proportion of people aged over 64 (from 6.4% to almost 16.2% of the total population in the year 2009) and a significant drop in the active working population in the 20-40 age group.

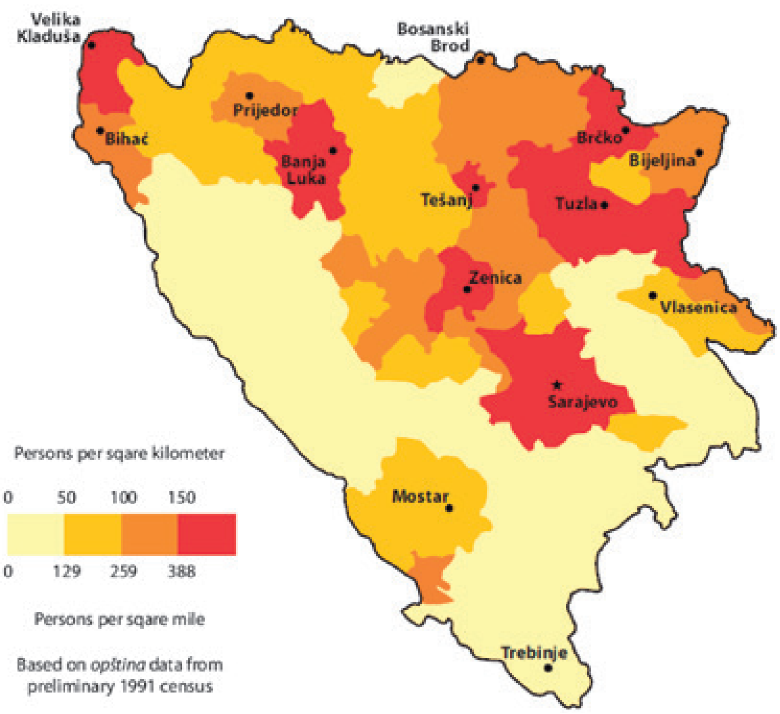


Figure 2. Bosnia and Herzegovina population density according to the 1991 census.

In Bosnia and Herzegovina in 2010 there were 33,528 live births and 35,118 deaths, which indicates an increase in mortality compared to previous years. The following table shows the mid-year estimates of population size and population growth in BiH.

	Total population (mil)	Live births		Deaths		Net population growth
		Total	Male	Total	Male	
2008	3.84	34,176	17,585	34,026	17,687	150
2009	3.84	34,550	18,001	34,904	17,884	-354
2010	3.84	33,528	17,277	35,118	17,900	-1,590

Table 1. Estimated population size in BiH (mid-year) and net population growth, 2008-2010

1.4. Climate characteristics

Bosnia and Herzegovina has several climate types: the temperate continental climate type, which is represented mostly in the northern and central parts of BiH; the sub-mountainous and mountainous type (over 1000 m); and the Adriatic (Mediterranean) and modified Adriatic climate type, which represented in coastal area of Neum and includes the Herzegovinian lowlands. The climate of Bosnia and Herzegovina therefore varies from a temperate continental climate in the northern Pannonia lowlands along the Sava River and in the foothill zone, to an alpine climate in the mountain regions, and a Mediterranean climate in the coastal and lowland areas of the

Herzegovina region in the south and southeast. In the northern part of the country, air temperature generally ranges between -1 and -2°C in January and between 18 and 20°C in July. In highlands with the altitude above 1000 m, the average temperature ranges from -4 to -7°C in January to 9 to 14°C in July. On the Adriatic coast and in the lowland regions of Herzegovina, air temperature ranges from 3 to 9°C in January to 22 to 25°C in July (for the period 1961-1990). Extremes of -41.8°C (low) and 42.2°C (high) have been recorded.

The lowland area of northern Bosnia and Herzegovina has a mean annual temperature of between 10°C and 12°C, and in areas above 500 m the temperature is below 10°C. Mean annual air temperature in the coastal area ranges between 12°C and 17°C. In the period 1981-2010, an increase in air temperature was recorded in the entire territory of Bosnia and Herzegovina. The highest increase of approximately 1°C is recorded during summer and winter period.

Annual precipitation amounts range from 800 mm in the north along the Sava River to 2000 mm in the central and southeastern mountainous regions of the country (period 1961-1990). In the continental part of BiH belonging to the Danube River catchment area, a major part of annual precipitation occurs in the warmer half of the year, reaching its maximum in June. The central and southern part of the country with numerous mountains and narrow coastal regions is characterized by a maritime pluviometric regime under the influence of the Mediterranean Sea, so the monthly maximum amounts of precipitation are reached in late autumn and at the beginning of the winter, mostly in November and December. During the period 1981-2010, major parts of the Herzegovinian lowlands saw a decrease in annual precipitation, whereas the majority of mountainous meteorological stations recorded an increase in precipitation. Compared to 1961-1990, this period had a more uneven distribution of precipitation throughout, which was one of the main factors causing more frequent droughts and flooding.

The duration of sunshine decreases from the sea towards the mainland and at higher altitudes. Annual duration of sunshine in the central mountainous area is 1700-1900 hours, as a consequence of the above average cloudiest conditions (60-70%). Due to frequent fogs during the cold part of the year, solar irradiation inland is lower than at the same altitudes in the coastal area. In southern regions, there are 1900-2300 hours of sunshine (Mostar = 2285 hours). In northern Bosnia and Herzegovina, there are 1800-2000 hours of sunshine, more in the eastern part than in the western part. Cloudiness declines from the west to the east.

Average annual precipitation in BiH is about 1,250 mm, which -- given that the surface area of BiH is 51,209 km^2 -- amounts to 64 x 109 m^3 of water, or 2,030 m^3/s. The outflow from the territory of BiH is 1,155 m^3/s, or 57% of total precipitation. However, these volumes of water are not evenly distributed, either spatially or temporally. For example, the average annual outflow from the Sava River basin, which has a surface area of 38,719 km^2 (75.7%) in BiH, amounts to 722 m^3/s, or 62.5%, while the outflow from the Adriatic Sea basin, which has a surface area of 12,410 km^2 (24.3%) in BiH, is 433 m^3/s, or 37.5%.

1.5. Sector analysis

The following sections briefly describe the current events and changes that have occurred in particular sectors since the Initial National Communication, as well as the basic impact parameters of those sectors with respect to climate change and events in this field in BiH. Detailed descriptions of sectors and possible climate change mitigation and adaptation scenarios with lists of proposed climate change mitigation and adaptation measures for Bosnia and Herzegovina are presented in the following chapters of this Report.

1.5.1. Economy and industry

Despite comprehensive efforts, the pace of post-war economic recovery has been much slower than initially anticipated. Estimates made by the BiH Agency for Statistics for the year 2010 show that GDP was KM 24,584 million, while an average GDP per capita was KM 6,397. In 2009, the share of GDP by sector was as follows: 10.2% agriculture, 23.9% industry, and 66% services (BHAS 2009).

Indicators	2004	2005	2006	2007	2008	2009
Nominal GDP (EUR billion)	8.1	8.7	9.8	11.1	12.6	12.3
GDP per capita (EUR)	2,101	2,279	2,562	2,896	3,287	3,192
Real growth rate of GDP (%)	6.3	3.9	6.1	6.2	5.7	-2.9
Average net salary (EUR)	258	275	300	322	385	404
Annual inflation (%)	0.4	3.8	6.1	1.5	7.4	- 0.4
Annual unemployment rate (%)	43.2	43.0	31.0	29.0	23.4	24.1
Foreign currency reserves (EUR million)	1,779	2,160	2,787	3,425	3,219	3,176
Balance of trade (EUR billion)	-3.68	-3.96	-3.41	-4.14	-4.82	-3.48
Total FDI (EUR million)	567	478	564	1,628	701	452
FDI contribution to GDP (%)	7.0	5.5	5.8	14.7	5.6	3.7
Household deposits in commercial banks (EUR million)	1,273	1,629	2,097	2,641	2,662	2,895
Population (million)	3.84	3.84	3.84	3.84	3.84	3.84

Table 2. Main economic indicators for BiH, 2004-2009 ([2])

	2005	2006	2007	2008	2009	2010
Federation of BiH	63.79	63.62	63.73	63.30	63.45	63.77
Republic of Srpska	33.59	33.95	33.75	34.35	34.26	33.93
Brčko District	2.62	2.42	2.52	2.35	2.29	2.30

Table 3. Share of GDP in BiH by entity, 2005-2010

2 Source: FIPA – The Foreign Investment Promotion Agency of BiH, 2010

BiH GDP per capita, expressed as PPS (Purchasing Power Standards) in 2010 was 31% of the EU-27 average, while consumption per capita in PPS for the same year was 37% of the EU-27 average. During the period of 2008 - 2010, BiH GDP in PPS increased from 30% to 31% of the EU-27 average. The general level of prices in BiH in the year 2010 was 50% of the EU-27 average. During the period of 2008 – 2010, the general level of prices in BiH increased from 49% to 50% of the EU-27 average (BHAS 2012).

In 2009, BiH experienced a recession, with a decrease in real GDP by 2.9% that followed a 5.7% increase in 2008. The economic crisis was mainly caused by depressed domestic private consumption, reductions in investments, and reduced foreign demand. Trading was dramatically reduced, construction works and industrial production in 2009 were reduced, and the unemployment rate increased. In view of the facts that no sufficient fiscal reserve had been created in years preceding the crisis and that high costs had prevailed, the decline in revenues in 2009 that was caused by the recession placed a heavy burden on public finances, forcing the BiH authorities to seek external assistance from the international community. Fiscal adjustment measures that were negotiated with the International Monetary Fund and the World Bank for the budgets of 2009 and 2010 significantly contributed to the consolidation of public finances, while certain important structural reforms progressed considerably. The years of 2010 and 2011 showed certain signs of economic recovery, since physical volume of the BiH industrial production in 2011, according to BHAS, increased by 5.6% compared to the preceding year.

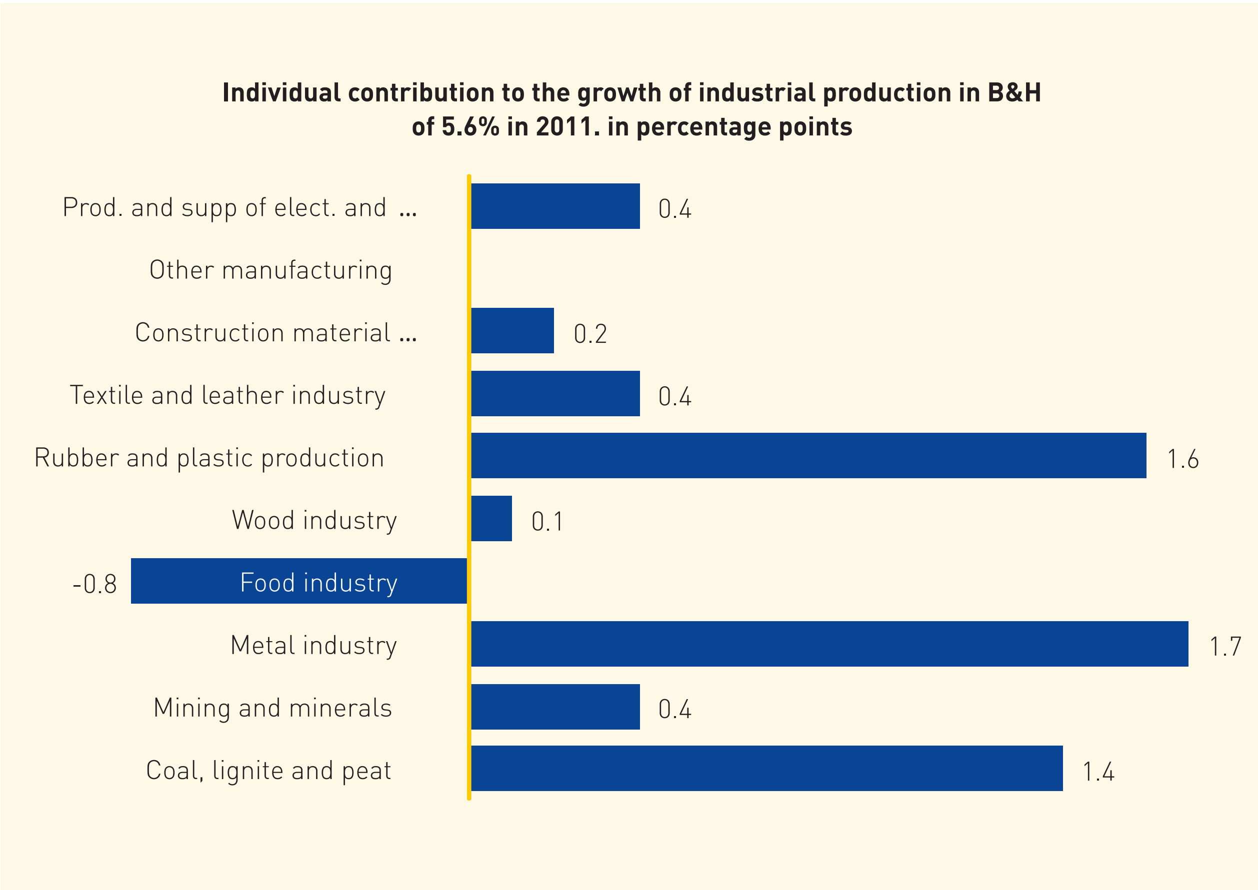


Chart 1. Contributions to the 5.6% annual growth of industrial production in BiH in 2011 (BHAS 2012)

	Ore and minerals extraction	Processing industry	Generation and supply of electricity, gas, steam and air-conditioning	Water supply; waste water treatment, waste management and environmental protection	Total (million KM)
BiH	725.4	8011.9	1284.5	212.1	10233.9
FBiH	535.4	5215.4	852	153.7	6756.5
RS	189.7	2519.5	432.4	56.8	3198.4
Brčko District	0.3	276.9		1.6	278.8

Table 4. Value of sale/delivery of industrial products in 2011, by fields of activity and entities (BHAS 2012)

The value of BiH imports in 2011 was 15.5 billion of KM, which is 14% more than in 2010, whereas export value increased by 15.9%, and in the year 2011 amounted to 8.2 billion of KM.

	2008	2009	2010	2011
Export of goods (thousand KM)	6,711,690	5,530,377	7,095,505	8,222,112
Change in exports (%)	13.05%	-17.6%	28.3 %	15.88%
Import of goods (thousand KM)	16,286,056	12,348,466	13,616,204	15,525,428
Change in imports (%)	17.18 %	-24.18 %	10.27 %	14.02 %
Trade balance (thousand KM)	-9,574,366	-6,818,089	-6,520,699	-7,303,316
Import-export coverage (%)	41.21 %	44.79 %	52.11 %	52.96 %

Table 5. Foreign trade indicators, 2008 – 2011 (BHAS)

The unemployment rate in 2011 was 27.6%. In July 2012, the number of registered unemployed individuals in BiH was 539,366, which is approximately 2% more than in the same period in 2011. The share of women in the total number of registered unemployed individuals is 50.9%, or 274,775. In general, the labour market remains fragmented, and its conditions are very inflexible.

The average fluctuation of the consumer price index (CPI) in Bosnia and Herzegovina in 2011 compared to the 2010 average indicates that average inflation in that period was 3.7%. Price increases were recorded in all categories, with the exception of apparel and footwear and the health and education sectors. Annual inflation in 2009 was negative and reached -0.4%. Nevertheless, this downward pressure shifted at the beginning of 2010, and inflation for 2010 on the whole was 2.1%.

The postulates of monetary policy have not changed since May 2009, just after the mandatory minimum reserve requirements had been reduced several times since October 2008 in order to increase the liquidity of the banking sector in times of financial fluctuation. The severe economic crisis in 2009 revealed the vulnerability of the BiH growth model, which was reliant on externally financed consumption, which in turn created a growing external imbalance. On the whole, the sustainability of macroeconomic policies was weak due to structural weaknesses in public finances, despite the fact that external imbalances have improved and financial and monetary stability have been maintained.

1.5.2. Energy

Total electricity generation of BiH in the year 2011 was 14,049 GWh, which represented an approximate decrease of 13% compared to the preceding year. This decrease in generation was primarily caused by unfavourable hydrological conditions (compared to the preceding year), which resulted in significantly reduced electricity generation by hydropower plants.

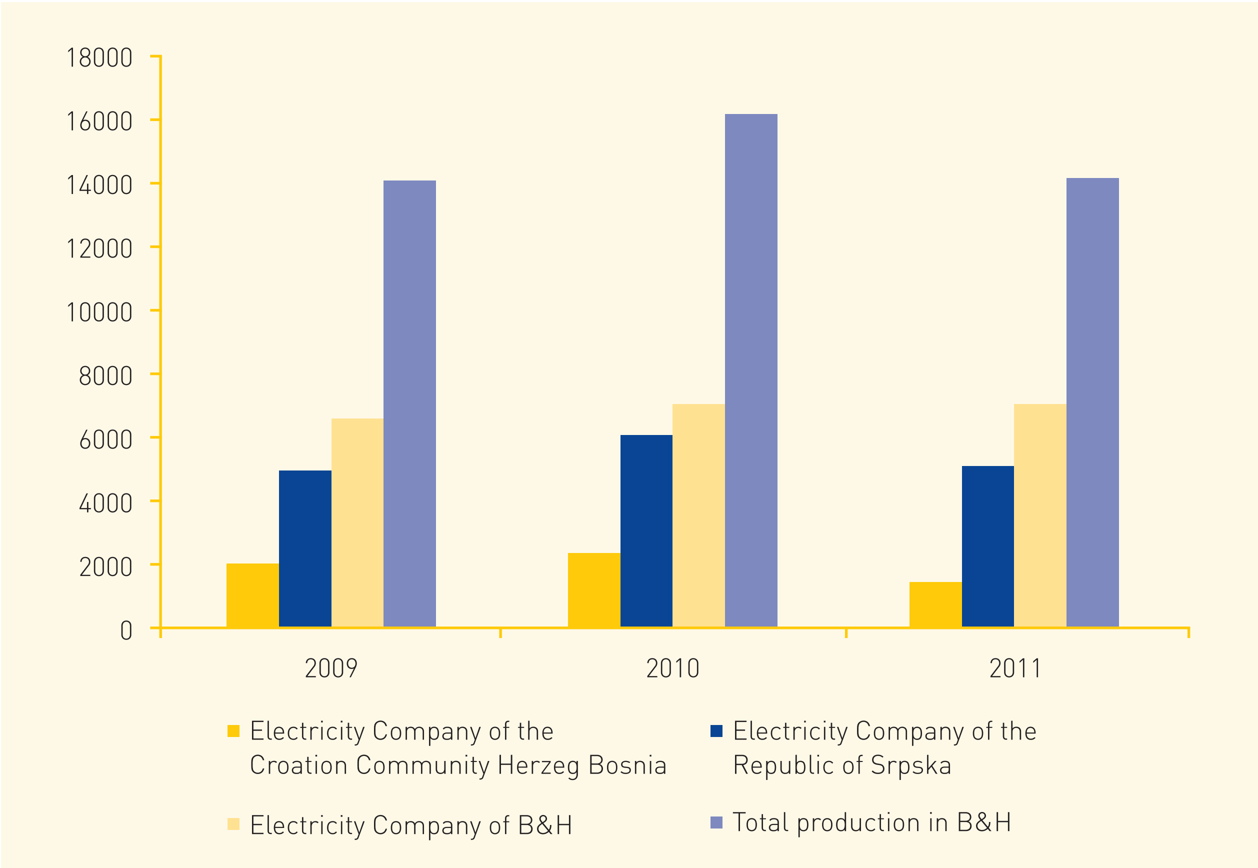


Chart 2. Electricity generation in BiH, in GWh (The State Electricity Regulatory Commission of BiH)

Total electricity consumption in BiH in the year 2010 amounted to 10,347 GWh, and in 2011 it continued to increase; i.e., it was 3% higher than in the preceding year. Total electricity consumption in 2010 was divided among households (43.9%), industry (35.7%), and other consumers, including the building sector, transport and agriculture (20.4%).

Total generation of thermal energy in Bosnia and Herzegovina in the year 2010 was 6,001 TJ, of which 3,791 TJ (63.2%) was generated in heating plants, 1,403 TJ (23.4%) in thermal power plants, and 807 TJ (13.4%) was generated in industrial energy plants. Total thermal energy consumption in 2010 was divided among households (74.6%), and industry and other consumers (25.4%). There is no comprehensive energy strategy for the country, and entities have so far failed to harmonize their plans. Obligations under the Agreement on the Energy Community with respect to promoting energy generated from renewable sources and biofuels have not been fulfilled. There have been delays in developing an energy efficiency action plan, which is also required under the Agreement on the Energy Community.

Energy efficiency in Bosnia and Herzegovina in generation, transmission and distribution, and end use, is low relative to developed economies. Energy production in BiH is based on technologies developed some thirty years ago, when a number of blocks in its thermal power plants were constructed. In the case of construction of new plants and in major reconstructions of existing facilities, new technologies should be introduced whenever possible. Generally, awareness of the savings that could be achieved by increasing energy efficiency needs to be increased. Energy savings require investments, but these investments pay off quickly.

Renewable energy sources (except for significant, existing hydropower capacity), at the current level of development and at the current share in the overall energy consumption, can only complement, rather than replace major plants. However, due to their low environmental impact, these technologies are developing rapidly, and their use is increasing.

1.5.3. Transport

According to data gathered from the relevant authorities, the total length of the road network in Bosnia and Herzegovina is 22,740.20 km, which is comprised of 72.60 km of motorways, 3,786.00 km of trunk roads, 4,681.60 km of regional roads, and approximately 14,200 km of local roads.

Length (km)				
Category	**FBiH**	**RS**	**Brčko District**	**Total**
Motorways	37.60	35.00		72.60
Trunk roads	2,005.00	1,781.00		3,786.00
Regional roads	2,461.80	2,183.00	36.80	4,681.60
Local roads			170.66	14,200.00
TOTAL	**4,504.40***	**3,999.00***	**207.46***	**22,740.20**

*data on exact length of local roads on entity level have not been available

Table 6. Total length of road network in Bosnia and Herzegovina

The total number of registered road motor vehicles in 2011 was 1,026,254. Of the total number of registered road motor vehicles in 2010, 86% were passenger vehicles, 9% were cargo vehicles, and 5% were from all other categories of vehicles. In addition, in the total number of registered motor vehicles, 6% were road motor vehicles registered for the first time in 2010. With respect to the type of fuel used, 57% of vehicles use diesel, 41% use petrol, and 2% of vehicles use other forms of energy.

Cargo transport	2010	2011
Vehicle-kilometres travelled (thousands)	284,680	317,032
Tons of goods transported (thousands)	4,837	4,857
Ton/km (thousands)	2,038,731	2,308,690

Passenger transport	2010	2011
Vehicle-kilometres travelled (thousands)	97,663	93,823
Transported passengers (thousands)	28,702	29,303
Passenger-kilometres (thousands)	1,864,471	1,926,212

Table 7. Volume of transport, by type

The overall volume of road transport in Bosnia and Herzegovina for 2011 is represented by two indicators: cargo transport and passenger transport. According to both of these indicators, the volume of transport increased compared to 2010 by approximately 3%. More detailed indicators on the volume of transport by type are presented in the following table.

The rail network of BiH consists of 1,031 km of railways, of which 425 km are in the RS and 616 in FBiH. Although the density of the railway network in BiH is comparable with that of Western European countries, the volume of transport of goods and passengers per kilometre of railways is far below the European average. The condition of the existing railway infrastructure is such that normal transport is not possible without major investments, and the existing volume of transport is insufficient to generate income that would be sufficient to cover expenditures.

The overall volume of the rail transport in Bosnia and Herzegovina for the base year 2011 can be divided into two categories: cargo transport and passenger transport.

Cargo transport	2010	2011
Tons of goods transported (thousands)	12,882	14,224
Ton/km (thousands)	1,232,034	1,298,294
Passenger transport	**2010**	**2011**
Transported passengers (thousands)	898	821
Passenger-kilometres (thousands)	58,559	54,811

Table 8. Volume of rail transport in Bosnia and Herzegovina (2010-2011)

Contrary to road transport, the volume of the railway passenger transport showed an approximate decrease of 8.5% compared to the year 2010. The indicators listed in Tables 7 and 8 best illustrate existing trends, as well as the existing climate change mitigation potential in the transport sector in BiH.

Out of 27 officially registered airports, only four (Sarajevo, Banja Luka, Mostar and Tuzla) are registered for international traffic (BiH Ministry of Communications and Transport, 2005). The annual number of passengers is around 570,000 for Sarajevo International Airport, while Banja Luka, Mostar and Tuzla have relatively small but continuously increasing numbers of passengers. There is no domestic air traffic in Bosnia and Herzegovina, and all data refer to international traffic. In the first quarter of 2011, the number of airport operations showed a decrease of 4.9% compared to the same period of the preceding year. The number of transported passengers is 7.8% higher than in the same quarter of the preceding year.

Bosnia and Herzegovina has a very short coastline off Neum and does not have regulated adequate access to international waters; therefore, it does not have regulated sea ports. The international port that is the most important for the BiH economy is the port of Ploče in Croatia, which has a capacity of 5 million tons/year (BiH Ministry of Communications and Transport, 2005).

In BiH, the Sava River is the main navigable river, and its 333 km length in BiH is also the border between BiH on one side and Croatia and Serbia on the other. Because the Sava is a tributary of the Danube, water transport along the Sava is linked with the Danube, which is designated as Trans-European Transport Corridor VII. Main features of river transport in BiH are as follows: neglected navigable routes, the absence of a technologically modern fleet (and the use of towing instead of pushing), technical and technological obsolescence, devastated ports and no shipyards with slipways. On a positive note, river navigation has the same institutional status as other forms of transport.

1.5.4. Agriculture

Agriculture represents a strategic sector in the economic development of BiH, and it is related to a large share of the country's economic activities, especially in rural regions. The share of agriculture, hunting, and related services comprised 6.25% of GDP in 2010 (BHAS). According to data from the 2011 Workforce Survey, which was conducted by statistical institutions, the number of individuals employed in the agriculture sector was approximately 160,000, which is more than 19% of the total number of employed individuals in BiH. Approximately 2.3 million ha (46%) in BiH is suitable for agriculture, of which only 0.65% is irrigated. Arable land covers 1,009,000 ha, or 20.0% of the total area of BiH; 478,000 ha (47%) of arable land is not cultivated at present. There is approximately 0.56 ha of farmland land per capita, of which 0.36 ha is arable land and vegetable gardens.

45% of agricultural land is hilly (300 to 700 metres above sea level), of moderate quality and suitable for semi-intensive cattle breeding. Mountainous regions (above 700 metres above sea level) represent an additional 35% of farmland. However, high altitude, slopes, and aridity limit the use of mountain pastures to spring and summer months.

Less than twenty percent of agricultural land (half of all arable land) is suitable for intensive agriculture, and most of it is in the northern lowlands and in river valleys. Natural water resources are abundant, with many unpolluted rivers and accessible underground waters. Despite the abundance of water, water supply represents a limiting factor for production in many sectors. Approximately 10,000 ha (0.1% of arable land) was irrigated before the war. Presently irrigated territory is considerably reduced, as a result of war damage, mine fields, insufficient maintenance, theft, etc.

In lowland areas, natural conditions are favourable for sustainable agricultural production and a modern market economy. The highest quality soils are to be found in the valleys of the Sava, Una, Sana, Vrbas, Bosna and Drina Rivers. In the highlands of Bosnia and Herzegovina, there is less valuable agricultural land. In these areas, it is possible to organize cattle breeding and complementary agricultural production, then healthy human food and animal feed production, barley production for breweries, potato production, etc. Agricultural lands in the Mediterranean region cover the territory of the southern Dinarides and the lowlands of the Herzegovina region. Karstic fields in this area cover about 170,000 ha. It could be possible to organize intensive greenhouse and open-space agricultural farming, vine-growing, large-scale cultivation of citrus fruits and vegetables, freshwater fish farming, and bee-keeping.

BiH has more than 500,000 farms (estimates of USAID FARMA Project). The average size of approximately 50% of farms is 2 ha, whereas the size of more than 80% of farms is less than 5 ha. In view of the fact that most farmers are mainly private farm owners and that a single plot is usually used to grow several types of fruits and vegetables, serious development of agricultural production cannot be expected. Even though some tangible progress is evident, the labor-intensive production of fruits and vegetables is still prevalent, resulting in low average yields and additional increases in product prices, which make products uncompetitive in both local and international markets. The level of rational utilization of land resources plays a key role, as well as the ownership of the land and the size of the property.

Erosion and flooding of farmlands in BiH endanger harvests and sustainable use of soil. Lijevče polje, Semberija and fertile farmlands along Drina, Bosna, Vrbas, Sana, Una, Sava, Neretva and Trebišnjica Rivers are all endangered.

BiH policy in the sector of agriculture, food and rural development has recently been developing in accordance with the goals and requirements of the EU association process. Although BiH has in past years achieved considerable progress, economic reforms are still necessary in order to fulfill the conditions for the EU association. According to the European Commission's 2010 Progress Report for Bosnia and Herzegovina, there has been little progress in alignment with European standards in the field of agriculture and rural development. A State-level strategic plan and operational programme for the harmonisation of agriculture, food and rural development are in place. However, implementation has not started. The Republic of Srpska rural development strategy and action plan and the Federation of BiH operational programme for the harmonisation of agriculture, food and rural development need to be harmonised with the State-level framework. Some legislation implementing the Framework Law on Agriculture, Food and Rural Development and the Law on Tobacco has been adopted, but there is still an overall lack of implementing legislation that impedes the coordination of harmonised strategies and legislation in this sector throughout the country.

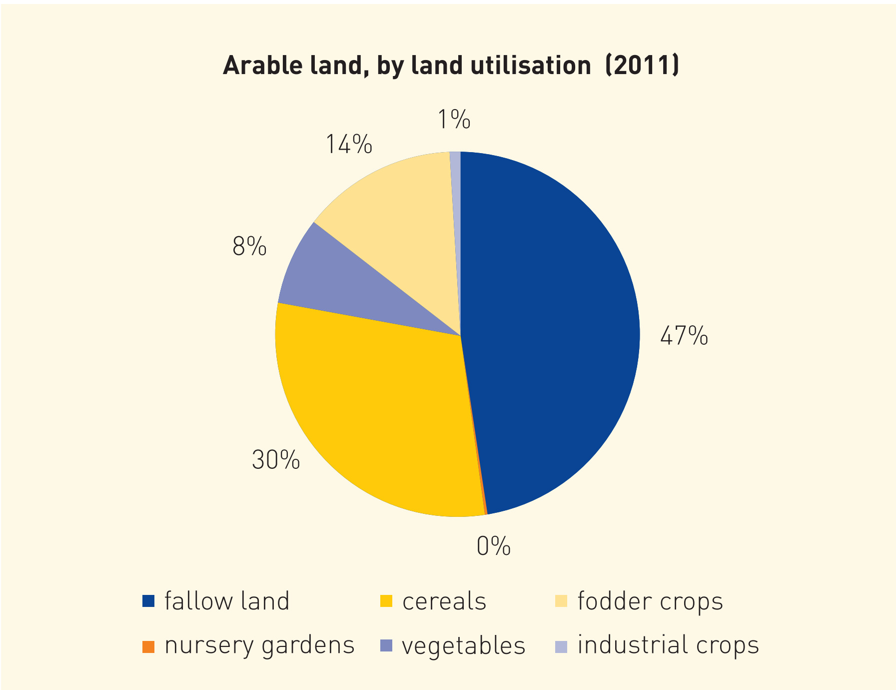


Chart 3: Arable land, by land utilization (BHAS 2011)

Commodity exchange in the agro-industrial sector (agricultural products classified according to WTO classification) in 2010 recorded a 6.83% increase in imports compared to the preceding year, while BiH exports in the same period increased by 30.29%. Imports of agricultural products comprise 18.81% of total BiH imports, while the share of agricultural exports totalled 8.65% of all BiH exports. The percentage of import coverage by export of agricultural products for the observed period was 23.97%.

According to the date available from the 2011 BiH Foreign Trade Exchange Analysis, conducted by the Ministry of Foreign Trade and Economic Relations (MOFTER), total area covered by cereal crops was 303,000 ha, by fodder crops - 138,000 ha, by vegetable crops - 78,000 ha, and by industrial crops - 8,000 ha. Total achieved production in 2011 was as follows: 1,077,387 tons of cereals, 771,999 tons of fodder crops, 676,109 tons of vegetable crops, and 10,113 tons of industrial crops.

Small and fragmented properties, poor technical equipment on agricultural farms, obsolete production technologies, low efficiency of inputs, the symbolic utilisation of irrigation systems, and the continuing dominance of labor-intensive methods of production are only some of the factors that have an impact on the overall modest agricultural production. In addition, low average yields increase commodity prices, making agricultural commodities uncompetitive in both foreign and local markets. Contributions to the agricultural sector in BiH were not sufficient, and amounted to KM 26 per capita, KM 44 per ha of agricultural land, and KM 61 per ha equivalent of arable land. Even though budgetary support to this sector has generally increased over the several past years, it needs to be harmonized and brought in line with measures similar to those applied in EU countries.

1.5.5. Forestry

Bosnia and Herzegovina has particularly rich biodiversity due to its location in three distinct geological and climatic regions: The Mediterranean region, the Euro Siberian-Bore American region, and the Alpine-Nordic region. BiH is one of the countries in Europe with the greatest diversity of species of plants and animals. Flora in Bosnia and Herzegovina accounts for about 4,500 species of high plants, 600 moss taxa and 80 ferns (Brujic, 2011). There are around 250 forest tree species. Over 200 fauna species are living in the forest. As much as 30% of the total endemic flora in the Balkans (1,800 species) is contained within the flora of Bosnia and Herzegovina. Fauna inventories indicate that the animal kingdom is rich and diverse, particularly in comparison to other countries in the Balkans and in Europe, but this rich biodiversity is endangered. It is important to emphasize that only about 1% of the BiH territory is protected (three national parks and two wildlife parks), which is a devastating fact considering the richness of biodiversity and natural resource potential. Given the size of the country and the number of registered geological rarities, Bosnia and Herzegovina is one of the countries with the greatest diversity, both in Europe and in the world.

Forests and forest land occupy a surface area of approximately 27,100 km^2, or about 53% of the territory of BiH: about 23,000 km^2 of this land is comprised of forests and about 4,000 km^2 is forest land. The annual increment in the forests is relatively low, because so-called economic forests (forests that can be managed on an economic basis) cover only about 13,000 km^2 (approximately 25% of the country), and even these forests have low timber reserves (as low as 216 m^3/ha with an incremental increase of timber of a mere 5.5 m^3/ha, or half of the potential of the habitat). There are about 9,000 km^2 (approximately 17%) of low and degraded forests with a very low incremental increase (approximately 1 m^3/ha) and with no economic value from the timber production perspective. Based on this increment, about 7,000,000 m^3 per year was cut in BiH before the war, and this potential should be the basis for the strategic development of the wood-processing industry.

Due to activities such as illegal logging, ore mining, forest fires, the area under forest cover has been shrinking rapidly; furthermore, a significant part of the forest cover has been declared as mined (numbers indicate approximately 10%) and has evident damage due to war activities. In addition, there are extensive unresolved property disputes and cases of illegal land acquisition that are awaiting resolution due to complex legal mechanisms and administration.

Currently around 50% of state-managed forests in BiH have been certified according to FSC Standards, and some have gone further to ISO certification in order to upgrade their operations and demonstrate their commitment to sustainable forest management.

The legal and institutional framework covering forestry has been structured through the two entity governments.

Total production of forest assortments in Bosnia and Herzegovina in 2011 decreased by 3.17% compared to 2010 (BHAS). Production of coniferous (softwood) assortments recorded a slight increase of 0.16%, while production of broadleaf (hardwood) assortments in the same period recorded a significant decrease of 5.74%. The most significant production increase is recorded in category of technical coniferous wood; i.e., mining coniferous wood by 16.20% and other long coniferous wood by 11.96%. Production of broadleaf assortments recorded a drop in all categories, the most significant in the production of cord broadleaf wood: 19.35%. Overall sales decreased by 4.27% compared to 2010, while average reserves amounted to 351,844 m^3 of assortments, and were lower by 14.21% compared to 2010.

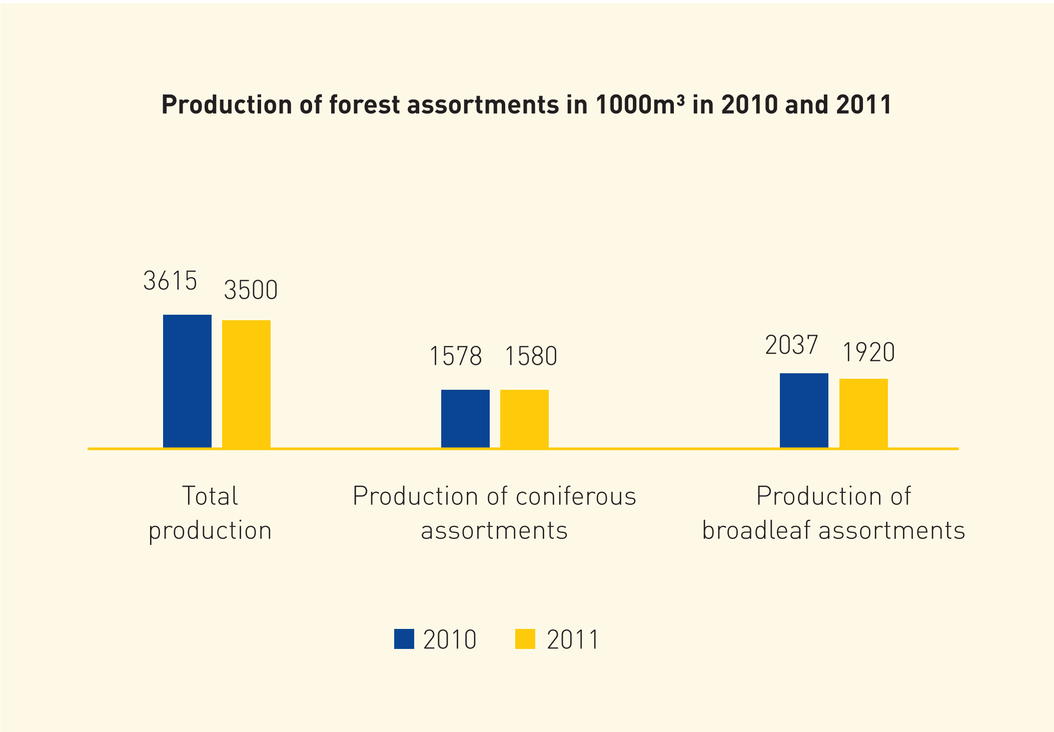


Chart 4: Production of forest assortments in 1000 m^3 (2010 and 2011) (BHAS)

1.5.6. Waste management

The estimated quantity of municipal waste generated in 2010 was 1,521,877 tons; i.e., 396 kg per year per capita or 1.08 kg per capita per day. In 2010, the amount of municipal waste collected by public waste collection services was 1,499,023 tons, which is 10% more than in 2009. The percentage of the population covered by waste collection services is on average 68%. The remaining population, which is not covered by municipal services, mainly resides in rural areas. The total quantity of waste collected is comprised of municipal mixed waste (92.4%), collected municipal waste separated at the source (6.0%), waste from gardens and parks (1.1%), and packaging waste (0.4%).

The total amount of waste disposed of at landfills in 2010 was 1,516,423 tons, which is 6.6% more than in 2009. Data on flows of waste disposed of at waste disposal landfills confirm the practice of full reliance on permanent disposal of municipal waste at landfills.

The PRSP Medium-Term Development Strategy, which was funded by the World Bank in 2004, envisaged the introduction of 16 sanitary solid waste disposal sites: 10 in FBiH and 6 in RS. Particularly important is the fact that treatment plants for medical and other hazardous waste still do not exist in BiH, while recycling of industrial and municipal waste continues to be limited. Therefore, improvements in treatment of industrial and medical waste, disposal of municipal waste and recycling present key challenges.

1.5.7. Water management

The territory of BiH covers two main river basins: the Sava River basin (38,719 km^2 or 75.7% of total surface area) and the Adriatic Sea basin (12,410 km^2 or 24.3% of the total surface area). The average annual runoff from the Sava River basin amounts to 722 m^3/s (62.5%), while the runoff from the Adriatic Sea basin amounts to 433 m^3/s (37.5%).

Bosnia and Herzegovina possesses considerable water resources, and in the future water may become one of the foundations of general economic development in many areas. However, the unfavourable spatial and temporal distribution of water outflows will require the construction of water management facilities of considerable scale and complexity to permit the rational exploitation of waters, preserve water quality and quantity, and protect the country from the damaging effects of water.

The condition of flood control facilities is very poor as a result of wartime damage, many years without maintenance, and minefields around some facilities. This is particularly true for towns along the Sava River. The consequences of floods resulting from exceptionally high waters in this area, if they were to occur, would be immeasurable.

In January 2008, two agencies were established for FBiH: the Agency for Water Catchment Area for the Sava River basin and the Agency for Water Catchment Area of the Adriatic Sea. In January 2013 in RS, instead of two water agencies: one for the Sava River basin and one for Trebisnjica River basin,,one public institution in charge for water management in the Republic of Srpska "Vode Srpske" was formed.

In 2011, total water intake was 329,954,000 m^3, which is 3% less than in 2010. In the structure of the total water intake, 45.9% of water came from underground sources, 36.8% came from surface sources, 15.1% came from river courses, 0.8% came from reservoirs, and 1.3% came from lakes. In 2011, the amount of water delivered from public water supply systems was 150,834,000

m^3, which is 8.4% less than in the preceding year. The structure of water consumption shows that households were the largest water consumers, consuming 76.3% of the water delivered by public water supply systems. Outlets of untreated wastewater, access to drinking water and flood management remain key issues in this sector.

Figure 3. Map of the two basins in BiH

1.5.8. Health

Bosnia and Herzegovina (BiH) is a member state of the World Health Organization (WHO), which endorsed the revised International Health Regulations [IHR (2005)] that entered into force on 15 June 2007 [IHR (2005) Article 59]. The organization, financing and provision of health care services are the responsibilities of the entities and Brčko District, and they are regulated by the FBiH Ministry of Health, the Ministry of Health and Social Welfare of the Republic of Srpska and Department of Health and Other Services of Brčko District. At the state level, the Ministry of Civil Affairs, as the competent ministry in the Council of Ministers of Bosnia and Herzegovina, is responsible for "carrying out tasks and discharging duties which are within the competence of BiH and relate to defining basic principles, co-ordinating activities and harmonising plans of the Entity authorities and defining a strategy at the international level in the field of health and social welfare" (Law on Ministries and Other Bodies of Administration of Bosnia and Herzegovina, 2003, Article 15). Two years after the submission of the Initial National Communication, total current health care public expenditure in BiH amounted to 10.3% of GDP, which is higher than the EU-27 average (9.2% of GDP) and nearly 3.0% higher than reported in the INC (7.6% of GDP). However, if analyzed per capita, these expenditures are seven times lower than in Slovenia and three times lower than in Croatia.[3]

Household health care expenditures, i.e. "out-of-pocket expenditures," represent a significant share of spending for health services. In 2008, these expenditures amounted to 42% of total expenditures, and they were significantly higher than in EU member states (9.6% in Slovenia; 13.1% in Germany; 22.3% in Portugal).

3 EuropeAid/120971/C/SV/, Izvještaj Jačanje zdravstvenih sistema BiH za integraciju u EU

As of 2009, the leading causes of death in Bosnia and Herzegovina were still circulatory system diseases (50.92% in RS and 53.4% in FBiH) and malignant neoplasms (20.48% in RS and 20.0% in FBiH). In other words, nearly three quarters of all deaths could be grouped into these two categories. Respiratory system diseases are ranked among the five leading causes of death in FBiH (3.4%), and as a sixth cause of death in RS (7.8%). All of these causes are linked to the high prevalence of risk factors and the increase of chronic diseases in population morbidity.

Neither direct nor indirect climate change effects on human health have been continuously monitored in BiH. Although some reports systematically cover climate change issues in BiH, there is still no established system for monitoring the incidence of certain diseases in a particular region that could be linked to changes in some climate parameters and subsequent natural disasters. Data gathered at the state level have not been used for development of a clear response methodology for crisis situations caused by climate change, preventive measures that must be implemented in order to avoid the occurrence of crisis situations, or mitigating measures for consequences caused by climate change (e.g. reduced food yield due to drought or flooding or a shortage of safe drinking water). In BiH practice, there is still no clear model of information flow between different sectors, competences frequently overlap, and it is not clear who is responsible to whom, who takes data from whom and by which methodology or how data are delivered. Consequently, there is a lack of adequate environmental reports and reports on environmental risk factors and their impact on climate change and human health, even though reporting in the health sector is well regulated and harmonized with OSTATA requirements. Accordingly, it can be assumed that human vulnerability is still high.

1.5.9. Education

In the 2010/2011 school year, there were 487,389 students in Bosnia and Herzegovina (source: BHAS). Of these, 335,665 students attended 1,849 primary schools, which is 4.15% less compared to the preceding school year; and 151,724 students attended 309 secondary schools, which is 3.3% more than in the preceding school year. There are seven public universities (with 95 schools) and numerous private universities with a total of approximately 105,000 full-time students.

Education in BiH is covered by legislation at various levels in the FBiH and RS. In RS, all education levels are covered by entity level legislation. There are separate laws for each of the four levels of education mentioned above. In FBiH, education is regulated by legislation at the cantonal level. Each of the ten cantons has its own law on pre-school, primary and secondary education, and the cantons that have universities also have laws on higher education. The Brčko District, as a separate organizational unit in BiH, has its own laws covering each of the four levels of education. Therefore, there are more than thirty laws at different levels regulating this area.

The responsibility for issues of higher education and science lies with the Entities of Republic of Srpska and Federation of BiH, and in FBiH this role belongs to the cantons. The Ministry of Civil Affairs of BiH has a coordinating role at the state level; i.e., it coordinates the activities of the relevant entity bodies in this field and is in charge of international cooperation. Through two of its sectors – the Sector for Science and Culture, and the Sector for Education – this Ministry coordinates and monitors the implementation of international agreements and strategic documents in the field of education and science, participation in activities of international organisations in the field of education and science, participation in EU programmes (FP7, COST, EKA, Erasmus Mundus, etc.) and monitoring the process of European integration.

In RS, sectors of higher education and science are regulated at the entity level by the RS Ministry of Education and Culture and the RS Ministry of Science and Technology. The RS Ministry of Science and Technology is in charge of issues related to science and technology within the RS, and it actively participates in distribution of information related to research funds (such as FP7) in the field of science and technology. The Centre for Project Implementation is a part of the Ministry, and its main goal is to stimulate research activities and the participation of RS universities and private companies in research programs (EU and domestic).

In FBiH, public universities are established by cantons, whereas the FBiH Ministry of Education and Science performs administrative, professional and other tasks at the level of entity, including copyright and protection of intellectual property rights, as well as coordination of scientific and research activities. Cantonal ministries in FBiH regulate the education and science policy for their cantons. In addition, cantonal governments monitor the educational policy, finances and operations of public and private institutions of higher education.

The Brčko District, as a separate administrative unit, is responsible for education and science policy.

The Institute for Intellectual Property of BiH is responsible for intellectual property rights in Bosnia and Herzegovina.

Certain progress has been achieved in past years in the field of research and innovation policy. Participation in the Seventh Framework Programme of the European Union (FP7) has increased somewhat. Cooperation with COST and EKA programmes has commenced. The Ministry of Civil Affairs provided financial support for individuals developing projects for FP7, COST and EKA. However, administrative and research capacities are too weak for BiH to take full advantage of its participation in FP7 and funds actively stimulating the scientific community. Participation and success rates in activities of the Marie Curie Programme are low, as is the involvement of the private sector.

Some efforts have been exerted in the field of integration into the European Research Area (ERA), and contributions have been made to the Innovation Union (IU). BiH has joined the EURAXESS network in order to increase the mobility of its researchers. An umbrella organization for the coordination of the national EURAXESS network has been established at the University of Banja Luka. Financing has slightly increased, mainly for researchers, and modernization of infrastructure, equipment and publications has been achieved, especially by admittance to the COBISS library information system. The RS entity government and other bodies increased their investments into research and development activities. However, in general terms, investments into research activities continue to be at a very low level, especially in the private sector. As with the entities, cantons finance their laws through their budgets, thus it is difficult to improve research regulation and avoid fragmentation, which is one of the main goals of the ERA. Precise science and technology statistics do not exist.

All things considered, harmonization with European standards in the fields of education and culture is still in its initial phase. Strategies and framework laws should be implemented. Structures of state level agencies for education and quality assurance should be operationalized. The country's participation in the Culture Programme contributes to the implementation of the EU Acquis Communautaire. In the fields of research and innovation, preparations for future integration into ERA and the Innovation Union have commenced, but serious efforts still need to be made. There is also a need for careful monitoring.

1.6. Challenges of long-term development - Millennium Development Goals (MDG)

The Millennium Development Goals, which were introduced by the United Nations in 2005 and adopted by all countries, establish a series of targets in eight areas for the year 2015. These targets are designed to allow countries to guide future development. Bosnia and Herzegovina's future lies in its full integration into the European mainstream, and this integration directly implies close cooperation, followed by membership in the EU. European integration requires a series of policy and legislative changes associated with adopting the Union's treaties and conventions, which are known as the Acquis Communautaire. This is a vast body of law, and much work will be required to make BiH's legal provisions and technical standards compliant with current EU practice. However, that European pathway should be something more than a sterile technical process: it should be a process in which BiH citizens shall be in position to have same rights and responsibilities as other Europeans. Moreover, it is likely that the accession reforms, particularly those in the economic sphere, will be difficult to accomplish and will potentially have considerable social fallout. The Millennium Development Goals therefore have two roles to play; first, they afford a broader perspective by which to measure reform by bringing in social and environmental considerations; and second, they offer a vehicle by which the public can be engaged and their support retained.

The Millennium Development Goals offer a holistic framework for guiding long-term development in BiH on a path to becoming a prosperous and sovereign European democracy. The MDG Progress Report has built on the preceding National Human Development Report / MDG report to improve and further tailor the monitoring and evaluation framework. However, even though a great deal has been achieved, it is evident that the MDG Progress Report represents only a starting point and not the end of the process. Achievement of the MDGs shall require significant changes in the field of policy measures and resource allocation, and the following challenges should be emphasized:

Health and education

BiH already meets minimum European standards in fields of health and education. Nevertheless, declining enrolment rates and a reduction in access to health care services imply that this status quo should not be taken for granted, and without new attention to these issues, declines and disparities in service provision will become increasingly visible. BiH must be proactive and deal immediately with fragile economic prospects and insufficient public revenues by implementing a comprehensive development strategy.

Central importance of good governance in achievement of MDGs

Good governance represents a prerequisite of the social and economic progress. In BiH, all hallmarks of good governance have been brought into question: accountability, transparency, citizens' participation, professionalism and efficiency. For example, prohibitively high public spending exacerbated the crisis in the BiH public sector. Delays in implementation of reforms shall lead to stagnations, and consequently to a failure to achieve MDGs. In addition, good governance cannot be achieved without the protection and promotion of human rights. In the BiH context, the transfer of power to local governments needs to be encouraged, especially to municipal authorities, as that is the level of administration that is closest to citizens, and thus is in a position to advocate and to achieve development based on rights.

Institutional arrangements for MDG monitoring

The achievement of each individual MDG requires harmonized development support from different institutions at the state level. Of particular importance are strengthening of and coordination between statistical institutions in the country, in order to establish a reliable and coherent data collection system. Another priority is to conduct a comprehensive population census in April 2013. These initiatives are related to the development of institutions that are of essential importance for successful processes of MDGs monitoring and evaluation.

Participation of citizens and the civil society as a driving force

As underlined in the United Nations Development Assistance Framework (UNDAF), active civil society organizations and citizens are of vital importance for efficient monitoring and achievement of the MDGs. It is important to establish links, especially with civil society organizations dealing with particular Millennium Development Goals. For such a commitment to mean more than a mere gesture, efforts need to made in the fields of education and information regarding policy measures related to MDGs.

Achieving complementarity with EU association process

Even though it is clear that the Stabilisation and Association Agreement represents a key step in direction towards fulfilment of criteria in the process preceding the full EU membership, it is believed that it has a very narrow focus that rests on technical and economic issues. MDGs offer a complement, as they introduce a social and development sphere to the EU association process, providing the instrument for enhancing citizens' support and the commitment of authorities to EU accession.

2. CALCULATION OF GREENHOUSE GAS EMISSIONS

2.1. Methodology

As in the development of the Initial National Communication under the UNFCCC, the calculation of greenhouse gas emissions in the Second National Communication is one of the essential steps in systematically reviewing and addressing problems related to climate change. The knowledge acquired, positive practice and data collected, together with calculations of GHG emissions for the Initial National Communication under the UNFCCC, formed a solid basis for the estimation of greenhouse emissions in the Second National Communication.

GHG emissions in this communication cover the period 1991-2001. It should be noted that the most detailed emission data were reported for the year 2001, because a much more complete set of data were available for the year 2001 than for the prior year of 2000. This was due to the availability of data on energy balances (missing for previous year), which made it possible to use a "Reference Approach." The mandatory tables were prepared for other years in the CRF (in Excel format) on the basis of data available for those years. Because the period of 1992-1996 in BiH was a period of civil war, input data for that period feature a greater degree of uncertainty, as do the data for 1997 and 1998, as institutional data collection in these years did not provide data sufficient for the proper calculation of GHG emissions.

For the purposes of calculating emissions in this communication, the team used both the Intergovernmental Panel on Climate Change (IPCC) methodology laid out in the Convention, based on the reference manual Revised IPCC 1996 Guidelines for National GHG Inventories and Good Practice Guidance and Uncertainty Management in National GHG Inventories and the CORINAIR and REPORTER software for databases, with predominant use of the recommended IPCC default emission factors with the exception of the energy sector, where local emission factors were also used. For the calculation of emissions from the agriculture sector and of CO_2 sinks (LUCF), the team used the recommended IPCC Excel tables, which--together with the Common Reporting Format (CRF) tables--constitute an integral part of this communication.

The IPCC methodology and approach ensure the transparency, completeness, consistency, comparability and accuracy of calculations. The methodology requires the estimation of uncertainty of calculations and the verification of inputs and results in order to enhance the quality, accuracy, and reliability of the calculations. In addition, one of the internal verifications of calculations within the methodology is the calculation of CO_2 emissions from fuel combustion in two different ways: the more detailed Sectoral Approach and the simpler Reference Approach.

The BiH inventory of greenhouse gases covering a ten-year period, 1991 to 2001, has been compiled in line with the inventory development recommendations – UNFCCC Reporting Guidelines as per Decisions 3/CP.5 and 17/CP.8, including the CRF and the Revised 1996 IPCC

Guidelines for National Greenhouse Gas Inventories, which specify reporting requirements under Articles 4 and 12 of the UNFCCC (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

2.2. Data collection and processing system

The greenhouse gas inventory in this report covers the ten-year period of 1991 to 2001. Because no institution at the level of Bosnia and Herzegovina is responsible for gathering specific "activity data" needed for the estimation of the inventory of emissions according to UNFCCC, these activities were conducted at the entity level.

For the preparation of this communication, UNDP Bosnia and Herzegovina hired experts from both entities in a public tender. The experts participated in data collection for the sectors defined by IPCC instructions: energy, industrial processes, agriculture, waste management and sinks. They also jointly participated in the development of individual emissions assessments by sector. This chapter represents a synthesis of individual reports drawn up by working groups using a database on emission factors and written information on the combustion of fossil fuels in BiH. Intensive cooperation on data collection was maintained with the Hydrometeorological Institute of FBiH and the Republic Hydrometeorological Institute of RS, whose experts gathered part of the data on fossil fuel combustion and industrial processes and performed the calculations for GHG emissions in accordance with IPCC methodology in the following sectors: energy, waste management, agriculture, and sinks.

Although there is a state-level Agency for Statistics of BiH and two entity-level statistical institutes, they currently have only a very small portion of the data needed for the estimation of the emission inventory. Large energy production facilities, mainly thermal power plants, keep records on data about fossil fuel consumption. Some thermal power plants also have emission monitoring systems, but the maintenance of these systems is irregular, and these data may only be used to verify emissions calculations.

Power utility companies in both entities definitely have data on the consumption of fossil fuels in thermal power plants, and these data may be considered reliable. In addition, larger energy and heating plants in cities have activity data.

Emissions or activity data from mobile sources may be obtained through the entity-level statistical institutes (the Republic of Srpska Institute of Statistics and Federal Office of Statistics of FBiH). The type and age of individual categories of mobile sources and annual fuel consumption must be estimated, but that is not a serious problem.

However, problems arise when data on total annual consumption of liquid fuels are needed, whether at the entity or state level. These records are very poor, because the calculations regarding consumption data for the post-war period are not comparable. The problem is due to the failure to log all liquid fuels that are imported into BiH across border crossings, and which are consequently not shown in statistical reports.

A bigger problem is posed by activity data for industrial processes, as these data are inadequately presented in statistical publications and official documents. In the post-war period, industry in Bosnia and Herzegovina has been operating at a limited capacity, which is for the most part a consequence of wartime destruction of industrial facilities and partly a result of the failure to restore production in facilities that exist but are technologically obsolete.

Similar problems are encountered with the activity data for agriculture, land use change and forestry (LUCF), and waste. There is no clear delineation of responsibilities among institutions in charge of data collection. Although it is stated that each sector is covered by several institutions, it is not clear what the responsibilities of each institution are and how much data they need to collect. The problem lies in the fact that there are no clear instructions at the entity level for reporting on activity data. Experts from the Faculty of Agriculture and the Hydrometeorological Institute, who were included in the working group, completed calculations of GHG emissions and CO_2 sinks in these sectors in accordance with the IPCC instructions and with Excel tables recommended by IPCC.

Another current problem is a lack of knowledge on the part of corresponding entity authorities and of the majority institutions about BiH's commitments under the UNFCCC and Kyoto Protocol. Significant changes are expected, as laws recently adopted include commitments on reporting, inventory preparation and activity data collection. Naturally, the key issue is the extent to which the laws adopted will be implemented at all levels.

In summary, key issues identified in the field of GHG inventories are as follows:

- incompatibility between the existing data and those required under the IPCC methodology;
- missing data;
- lack of legislative requirements on the type and scope of data to be collected; and
- insufficient knowledge regarding treaty obligations.

CORINAIR and IPCC methodology, as well as COPERT software, have been used to archive the data in digital form. The experience of working with these methodologies and software has been very valuable and will certainly be useful in further work on the development of subsequent national communications under the UNFCCC.

2.2.1. Calculating emission factors

Calculating emission factors (EFs) is one of the main requirements for preparing a good inventory of GHG emissions.

The CORINAIR methodology, together with the latest software, enables the development of an emissions inventory not only for the purposes of the LRTAP convention, but also for the purposes of UNFCCC and IPCC. It is known that the new software offers the possibility of obtaining the necessary tabular formats in the CRF very quickly.

The main challenge for the reporting period (1991-2001) will be the gathering of data and estimation of GHG emissions for the four wartime years, although the process will also be very complicated for the post-war years, too.

As far as industrial processes are concerned, there are no solid measurement data. Consequently, it is suggested to use the factors recommended in IPCC guidelines and instructions.

Regarding agriculture, default emission factors stated in the IPCC guidelines are sufficient.

LUCF and waste are more problematic due to the absence of real inputs needed for calculation; thus, the recommended IPCC methodology will be used.

2.2.2. Reporting

In terms of Article 12 of the UNFCCC, the responsibility for reporting rests with the Ministry of Spatial Planning, Civil Engineering and Ecology of RS in its capacity as the national focal point. In the Entities, the responsibility for reporting rests with the relevant line ministries in charge of environmental issues and in FBiH, additionally with the relevant cantonal ministries in charge of environmental issues; in short, a complicated process of GHG emissions inventory development in Bosnia and Herzegovina. In the Republic of Srpska, the Republic Hydrometeorological Institute of RS is the responsible institution for development of the GHG emissions inventory.

Major difficulties in Bosnia and Herzegovina in the area of reporting are as follows:

- Lack of permanent funding for reporting;
- Lack of relevant implementing regulations for data collection requirements;
- Lack of activity data needed for reporting to IPCC and fulfilling commitments under the UNFCCC;
- Lack of personnel with the experience needed for preparation of data in industry, agriculture and LUCF;
- Lack of administrative capacity for the preparation of high-quality subordinate legislation on activity data collection; and
- Lack of expert assistance to allow implementation of commitments under UNFCCC.

2.2.3. Quality control (QC) and Quality assurance (QA)

UNFCCC and IPCC recommendations emphasize data quality control (QC). This is, in fact, a system of certain technical activities, estimations, and quality control of the emissions inventory. Quality control includes a careful verification of the accuracy of collected data, emission factors, and an estimation of uncertainty.

Quality Assurance (QA) activities include a planned system of review for procedures conducted by personnel not directly involved in the inventory development process.

Bosnia and Herzegovina as an economy in transition has, in accordance with the decisions of the Convention bodies, utilized the possibility of inventory review and uncertainty estimations regarding the inventory by a group of international experts formed for that purpose by the UNFCCC Secretariat.

Unfortunately, this measure is not sufficient for the full implementation of QA/QC in Bosnia and Herzegovina, because the main problem related to quality assurance is the quality of input activity data.

Recommendations for improvements in the GHG inventory are as follows:

- Delineation of institutional responsibility for the systematic compilation of national GHG inventories;
- Capacity building in the BiH Agency for Statistics and entity institutes of statistics in data collection and statistics necessary for the establishment of the GHG inventory;
- Increase in the number of personnel and the amount of financial resources for the collection of basic data and emission data;
- Ensuring regular publication of national emission statistics;
- Expansion of financial resources for the training of personnel, calculating emissions and emission factors, research and projections of national GHG emissions, establishment and implementation of a national GHG emission inventory review system by an independent team of experts, and improvements in the quality of data archiving;
- Continued investment in hardware and training of personnel for data collection, measurements and management with the aim of improving the quality of data on emissions associated with natural gas, waste and industrial processes;
- Issuing authorisations for creation of individual emission databases in relevant institutions; and
- Increasing public awareness of problems associated with climate protection and the potential consequences of climate change.

2.3. CORINAIR system

The inventory is based on the CORINAIR (CORe INventory of AIR emissions) system created by ETC/AE (the European Topic Centre on Air Emission). As many other European countries, BiH uses this calculation method for quantifying emissions.

The aim is to collect, maintain, track, and publish air emission data for the purpose of the European emission inventory and database system. This system includes air emission from all sources relevant for environmental problems, climate change, acidification, eutrophication, tropospheric ozone, air quality and dispersion of hazardous substances.

Since CORINAR is source-oriented, there is a clear distinction between the point source and surface source. Point sources are large stationary emission sources releasing pollutants into the atmosphere. Facilities or activities with small, individual emissions that are not sufficient to be classified as point sources are combined into surface sources. These surface sources can contribute significantly to total emissions.

The CORINAIR system is designed for the collection of emission data and national reporting on air emissions to the European Environment Agency (EEA) using a uniform format. This common Europe-wide database can be used for preparing certain inventories in line with the UNECE/CLARTAP and UNFCCC guidelines. A brief description of the AE-DEM software package is given below:

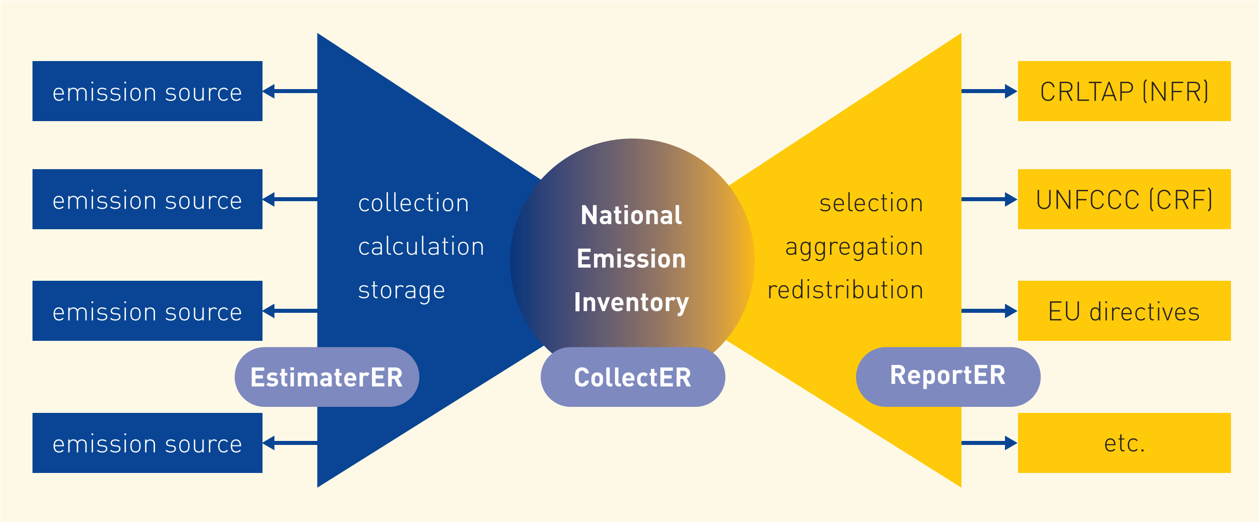


Figure 4. National emission inventory

2.4. Results of 1991-2001 GHG emissions estimation

This section provides an overview of results of the GHG emission calculation for Bosnia and Herzegovina. The results have been given first as total (aggregated) emissions of all greenhouse gases by sector and then as emissions of specific greenhouse gases, also by sectors.

Because certain greenhouse gases differ in terms of their radiating characteristics, their contribution to the greenhouse effect varies. In order to allow the aggregation and total overview of emissions, it is necessary to multiply the emission of each gas by its Global Warming Potential (GWP). GWP is a measure of how much a specific gas contributes to the greenhouse effect in relation to the impact of CO_2. In this case, the emission of greenhouse gases is expressed in Gg CO_2e (mass of equivalent CO_2).

Table 9. shows the global warming potentials for individual gases for a period of 100 years.

Greenhouse gas	Global warming potential
Carbon dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous oxide (N_2O)	310
CF_4	6500
C_2F_6	9200
SF_6	23.900

Table 9. Global warming potentials for individual gases for a period of 100 years

Carbon dioxide (CO_2) is one of the most important greenhouse gases, especially where the consequences of human activities are concerned. Carbon dioxide is estimated to be responsible for around 50% of global warming (Source: IPCC). Almost everywhere in the world, including Bosnia and Herzegovina, the most common anthropogenic sources of CO_2 are the combustion of fossil fuels (for power production, industry, transport, heating, etc.), industrial activities (steel and cement production), and land use change and forestry activities (in BiH, due to an annual biomass increase, there is a negative emission, or sink, in this sector).

When appropriate data do not exist, reporting tables (CRF) use suitable signs to fill in the empty fields; i.e., NO when emissions are not occurring, and NE when emissions are *not estimated*.

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Total emissions without sinks (Gg CO_2e)	30,797	10,567	4,010	4,474	4,458	7,390	10,244	14,225	14,599	15,249	16,118
1. Energy	**23,282**	**6,406**	**2,393**	**2,615**	**2,304**	**4,703**	**7,358**	**11,109**	**11,192**	**11,804**	**12,330**
A. Fuel combustion (sectoral approach)	21,699	5,960	2,237	2,455	2,145	4,401	6,911	10,568	10,678	11,290	11,824
1. Energy industries	14,572	5,149	1,872	2,092	1,871	3,816	6,138	7,956	7,425	7,803	7,997
2. Manufacturing industries	685	NE	NE	NE	NE	37	67	42	58	77	95
3. Transport	2,508	NE	NE	NE	NE	NE	NE	1,704	2,038	2,123	2,500
4. Other sectors	3,934	811	365	363	275	548	706	866	1,157	1,287	1,232
5. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
B. Fugitive emissions from fuels	1,583	446	156	160	159	302	446	541	515	514	506
1. Solid fuels	1,583	446	156	160	159	302	446	541	515	514	506
2. Oil and natural gas	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Industrial processes	**2,500**	**42**	**NE**	**NE**	**21**	**89**	**191**	**307**	**394**	**456**	**597**
A. Mineral products	346	42	NE	NE	21	89	181	248	289	309	422
B. Chemical industry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Metal production	2,154	NE	NE	NE	NE	NE	9	59	106	147	175
D. Other production	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Production of halocarbons and SF_6	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Consumption of halocarbons and SF_6	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3. Solvent and other product use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
4. Agriculture	**4,023**	**3,439**	**1,241**	**1,405**	**1,624**	**1,852**	**1,956**	**1,989**	**2,102**	**2,026**	**2,203**
A. Enteric fermentation	1,607	1,719	461	514	633	710	775	789	814	777	777

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
B. Manure management	493	157	48	54	67	82	81	81	83	77	80
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils[2]	1,922	1,562	732	837	924	1,060	1,101	1,119	1,206	1,172	1,345
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
5. Land use change and forestry (sinks)	**-7,689**	**-10,147**	**-10,568**	**-10,081**	**-10,240**	**-9,367**	**-8,483**	**-8,307**	**-7,297**	**-7,302**	**-7,212**
6. Waste	**992**	**680**	**376**	**454**	**508**	**746**	**739**	**819**	**909**	**964**	**988**
A. Solid waste disposal on land	992	680	376	454	508	746	739	819	909	964	988
B. Wastewater handling	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Table 10. CO_2e emissions (Gg)

Analysis of these data (1991-2001) must account for the fact that Bosnia and Herzegovina was in a war from 1992 to 1996, and the data for that period and for the period until 1998, have increased uncertainty.

In Table 10, some data for the wartime and post-war period are marked as "NE" – not estimated. This is particularly notable in the transport sector for the period 1992-1997, as it is indisputable that traffic did run; however, no official data exist on the number of vehicles, and an estimation of emissions without those data was not possible. According to the opinion of members of the working group and the leader of the team in charge of the GHG emission calculations from the transport sector, any such estimation would have too much uncertainty to meet the established criteria. Other "NE" marks mean that there were no activity data that could provide a calculation of GHG emissions with an acceptable level of uncertainty.

It should be noted that there are no official statistical data available for the calculation of emissions in the 1991-2001 period. Only since the year 2008 have data of a certain quality been provided by the BiH Agency for Statistics and entity institutes for statistics, including some activity data necessary for calculations of GHG emissions by individual sectors. Naturally, data also exist in statistical reports covering the period prior to 2008, but it is believed that the data quality is less suitable for calculations.

An additional issue concerned records of imported liquid fuels. Calculations of emissions from the transport sector were performed in COPERT software based on the number of vehicles, for which official 1998 records still exist, as well as from certain information about liquid fuels imported to BiH. They were then imported into the collectER software.

2.4.1. Emission of carbon dioxide (CO_2) by sectors

Chart 5. depicts CO_2 emissions for the period 1990 to 2001. It is evident that analysis in this chart deviates from charts from most other countries, since instead of a normal increase in emissions of CO_2e it shows a decrease of GHG emission during the war (12% in 1993 compared to the base year of 1990).

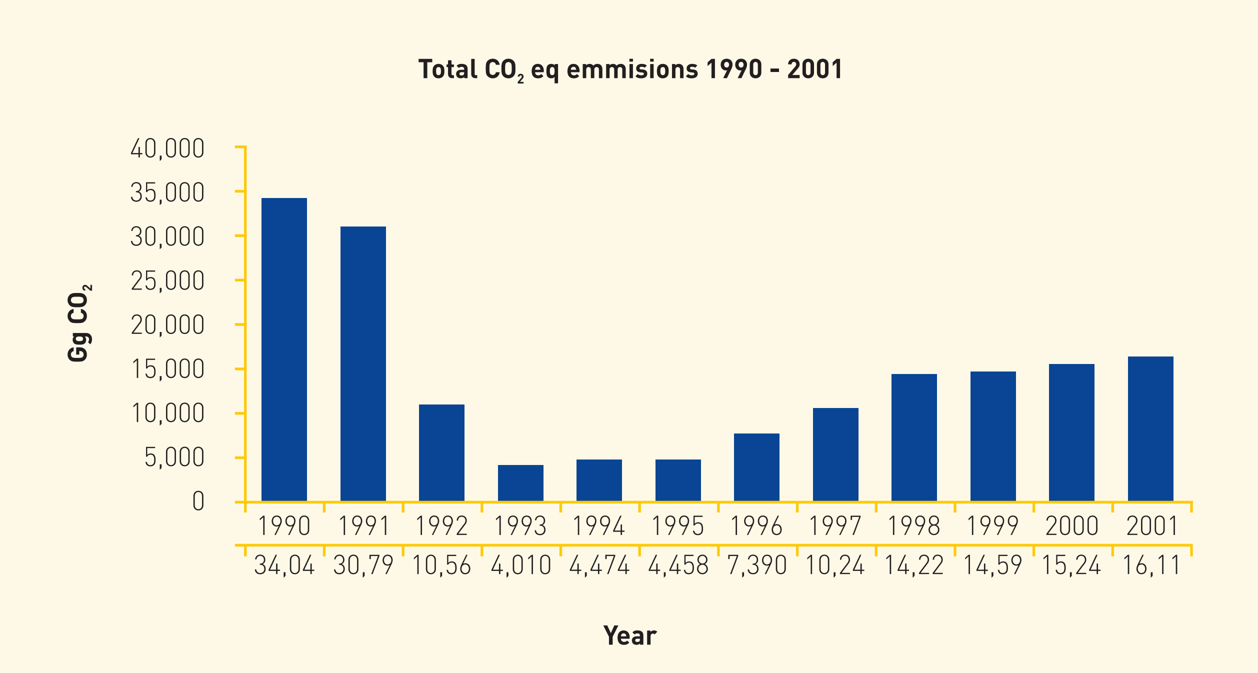


Chart 5. CO_2 emissions, 1990 – 2001

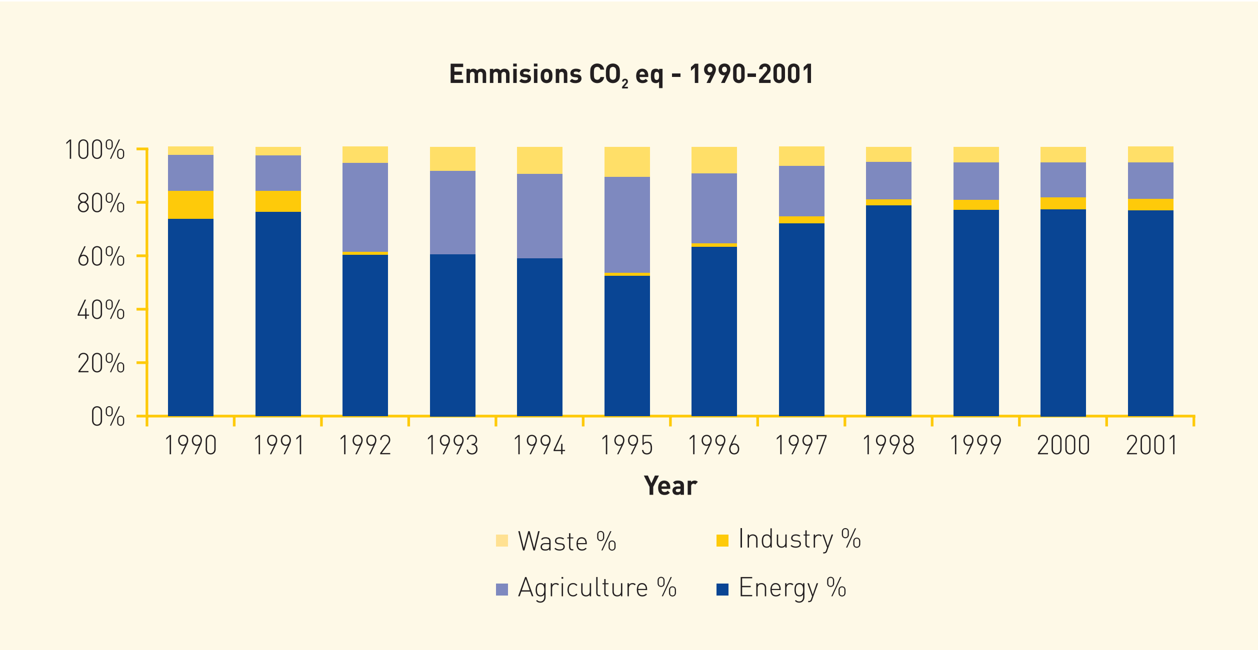


Chart 6. Emissions of CO_2 in % by sectors, 1990 – 2001

A slight increase in emissions is recorded for the period between the years 1993 and 2001. Shares of individual sectors start to approach their 1990 base year levels only in 1998. Due to the wartime destruction of infrastructure, total emissions in 2001 were only 47% of the base year of 1990.

2.4.1.1. Energy production

The main source of CO_2 is certainly the energy production sector, which contributes more than 70% of total CO_2 emissions. This sector covers all activities encompassing the consumption of fossil fuels (fuel combustion and non-energy fuel consumption) and fugitive emissions from fuel (Common Report Category – CRF 1.A. and 1.B. categories).

Fugitive emissions occur during production, transport, processing, storage and distribution of fossil fuels. The energy sector is the main source of anthropogenic emission of greenhouse gases.

Emissions over time are also shown in Table 10. Emission calculations have been based on the fossil fuel consumption data obtained on the basis of official written information submitted by energy entities, which allowed a calculation to be performed within the prescribed IPCC and CORINAIR methodology for the period 1991 – 2001 (Sectoral Approach).

Also, a simpler calculation was carried out (the so-called Reference approach), which considers only the total balance of fuel, without sub-sectoral analysis. A comparison of the results (a type of internal control) of both calculation approaches indicated a 1% difference in 1990; in the year 2001, the year with the most complete data in post-war period for the reporting period, this difference was 9%. These results confirm the aforementioned presumptions about the availability and quality of data in the post-war period.

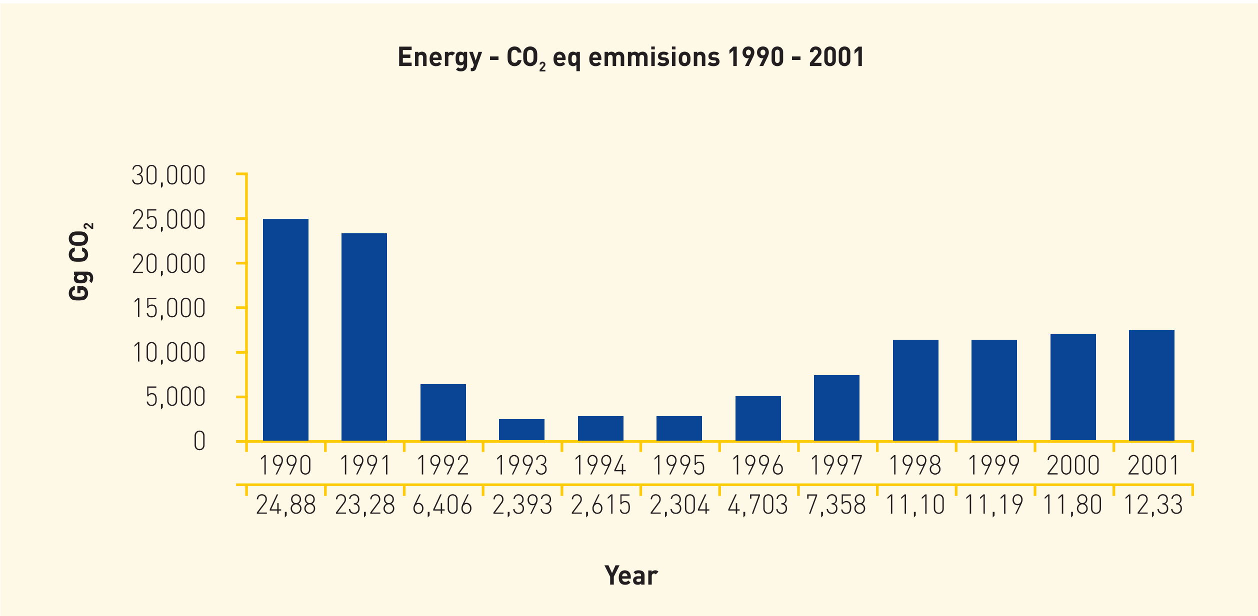


Chart 7. Share of CO_2 emissions from the energy sector, 1990-2001

Two of the most carbon-intensive energy sub-sectors are energy conversion (thermal power plants, heating plants, transport) and industrial fuel combustion. Most of the CO_2 emissions in energy conversion are from fuel combustion in thermal power plants.

Naturally, it is evident that emissions from the energy sector are dominant for the period under review, varying between 73% in 1990 to 78% in 1998. The minimal percentage was 52%, recorded in 1995. While the analysis of this chart is full of inconsistencies, in view of the fact that war lasted for several years (between 1992 and 1995) the data are logical and comprehensible.

Particular emphasis should be made of the fact that total emissions from the transport sector are about the same for the years 1990 and 2001, as is the number of vehicles (approximately 450,000). However, because total emissions from the energy sector were lower, road transport emissions comprised a relatively larger share of emissions than in 1990.

2.4.1.2. Industrial processes

Greenhouse gases may also occur as a by-product of various industrial processes outside of the energy sector in which an input substance is chemically transformed into a final product. The industrial processes known as significant contributors to CO_2 emissions are the production of cement, lime, ammonia, iron and steel, ferroalloys, and aluminium, as well as the use of lime and dehydrated soda lime in various industrial processes.

The recommended IPCC methodology has been used for calculation of emissions from industrial processes (Source: Revised IPCC Guidelines for National Greenhouse Gas Inventories).

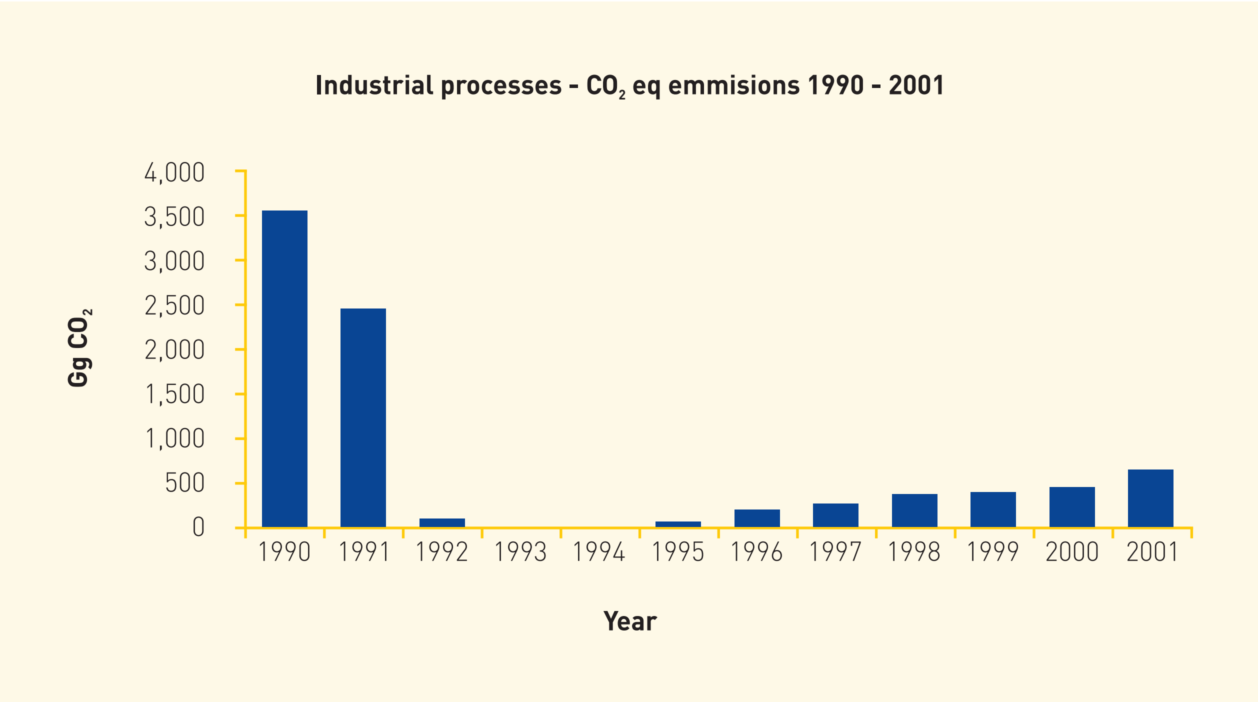


Chart 8. CO_2 emissions from industrial processes, 1990-2001

Chart 8 clearly shows the trend of emissions from industrial processes between 1990 and 2001. CO_2e emissions in 1990 totalled 3,554 Gg CO_2e, while in 2001 they were a mere 597 Gg CO_2e. Comparison of these two years shows that emissions in 2001 were only 16.8% of the 1990 base year emissions.

2.4.1.3. Sinks - LUCF

As already mentioned above, when absorption of greenhouse gases occurs (e.g. absorption of CO_2 due to an increase in forest wood biomass), we talk about greenhouses gas sinks, and the amounts are shown with a minus sign.

Total emissions and sinks in the forestry sector and land use change for BiH have been calculated for the period of 1991 - 2001. According to the data collected, the results of the calculation indicate that forests in BiH represent a significant CO_2 sink.

According to the data available for the baseline year, forests in BiH cover an area of approximately 2.28 million hectares (FAO, 2005). Deciduous trees (which have a high capacity to absorb carbon) account for 68.8% of all trees, with beech dominating (39%) and sessile-flowered oak accounting for 18.9%.

Coniferous trees total 31.2% of all trees, with a significant proportion of fir (12.8%), spruce (8.6%), black pine (7.2%) and Scots pine (2.5%) trees and only a minute proportion of other coniferous trees (0.1%). Based on these indicators and the annual increment of 10.5 million hectares (GTZ, 2001), an annual increment factor was determined in tons of dry matter per hectare (2.375). Noble broadleaves and wild fruit trees have been also included in the calculations.

The proportional amount of biomass is 2,386.5 Gg of dry matter, while the net annual amount of CO_2 is 2,024.60 Gg, calculated on the basis of instructions for changes in forest systems and other wood biomass stocks.

Using the IPCC values of carbon proportion in dry matter, the total carbon uptake was calculated at 3217.85 Gg. Based on these results and calculations of the annual release/emission of carbon, the final annual sink of carbon dioxide by forest ecosystems in BiH for the baseline year 1990 is 7,423.53 Gg CO_2, and for the year 2001 is 7,212.2 Gg CO_2.

Detailed calculations of sinks were performed in accordance with the 1996 IPCC Guidelines, and the enclosed IPCC CRF tables are used for calculations per years.

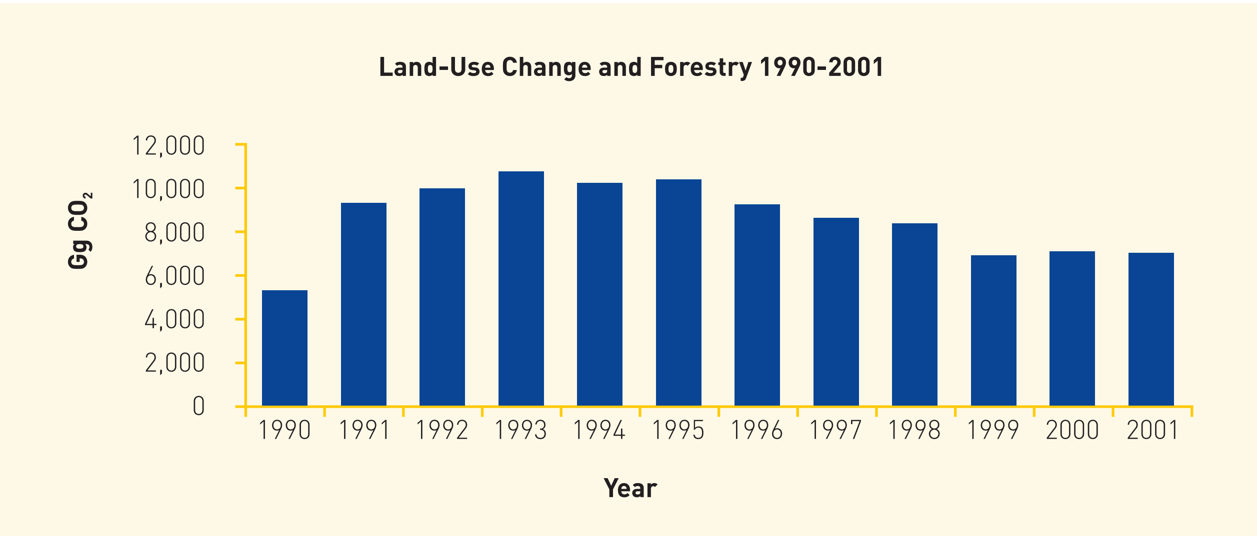


Chart 9. Sinks, 1990-2001

Considering the past years of warfare and the current decentralization of the forest management and corresponding legislation, data for the base year and for all other years were collected from various domestic and international studies, which to a certain extent contributed to the uncertainty of some of the categories.

2.4.2. Emission of methane (CH_4) by sectors

2.4.2.1. Agriculture

Methane emissions from the agriculture sector were calculated with CollectER software. CH_4 emissions from agriculture in 2001 totalled 40.80 Gg CH_4.

Methane is a direct product of metabolism of herbivorous animals (enteric fermentation) and a result of organic decomposition of animal waste (manure management). According to the IPCC methodology, methane emissions are determined for all types of domestic animals (dairy cows, non-dairy cows and bulls, sheep, horses, swine and poultry).

2.4.2.2. Solid waste

The calculation of CH_4 emissions from solid waste disposal on land was also performed with CollectER software. The total amount of waste was calculated per capita, and the data were taken from the BiH Agency for Statistics and entity statistical institutes.

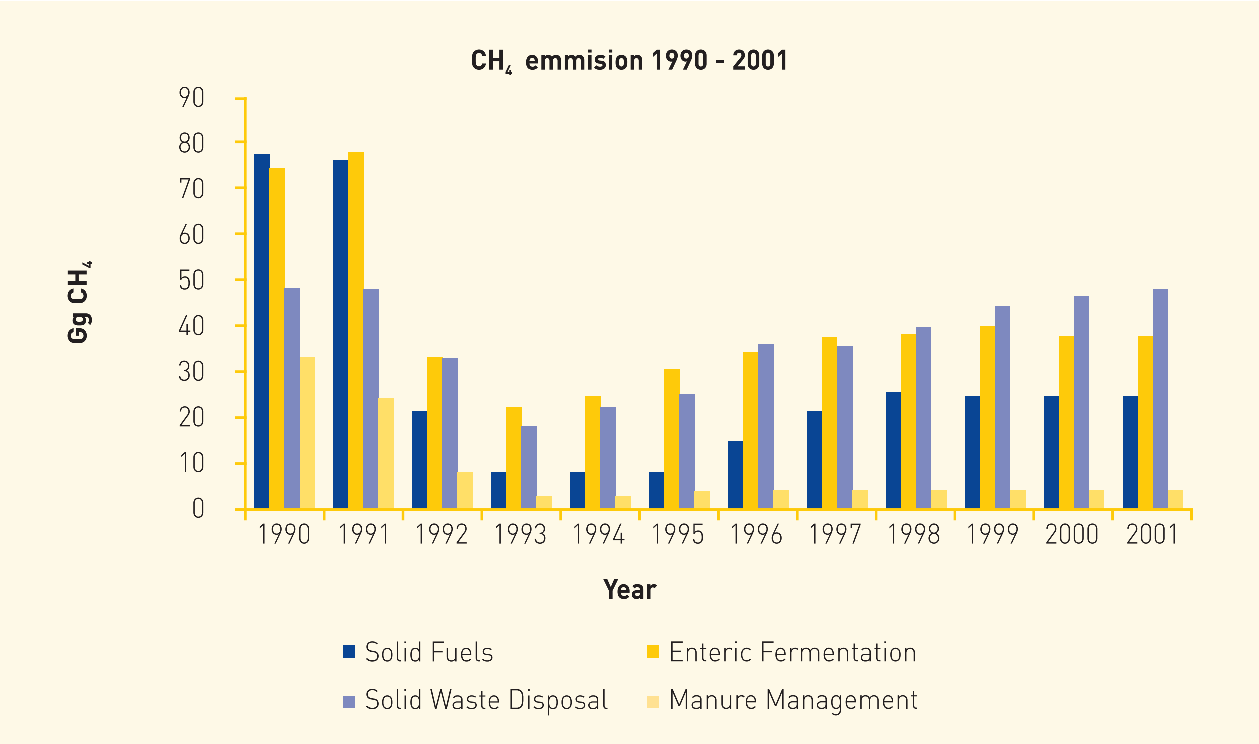


Chart 10. Total methane emissions, 1990-2001

CH_4 emissions calculated in 2001 totalled 47.05 Gg.

Methane emissions from waste disposal sites occur as a by-product of anaerobic decomposition of waste material with the help of methanogenic bacteria. The amount of methane released during the decomposition process is directly proportional to the Degradable Organic Carbon (DOC) content, which is defined as the carbon content of various types of organic biodegradable waste.

IPCC emission factors were used for the calculation of all of the sectors mentioned above.

Chart 10 shows methane (CH_4) emissions by sectors. The main sources of methane in Bosnia and Herzegovina are: agriculture (cattle breeding), fugitive emissions from coalmines, and waste disposal.

2.4.3. Emission of nitrous oxide (N_2O)

The principal source of N_2O in Bosnia and Herzegovina is the agriculture sector. Many agricultural activities add nitrogen to soils, thus increasing the available nitrogen for nitrification and de-nitrification, which has an impact on the amount of N_2O emissions.

The methodology used here identifies three N_2O emission sources: direct emissions from agricultural soils, emissions from domestic livestock, and indirect emissions caused by agricultural activities. Of these three sources, the largest amount of emissions comes from agricultural soils through soil cultivation and crop farming. This includes the application of synthetic fertilisers, nitrogen from animal manure, legume and soy farming (nitrogen fixation), and nitrogen from crop residues and peat-bog cultivation.

In the energy sector, emissions have been calculated on the basis of fuel consumption and the corresponding emission factors (IPCC), and in agriculture on the basis of prescribed IPCC CRF tables.

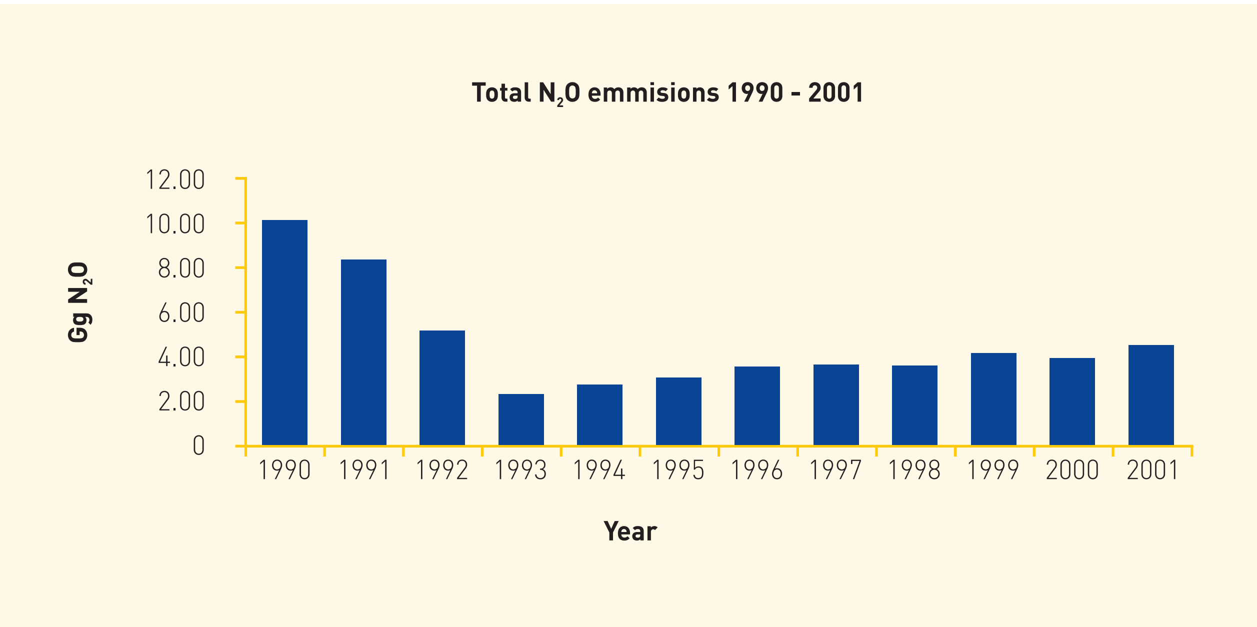


Chart 11. Total N_2O emissions, 1990-2001

2.4.4. Key emissions sources

Analysis of key emissions sources for the year 2001

KEY SOURCES – BOSNIA AND HERZEGOVINA, 2001				
	Gg	CH_4	CO_2	N_2O
1	Total energy	25.26	11580.53	0.62
1.A	Fuel combustion activities (sectoral approach)	0.71	11580.53	0.62
1.A.1	Energy industries	0.10	7895.3	0.12
1.A.1.a	Public electricity and heat production	0.10	7895.3	0.12
1.A.2	Manufacturing industries and construction	0.00	82.23	0.02
1.A.2.a	Combustion in manufacturing industries and construction: iron and steel	0.00	82.23	0.02
1.A.3	Transport	0.61	2435.00	0.42
1.A.3.b	Road transportation	0.6133	2435.00	0.42
1.A.4	Other sectors		1168.00	0.06
1.A.4.a	Commercial/institutional		392.00	
1.A.4.b	Residential		776.00	
1.B.1	Fugitive emissions from solid fuels	24.55		
1.B.1.a	Fugitive emissions from solid fuels: coal mining and handling	24.55		
2	Total industrial processes	0.0007	596.62	
2.A	Mineral products		421.84	
2.A.1	Cement production		350.87	
2.A.2	Lime production		70.97	
2.C	Metal production	0.0007	174.79	
2.C.1	Iron and steel production			
2.C.2	Ferroalloys production	0.0007	2.64	
2.C.3	Aluminium production		172.15	
4	Total agriculture	40.8		4.34
4.A	Enteric fermentation	40.8		
4.D	Agricultural soils			4.34
6.A	Solid waste disposal on land	47.05		

Table 11. Key sources of emission by Common Reporting Format (CRF) categories

The total amount of emissions from key sources covered for 2001 was 16,090 Gg CO_2e, or more than 99%. A major share comes from public electricity and heat production (49% - CRF category 1.A.1.a), followed by road transportation (15.1% -1.A.3.b), agricultural soils (8.4% - 4.D), and solid waste disposal on land (6.1% - 6.A).

Analyses of key emission sources were similar for the base year of 1990, with exception of emissions from industrial processes, which ranked second in 1990 (by %). Due to the destruction of the industrial base, CO_2 emissions from this sector were approximately 6.5 times lower in 2001 than in the base year 1990.

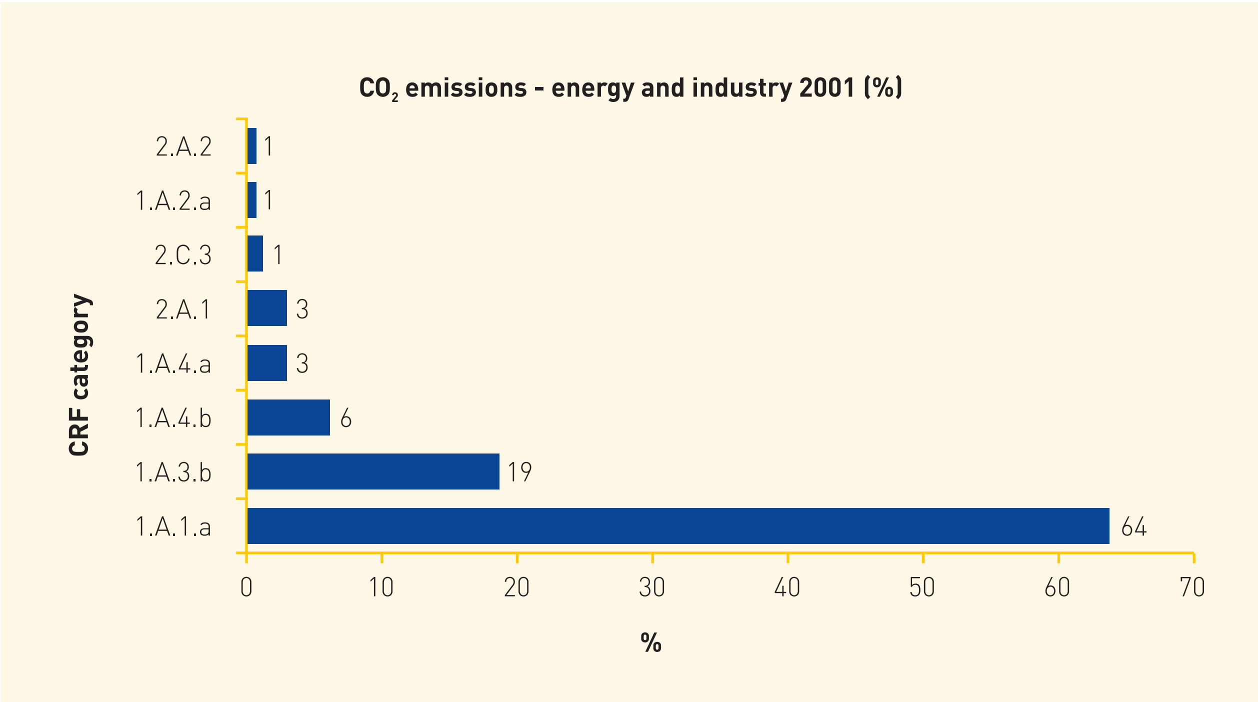


Chart 12. Emissions from energy and industry by CRF category (%)

The results of key source analyses for the period of 1998-2000 were similar to those for the year 2001.

2.4.5. Emission of indirect greenhouse gases

As mentioned above, photo-chemically active gases, such as carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOCs) indirectly contribute to the greenhouse effect, although they are not technically greenhouse gases. They are commonly called indirect greenhouse gases, or ozone precursor gases, because they contribute to and participate in the creation and breakdown of ozone, which is one of the greenhouse gases. It is believed that sulphur dioxide (SO_2) as a sulphate and aerosol precursor increases the greenhouse effect.

Emissions of sulphur dioxide (SO_2) followed the trend for CO_2 over the 1990-2001 period. Chart 13 illustrates this trend and does not require any additional explanation. However, it should be emphasized that SO_2 emissions in the year 2001 were only 47.1% of those in the base year 1990.

Currently, the dominant contribution to SO_2 emissions comes from fuel combustion, which in 1990 amounted to 97.3%, and in 2001 to 99.1% of total SO_2 emissions. The increase in the total share is the consequence of reduced emissions from industrial processes in 2001 relative to the base year.

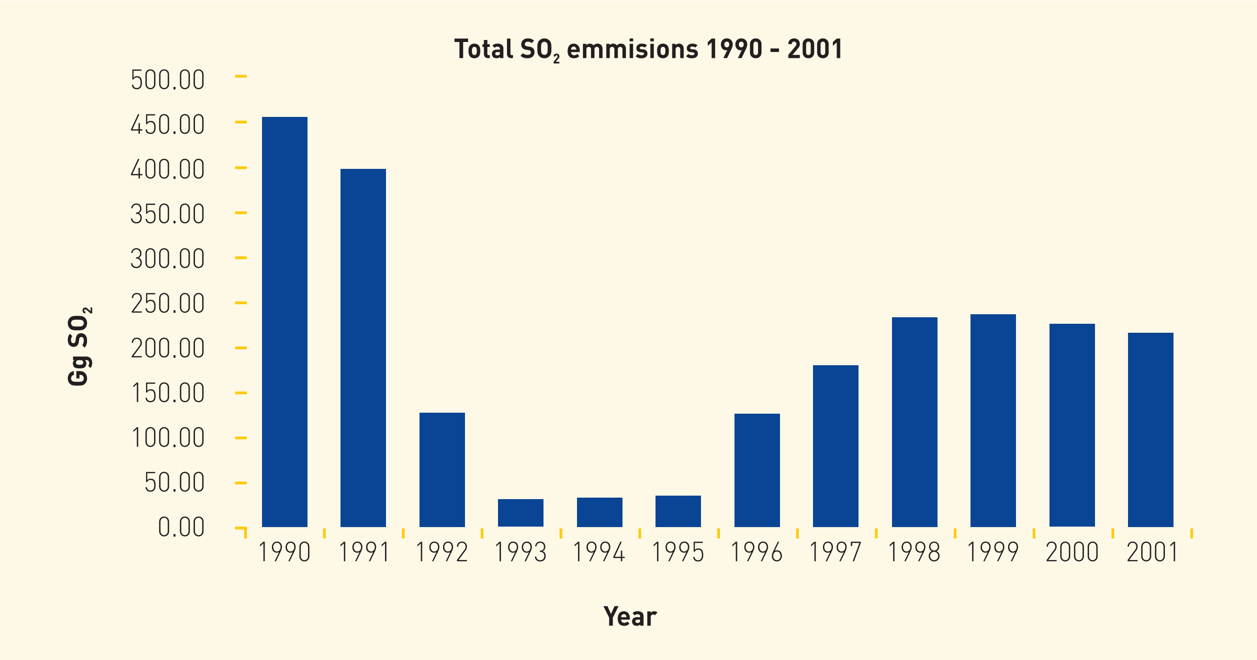


Chart 13. Total SO_2 emissions for the period 1990-2001

Similar trends apply to the nitrogen oxide (NO_x), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOCs) emissions.

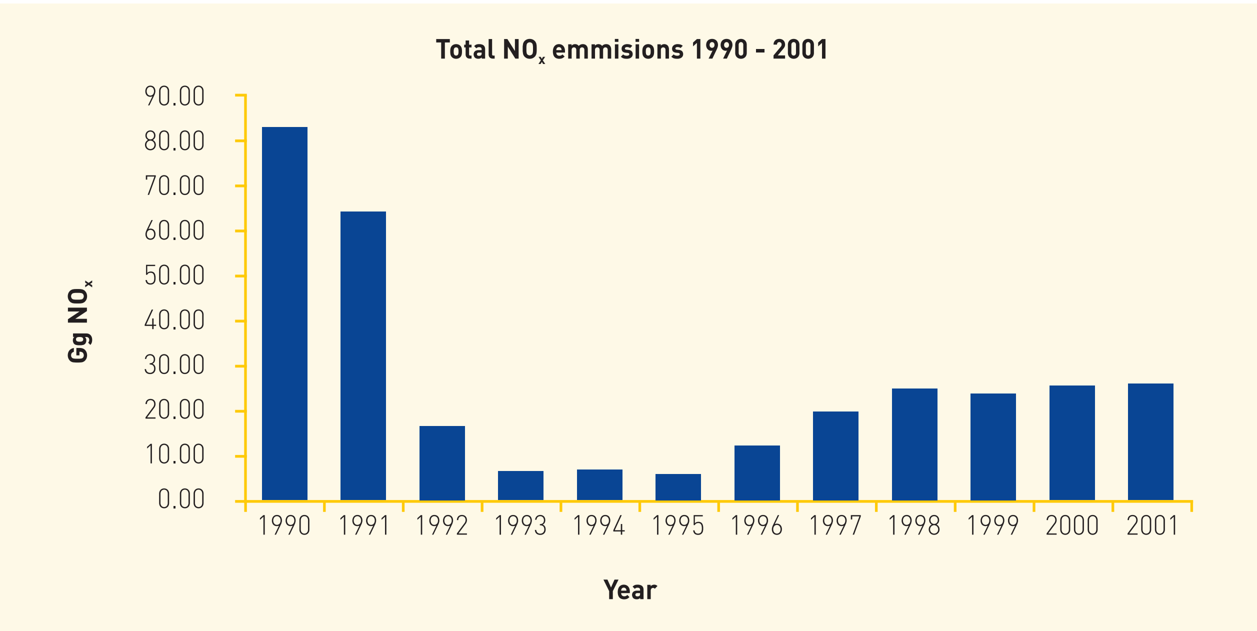


Chart 14. Total NO_x emissions for the period 1990-2001

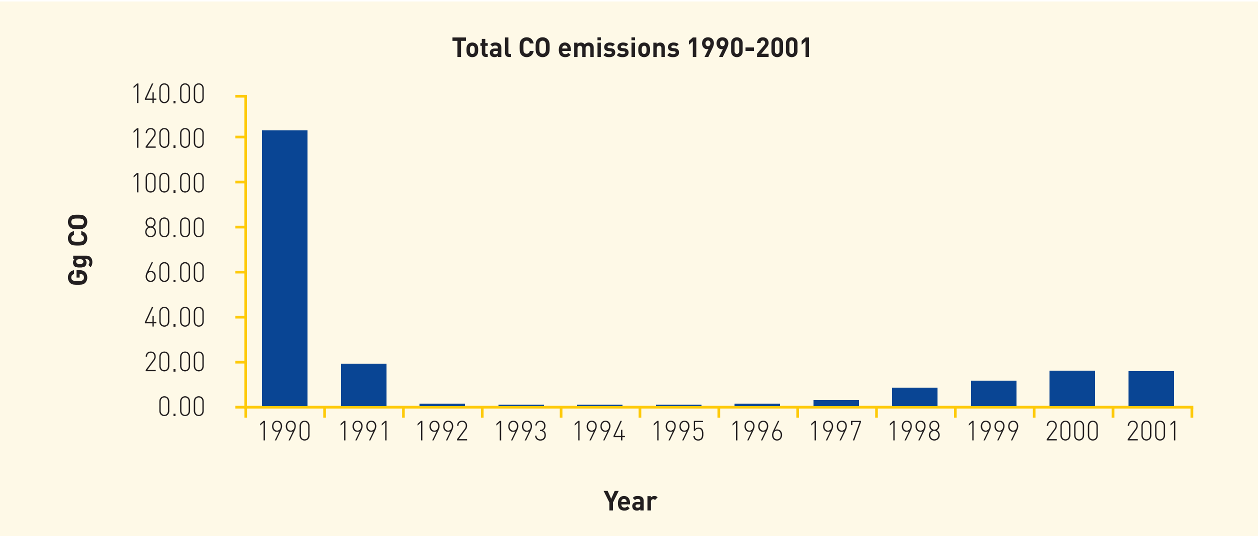


Chart 15. Total CO emissions for the period 1990-2001

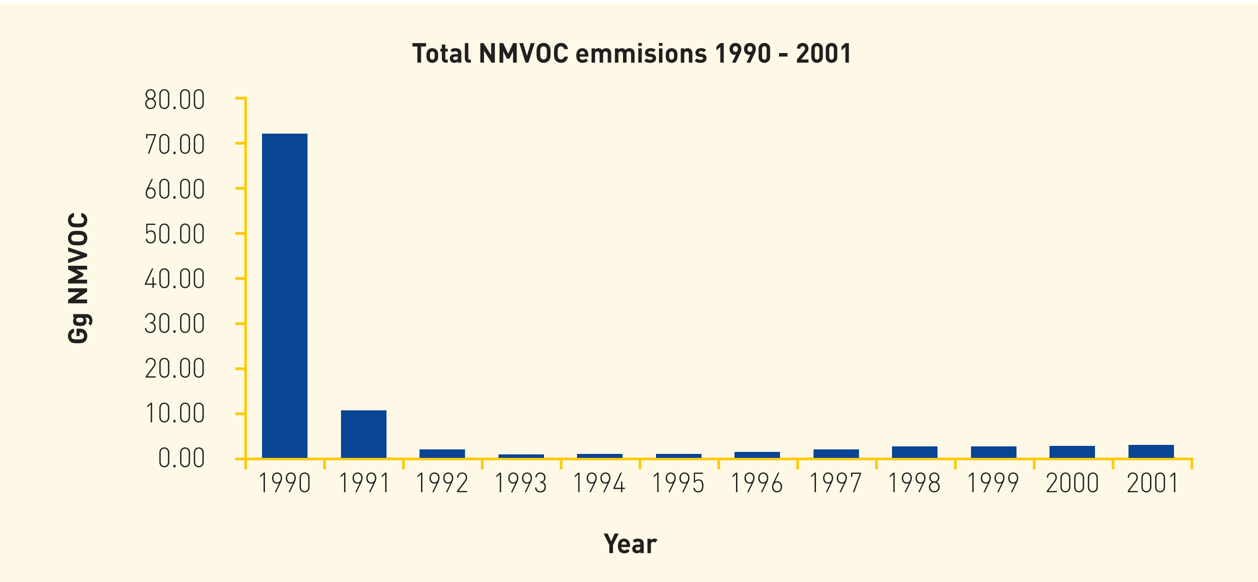


Chart 16. Total NMVOC emissions for the period 1990-2001

2.5. Uncertainty estimate of calculations

The uncertainty estimate of calculations is one of the most important elements of a national emission inventory. Information on uncertainty does not contest the validity of calculations, but it helps to determine priority measures to increase the precision of calculations, as well as in the selection of methodologies.

There are many reasons why actual emissions and sinks may differ from the value calculated in a national inventory. Some sources of uncertainty may generate well-defined, easily characterised estimates of the range of potential error, contrary to other sources of uncertainty, which may be much more difficult to define. The estimated uncertainty of emissions from individual sources is a combination of individual uncertainties of two emission calculation elements: 1) uncertainties associated with emission factors (from published references or measurements); and 2) uncertainties associated with activity data.

Based on the uncertainty analysis conducted for this National Communication, data were divided into three groups:

1. High-reliability data: data from the energy sector (emission factors and activity data) and activity data from industrial processes.

2. Medium-reliability data: emissions from industrial processes (applicability of emission factors for BiH), emissions from agricultural soil, emissions in the agricultural sector, emissions from municipal waste disposal, emissions from food production, and changes in the carbon content in forests.

3. Low-reliability data: data for other (non-CO_2) emissions from fuel combustion, fugitive emissions from coal mining, emissions from burning crop residues, and data associated with land use methods and changes.

2.5.1. Uncertainty in calculation of CO_2 emissions

CO_2 emissions from fuel combustion depend on the quantity of fuel consumed (national energy balance), its calorific value (national energy balance), the carbon emission factor (typical IPCC value), the share of oxidized carbon (typical IPCC value), and--in the case of non-energy fuel--consumption and share of stored carbon in a product (typical IPCC value).

The energy balance used for this National Communication is based on data from all available sources. It used data provided by entity institutes for statistics in relation to production, use of raw materials, and fuel consumption. It also used data on monthly consumption of natural gas and annual consumption of coal in particular sectors. Data from these and other sources are stored in the CollectER database.

As in previous cases, it should be emphasized that energy balances for Bosnia and Herzegovina were not prepared for the wartime years and for the postwar period until 2001. There were some consumption estimates in balances of entity governments and Brčko District. In addition, data exist in the "BiH Energy Sector Strategy" developed by the Energy Institute "Hrvoje Požar". In addition to the sources listed above, the inventory team also used data provided directly by energy utilities.

Considering all the given circumstances -- i.e., the lower quality of input data -- the estimated total uncertainty for the energy sector data is different for the wartime years and the first postwar years. This uncertainty is estimated to be ±10%.

For the period of 1999-2001, which is covered by the Second National Communication under the UN Framework Convention on Climate Change, uncertainty is somewhat reduced and is estimated to be ±8%.

Other data required for calculations, such as carbon emission factors, the share of oxidized carbon and the share of stored carbon, were taken from IPCC Guidelines (Revised 1996 IPCC

Guidelines for National GHG Inventories). Although experts believe that IPCC Guidelines values are mainly well calculated, with an uncertainty of ±5%, our estimates of this uncertainty are somewhat higher and total ±6%, mainly due to the fact that BiH uses more than ten types of coal with different and variable carbon values. In addition, inefficiency in the combustion process is assumed, which can result in ash or soot that remains unoxidized for longer periods of time. All of these factors contribute to the uncertainty in the calculation of CO_2 emissions. The total uncertainty of CO_2 emissions from fossil fuels is estimated to be approximately ±7%, and its share in the uncertainty of total emissions of all GHGs in BiH for 2001 is estimated to be less than 5% (Table 12). The uncertainty of activity data for liquid fuels is ±8%, and the uncertainty of emission factors (in line with IPCC Guidelines) is ±5%.

IPCC uncertainty estimates were used for natural gas (±5% for both activity data and emission factors).

IPCC CODE		GHG	Uncertainty of activity data %	Uncertainty of emission factors %	Total uncertainty %
1A	Fuel combustion – coal	CO_2	8	6	10.00
1A	Fuel combustion – liquid fuels	CO_2	8	5	9.64
1A	Fuel combustion – natural gas	CO_2	5	5	7.07

Table 12. Estimated uncertainty in the calculation of CO_2 emissions for 2001

Naturally, it must be noted that CO_2 emissions from the energy sector (CRF category 1.A) comprise more than 76% of total CO_2 emissions.

2.6. Verification of calculations

The verification process is intended to establish the reliability of calculations. Verification refers to procedures that need to be followed during the data collection process, during inventory development, and after inventory development in order to establish the reliability of calculations. Verification identifies flaws in calculations that indicate which parts of the inventory need to be improved, which indirectly leads to the improvement of the inventory's quality.

With an aim of improving the quality of calculations, the inventory team took the following steps:

- After receiving activity data from various sources, it performed additional data checks and additional analysis.
- Emission factors were used in accordance with 1996 IPCC Guidelines.
- CORINAIR methodology was used, and at the same time verifications were in line with IPCC methodology.

In the energy sector, the sectoral approach and the reference approach were both used in order to check the state level estimates of CO_2 from fuel combustion. The difference expressed in %, in the year 2001, was 9% (to the benefit of the reference approach). The difference in percentages between these two approaches was 1% for the base year 1990.

It must be noted that data for 1990, before the civil war in BiH, were available as official statistics and in the BiH Energy Balance, as well as from direct contacts with consumers of fossil fuels. In the year 2001, the difference of 9% is explained in greater detail in the discussion of uncertainty estimates above.

Data calculated for the year 2001 (the last year of the inventory) were also compared to statistical data of the International Energy Agency (IEA), as well as the BiH Energy Sector Study. Data are shown in Table 13.

Total energy	Million tons CO_2
IEA – Reference approach BiH 2001	13.2
SNC – Reference approach BiH 2001	12.5
BiH Energy Sector Study, S2 – scenario 2001*	12.8

*Estimates made based on data for the year 2000

Table 13. Comparison of data calculated for the year 2001

The differences between the SNC reference approach of -5% (relative to the IEA reference approach in BiH 2001) and -2.4% (relative to the BiH Energy Sector Study, S2 – scenario 2001*) are within the tolerated limits.

3. VULNERABILITY OF SECTORS AND ADAPTATION TO CLIMATE CHANGE

Developing countries, including Bosnia and Herzegovina, are among the most susceptible to the adverse effects of global climate change as confirmed by many previous studies. Estimates show that BiH will be exposed to climate change impacts that could have consequences for its entire society. Opportunities to protect against such impacts at the local level are quite limited, but there are still numerous options for climate change adaptation. Global climate change and its impacts will require the introduction of new environmental models and development strategies. These strategies will have to be both sectoral and integrated; they should address impacts at all levels (local, regional, entity, and state); and they should support sustainable development.

The following chapter is divided into five sections. Section 3.1 describes observed changes in climate over time in Bosnia and Herzegovina, including temperature and precipitation changes and extremes by region and by season, using data from 22 meteorological stations. Section 3.2 uses two IPCC scenarios and a regional climate model to project future climate change for the periods 2001-2030 and 2071-2100. Section 3.3 describes sectoral vulnerability and impacts in five key sectors: agriculture, water, human health, forestry, biodiversity/vulnerable ecosystems, as well as in regional development. Section 3.4 then examines current adaptive capacity in BiH. Finally, Section 3.5 provides an overview of potential adaptation measures that have been identified using expert consensus, stakeholder consultation, and a review of research.

3.1. Observed climate changes in Bosnia and Herzegovina

Observed climate change was estimated by analyzing available data from the Hydrometeorological Institute of FBiH and the Republic Hydrometeorological Institute of RS. The analysis included data from a homogeneous series of observations from 22 meteorological stations and from approximations where appropriate. Climate change determinants were established based on an analysis of temperature change and precipitation change. Detailed analyses covered: changes in annual temperature and precipitation for the periods 1961-1990 and 1981-2010; trends in temperature and precipitation changes; and extremes in temperature and precipitation for Banja Luka, Sarajevo and Mostar for the period 1960-2010.

3.1.1. Changes in temperature

Studies of temperature change for the period 1961-2010 indicate that temperatures have increased in all areas of the country. A comparative seasonal analysis for 1981-2010 and 1961-

1990 showed that the largest increases in average temperature during the summer months were observed in Herzegovina (Mostar 1.2°C) and in central areas (Sarajevo 0.8°C), while the largest increase in spring and winter temperatures was recorded in north-central areas (Banja Luka 0.7°C). The lowest increase in autumn temperatures ranges from 0.1 to 0.3°C (Figure 5).

The increase in annual air temperature ranges from 0.4 to 0.8°C, while the increase in air temperature during the growing season (April – September) even reaches 1.0°C. However, increases in air temperature during the last decade are even more pronounced (Table 14). It must be emphasized that, in addition to increases in GHG emissions, increases in insolation and urban heat island effects have also contributed to the air temperature increases.

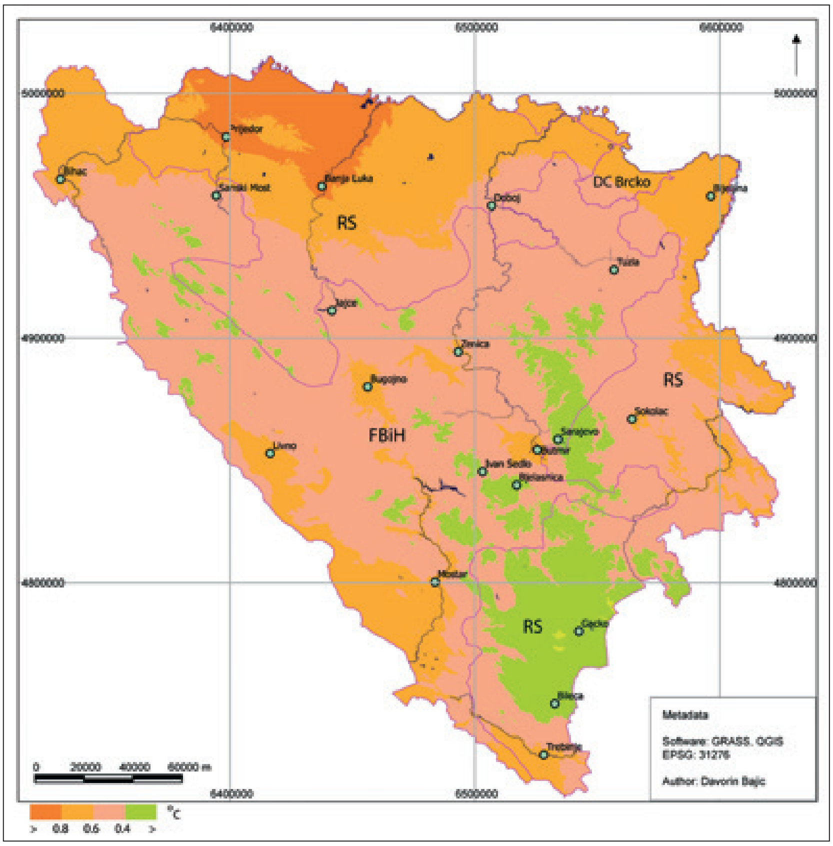
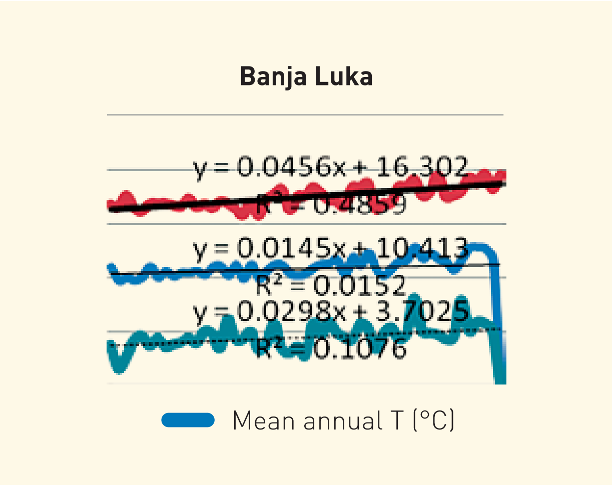


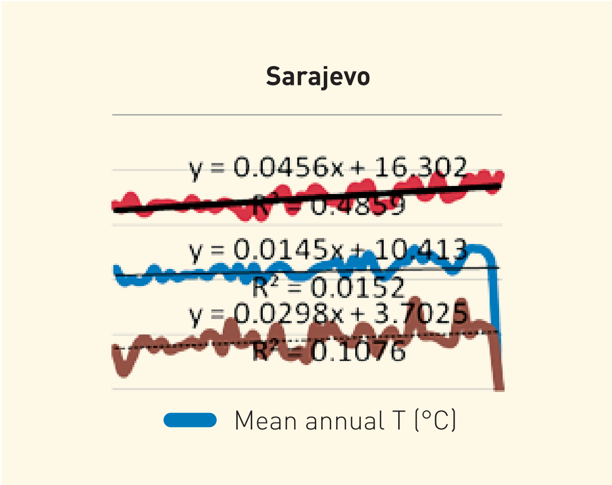
Figure 5. Changes in annual air temperature in Bosnia and Herzegovina (during 1981-2010 compared with 1961-1990)

		Year	Vegetation period	Spring	Summer	Autumn	Winter
Banja Luka	1961-1990	10.6	16.9	10.9	19.7	10.9	0.8
	1981-2010	11.4	17.9	11.6	21.0	11.5	1.5
	Deviation	0.8	1.0	0.7	0.3	0.6	0.7
	2001-2010	11.9	18.4	12.3	21.7	11.8	2.2

		Year	Vegetation period	Spring	Summer	Autumn	Winter
Sarajevo	1961-1990	9.7	15.7	9.7	18.3	10.4	0.4
	1981-2010	10.1	16.2	10.0	19.1	10.5	0.7
	Deviation	0.4	0.5	0.3	0.8	0.1	0.3
	2001-2010	10.4	16.5	10.5	19.6	10.6	1.1
Mostar	1961-1990	14.6	20.3	13.6	23.5	15.3	5.9
	1981-2010	15.2	21.2	14.3	24.7	15.5	6.2
	Deviation	0.6	0.9	0.7	1.2	0.2	0.3
	2001-2010	15.5	21.8	14.9	25.3	15.5	6.5

Table 14. Change in air temperature (°C) in Banja Luka, Sarajevo and Mostar, 1961-2010





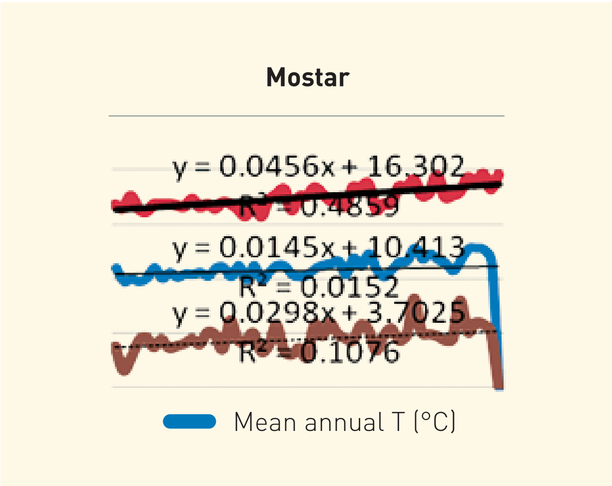


Chart 17. Changes in air temperature in Banja Luka, Sarajevo and Mostar, 1961-2010

3.1.2. Changes in precipitation

During 1961–2010, much of the territory of Bosnia and Herzegovina showed a slightly increasing trend in annual precipitation. The largest increase in annual precipitation occurred in the central mountain areas (Bjelašnica and Sokolac) and near Doboj, while the largest deficit was recorded in the south (Mostar and Bileća). The largest decrease in precipitation was during the spring and summer seasons, in the region of Herzegovina (up to 20%). The autumn season saw the largest increase in precipitation, particularly in northern and central areas. Although the level of annual precipitation has not significantly changed, the pluviometric regime, i.e. annual distribution, has been greatly altered. The number of days with rainfall above 1 mm decreased across the entire country, while the percentage of annual precipitation due to rainfall above 95th percentile during 1961-2010 was increasing. In other words, although the level of annual precipitation has not significantly changed, a decrease in number of days with rainfall above 1.0 mm and an increase in the number of days with intense rain events has significantly distorted the pluviometric regime. Pronounced variability in the annual rainfall regime and temperature increases are key factors in the occurrence of more frequent and intense droughts in Bosnia and Herzegovina.

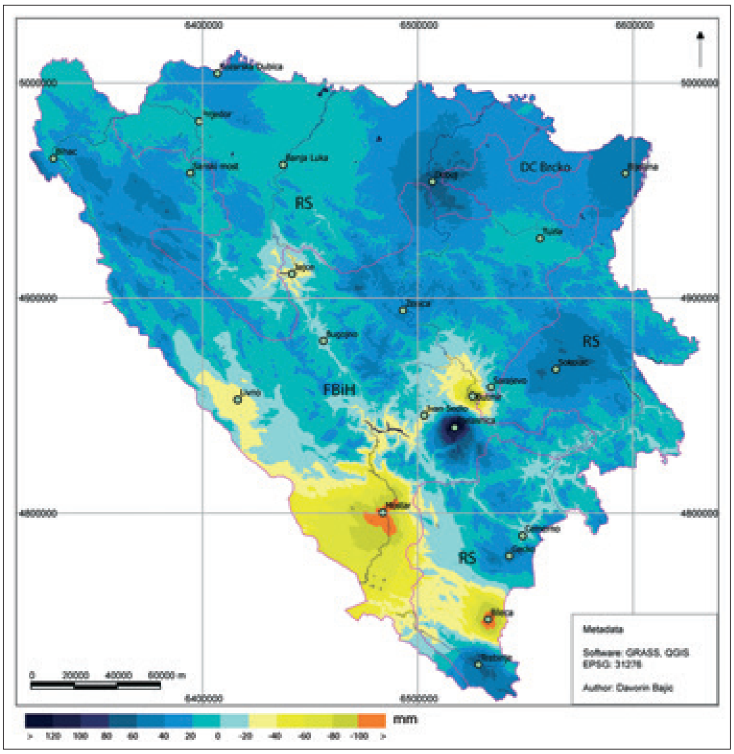


Figure 6. Changes in annual precipitation in Bosnia and Herzegovina (1981-2010 compared with 1961-1990)

		Year	Vegetation period	Spring	Summer	Autumn	Winter
Banja Luka	1961-1990	1027	562	262	298	246	221
	1981-2010	1034	540	258	270	278	227
	Deviation	+7.0	-22.0	-4.0	-28.0	+32.0	+6.0
	2001-2010	1078	546	263	271	280	221

		Year	Vegetation period	Spring	Summer	Autumn	Winter
Sarajevo	1961-1990	932	468	226	242	241	223
	1981-2010	936	472	221	236	266	213
	Deviation	+4.0	+4.0	-5.0	-6.0	+25.0	-10.0
	2001-2010	1014	514	226	252	304	226
Mostar	1961-1990	1523	522	379	196	450	497
	1981-2010	1405	502	335	173	458	439
	Deviation	-78.0	-20.0	-39.0	-23.0	+8.0	-58.0
	2001-2010	1514	534	339	188	472	506

Table 15. Changes in precipitation (mm) in Banja Luka, Sarajevo and Mostar, 1961-2010

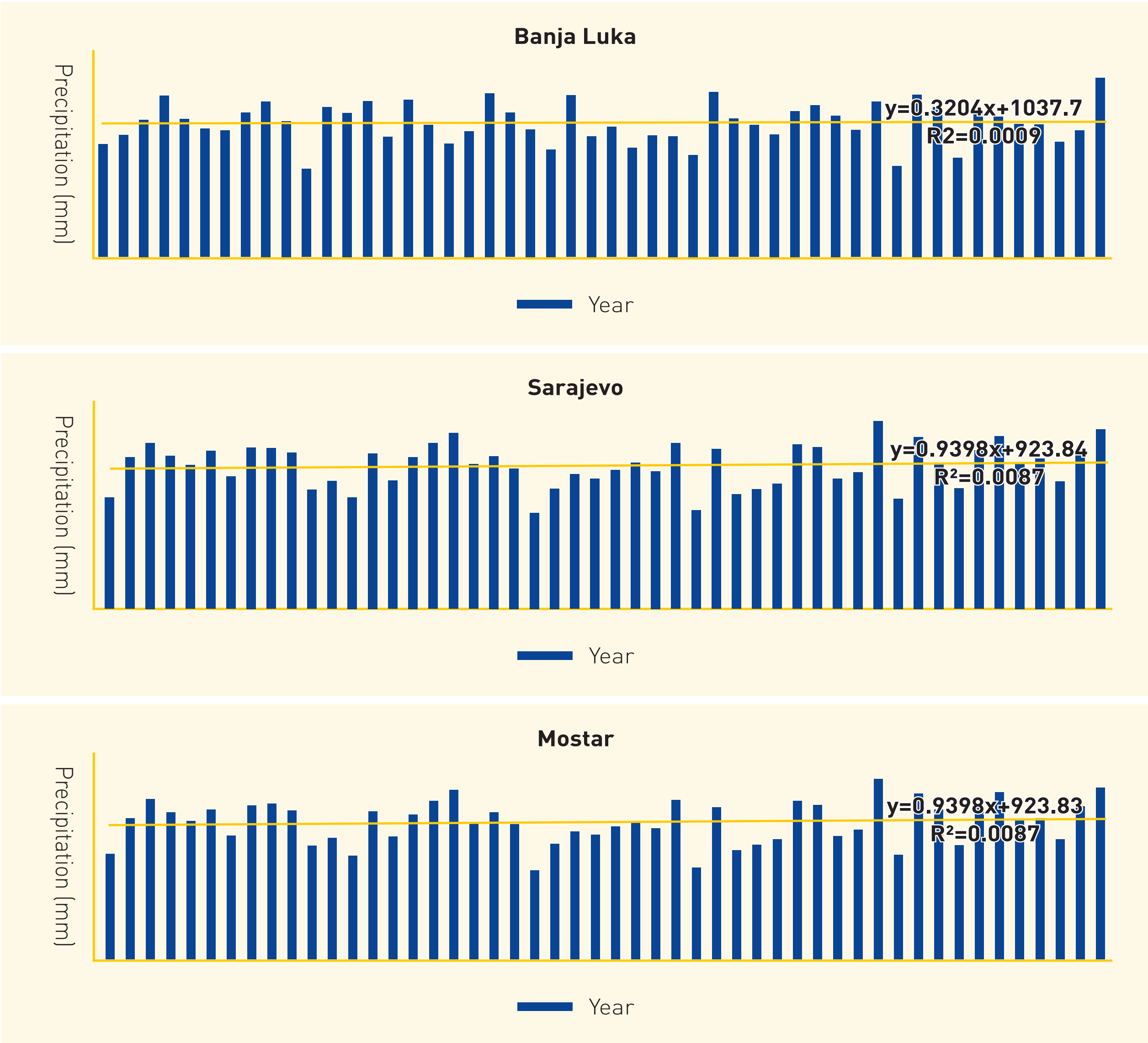


Chart 18. Changes in precipitation in Banja Luka, Sarajevo and Mostar, 1961-2010

3.1.3. Climate variability and projections of extreme events

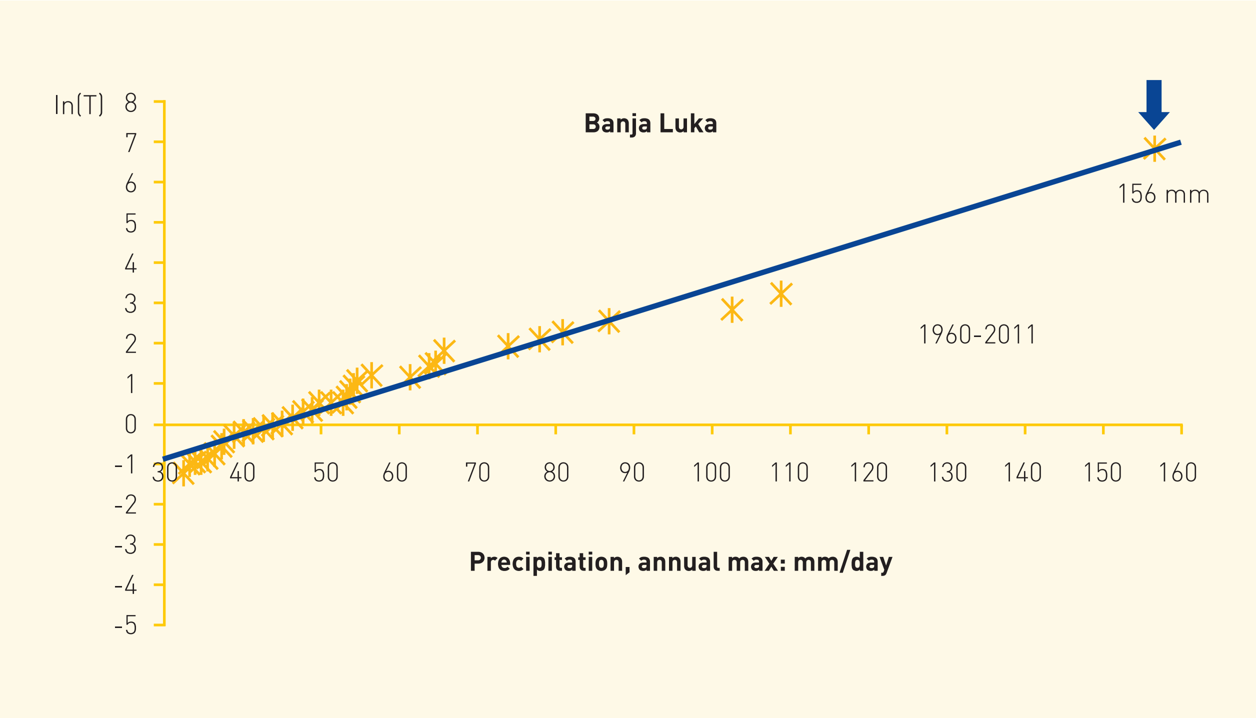
There is an evident increasing trend in number of "hot" days (tropical days with a maximum daily air temperature above 30°C) across almost the entire territory (Chart 19).[4] Most of these days are recorded in the north (Posavina), central parts and in Podrinje (Višegrad). In the lowland area of the Herzegovina region (Mostar), there is a slight increase of a number of tropical days. However, during the last 5 years (2007 – 2012), there is an increased occurrence of extremely high temperatures (over 40 °C). In other words, although there is no significant increase in number of tropical days, there is an increased number of days with temperatures over 40 °C (Federal hydrometeorological institute FBIH).

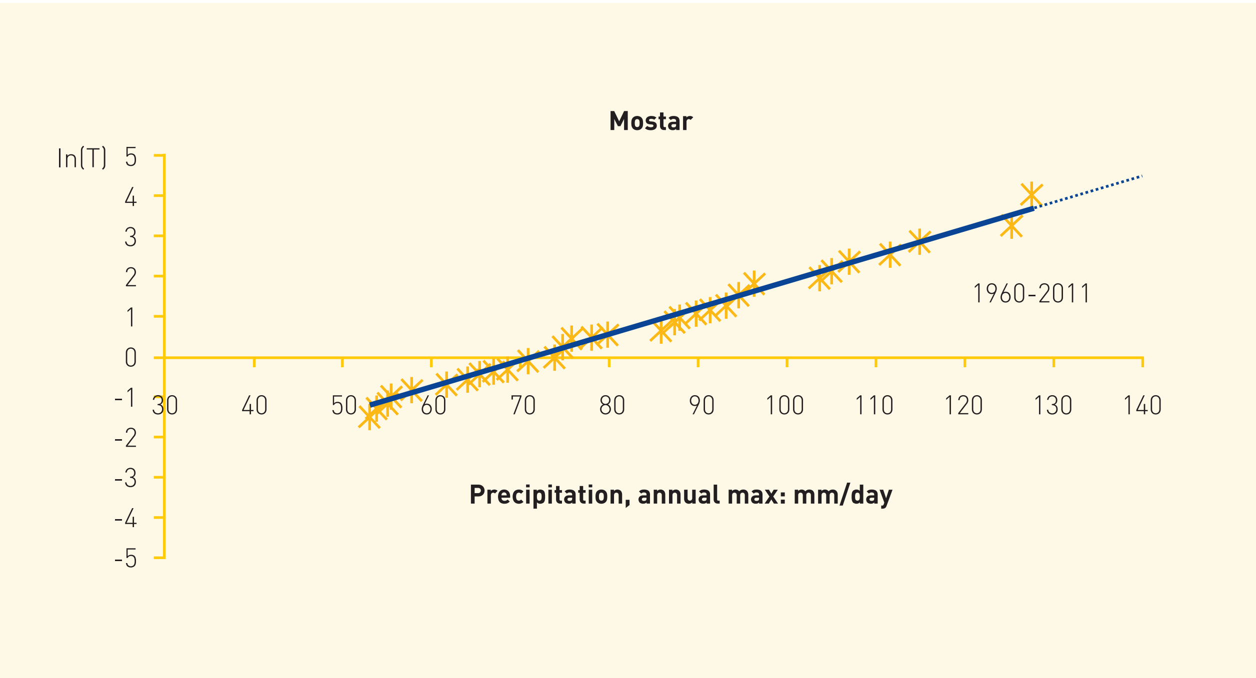
Chart 19. Average number of tropic days (tmax>30°C)

4 Federal hydrometeorological institute FBIH, Republic hydrometeorological institute RS

3.1.3.1. Projection of extreme daily precipitation

Maximum daily precipitation during 1961-2011 was as follows: Banja Luka - 156 mm, Mostar - 127 mm, and Sarajevo - 118 mm. Average maximum precipitation for the same period was: Banja Luka - 54 mm, Mostar - 79 mm, and Sarajevo - 50 mm. The return period for these values is approximately 1000 years. Even though the probability of increasing the absolute maximum daily precipitation is low, the increase in the number of days with rainfall above 10.0 mm speaks to the seriousness of the problem.





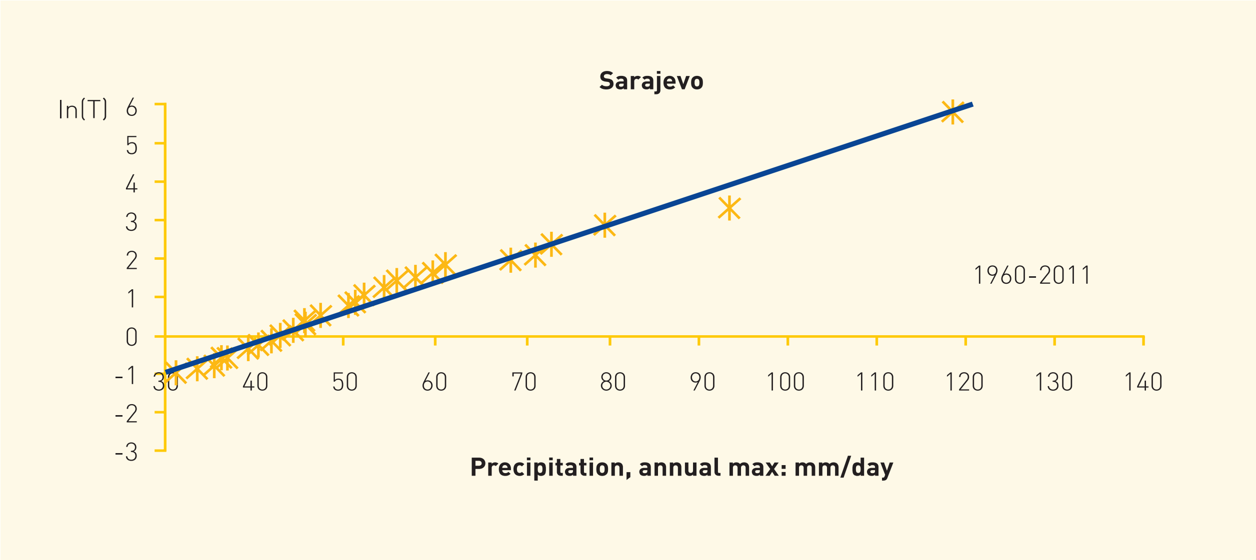


Chart 20. Empirical function – distribution of maximum daily precipitation in Banja Luka, Mostar and Sarajevo, 1961-2011

3.1.4. SPI-based analysis of precipitation and droughts in BiH

The notion of drought can be defined as meteorological drought (low rainfall), hydrological (low water level, insufficient discharge), agricultural drought (insufficient soil humidity) and landscape drought (combination of previous). For the purposes of SNC, an SPI[5]-based analysis of meteorological droughts was performed.

An analysis was made of data gathered from the network of eight meteorological stations: Bihać, Banja Luka, Doboj and Bijeljina in the Peripannonian rim; Livno, Mostar and Bileća in Herzegovina; and Sarajevo in the center of the highland mountainous region of Bosnia and Herzegovina. SPI reference period covered the same sequence of 50 years (1961-2010), and processing included all drought (SPI<=-1) and humid (SPI=>1) values for particular time periods (for SPI1, SPI3 and SPI12).

During the period of 1961-2010, stations in Herzegovina (Livno, Mostar and Bileća) had a negative linear SPI12 trend (increased dryness), but changes were not statistically significant. Other stations recorded a positive linear trend, but only Bijeljina had statistical significance. The drought was most pronounced in 2000 and 2003, when seven stations simultaneously had SP12 values below or equal to -1.

5 The Standardized Precipitation Index (SPI) was developed for the purposes of defining and monitoring drought (McKee et al. 1993). Long-term observations enable analysis of drought occurrence for the time scale if interest (month, season, year, etc), when these values are compared to values of any particular region. Longer time intervals are applied in analysis of extreme precipitation. Commencement of a drought is identified by observation of a "step towards the back." Namely, commencement of a drought is confirmed only if occurring continuosly in sequences with values SPI<=-1. A dry period stops when the value of the SPI turns positive. Each drought is characterized by: a) time interval (1, 2, 3, 6, 12, 24 months), i.e. a number of consequent occurrences of SPI values <=-1; b) duration, which represents time between a commencement and the end of a drought; s) category of a drought, which is defined by the value of SPI; d) drought magnitude, which is computed as a sum of the SPI values for each month from the commencement to the end of a dry period; e) drought intensity, which is a ratio of drought magnitude to its duration.

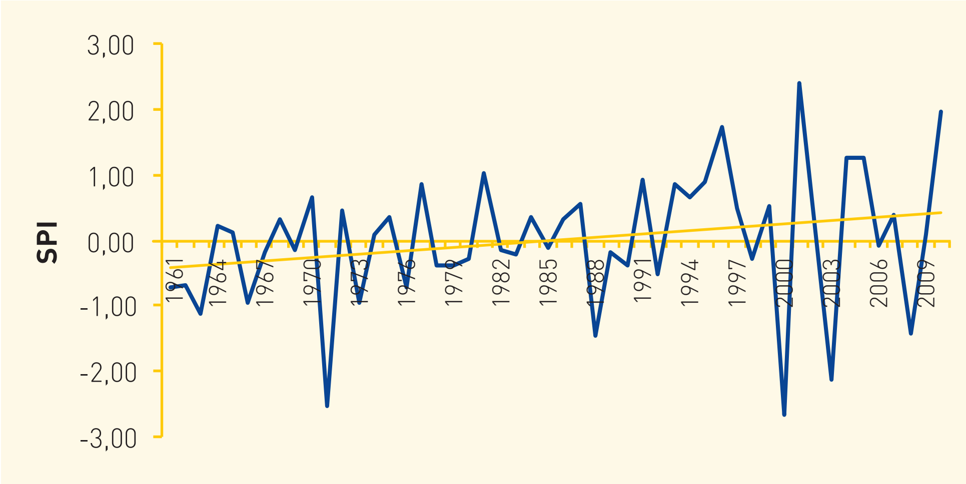


Chart 21. Inter-annual variability for SPI12, meteorological station Bijeljina

The Initial National Communication reported that significant changes could be seen in Mostar, where the average amount of precipitation in the period 1982-2007 is significantly lower than in the period 1956-1981 in all months except in September.

Analysis of the linear trend for SPI3 in February (meteorological winter) shows that during the observed period stations in Herzegovina (Livno, Mostar and Bilećа), in Sarajevo and Doboj, had a downward SPI trend (increase in dryness), but changes were not statistically significant. In Bihać, Banja Luka and Bijeljina, the trend was insignificantly positive. During the winter season, recordings were made of best correlations with circulation parameters NAO and AO, where correlation coefficient again reached the highest value between AO and SPI3 for Mostar, equalling -0.73.

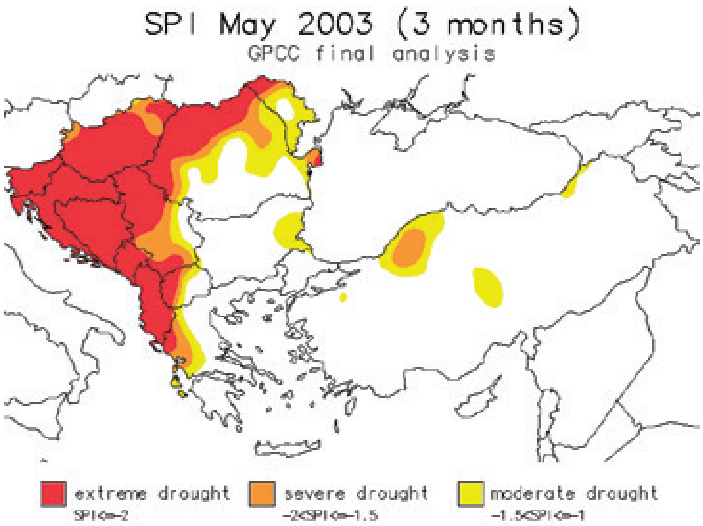


Figure 7. Spatial distribution of drought in SEE (SPI3 May 2003)
http://www.dmcsee.org/en/spi/?year=2003&month=May&TimeScale=3&DataType=GPCC

The linear SPI3 trend for May (meteorological spring) was not statistically significant in any of the stations, and there was no particular geographical regularity, such as trend. The drought was most pronounced in 2003. During that spring, drought was recorded by all eight stations, and seven of them recorded the absolute minimum SPI value, meaning that this season can be considered as an extreme in every aspect.

The linear SPI3 trend for August (meteorological summer) is negative for majority of stations (five), i.e. there was an increase in dryness, with Bihać and Bileća showing statistically significant trend. The highest intensity of drought was recorded in 2000, when stations in Banja Luka, Bijeljina, Sarajevo and Livno had absolutely lowest SPI values.

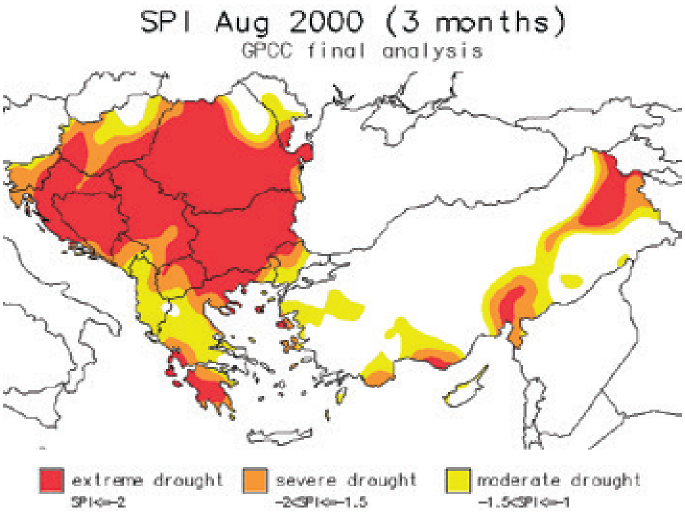


Figure 8. Spatial distribution of drought in SEE (SPI3 August 2000)
http://www.dmcsee.org/en/spi/?year=2000&month= Avg&TimeScale=3&DataType=GPCC

Six out of eight stations marked the last decade as a decade with the largest number of dry summers, which undoubtedly proves the fact that the last decade saw an increase in frequency of summer droughts. Nevertheless, if wet summers are taken into consideration, it is evident that five stations marked the last decade (independently or combined with another) as a period with the largest number of wet summers. Hence, in addition to dry summers, the last decade also saw an increase in frequency of wet summers, which contributed to the fact that in six stations the 2001-2010 decade had the largest number of extreme summers in terms of precipitation quantity.

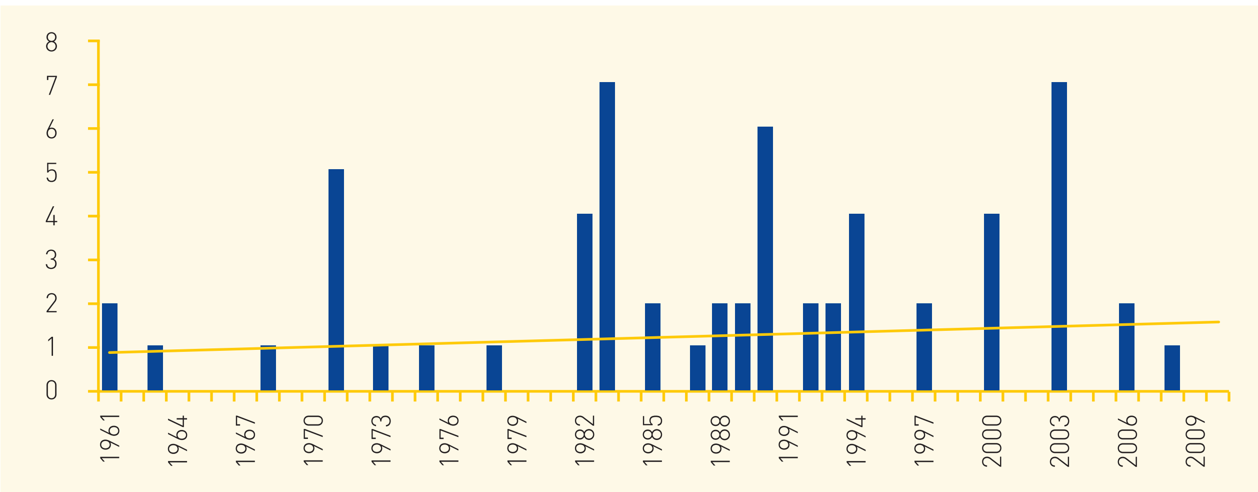


Chart 22. Inter-annual variability in number of meteorological stations for SPI12<=-1

The linear SPI3 trend for November (meteorological autumn) is positive in all stations except Livno, where it is statistically significant only in Bijeljina. Even though the trend was positive throughout the entire observed period, the only autumn when all stations recorded a drought was near the end of the period, in 2006, with Banja Luka and Doboj recording the absolute minimum SPI value.

3.2. Projections of future climate change

One of the main tasks of the Second National Communication of Bosnia and Herzegovina under the UN Framework Convention on Climate Change is a development of climate models and a selection of adequate future climate change scenarios. This report presents the results of the coupled regional climate model EBU-POM from future climate change experiments, received by the method of dynamic downscaling of results from two global climate change models of atmosphere and ocean, SINTEX-G and ECHAM5. The focus was on results from two IPCC scenarios on climate change: the SRES A1B and A2 scenarios. These reference or "baseline" scenarios are defined by the IPCC special report on emission scenarios (Nakicenovic and Swart, 2000) and each makes assumptions about greenhouse gas emissions from future technological, social and economic development based on human activity.

In terms of GHG concentrations, A1B is characterized as a "medium" scenario and A2 as a "high" scenario according to the projected levels of greenhouse gases in the atmosphere. In the A1B scenario, the value of the atmospheric concentration of carbon dioxide (CO_2), one of the greenhouse gases is approximately 690 parts per million (ppm) at the end of 21st century, and in the A2 scenario it is approximately 850 ppm. Model results were analyzed for the time series 2001-2030 and 2071-2100. This section focuses on two basic ground meteorological parameters: air temperature at 2 meters and accumulated precipitation. Changes in these parameters are shown with reference to mean values from the so-called base (standard) period of 1961-1990.

3.2.1. A1B scenario, 2001-2030

According to climate model results, the mean seasonal temperature changes for the observed thirty-year period 2001-2030 are expected to range from +0.6 to +1.4°C, depending on the season and the region of Bosnia and Herzegovina. The biggest changes will be during the months of June, July and August (JJA), with predicted changes of +1.4 in the north and +1.1°C in southern areas. During the months of December, January and February (DJF) changes are approximately +0.7°C, with maximum values in central parts of BiH. During the months of March, April and May (MAM) changes are slightly bigger than during DJF, with values ranging from +0.8 to +0.9. During the months of September, October and November (SON) changes range from +0.6 in the western part of the country to +0.8, in the eastern part..

Figures for precipitation changes show that the models resulted in both positive and negative variations of this parameter. Positive changes in precipitation, i.e. an increase, may be seen during the March, April, May (MAM) season, i.e. +5% in the north and northeast, and during the June, July and August (JJA) season in almost the entire territory, with a maximum of +15%, with the exception of the southeast. The biggest deficit is predicted along the southwestern border of BiH, with a maximum of -20%.

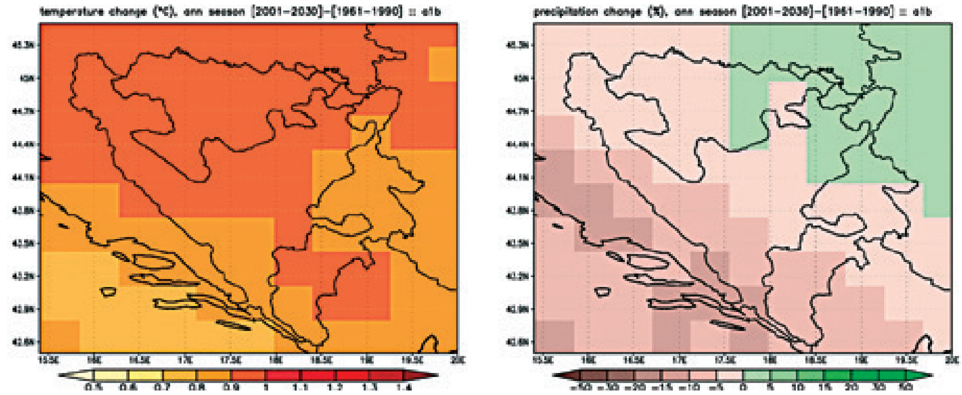


Figure 9. Average annual temperature change in °C (left) and precipitation change in % (right)

Annual temperature changes range from 0.8 to 1°C, with higher values in the north and in the west of the country (Figure 9). Annual precipitation change is negative for the entire territory (ranging from 0 to -10%) with the exception of the northeast, where precipitation is expected to increase by up to 5%.

3.2.2. A1B scenario, 2071-2100

Results for the A1B scenario during the period 2071-2100 show that spatial distribution of changes in corresponding parameters, mainly the temperature, are similar to the previously observed period 2001-2030, but with a greater magnitude of changes. This time, changes in temperature range from +1.8 to +3.6°C. The biggest changes of +3.6°C are again predicted for the months of June, July and August (JJA). During the winter season (December-January-February), maximum is again predicted in central regions, with values up to 2.4°C. During the March-April-May season, these changes range from 2.4 to 2.6°C in the entire territory. Finally, during the September-October-November season, changes range from 2.0 to 2.4°C.

During this period, there is almost no season or region that is characterized by a positive precipitation anomaly. Large negative anomalies are predicted for the December-January-February (DJF) and September-October-November (SON) seasons, with changes ranging from -15 to -50%. The March-April-May (MAM) season is characterized by values of approximately -10% for the entire territory. The deficit during the June-July-August season (JJA) is greater in southern than in northern regions, ranging from -30 to 0%.

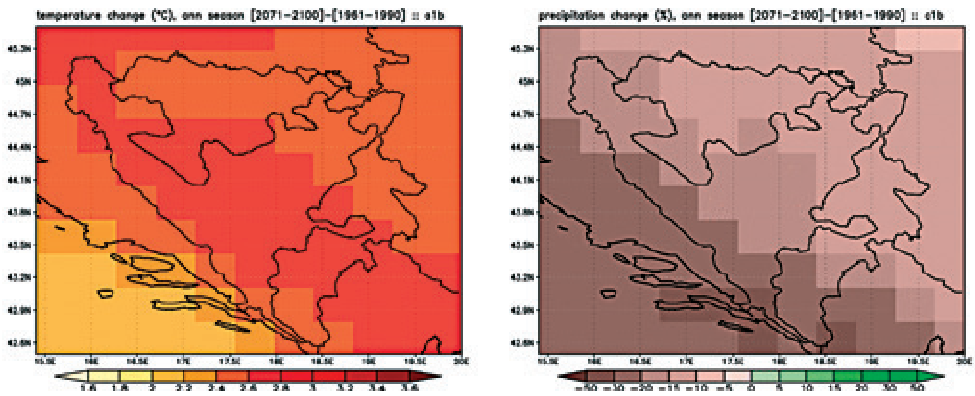


Figure 10. Average annual temperature change in °C (left) and precipitation change in % (right)

Annual temperature changes range from 2.4 to 2.8°C, with greater values in the south and in the west of the country (Figure 10). Annual precipitation change is negative in the entire territory, ranging from -30 to -10%.

3.2.3. A2 scenario, 2071-2100

In the A2 scenario for the period 2071-2100, the expected increase in temperature in the entire territory of BiH ranges from 2.4 to 4.8°C. The biggest increase will be during the months of June, July and August (JJA) season with values above 4.8°C. During the December, January and February (DJF) season, the maximum predicted change is approximately 3.6°C. The March, April and May (MAM) season have predicted values ranging from 3.4 to 3.6°C. During the September, October and November (SON) season the changes are again bigger in the western part of the country, ranging from 2.8 to 3°C. With the exception of the DJF season, the A2 scenario has a negative anomaly in terms of accumulated precipitation across the entire territory. With the exception of the southeastern regions, the December, January and February (DJF) season has a positive anomaly across almost the entire territory, ranging from 0 to +30%. The biggest changes in this scenario are predicted during the June, July and August (JJA) season, with values of -50%. During the March, April and May (MAM) season and the September, October and November (SON) season, anomalies range from -30 to 0%.

Annual temperature changes under the A2 scenario range from 3.4 to 3.8°C for this period (Figure 11). Annual precipitation change is negative throughout the entire territory, ranging from -15% to 0%.

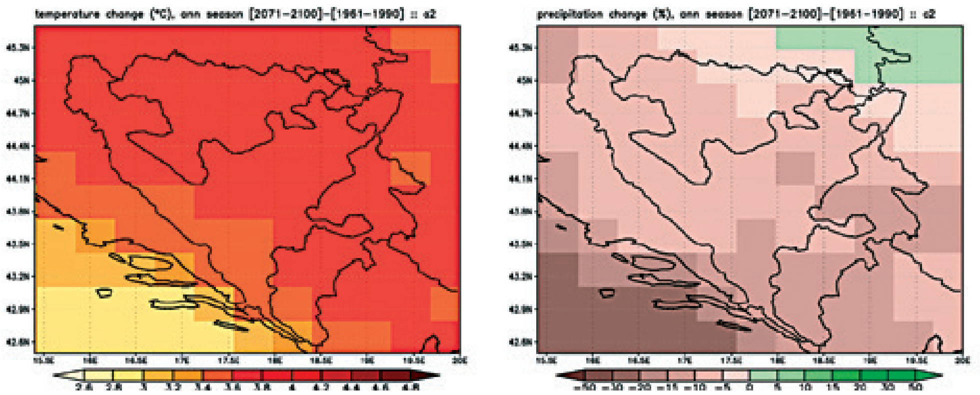


Figure 11. Temperature change (°C), annual season (left) and precipitation change (%) (right)

3.2.4. Summary of scenarios

Results from two global climate models: SINTEX-G and ECHAM5 indicate a mean seasonal temperature increase averaging +1°C by 2030 compared to the base period 1961 – 1990 over the whole Bosnia and Herzegovina. The largest increase of +1.4°C is expected during summer time (June – August). For the A2 scenario (2071-2100), the rapid temperature increase of +4°C yearly average is expected, while the expected increase in temperature during summer time will go up to +4.8°C. Models indicate uneven precipitation changes. A slight increase in precipitation in mountain and central areas is expected, while negative precipitation anomalies are projected for the other areas. According to the A2 scenario for the period 2071-2100, negative precipitation is expected across the whole BiH territory. The largest precipitation deficit of up to 50% compared to the base period 1961-1990 is expected during summer months.

	A1B 2001-2030	A1B 2071-2100	A2 2071-2100
DJF	0.6 – 0.9	1.8 – 2.4	2.4 – 3.6
MAM	0.8 – 0.9	2.4 – 2.6	3.4 – 3.8
JJA	1.1 – 1.4	3.4 – 3.6	4.6 – >4.8
SON	0.5 – 0.9	2.0 – 2.4	2.8 – 3.2
YEAR	0.8 – 1.0	2.4 – 2.8	3.4 – 3.8

Table 16. Temperature change in °C, SINTEX -5 model

	A1B 2001-2030	A1B 2071-2100	A2 2071-2100
DJF	0.2 – 0.5	3 – 3.8	3.2 – 4
MAM	< 0.2	2.2 – 2.6	2.6 – 3.2
JJA	0.5 – 0.8	4 – 4.2	4.4 – 4.8
SON	0.9 – 1.1	3.4 – 3.8	3.8 – 4.2
YEAR	0.4 – 0.6	3.2 – 3.6	3.6 – 4.0

Table 17. Temperature change in °C, ECHAM5 model

	A1B 2001-2030	A1B 2071-2100	A2 2071-2100
DJF	-15 – -5	-50 – -10	-5 – 30
MAM	-10 – 5	-15 – 0	-30 – 0
JJA	-5 – 15	-30 – 0	-50 – 0
SON	-10 – 20	-50 – -15	-30 – 0
YEAR	-20 – 10	-30 – -10	-15 – 0

Table 18. Precipitation change in %, SINTEX -5 model

	A1B 2001-2030	A1B 2071-2100	A2 2071-2100
DJF	0 – 10	-15 – 5	-30 – 15
MAM	0 – 15	-5 – 15	-10 – 10
JJA	-10 – 10	-50 – -20	-50 – -20
SON	-10 – 5	-30 – -5	-20 – 0
YEAR	-5 – 10	-15 – -5	-20 – -5

Table 19. Precipitation change in %, ECHAM5 model

3.3. Climate change impacts by sector

Sectors that are most vulnerable to climate change in Bosnia and Herzegovina are as follows: agriculture, water resources, human health, forestry, and biodiversity, as well as vulnerable ecosystems. In this regard, detailed analyses were conducted of long-term climate change in these sectors. Assessments were made based on the SRES climate scenarios A1B and A2 that were developed for Bosnia and Herzegovina for the purposes of the Second National Communication (SNC). For each section, proposed adaptation measures were also identified using expert consensus, stakeholder consultation and a review of relevant research.

This section also includes a discussion of potential financial and technological support for these measures, because the economic situation in Bosnia and Herzegovina is such that external assistance will be necessary to realize many adaptive measures. Bosnia and Herzegovina is a developing country, and its GHG emissions are significantly lower than in the reference year 1991, mainly due to the wartime period 1992-1995 and industrial damage and restructuring. Nevertheless, even though the country's impact on global climate change is negligible, its economy suffers from the major pressure instigated by climate change. Due to such situation, adaptation, primarily in the key sectors mentioned above, should be an imperative in fighting climate change. The prioritization of measures identified using cost-benefit analysis is anticipated as an activity during the preparation of the Third National Communication.

3.3.1. Agriculture

3.3.1.1. Impact on agriculture, based on climate scenarios

Agriculture is the economic sector that is in general most vulnerable to climate change (Spasova et all, 2007, Majstorovic, 2008, Trbic 2012) given the climate-sensitivity of the sector, the share of agriculture in the BiH economy, the number of people employed in the sector, and closely related socio-economic issues of food security.

Because of the varied topography and diversity of BiH, scenarios must take into account the prevailing patterns of land use in each of the country's regions. For example, in northwestern BiH, orchards would benefit from the projected reduction in exceptionally cold winters and late spring and early autumn frosts. These would be significantly minimized in the A1B scenario (2001-2030). Scenario A1B (2001-2030) envisages extension of the growing season (days with temperature above 5°C) in lowlands from 32 to 75 days, as well as the extension of the period with temperatures above 20°C from 38 to 69 days (Federal hydrometeorological institute FBIH, Republic hydrometeorological institute RS), which can have a positive effect on crop yield levels, as well as on the quality of crops in general. An increase in minimum temperature, i.e. in the number of days with physiologically active temperatures, can also enable the breeding of late crops, thereby providing greater yields and crops which are more convenient to store. Results from this scenario also indicate that climate change affecting the southern part of BiH (the Herzegovina Region), can maximise agricultural production and spread Mediterranean crop varieties. Because agricultural products comprise a significant share of current imports, these preconditions for exports could eventually decrease the foreign trade deficit.

Positive impacts can also be expected with Maloideae fruits (primarily apples and pears) and, to a certain extent, with the common grape vine. Positive impacts can also be expected with garden crops, especially those produced in greenhouses, where significantly less thermal energy will be needed during production cycles. Improved yields would also increase competitiveness compared to crops that are currently imported from countries with warmer climates and lower production costs.

Negative impacts can also be expected under the scenarios examined. While the extension of the growing season in arable crops can increase winter crop yields, the absence of optimum low temperatures (0-10°C) may have a negative impact on the vernalization process. In stone fruits, for example, warmer winters can reduce yield due to the lack of optimal winter cooling. Summer crops may be threatened by higher air temperatures and summer droughts. According to the regional A1B climate change scenario (2001-2030), it is also expected that the frequency of abundant precipitation followed by storms will increase, accompanied with significant surface runoff and soil salinization, primarily in southern parts of BiH. These changes will cause the further depletion of pastures in given regions and reductions in grazing fodder, which can result in lower quality and reduced milk yields, especially in small ruminants.

These impacts will require major changes in agricultural equipment and practices, as well additional work on the selection and introduction of new crop varieties adapted to emerging climate conditions. In the long-term, it will also be necessary to carry out field trials with varieties that are not presently cultivated or are cultivated only in very limited areas of BiH. One such example is sorghum bicolour (Sorghum vulgare var. sudanense), which has a major economic value as an energy crop (for biogas) and as ruminant fodder.

A warmer and drier climate will certainly reduce the spread of phytopathogenic fungi (which are fostered by frequent rainfall and high relative humidity), making some plant diseases easier to control. However, a drier climate will require changes in the use of agricultural technology, such as the intensification of irrigation, which can increase the incidence of some phytopathogenic bacteria. Treating these bacteria can increase production costs, and when they result in quarantine (as with Ralstonia solanacearum and Clavibacter michiganensis ssp. sepedonicus (Spiec. et Kott.), they can cause significant financial losses.

In addition, mild winters can increase the prevalence of pest insects (for example, intensified migration of one of the most dangerous pests for stone fruits, Capondis tenebrionsis, from southern BiH towards northern BiH) or even the emergence of new species that could would require pest control measures that would significantly increase production costs or even damage perennial plants. For example, the warmer climate could enable the spread of invasive thermophilic weeds such as Amorpha fructicosa, Ambrosia sp., Xanthim strumarium, Helianthus tuberosus and others, generating substantial costs for pest control.

The total quantity, distribution and intensity of precipitation are of exceptional importance for provision of optimum field water capacity. If adequate crop irrigation is not ensured during a drought period, a reduced yield or even total yield loss will be unavoidable if the dry period affects the crops in a sensitive phenophase. In other words, an exceptionally dry period during pollination may completely prevent fertilization and seed formation and prevent crop growth. In the past, droughts in BiH occurred every three to five years and, depending on their duration and intensity, the reduction of yields on averaged from range of 30- 95%. Droughts were registered in 1992, 1995 and 1998, whereas in 2000, 2003, 2007, 2011 and 2012, a state of natural disaster was declared in some regions. Irrigation can alleviate yield reductions during drought periods, but the amount of arable land with installed irrigation systems is extremely limited (approximately 0.65%), so it would be necessary to undertake significant measures to expand areas with installed irrigation systems.

The growth, behaviour and health of domestic animals depend both on hereditary traits and on external conditions. Climate conditions and climate change affect the appetite and health of livestock and directly influence the profitability of cattle breeding. The direct climate impact, heat exchange between animals and the environment, is linked to the temperature and relative humidity, as well as to the pace of airstream circulation and heat radiation. These factors have a specific impact on animal health and wellbeing that depends on a species, race and class of each individual head of cattle. Warming in general encourages the spread of pathogenic microorganisms and parasites. The indirect impact of a warmer climate is reflected in increased crop yields and the quality of pasture, forage plants and grains. Since plants are autotrophic organisms, they are the main source of food for ruminant livestock in the food chain of ecosystems around the world. Pastures provide more than 90% of food for wild ruminants, and an elevated concentration of CO_2 in many ways improves fodder, as opposed to reduction of nitrogen, which causes a low protein value of fodder.

3.3.1.2. Socio-economic impact of climate change on agriculture

The share of agriculture, hunting, forestry and fishery in GDP in BiH in 2010 was 7.11%, which is a slight decrease compared to 2009 (7.4%) and 2008 (7.5%). Much more important is the fact that sector of agriculture of Bosnia and Herzegovina employs the greatest number of people -- approximately 160,000 -- especially in rural territories. In 2009, the sector employed 166,000 workers.

In terms of crops, total production of grain in 2010 was slightly more than 1.1 million tons, and approximately 77% of that total was corn (more the 850,000 tons) and wheat. There were some sharp decreases in grain production in 2010, with 11.4% less corn and 43.2% less wheat than in 2009. Tendencies are similar for other agricultural products (rye, oats, barley, hay, vegetables, milk, etc.). Climate change has undoubtedly had a substantial impact on total yields.

At this moment, climate change adaptation measures in the BiH agricultural sector are marginalized. A simplified analysis performed under SNC preparation of potential climate-related damages and the possible advantages of climate change adaptation implies a need for further research and investment in agriculture to reduce vulnerability to extreme climate change. Considering the fact that average price of wheat and corn in 2010 was 300 KM/T, a 15-20% decrease in production would cause approximately KM 45–60 million of damage. Together with damage to industrial plants, fruits, vegetables and other crops, losses could easily reach KM 165 million – the total budget for agriculture in BiH (which includes only KM 90 million for direct support to farms, as approximately KM 60 million is allocated to rural policy measures).[6] The consequences of reduced production are visible in increased prices of agricultural products.

A crucial factor in vulnerability of agriculture has been the insufficient utilization of agro-technical measures, and especially undeveloped and obsolete irrigation systems and hail-protection systems. Damages caused by droughts, flooding and hail in Bosnia and Herzegovina have for quite some time been a reality. Consequently, it is expected that agriculture will suffer from the greatest damage caused by climate change and, unless drastic improvements are made, extreme precipitation and temperatures can be expected, along with other extreme weather conditions and evaporations, which together will cause reductions in total agricultural production (Popovic, 2008). Therefore, the existing climate variability already significantly affects the agricultural sector, meaning that extreme weather conditions resulted in average losses of at least 200 million KM annually. Damages caused by climate change are far greater than annual incentives that are paid to farmers.

6 1 EUR equals 1.95583 KM, BiH Central Bank, Jun 2013

Rural areas in Bosnia and Herzegovina are neglected, and rural development strategies have only recently been adopted and involve only minimal investments. Rural areas are more vulnerable due to lack of infrastructure and poorer living conditions than in urban areas. Only about KM 60 million (approximately EUR 30 million) is invested annually in rural development. In the EU accession process, CEFTA (Central European Free Trade Agreement) trading advantage should be used, along with other available EU resources such as the Agricultural and Rural Development Programme (ARDP), the Instrument for Pre-Accession Assistance (IPA), and the Technical Assistance and Information Exchange Instrument (TAIEX). Particular attention needs to be paid to the sustainable aspect of rural development; i.e., protection of waters, forests and forest ecosystems, protected biodiversity areas, etc. Inhabitants of rural areas have low incomes and are most vulnerable to negative effects in almost all sectors. They are particularly vulnerable due to high adaptation costs, and rightfully expect activities and assistance from state institutions.

Climate change also has a significant impact on food production and food safety. Frequent changes in climate conditions and new pathogens and plant diseases are evident (FAO, 2007). These and other changes cause reductions in production due to reduced crop yields and the reduction of arable land, which leads to short-term price instability and long-term increases in food prices in the world. FAO Reports indicate that global food prices increase as a consequence of bad climate conditions, energy prices increase etc. According to FAO data from 2007 (FAO, 2007), nearly 11% of arable land in developed countries could face impacts from climate change, which also include reduced crop yield in 85 countries and a reduction in agricultural production as a share of GDP for 16% of countries. According to this report, the key socio-economic impacts are as follows:

- Decrease in crop yield and agricultural production;
- Decline of agriculture production as a share of GDP;
- Fluctuation of prices on world markets;
- Increase in the number of people without access to sufficient amounts of food;
- Migration and social unrest.

According to climate scenarios A1B and A2, the agriculture, forestry and fishery sectors will face land degradation and erosion (due to extreme weather), a loss of arable land, and a decrease in livestock (due to frequent cases of livestock deaths), etc. In a 2008 FAO Report (FAO 2008), which is based on the IPCC projections from 2007, the biggest decrease in crop yields in Europe is expected in the Mediterranean, the Southwestern Balkans and the Southern region of the European part of Russia. It may be expected that there will be a geographic redistribution of certain crops (e.g. sunflowers and maize, which will be cultivated in northern areas, unlike today). This study is of specific interest and concern for Bosnia and Herzegovina, because it is situated in the risk area when it comes to food production. The overall situation is exacerbated by price increases and demand on the world food market, an increase in energy prices, and more frequent financial crises that will create general macroeconomic instability and insecurity. As a result, the foreign trade deficit in agricultural product exchange would be worsened. In addition, it is expected that there will be increased needs for irrigation, an increased risk of forest fires, increases in 'barren' land and reduced biodiversity, etc.

3.3.2. Water resources

Average annual precipitation in BiH is about 1,250 l/m^2, which - given that the surface area of BiH is 51,129 km^2 - amounts to 64 x 109 m^3 of water, or 2,030 m^3/s. The outflow from the territory of BiH is 1,155 m^3/s, with an average discharge coefficient of 0.57.[7] The average outflow towards the Danube River basin, which has a surface area of 38,719 km^2 (75.7%) in BiH, amounts to 722 m^3/s, while the outflow from the Adriatic Sea basin, which has a surface area of 12,410 km^2 (24.3%) in BiH, is 433 m^3/s.

Basin	Surface area [km^2]	Length exceeding 10 km [km]	Average outflow [m^3/s]
Immediate basin of Sava River in BiH and Ukrina	5,506	1,693.2	63
Una in BiH	9,130	1,480.7	240
Vrbas	6,386	1,096.3	132
Bosna	10,457	2,321.9	163
Drina in BiH	7,240	1,355.6	124
DANUBE RIVER BASIN	38,719	7,947.7	722
Neretva and Trebišnjica in BiH	10,110	886.8	402
ADRIATIC SEA BASINS	12,410	1,063.8	433
Bosnia and Herzegovina	51,129	9,011.5	1,155

Table 20. Specific indicators of basins and sub-basins in BiH
(Source: IPA 2007 PROJECT – Support to the Water Policy in BiH, 2011)

Low water levels in basin and sub-basin areas are highly prominent. The value of minimal median monthly flows with assuredness levels of 95% (which are the ones most often referred to when discussing minimal water flows that ensure the survival of ecosystems in and around the water bodies) amounts to around 15% of median annual flows. That indicator points to the poor conditions existing in the sub-basin of River Bosna. The non-linearity is even more prominent in the watershed of Adriatic Sea, where certain water streams have gone dry.

High water levels in the territory of BiH appear in the form of torrential flow regimes, with brief flooding waves and large outflow modules (1–1.5 m^3/s/km^2). For the watershed of River Sava, the average ratio of median annual flows and high water levels at a 1% probability level of the phenomenon amounts to $Q_{(1\%)}=18.5Q_{ann.avg.}$, which means that the watershed in question is unfavorable, judged by the regime of both low and high water levels with the highest population density and the most pronounced water requirements (IPA 2007 Project – Supporting Water Policy in BiH, 2011).

Previous hydrological analyses in BiH have faced the problem of a complete absence of data regarding the outflows of rivers in BiH in the 1990s, and the same problem occurred again during the development of this study.[8] In particular, the absence of sufficiently processed outflow

7 IPA 2007 PROJECT – Support to the Water Policy in BiH, 2011

8 This problem is in more details elaborated in INC.

data for the Adriatic Sea basin meant that it was not possible to conduct a reliable analysis of this very important basin in BiH.

The Bosna River basin analysis does not show changes in values of average monthly outflows over time. A trend analysis of monthly precipitation for the period 1961-2011 (calculated as average value of monthly precipitation in meteorological stations Sarajevo, Zenica and Tuzla), and the average monthly outflow of the Bosna River in Maglaj during the same period[9] does not indicate any significant change.

The same conclusion is reached when comparing statistical parameters of sequences in mean monthly outflows of the Bosna River in Maglaj during the periods 1961-1990 and 1991-2010 with statistical parameters of monthly precipitation (expressed as average value of monthly precipitation in MS Sarajevo and MS Zenica), during the same periods.

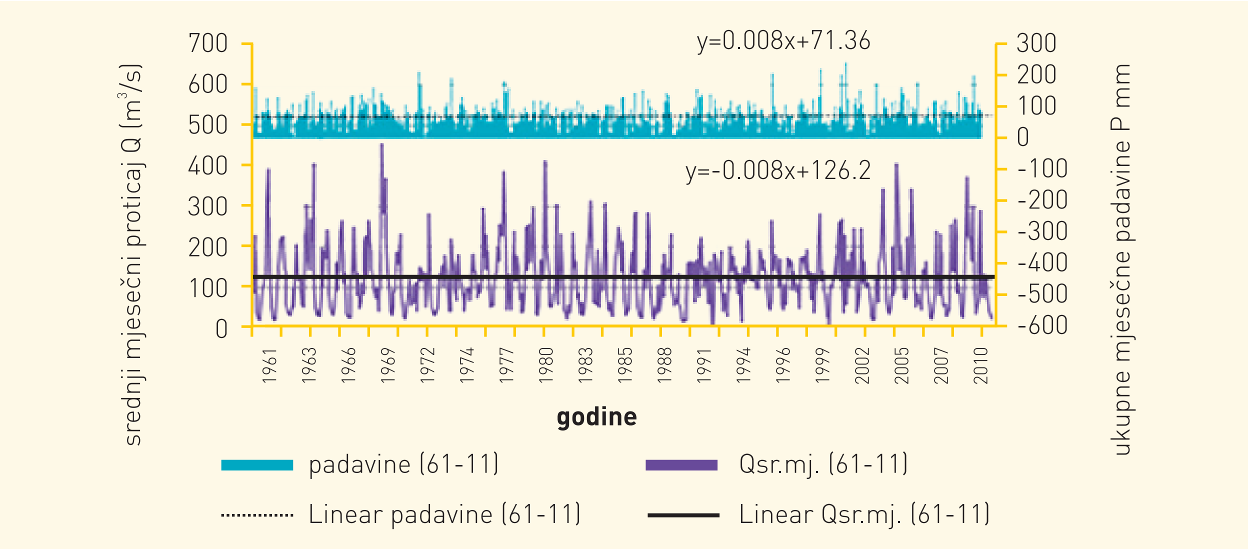


Chart 23. Sequence of mean monthly outflow of the Bosna River in Maglaj, with a trend, and average value of monthly precipitation (MS Sarajevo, MS Zenica, MS Tuzla) with a trend (period 1961-2010)

Statistical parameter	Mean monthly outflows Bosna (Maglaj)		Monthly precipitation average (MS Sarajevo, MS Zenica)	
	1961-90	1991-2010	1961-90	1991-2010
Mean value	123.28	132.05	71.31	78.33
Median	108.78	111.73	68.98	71.70
Stand. dev.	79.94	85.12	36.95	40.43

9 Values of Bosna River outflows in Maglaj, Qmean av. for January 1992 - December 2000 calculated based on multiple correlation between values of Qmean av. for Bosna in Maglaj in period January 1961 – December 2010, with following monthly values during the same period:
- MS Sarajevo (total monthly precipitation, mean monthly temperature)
- MS Zenica (total monthly precipitation, mean monthly temperature)
- MS Tuzla (total monthly precipitation, mean monthly temperature).
Multiple correlation calculated by months (Multiple R: 0.610220455-0.857194005; R Square: 0.372369004-0.734781563).

Statistical parameter	Mean monthly outflows Bosna (Maglaj)		Monthly precipitation average (MS Sarajevo, MS Zenica)	
	1961-90	1991-2010	1961-90	1991-2010
Variance	6389.69	7244.97	1365.14	1634.50
Flatness	1.38	0.45	0.84	0.61
Obliqueness	1.12	0.97	0.71	0.80
Range	437.93	387.07	224.65	208.10
Minimum	16.29	19.28	0.50	8.45
Maximum	454.22	406.35	225.15	216.55

Table 21. Statistical parameters – sequences of mean monthly outflows of Bosna River in Maglaj, for periods 1961-90 and 1991-2010, and statistical parameters of monthly precipitation in MS Sarajevo and MS Zenica, during same periods

One should emphasize that the sequences analyzed are relatively short. The sensitivity of results based on short sequences is evident from the results of the trend-based analysis, which, in addition to the trends for 1961-1990, also shows the trends for equations for 2001-2010, as well as for 1991-2011. The equations show that a single year or two may have a significant impact. In this particular case, the extremely humid 2010 and the extremely dry 2011 had had such a strong impact on median monthly flow values that they had led to the trend being reversed from positive (a growth trend) to negative (a trend of decline).

Exceedingly drier periods in Bosnia and Herzegovina are manifested in the occurrence of low water levels; i.e., reduced and small outflows on all significant waterways in the Republic of Srpska and whole Bosnia and Herzegovina. In RS, winter (January – February) and summer (July-August) periods of low water levels are experienced. The majority of rivers are supplied from ground water during low water periods, and this significantly reduces the supply of ground water in Bosnia and Herzegovina. Because drought is a highly adverse weather phenomenon, numerous research activities around the world are focused on its prevention or on the mitigation of its adverse effects.

3.3.2.1. Impacts on water resources, based on climate scenarios

Overall, all two scenarios for the periods 2001-2030 and 2071-2100 (A1B 2001-2030; A1B 2071-2100; A2 2071-2100) predict the increase of air temperature in BiH in all observed seasons throughout the year. At the same time, all three models depict reduced amounts of precipitation. Changes in the rainfall regime will also be experienced in the timing, frequency and intensity of extreme events – floods and droughts. The highest increase in air temperatures is predicted during the growing season (June, July and August), and a somewhat more moderate increase during the months of March, April and May. This means increased evapotranspiration and more pronounced extreme minimums in the water levels of waterways. On the other hand, increasingly frequent precipitation of a significant intensity will cause sudden outflows, often in the form of floods. The impact of snowfall is also significant for waterway outflow, and there is a significant predicted increase in air temperatures during the winter season (the months of December, January and February). All of the findings above imply various different scenarios leading to even more pronounced inter-annual nonlinearity of water outflows in BiH. On one hand, there will be a general reduction in the availability of water resources during the growing season, when needs are greatest; on the other, the risk of flooding will be increasingly pronounced.

In addition, projections indicate even more frequent and intensive occurrences of droughts and flooding that will be more widespread and last longer. It can be concluded that additional and more complex research of climate change and its effects on water resources are required, along with the development of a sectoral climate change adaptation strategy with an action plan and specific measures.

3.3.2.2. Socio-economic impact of climate change on water resources

Even though Bosnia and Herzegovina is rich in water resources, pressures, problems and shortages are very frequent. Huge amounts of drinking water are still wasted in distribution systems, additionally creating enormous economic losses. Although there are no exact indicators to quantify these negative impacts, it is certain that these losses are at least EUR 25 million a year (for example, Croatia, which has more inhabitants and better infrastructure, experiences annual losses estimated at approximately 286 million EUR). In addition, greenhouse gas emissions are constantly increasing due to the increased consumption of energy required for production of drinking water. An additional problem is the shortage of water in agriculture, especially in risky periods when soil needs minimum quantities of moisture.

The energy sector of Bosnia and Herzegovina is also potentially vulnerable, particularly due to the fact that climate change could cause reductions in river flows. Such extreme situations could lead to reductions in generation of hydroelectric power, which would put in danger the energy safety and production of electricity intended for export. Droughts have in past affected the level of losses in production of hydroelectric power. Reduced production of hydroelectric power caused by reduced river flows must often be replaced by other domestic sources or by imports, which is unfavourable from the aspect of increased greenhouse gas emissions (additional production in electric power plants), but also from a macro-economic aspect (increases in the foreign trade deficit).

All of these challenges together have a negative impact on the socio-economic status of the population and all economic actors, because the lack of a stable supply of electricity may lead to price increases. Even though there are no exact indicators of direct and indirect losses caused by reduced water flows, it could still be concluded that such losses are much greater than losses caused by the inadequate water supply network; i.e., they could easily exceed KM 100 million (for example, if water flows decrease by 5-10%). Anyhow, according to the World Bank data (2008), planned investments in electric power sector in BiH by 2020 amount to slightly over 4 billion EUR, where certain finances should be redirected towards reduction of vulnerability in the sector of hydro energy. Therefore, adaptation measures must be focused on strategies and regulations, as extreme climate change has a negative impact on water cycles, which could lead to droughts and impacts in other sectors, especially in agriculture and natural ecosystems. BiH decision-makers have still not taken into account all the climate change dangers in their strategies and water resource management plans. In parallel, there is a need to research the socio-economic effects of climate change on protected areas and wetlands and to study risks of floods or reduced river flows. Scientific and expert research is also needed with respect to necessary adaptation measures, including cost-benefit analyses of measures, and on climate change interactions, the production of hydropower, and the supply of drinking water.

3.3.3. Health

3.3.3.1. Impacts on human health, based on climate scenarios

The leading causes of morbidity and mortality have not changed since the publication of the Initial National Communication (INC): circulatory system (cardiovascular, cerebrovascular,) and malignant neoplasms (i.e. cancer). Although findings in the literature data point out some links between these diseases and climate change, this cannot be claimed since no specific surveys have been so far conducted in BiH to confirm the link between climate change and its impact on human health.

Neither direct nor indirect impacts of climate change on human health have been continuously monitored in BiH. Despite the fact that some reports systematically analyze climate change in BiH, there is still no established system for monitoring of frequency of particular diseases in particular regions that could be linked to changes in individual climate parameters and, consequently, occurrence of natural disasters. Data collected on the state level were not used for development of a clear methodology for climate change crisis responses, and no preventive measures have been adopted in order to prevent the occurrence of critical situations, or to mitigate consequences caused by climate change (reduced crops yield due to droughts or floods; shortage of drinking water safe for human consumption and health...)

Two years later, it is evident that both entities in Bosnia and Herzegovina continue to apply the Law on Statistics, i.e. adopt their programmes of statistical research with equal time intervals between two cycles. These programmes define a framework for collection of data on hygienic status of drinking water, health safety of food items and objects of general use, as well as data related to environmental risks and their effects on human health. The RS Law on Records and Statistical Research in Health Sector closely defines the scope and manner of data collection and the implementation of statistical research, as is also the situation in the Federation of BiH. In practice, BiH still does not have an established model for information flow between different sectors, jurisdictions quite often overlap and it is not always clear who is responsible to whom, who collects data from whom, and which methodology is used with data. Consequently, there is an absence of available adequate environmental health reports, including reports on risk factors and their impact on climate change and human health, despite the fact that this field is legally well regulated and that reporting practice is harmonized with EUROSTAT requirements. Accordingly, we may say that vulnerability of people is still present.

Even though there are no detailed surveys, it still can be claimed with quite high certainty that climate change strongly affects the health of people in Bosnia and Herzegovina. It is indisputable that there is a high concern of the society for the general health of the population, but public involvement in these issues is crucial for definition of efficient responses in climate change adaptation. A well informed and educated public, which is well acquainted with dangers of extreme climate conditions, can reduce their vulnerability to negative impacts through appropriate measures. The main causes of serious health impacts caused by extreme climate change are heat strokes, which lead to the increased mortality of the population BiH. The deterioration of climate conditions will lead to more frequent changes of and worsening in the health status of most serious patients. These include diseases with cardiovascular risks, allergy reactions and other acute reactions to high daily temperatures, as well as other health problems such as diseases caused by waterborne and foodborne bacteria, diseases transmitted by insects, birds, etc.

3.3.4. Forestry

Forests in Bosnia and Herzegovina cover 53% of the total surface area of the country. Due to their natural and diverse structure, as well as a high rate of natural regeneration (approximately 93%), forests in Bosnia and Herzegovina represent a key natural resources. Approximately 20% of wood weight is carbon; in addition, total forest biomass plays a "carbon storage" role. For example, organic substances from forest soil, such as humus formed as a product of decomposition of plant material, also store carbon. As a result, forests store enormous amounts of carbon: according to an FAO survey, two times more than in the atmosphere. Carbon dioxide as a "fertilizer" can improve the growth and development of plants, so that forests can grow faster due to the increased level of CO_2 in the atmosphere. Experiments in laboratory conditions showed that doubling the level of CO_2 leads to an initial increase from 20% to 120%, with an average increase of 40% (Eamus & Jarvis, 1989). In some cases, however, increases in the level of carbon dioxide induce growth only temporarily, while further increases in the concentration of CO_2 can even reduce it. Reduced growth may be caused by increases in the concentration of starch in leaves and by the reduction of photosynthesis (Wullschleger et al., 1990).

Richness of diversity is reflected in a number of plant and animal species present in the region, which places BiH high on the list of the most interesting countries in Europe. This very significant diversity provides a better starting position to forest ecosystems to adapt to climate change, but at the same time there is the threat that rare, unique specimens may be lost.

Forest ecosystems in BiH will be exposed to direct impacts from the following sources:

- changes in temperature and changes in precipitation;
- increased atmospheric concentration of CO_2 (changes in growth of trees and in utilization of water), and
- changes in the occurrence of forest fires, in the prevalence of a spectrum of vermin, and in other intensive natural disasters (drought, ground water depletion, early frosts, strong rains, snowdrifts, windstorms, etc.).

3.3.4.1. Impacts on forestry, based on climate scenarios

Based on the assumed climate change models, a comparison was conducted with known, general data on climate parameters for particular forest communities (Bertović, 1975).

Currently, average temperatures in different forest ecosystems in BiH range from beech forests in the Dinaride range (with average annual temperatures of 7.2 to 7.7^{0}C) to the stands of downy oak and hornbeam (with average annual temperatures of 12.7 to 13.5^{0}C). This range shows that the A2 scenario for the end of this century with its increase of average temperatures from 3.4 to 3.8^{0}C would be close to the currently existing average temperatures for extremely different forest communities. The assumed changes in forest ecosystems indicate that drastic changes would occur even in the mildest scenario. The majority of forests characteristic of the mountainous (Dinarides) regions would evolve into forests of mountainous beech. In the A1B scenario at the end of this century, dominance is expected from the thermophilic forests of the sessile oak with hornbeam, the downy oak and the Holm oak. Model A2 leads to the total devastation of forest ecosystems and the formation of sub-Mediterranean and Mediterranean forest communities.

Generally speaking, the proposed scenario would have unforeseeable (unthinkable) consequences for forest ecosystems in BiH.

The possibility exists that climate change will affect forests in BiH in a manner that could potentially transform entire forest systems over time, shifting their distribution and composition. This carries a burden of socio-economic and environmental consequences. The climate change that has occurred will not have the same impact on all forest ecosystems throughout Bosnia and Herzegovina. In support of this argument goes the fact that survival of the forest community is not linked only (or exclusively) to the average annual temperature in the area where the community appears, which means that the increase of average annual temperature will not be the only factor affecting the change. In addition to average annual temperatures, other important elements include distribution and intensity of precipitation, which should be analyzed together and in interaction with the increase in average temperatures, as well as with a series of other factors that appear in immeasurable periods and with immeasurable intensity. A basic starting point was the increase of temperature in the entire area during the same interval, which was not the case in the predicted scenario. Each region for which the changes are predicted should be analyzed individually. This means that it could be expected that regions in which changes are not predicted would not see the changes in structure of forest ecosystems. Not all communities (or varieties) will react in the same way (some are located on higher altitude, some are less sensitive), meaning that each community's reaction should be analyzed separately. Varieties located in the centre of the habitat will be more tolerant to climate change, while those near the edges will be very vulnerable. Also, succession of varieties and a change of communities' structure are linked to the natural regeneration of forests and are defined by the age of the trees. In some varieties (such as oaks) this is more than 100 years, and in some varieties it is unrealistic to expect changes of the existing vegetation for the period shorter than one century (except in events of natural disasters). Finally, a series of other factors that affect the changes of forest ecosystems (changes in soil structure, changes in genetic resources and diversity, adaptability of species, etc.) must be taken into account in all changes and shifting of forest communities.

Fearsome temperatures and climate conditions, such as frost and heat waves, or changes in form, time and quantity of precipitation (for example, snow compared to rain, drought compared to flooding) may have an impact on particular trees, positions and levels of forest systems, because these changes can increase a vulnerability to vermin, pathogens and severe weather (Schlyter et al, 2006). Another significant threat to forest ecosystems is caused by increase in occurrence of forest fires. Increased risks of forest fires caused by increases in temperature and changes in patterns of precipitation are expected in some parts of BiH (especially in the territory of Herzegovina), which implies the need for expansion of fire protection capacities. All these aspects (weather, vermin, pathogens, fires) may, in a long term, cause lower productivity and poorer health status of forests in BiH.

3.3.4.2. Socio-economic impacts of climate change on forestry sector

Although their significance in a domestic product is not major, the forestry and wood processing industry are important economic and, above all, natural resources of Bosnia and Herzegovina. The share of the forestry sector in total employment is greater than its share in GDP (in RS 6.5%, and in FBiH 4.6% in 2008). While the share of forestry in GDP in BiH for 2010 was only 0.83%, this economic activity has a strategic significance because of its orientation towards exports and job creation. Forests are managed by public companies at the entity level and controlled by relevant ministries and entity parliaments. Forests are under full control of the state, and they have not been privatized.

Capacities of mechanical and chemical wood processing exceed domestic demand. Forestry is facing various problems: absence of the long-term strategy and development policy, inefficient organization, absence of laws and the practice that is not harmonized with EU. Global situation on wood market and a situation on BiH market cause indifference to changes, primarily due to an increase in supply and a technical progress that together contribute to the raising productivity in exploitation of forests, and continuous reductions in quantities of wood used in industry. This complicates the economic position of forestry, being reflected in inadequate cultivation and protection, biotic and abiotic vulnerability, reduction of forestland, losses in biodiversity and poor access to forests. This has a synergistic impact on vulnerability of forests and forest systems in Bosnia and Herzegovina.

Forest management models should include climate change adaptation measures, in order to reduce their vulnerability. All the activities must be synchronized at the state and entity level, as well as with general and sectoral policies. Climate change is accompanied by a long-term increase in average temperatures and lower average precipitation, leading to a reduced tree growth rate and lower exploitation efficiency. Extreme climate changes slow tree growth, because more time is needed for growth before the cutting. That can lead to the reduction in quantities of cut wood, worse socio-economic situation, reduced export activities and increased foreign trade deficit of Bosnia and Herzegovina. Negative consequences of extreme climate change in forests and forest ecosystems are more difficult to isolate. Their detection requires long-term research and monitoring activities. That is the only way to determine and isolate the cumulative effects of temperature and precipitation. Equally important are forest locations, such as geographic and climate zones, temperature and precipitation margins. If forests are located in zones with temperature of the upper temperature limit for certain groups of trees and precipitation rates are at the lower limit, it means that natural migrations of some species are possible, representing a type of adaptation.

Hence, it is indisputable that productivity depends not only on the type and location of the forest, but also on temperature and precipitation patterns. Upper temperature limits have a negative impact on productivity, since radical temperatures limit the growth. There are also some complex agents of stress in forests and forest systems: insects, diseases, drainage, unplanned cutting, fires, the impact of CO_2 etc. Frequent forest fires reduce productivity in forestry sector and wood processing industry, which directly affects the socio-economic situation. High temperatures increase the vulnerability of forests to forest fires, droughts and floods, which is in turn reflected in internal and external competitiveness. Bosnia and Herzegovina must implement measures that will reduce vulnerability to climate change, as well as measures that will improve the socio-economic status of forestry sector and wood processing industry. Adequate legislation based on EU practice should be adopted together with the programme of long-term forestry development harmonized with the Ministerial Conference on the Protection of Forests in Europe (MCPFE). This requires better forest inventories and databases, management, monitoring and sustainable financing of the revitalization of forests and forest ecosystems, afforestation, cultivation and protection. Improvements in socio-economic situation can be achieved through utilization of forest resources in hunting, production of forest by-products and tourism, in a manner that valorizes the protected ecosystems.

There is a need for continuous education and public awareness-raising regarding the importance of forests. Migration of the population from forested regions represents an important social and demographic problem, since the primary distribution is still done at the expense of less developed local communities with high unemployment rates.

3.3.5. Biodiversity and vulnerable ecosystems

One of the most evident consequences of global warming for biodiversity will certainly be the changes in water resources and in distribution of pests and diseases. According to IPCC scenarios, Mediterranean countries, which already greatly depend on irrigation, will have on average 15 to 25% lower soil moisture during summers.

In summary, available data and research indicate that climate change represents a threat for all three macro-regions in BiH (Pannonia, mountainous and Mediterranean). The Dinarides Region will be under particular threat, as a very important and rich centre of endemic species in Balkans. This mountainous chain is of extraordinary biological and geomorphologic significance. The rivers of the karst region and their ecosystems are particularly vulnerable. Analysis of the impact of climate change on distribution of sub-associations of Dinaric beech and fir forests in BiH shows that the surface of their habitat will be significantly reduced.

3.3.5.1. Impact on flora, based on climate scenarios

Climate change affects physiology and relations between plants, causing changes in their habitats, mainly in terms of expansions or reductions in habitat size and shifting (horizontal and vertical migration).

Significant changes are expected in lineages that inhabit mountainous regions of Bosnia and Herzegovina, in northwest migrations of wood species in the direction of the Dinarides, with possible local depletion of flora. It is feasible to expect reduction in number of herbaceous species of a narrow ecological valence in highest mountainous regions that will not be able to adapt their habitats fast enough. This group includes the species of circumpolar, pre-alpine and alpine type of distribution. The threats imposed on this rich flora and fauna by a wide spectrum of various human activities are numerous. One of many significant consequences of global warming for ecosystems will certainly be a shifting of water supplies and distribution of agricultural pests and diseases. The IPCC scenario envisages that Mediterranean countries, which already depend heavily on irrigation, will have 15 to 25% less soil moisture during summer months (IPCC, AR4, 2007).

Penetration of allochthonous species will continue, and those more aggressive types can extrude the autochthonous species from their natural habitats. Simulations assuming that average temperature will increase by 2°C indicate significant negative consequences for this biome. In general, it can be assumed that the most affected regions will be the high mountains in Bosnia and Herzegovina at approximately 1,500 m altitude, which corresponds to the border of sub-alpine belt.

In the scenarios tested for climate change impact on biological diversity (A1B scenario, 2001-2030; A1B scenario, 2071-2100; and A2 scenario, 2071-2100), a distribution of species and populations was observed. Comparisons between the present situation and situations in 2030 and 2100 indicate that changes of habitat will occur for most species. Major changes can be expected during June, July and August in southern parts of the country (A1B scenario, 2001-2030), with values ranging from +1.4°C in north to +1.1°C in southern parts, and with increase in precipitation ranging from +5 to +15%.

Similarly as in Croatia, areas in which a species is present in abundance will increase only for some species, such as European Wild Ginger (Asarum europaeum L.); will stagnate for spurge-laurel (Daphne laureola L.), and will be reduced for purple lettuce (Prenanthes purpurea L.). Some will even completely disappear. Depending on the region, precipitation shows both positive and negative changes that will affect the plant world differently.

It is currently not possible to make a precise prognosis of successful adaptation to a life in new habitats created by climate change. The ideal case of a species' survival with migratory changes is only sometimes possible due to isolated ecological niches, natural and artificial barriers. Anthropogenic effects on space, primarily fragmentation of habitats and disruptions of migratory pathways, increase the risk of shrinking habitats or disappearance of species. Species exposed to climate change can attempt to migrate following their life optimum, can try to adapt to the newly established circumstances or will become extinct (locally or wider).

3.3.5.2. Impact on plant communities, based on climate scenarios

Based on the Hopkins Law of Bioclimatics, by which 3°C increase of temperature (specifically referring to A2 scenario, 2071-2100) corresponds to the elevational migration of vegetation to 500 m altitude, it is assumed that there will be a substitution of vegetation of pre-mountainous region of Dinarides with the vegetation of temperate climate-zoning belt. The most vulnerable group includes the species of circumpolar, pre-alpine and alpine type of distribution. These are mainly herbaceous species of a narrow ecological valence that will not be able to adapt their habitats fast enough. Successful adaptation is only possible with slow climate change (up to 0.1°C per decade) and absolute climate change below 1°C. The eliminating factor in will probably be temperature in higher regions and precipitation in continental lowlands.

Movements of climate-zoning vegetation belts may lead to a disappearance of inadaptable or poorly adaptable species. Penetration dynamics of non-autochthonous species may increase, and some more aggressive species can extrude the autochthonous species from their natural habitats. The most vulnerable will be the rich endemic flora (paleoendemic, neoendemic species), tertiary and glacial relicts, especially those that have remained in refuges due to weak migratory options and limited distribution.

It is expected that populations of many species, especially in peripheral parts of habitats, will be more exposed to fragmentation into smaller sub-populations. Populations with large and many sub-populations and a slow migratory ability will lose the smallest genetic diversities, and vice versa. Species that fail in fast genetic adaptation to climate change will become extinct.

3.3.5.3. Impact on water habitats, based on climate scenarios

Shifting of zones in mountainous regions will directly reduce snow-covered surfaces and subsequently the amount of water from snow, which will affect the amount of water from these sources that melts in spring and reaches rivers and other watercourses. Water and wetland habitats are specifically important at national and international level. They ensure and/or participate in a series of critical ecological functions, such as regulation of water regimes and formation of the environment for many stenovalent plant and animal species. Types of water and wetland habitats will be sensitive to changes occurring in amounts and in a distribution of precipitation, in water regime with secondary effects related to many species. Changes can be expected in annual rhythms of the water level and quality. This will probably affect the quality of sub-terrestrial and terrestrial waters, as well as directly or indirectly the composition of corresponding biocenoses.

3.3.5.4. Impact on fauna, based on climate scenarios

Processes related to climate change are directly linked to changes in ecological conditions in habitats. The most affected and most vulnerable are high mountainous ecosystems. The usual consequences of climate change are: extinction of threatened, rare or vulnerable organisms, loss of endemic gene pool, and loss of biodiversity at genetic, species and ecosystem level. Monitoring climate change consequences for the nature and biodiversity is performed with bio-indicators for climate change.

Adult animals, especially ranks of higher taxa, can use physiological mechanisms to mitigate the effects of global warming (behaviour, thermal regulation, hypothermia, temperature compensation, etc.). Even though these mechanisms significantly increase resilience, they cannot eliminate secondary effects on animal biology, especially mechanisms associated with propagation. In ecological sense, global warming can have as a consequence a reduction in number of fauna species in natural habitats, and their impact on spatial and temporal distribution. It has been observed that, for example, some butterflies change their habitat even at changes of temperature < 1°C. A particular impact can be expected on daily, seasonal and annual rhythms, activity and migration of insects, and on sensitive interaction between insects and plants. The group of nematodes showed that different species react differently to soil warming and that, depending on the group, both increases and decreases in number of species can be expected. No sufficient data exist that would enable better understanding of links between population biology of vertebrates and climatology. It seems that birds of marine coastal habitats will suffer from more negative effects than the rest of ornithofauna.

Climate change in BiH will affect different groups of animals. Probably the greatest influence will be felt by the endemic fauna of karst regions. Shifting of climate zones is expected to bring disruptions in the unknown physiological and ecological conditions that are necessary for survival of a particular stenoendemic genus of karst and coastal lizards. The wetland area in the park of nature "Hutovo blato," which is located in the sub-Mediterranean belt and belongs to the group of internationally important wetland regions under Ramsar Convention, is particularly vulnerable. Climate change will disrupt the temporal schedule of migrations and availability of food sources. Loss of wetland regions such as Hutovo blato could lead to disappearance of bird and marsh turtle populations that inhabit wetlands throughout the entire year or are present only during migrations.

Climate change and shifting vegetation can also significantly disturb the future distribution of animals, their number and survival. The pace of changes, especially in combination with artificial urban and agricultural barriers, may affect the ability of many species to move to zones that suit them much better in climatological and ecological sense. Threatened and rare species will be particularly sensitive to rapid changes, especially if their distribution is spatially limited and the width of their niche is narrowed down. Hence, climate change represents a significant threat to the biological diversity.

Past years showed a shift in the spawning period of freshwater fish from –0.11 to +0.34 days/year. Time of return of migrating birds from wintering grounds occurs earlier with 31% of species. Similar changes have been occurring in BiH. As is the case with plant species, populations of many animal species, especially those in peripheral parts of habitats, will be exposed to fragmentation into smaller sub-populations. That will make populations with large and many sub-populations and a slow migratory ability lose the smallest genetic diversities, and vice versa. Species that fail in fast genetic adaptation to climate change will become extinct.

Some invertebrates with a wide migration distribution will inevitably adapt to changes. Increased temperatures will disturb development cycles of species that are accustomed to colder environments (for example, mountain ranges). Vertebrates have the advantage of good migratory abilities (even though they can locally be distributed quite narrowly) and they move their habitat much faster than vegetation units. Interstitial fauna in the narrow coastal regions (depending on local topographic characteristics) may be directly exposed to salinization as a consequence of sea level increase. Immediately, and as a consequence of participation of some microorganisms and organisms in complex ecological chains, the total effect on biodiversity will be negative.

3.3.5.5. Impact on fauna of karst regions, based on climate scenarios

Karst regions represent unique phenomena that represent several specific patterns in the development of the earth's crust, hydrological networks, and biological and ecological diversity. Disruptions in one of them will have effects on the rest of the system (Watson et al., 1997) and, as a consequence, karst geo-ecosystems are highly fragile environments that are suffering from progressive degradation caused by human activities in many regions of our planet (Parise et al., 2009). Management of karst terrains is very difficult, especially in the face of overwhelming urbanisation and progress in agricultural technologies.

Karst fields are ecologically the most interesting phenomena of karst terrain, with characteristic networks of underground watercourses, disappearance of surface rivers through sinkholes and their re-emergence into daylight further downstream. Also, their specific feature is the emergence of temporary watercourses, which exist throughout one part of the year, and then disappear. These regions are habitats of numerous plant and animal species, many of which are endemic and specific only for these regions. At the same time, some of them have a very narrow distribution; i.e., they can be seen only in some parts of karst. Specifically interesting are endemic species of fish Paraphoxinus metohiensis, which spend one part of the year in underground waters, and then emerge to the surface.

According to the previously used system, these are: Paraphoxinus metohiensis (Steindachner, 1901), Paraphoxinus pstrossi (Steindachner, 1882) and Paraphoxinus ghetaldii (Steindachner, 1882), later classified as Phoxinellus, and given names of Phoxynellus metohiensis (Steindachner, 1901), Phoxynellus pstrossi (Steindachner, 1882), Phoxynellus ghetaldii (Steindachner, 1882).

Prior to the construction of reservoirs and systems of canals and tunnels, Phoxinellus had spent most of the year in underground waters. They used to appear in surface waters in spring, during the flooding period in eastern Herzegovina. As with other species living in karst waters and having a similar life cycle, Phoxinellus are characterized by specific complex of physiological adaptive mechanisms that enable this way of survival (Ivanc et al. 1989; Lučić, 2009).

It must be said that climate change, through changes in temperature and changes in hydrological regimes, also represents one of the forms of pressure imposed on fauna of these regions. Because the life cycle of these species is linked to periods of floods in these regions, every change in these events will cause changes for Phoxinellus. Thereby, it must be emphasized that propagation, biology and ecology of these species are still not sufficiently explored. Simultaneously with climate change, all changes in hydrological regime also lead to disruptions, since every change in regular variations may lead to disruptions that could significantly affect the populations of some species.

In addition to endemic fish, wetlands in karst regions are habitats of many bird species and at the same time represent corridors for migrating birds during their seasonal movements. These regions also host some globally threatened bird species, such as: Anthya nyroca, Aquila pomarina, Falco neumanni, Crex crex (IUCN Redlist), and their relatives. Species listed in the Wild Bird Directive as those requiring special protection, including habitats important for their survival and reproduction, include: Gavia artica, Ixobrychus minutes, Nycticorax nycticorax, Ardeola ralloides, Egretta alba, Egretta garzetta, Ardea purpurea, Platalea leucorodia, Plegadis falcinellus, Ciconia ciconia (Bosnia and Herzegovina, Land of Diversity). The specific fauna features of karst regions are numerous representatives living in caves and caverns.

3.3.5.6. Impact on protected areas, based on climate scenarios

Changes in the habitats of particular species and communities will also affect protected areas. This may lead to the need for some changes to be made on borders of national parks: ''Tjentište'' National Park (Foča), ''Kozara'' National Park (Prijedor) in RS, and ''Una'' National Park (Bihać) in FBiH. The "mitigating circumstance" is the fact that borders of these parks have not so far been clearly defined or set in accordance with biological criteria. However, as these are long-term processes and there is an opportunity to correct these omissions, even the potential need to acknowledge climate change can lead to changes in borders. The "aggravating circumstance" is the fact that so far only approximately 2% of BiH territory is classified into one of the categories of protected areas.

Rivers in the Dinaric basin, the especially Neretva and Trebišnjica, will be greatly affected. Due to its biological characteristics, region around Neretva River is protected and included in valuable wetland habitats under RAMSAR Convention (Hutovo blato), as possible negative trends are extremely unfavourable.

3.3.5.7. Impact on coastal ecosystems

In addition to the effects of changes in temperature and precipitation, the biodiversity of coastal ecosystems of the Adriatic Sea will also be affected by changes in sea level. Predicted sea level increases for the Mediterranean region are in the range of 34 to 52 cm. Habitats and biocenoses that will be directly exposed to these effects are in the low coastal areas, such as coastal sands, salines and estuaries. Changes can be expected in physical, hydro-dynamic, biological and chemical parameters, with accompanying qualitative and quantitative changes in composition of biocenoses. Serious consequences for freshwater biocenoses can be caused by surface water warming and deeper penetration of brackish water into estuaries. It is realistic to expect damages to or disappearance of certain valuable coastal habitats due to erosive processes. Directions of changes and impacts on particular taxonomic groups are difficult to predict.

3.3.6. Regional Development

3.3.6.1. Spatial and urban planning

The development of urban and peri-urban systems requires greater free space and increasingly greater consumption of energy-generating mineral and fossil fuels. In this way, urbanization and, within its scope, industrialization, become active environmental factors. Changes in the structure and manner of space utilization have been becoming an increasingly important factor in changes in the atmosphere and urban climate, which more or less affect general global climate change. Actually, increases in surface air temperature cause changes in climate and environmental living conditions. Increasing production volumes in some activities in the chemical and mechanical industries distort the structure and function of the ozone layer and contribute to the stronger effect of direct solar radiation with different consequences for living world, but also to the course of climate change. Urban systems, different morphologies, structures, function, size, etc., are increasingly important factors in climate change, both at the local and global level. Therefore, planning systems, especially urban planning, as well as special purpose zones in the form of appropriate planning documents, have a greater role in prevention of and adaptation to climate change.

3.3.6.2. Rural planning

Seen as a climate change adaptation factor, rural planning is of invaluable importance. It covers the utilization of land, water resources, forests and forest potential, and the development of particular economic activities that have an immediate effect on the environment and its climate, such as tourism, agribusiness, wood processing, utilization of minerals and other raw materials, and the development of transport systems.

Destructive forces in the field of rural development in Bosnia and Herzegovina are, more or less, imminent in all social systems and indicate inconsistencies between general, regional and local development, as well as inconsistencies between general and sectoral development. Despite such preconditions, rural development has survived and remained a key factor in sustainable development. That is why rural planning and rural development (as a key environmental segment) today have more and more scientific, political and practical importance.

With the aim of overcoming general development problems, regional divergence, deadlocks in the development of rural areas, revitalization of rural regions, etc., developed countries, particularly the European Union, established the concept of integrated rural development (IRD). This concept entails "all forms of human activity based on local resources, with an aim of economic strengthening of rural economies, integral protection of all elements of space, integration of development and protective goals in function of a long-term sustainable development."

The European model of rural planning, integrated rural development and rural sustainability, which is acceptable to RS and FBiH, defines a responsible approach to the valuation of development potentials in rural areas. Its final goal is to preserve the environment, and to establish sustainable development and sustainable functions with the goal of satisfying the needs of this and future generations.

Sustainable rural development depends directly on the preservation of the environment. Thus, it includes the ecology of water, air and soil, and the status of biodiversity as key indicators of preservation, possible valuation and necessary protective measures. Legislation and regulations on environmental protection, for example, establish a procedure for environmental impact assessment In this way, legislation has a role in stimulating rural development, i.e. sustainable rural development represents a key precondition for sustainable environment and prevention of climate change. At the local level some environmental law issues have been transferred to municipalities, such as the development of environmental action plans, issuance of environmental permits, etc.

The advantage of rural planning model based on an integrated rural development and sustainability model is that it supports both classical agriculture and complementary activities "in and around agriculture," allowing for an adaptive and preventive approach to climate change.

In rural economic planning, which is a key element of rural planning and integral rural development, priority should be given to a development policy focused on natural resources: agricultural land, water resources (rivers, lakes, thermal and mineral waters), protected areas, landscape values, eco-climate values, biogene values, etc. These resources can be used as a base for agriculture focused on the production of safe, healthy food; forestry focused on forest cultivation and wood processing, the collection and processing of forest fruits, medicinal herbs, etc.; and rural tourism, which can provide special opportunities for improving integrated rural development.

3.4. Overview of climate change adaptive capacity

The following section discusses adaptive capacity in five areas (adapted from Smit 2006 and CARE 2013): information, skills and management, economic resources, physical capacity, and institutions and networks. It summarizes the general political and administrative framework for climate change adaptation, the financing environment for investments in projects that directly or indirectly support adaptation, and then discusses adaptive capacity by sector.

3.4.1. Overall policy framework and climate change adaptation policies

At the regional level, Bosnia and Herzegovina supported the creation of the Southeast Europe Climate Change Policy Framework Action Plan for Adaptation (SEE/CCFAP-A) under the auspices of Belgrade Initiative on Climate Change (SEE, 2007). This general policy framework and other relevant activities are described in details in Section 5.5 of this report on International Cooperation. In the implementation of this adaptation framework, it is necessary to develop a system of indicators that is compatible with EU standards and that will also be suitable to the specific needs of Bosnia and Herzegovina. Monitoring the impacts of climate change will require building capacity in development management that is oriented towards these specific needs.

At the country level, a draft Climate Change Adaptation – Low Emission Development Strategy (CCA-LEDS) for Bosnia and Herzegovina has been prepared, and the strategy identifies areas that need strengthening in the current policy framework in order to support effective adaptation.

3.4.2. Economic incentives

Climate change adaptation measures are impossible to accomplish without adequate economic instruments. The most important instruments and measures are those at the state and entity level. The RS Law on the Fund for Environmental Protection (2002) and the FBiH Law on the Fund for Environmental Protection (2003) established funds to collect and distribute funds for environment protection, but these have not brought any expected effects yet. A new Law on the Fund for Environmental Protection and Energy Efficiency has been adopted in November 2011 in RS; it sets a new schedule for allocating funds for energy efficiency projects and modifies the name of the fund. Changes in the laws on environmental funds in FBiH and Brčko District are forthcoming.

In spite of the international obligations of BiH, climate change mitigation and energy efficiency efforts are far from satisfactory. The present period of economic development features decreased outputs in agriculture, industry and the energy sector due to post-war recovery, structural issues inherited from the planned economy of the 1980s, and impacts from the world economic crisis. As a result, environmental impacts have been minimised. However, the future development of BiH presumes recovery and faster growth in the three sectors above, which will generate bigger challenges to sustainability.

At present, it is possible to access funds for financing energy efficiency and renewable energy projects in the Western Balkans. In addition, funds from private investors should not be underestimated, because these investors are often searching for opportunities in this sector. It seems that the combination of funds and public and private capital would be able to resolve various climate change adaptation issues in Bosnia and Herzegovina. This could be one of the basic tasks for both institutions and decision makers. As there are no relevant strategic projects yet, it is necessary to make advance steps and continually allocate funds for the following: project promotion, technical guidance development, the development of documentation with regard to execution of obligations (due diligence), competition for funds (loans or funds), approvals, and other types of stimulus. Finally, it can be concluded that financing is key to planning and implementation of plans for climate change.

As is the case with other developing countries, BiH is already affected by climate change, but it lacks the necessary human and financial resources to adapt. Therefore, Bosnia and Herzegovina is turning to the European Union, which has committed itself to strengthening dialogue on climate change with candidate countries and potential candidate countries (the current status of BiH). However, this also represents a general message of all strategies tackling expansion issues, hence it is no surprise that in several key joint policies of EU and the budgets of EU and country members, there are significant resources allocated for sustainable development (including direct and indirect investments in the climate change mitigation measures.) Scientific research shows that climate change may significantly impact water resources, agriculture, forest and forest ecosystems, coastal areas, tourism, energy, land use and buildings, transport infrastructure conditions, natural ecosystems, human health, socioeconomic status and demographic trends in the countries of Southeastern Europe. Potential financial sources for adaptation include the Global Environmental Facility, including the Adaptation Fund; the Special Fund for Climate Change; and the Green Climate Fund. Other funders include the World Bank, the European Bank for Reconstruction and Development (EBRD) and FAO, the European Union (including pre-accession instruments, the EU Seventh Framework Program, and EIB funds), the WMO Technical Cooperation Program, the South East Initiative for Disaster Relief and Adaptation administered by the World Bank, and bilateral donors (UK, Spain, Switzerland, Sweden, and others). There is also potential funding for adaptation from private funds and investors, and it would also be possible to attract funding through an existing Multilateral Environment Agreement – MEA -- that could provide synergies with adaptation measures. Relevant MEAs include the Convention on Biological Diversity, the UN Convention Combating Desertification and the Ramsar Convention on Wetlands. In other cases, technical assistance that emphasizes education and cooperation on climate change issues can increase adaptive capacity.

3.4.3. Difficulties and risks in implementing proposed adaptation measures

The implementation risks of proposed measures are numerous, and it will be necessary to overcome many difficulties. The most significant barrier is the lack of funding necessary to implement adaptation measures. Some of the measures suggested assume the implementation of different types of research and the development of a system for climate change monitoring, all of which will require financing. Therefore, the provision of financing is a key first step in implementation. A second set of barriers consists of a lack of research capacity in addressing climate change adaptation, insufficient research on climate change impacts, and a lack of well-defined roles for various stakeholders. At the same time, it is necessary to further promote the importance of climate change and strengthen existing capacities.

3.4.4. Adaptive Capacity Assessment by Sector

3.4.4.1. Adaptive capacity in agriculture

At present, adaptive capacity to climate threats in the agricultural sector is low. In terms of available information and knowledge, there is a lack of detailed analysis on regional changes within BiH and a lack of crop modeling. Climate data is not fed into early warning systems for farmers, and farmers lack information about adaptive farming techniques, seed varieties, and crops that may be more appropriate with changes in season temperature and precipitation patterns.

In terms of skills and management, there is a general need for training farmers in less labor-intensive methods of agriculture, cultivation techniques for better-adapted crops, and hail protection techniques. In the economic sector, there is an overall lack of investment and a lack of crop insurance, which will become increasingly important with future increases in extreme weather.

In terms of physical capacity, there is a lack of modern technology (many farmers use obsolete farm equipment, and there is a low uptake of new technologies due to lack of funding and the small-scale structure of farming). There is also a lack of infrastructure that could address climate threats, such as irrigation systems and reservoirs and rainwater collection. In addition, farmers lack access to broader varieties of climate-suitable seeds and plant varieties.

In the institutional sector, there is a lack of integration of climate change issues into policies on agriculture and rural development, a lack of coordination and clear jurisdiction for agricultural policies, and a lack of support for agricultural extension programs.

3.4.4.2. Adaptive capacity in the water sector

In matters of adaptive capacity in the water sector, little has changed since the Initial National Communication. In terms of information, there is still a critical lack hydrological modeling, which makes it very difficult to determine the potential implications of climate change for uses such as energy, drinking water, and irrigation. While a general vulnerability assessment of the sector has been performed, there is a lack of a detailed vulnerability assessment and a need to assess climate change adaptive capacity for water resources.

In addition, there is a lack of vulnerability maps and risk charts of the threat of flooding using GIS techniques. There is also a lack of high-water early warning systems for flooding based on comprehensive, real-time data. In economic terms, this lack of information results from a lack of financing for monitoring systems and institutions. More broadly, low levels of investment also affect the water sector and water utilities, which still lack the resources to make important upgrades and to maintain water distribution systems effectively, and there is still a need for major investments in the sector.

As far as infrastructure is concerned, the condition of water supply systems is on the whole quite poor. Repairs and long-term maintenance are inadequate, and as a result, aging water supply systems "waste" lots of water. In some systems, the amount of water that is unaccounted for exceeds 85%, meaning that companies that manage these systems cannot operate with economic efficiency. Cost-effective technologies and practices such as more efficient pumps and leak detection programs, which would have co-benefits in terms of climate change mitigation, are not common. Thus, loss reduction represents the most important "resource" for households and could reduce vulnerability in this sector significantly.

Flood protection measures are another area where adaptive capacity is low. In terms of institutions and networks, there is still need to mainstream climate change issues into sectoral legislation and programmes and to harmonize those programs.

3.4.4.3. Adaptive capacity in the health sector

Even though there are no precise indicators of climate change effects on human health, it could be assumed that every investment in climate change adaptation in the health sector is both economically and, primarily, humanely feasible and cost-effective. It is a prerequisite to focus far more resources on the prevention of heat stroke, public education and information, and applied research.

In terms of information capacity, there is a lack of acute and chronic disease monitoring, which makes it extremely difficult to formulate an effective outreach and monitoring strategy for climate-related health issues. There is also a lack of information in the medical community about climate change and health, particularly health risks for certain vulnerable groups. These groups may also lack information about climate events -- particularly heat shocks -- that could threaten their health.

There is currently a lack of financing for health-related adaptation measures, and this problem is complicated by the fact there there has not been a cost-benefit analyses of climate adaptation measures in the health sector. If mortality in extreme climate situations such as heat shocks were reduced by only 10%, investments in adaptation measures would pay off many times over.

In terms of infrastructure, the greatest difficulties may be found in underdeveloped, smaller towns that do not have adequate primary health care facilities. Shortcomings in primary health care may make it difficult to quickly identify and respond to infectious disease threats, and they make patients with certain chronic health conditions (such as cardiovascular diseases) more vulnerable when those conditions are not effectively managed.

In terms of institutions and networks, the Public Health Institute would benefit from capacity strengthening to address climate threats. There is also a lack of effective warning systems and preventive measures for extreme weather events that may pose a threat to the health of the population in BiH.

3.4.4.4. Adaptive capacity in the Forestry Sector

Capacities of the forestry sector for adapting to changes in temperature and precipitation, to increased concentrations of CO_2, as well as to other weather-related changes, are at a very low level. Although there is a possibility that climate change will result in the long-term transformation of almost all forest eco-systems by shifting the schedule and the structure of forest communities, the areas most under threat of climate change have yet to be defined, and there is a lack of a more detailed analysis of climate change effects on individual forest communities; i.e., altitude zones at which they are widespread.

In view of physical capacities, it is important to note the insufficient and outdated infrastructure for forest fire control. In Bosnia and Herzegovina there is a lack of permanent measuring stations that can perform monitoring and follow up of changes and responses of the most significant forest eco-systems to climate change.

Within an institutional framework, there is a noticeable lack of integration of problems and issues of climate change into forestry policies and strategies, as well as the lack of coordination between the managers and the users of forest resources. Climate change is mentioned neither in regular, nor in legislatively defined forest governance plans.

3.4.4.5. Adaptive Capacity Related to Biodiversity and Vulnerable Ecosystems

The SNC is clear in detailing that certain plant and animal species are already largely under threat due to an increase in temperature and a decrease in precipitation. Although the changes in areals and habitat fragmentation are already noticeable, the most sensitive areas and the most under-threat species of flora and fauna are yet to be defined.

Biodiversity monitoring and scientific research are at a very low level due to a lack of funding. From an institutional perspective, it is necessary to strengthen activities and capacities that would facilitate the expansion of protected areas.

3.5. Proposed adaptation measures

This section provides a list of potential adaptation measures for BiH by sector and a list of potential investment projects that would support adaptation.

It is clear from the contributing research and analysis in this chapter that the single most important step that should be taken regarding the proposed adaptation measures listed below is a cost-benefit analysis. It is also very important to ensure that climate change issues and policy development are closely intertwined: findings from applied research should be used to inform sectoral development and general socio-economic development policies, and these policies must in turn take into account their potential affect on the ability of BiH to adapt to climate change.

3.5.1. Potential adaptation measures by sector

Sector	Potential Measures
Agriculture	Development of crop models that can provide information on planting schedules and suitable crop varieties;
	Implementation and adoption of annual crop variety lists, and improvements in the selection of varieties;
	Increased public awareness of the effects of climate change on agriculture and provision of education and training for farmers
	Construction of reservoirs and water collectors; collection of rainwater (individual households, local, regional, entity and state level)
	Increased production in greenhouses and other environmentally controlled areas
	Improvement and development of hail protection techniques
	Dissemination of agricultural "good practice"
	Development of diversified agriculture
	Promotion of integrated sustainable development and energy efficiency in the agricultural sector
	Development of a sectoral climate change adaptation strategy
	Adoption of long-term strategies for agricultural development on both state and entity levels
	Faster harmonization with European standards in the area of agriculture and sustainable development. Bosnia and Herzegovina is still unable to use significant funds from structural and cohesion funds, so the integration process is necessary to achieve production growth and a satisfactory employment rate in the sector
	Intensification of farming exothermic and/or xerophytes species resistant to higher temperatures and lower humidity,
	Decrease in production risks, especially for small agricultural producers (to preserve small farmers)*

Agriculture	Alleviation of the effects of fluctuations in agricultural commodity prices*
	Increase in investments in agriculture, especially in new seeds, improved management, and land management and irrigation*
	Provision of transparent and reliable regulatory surroundings for the development of agriculture that will attract private investments and increase productivity*
	Decrease in losses in food supply chains (especially during and after the harvest)*
	Development of sustainable management of natural resources, especially forests, water resources (including fisheries) which is of great significance for food security*
Water	A detailed vulnerability assessment and assessment of climate change adaptive capacity for water resources
	Development of vulnerability maps and risk charts of the threat of flooding using GIS techniques
	Construction of several functional reservoirs and regulation of rivers**
	Improvement in hydrological monitoring and measurement systems, and in high water early-warning systems
	Improve flood protection systems
	Development of a sectoral climate change adaptation plan
	Mainstreaming the problem of climate change impacts into sectoral strategies and action plans
	Strengthening of research activities regarding climate change impacts on water resources and modelling of hydrological processes
	Capacity building for competent institutions and local communities, and awareness raising regarding climate change impacts on water resources and adaptive capacity
	Promotion of integrated sustainable development and efficient water management
Health	Implementation of a detailed climate change vulnerability assessment in health sector
	Research on and determination of impacts of critical temperatures on human health
	Strengthening of primary health care services in towns and rural areas
	Improvement in research activities regarding climate change impacts on and connections with human health
	Inclusion of climate change in health sectoral strategies
	Establishment of monitoring of disease carriers, communicable diseases, and infectious diseases
	Strengthening capacity of the Institute of Public Health
	Strengthening of professional and research capacities
	Strengthening capacities of competent institutions and control programmes

Forestry	Performance of a detailed climate change impact assessment for forest ecosystems
	Improvements in forest fire protection systems (strengthen monitoring capacity, human resources, techniques and technology
	Increase in surface area of protected forests (at present amounting to 1-2%) and establish permanent plot sampling for climate change monitoring
	Development of a sectoral climate change adaptation plan
	Improvements in research activities and monitoring (forest fire early-warning system, pest warning system, etc)
	Development of methods and models of change in structures of forest ecosystems based on climate models
	Afforestation
	Detailed GIS mapping of forest real and potential vegetation
	Inclusion of the climate change issues into forestry sectoral strategy and action plans
	Improved protection of forests against vermin and forest diseases
Biodiversity and Vulnerable Ecosystems	Increase in the number of protected areas and improve protected areas management system to reach self-sustainability
	Adjustment of spatial plans and protected areas management plans in accordance with climate change impacts
	Planning and forecasting changes in the boundaries of protected areas
	Experimental research on climate change impacts, and studies on ecosystem responses to these types of impacts
	Preservation of migration routes and development of new migration routes and corridors of various types in areas of disrupted biotope
	Development of infrastructure for scientific evaluation, forecasting and monitoring of changes in land ecosystems and biological diversity
	Awareness-raising about importance of climate change for biodiversity and sensitive ecosystems
	Adjustment of protection programmes at the species level
	Additional protection of certain ecosystems in regions such as Bardača and Hutovo Blato.
	Establishment of seed banks to preserve genetic stock of endemic and vulnerable varieties of flora and fauna, to store collected plant seed material and samples of animal species;
	Necessary assessment of migrations of invasive species of flora and fauna
	Strengthening capacities of competent institutions and scientific communities dealing with biodiversity.

Regional Development	Modification of activities in and around agriculture in rural areas so that they will be less vulnerable to future climate change; develop agricultural production for internal markets within the framework of rural economies (e.g. food products to meet the needs of mountain, rural and recreational tourism and production of authentic food products in small family factories).
	Adaptation of non-agricultural activities and services to potential future climate change, such as developing spa or seaside tourism. Mountain tourism should be intensified, especially on the most attractive mountains, because temperature increases will make these destinations ideal for rest and recreation. In the future, these areas could become interesting and profitable for investors outside Bosnia and Herzegovina
	Adoption of an economic policy that will provide long-term economic growth, decrease unemployment, improve living standards and respect the need to mitigate the potential impacts of climate change. Economic development policies and strategies should be adjusted according to account for climate change scenario findings.
	Implementation of protective measures for people and property in areas prone to fires, floods, landslides, and torrents.
	Integration of climate change risk mitigation into environmental protection policy, energy policy, water resources management policy, forest management policy and other documents relevant to socio-economic development. It is necessary to adopt adaptation measures referring to some general activities (concrete measures are integrated in strategies, policies, development programs and plans). Suitable measures should incorporate basic social policies so as to minimise climate change impacts to social sphere (especially in areas with highest risks)
	Application of the following criteria for investment projects: justification in terms of impact on the living and working environment, in terms of employment and justification of investment projects with regard to regional and rural development
	Increase in activities in education of population, institutions and economy on climate change impacts, their negative impacts, and the risks and necessity of timely adaptation to these impacts (particularly for the general public, youth specifically, and decision makers at the state, entity and local levels)
	Intensification of efforts to resolve specific problems in BiH (demining and full integration displaced persons, refugees and returnees) that may pose a burden in carrying out strategic development plans and programs to mitigation the negative impacts of climate change
	Stimulation and intensification of scientific research in the climate change, including studies of the risks of negative impacts as well as their implications for socio-economic development. The current volume and quality of scientific research do not satisfy the needs of Bosnia and Herzegovina (neither internal needs nor requests for the euro-integration process)
Overall Policy and Planning	Conduct of a census, which would provide a thorough overview of available resources, their geographic distribution, and enable future strategies and development plans to reflect the real situation

Overall Policy and Planning	Selection of a stable monitoring system for data on climate change, adaptation results, and indicators that use internationally recognised methodologies and monitoring changes in sustainable development, even in the atmosphere of unfavourable climate change. This could be expanded and integrated into current meteorology reporting systems or in regular statistical reports from entity institutions and the Agency for Statistics of BiH.
	Improvements in the existing system of meteorological observations that would allow for monitoring climate change and the results of adaptation, including early warning systems. Capacity development for professionals should be integrated into the international observation system.
	Nomination of professional and political bodies to lead economic development in unstable climate conditions. The Council of Ministers, entity governments, economic and urban planning authorities, and other professional bodies at both the state and entity level should be capable of implementing measures to prevent unfavourable climate change impacts in addition to their traditional roles in classical economic planning and budgeting under a parliamentary structure. It is necessary to determine obligations of political institutions in Bosnia and Herzegovina and their roles and responsibilities regarding sustainable development in the midst of climate change. assical planning and proposing economic meausres aptation to clim
	Cultivation of public sentiment in support of taking serious steps to address climate change, including investments in both material and human resources. Key initiatives, policies and adaptation measures are at the state level within the framework of international cooperation.

*The proposed measures indicated with an asterisk (*) are adapted from the recommendations of an FAO report (FAO/IFAD/WFP 2011) that explores methods for decreasing world hunger. The report highlights speculation in world food markets, which leads to price increases and causes global insecurity in the sector. This condition is especially negatively projected on the poorest and developing countries.

** According to previous analyses, uneven outflows in BiH are becoming increasingly more pronounced, whereas predictions are that climate change effects will be stronger in regions where climate non-linearity has so far been most pronounced. The uneven distribution of outflows is characteristic of the karst region in the Adriatic Sea basin in BiH, where the network of waterways is quite undeveloped. High vulnerability is recorded in the Bosna River basin, where approximately 82% of ground water capacity (estimated at approximately 5.9 m^3/s) is exhausted by existing water intakes.[10] Reservoirs represent a way to utilize existing conditions in a manner that will achieve the optimum management of water resources. In addition to electricity generation, reservoirs can ensure the flood control, accumulation of water reserves for periods of drought, water supply, irrigation, navigation, fishery, recreational activities, and other demands. To date, BiH has built multipurpose reservoirs with a total volume of 3,851 hm^3. The selection of locations for the construction of dams and reservoirs is becoming more and more difficult due to increased economic, ecological and social costs. However, in order to satisfy increasing water demand, the expansion of total reservoir volume, either through the construction of new dams or the increase of capacity in existing reservoirs, should be considered.

Table 22: Climate change adaptation measures

3.5.2. Proposed project activities to support adaptation

Analyses of the priority sectors carried during development of the BiH Climate Change Adaptation and Low Emission Development Strategy determined that agriculture and water resources are the most vulnerable to climate change. Therefore, the priority investment projects listed below were chosen from these sectors. The realization of the proposed project activities is planned for the next three years, after the SNC is submitted to UNFCCC (expected 2013-2015). Potential sources of funding for the implementation of the projects are as follows: GEF, World Bank, the Green Climate Fund, the European Union (through IPA funds), the RS Environmental

10 IPA 2007 PROJECT – Support to the Water Policy in BiH, 2011.

Protection and Energy Efficiency Fund, and the FBiH Environmental Protection Fund.

Priority projects:

1. Adapting to Drought and Capacity Strengthening – covers the set of activities including drought research based on climatic indices, determination of regional drought schedules, concept solutions and executable projects with the objective of insuring against the lack of water in the period of drought.

2. Agro-climatic Zoning on the Basis of Climate Scenarios – implies the determination of physical space-based distribution of optimal agro-climatic conditions for cultivating individual agricultural crops in Bosnia and Herzegovina on the basis of analyses of temperature and precipitation, as the most significant agro-climatic elements. The analysis of agro-climatic conditions would be performed for projected climatic periods (by 2100).

3. Strengthening Meteorological, Hydrologic and Ecologic Monitoring – implies technical strengthening of institutions performing meteorological, hydrologic and ecologic monitoring in Bosnia and Herzegovina.

4. Irrigation and Drainage Systems Development – implies the construction of multi-functional reservoirs with the objective of adapting to floods and droughts.

5. Improvement of Water Supply to Population – including research of rural areas in the context of optimal water supply and technical realization (impoundment of water sources and development of local water supply systems) in pre-identified locations.

6. Economic Impacts of Climate Change in Bosnia and Herzegovina – implies research and assessment of economic impacts of climate change by sector (agriculture, water resources, biodiversity, forestry etc).

7. Development of Hydrology Models on the Basis of Climate Scenarios –hydrology models shall facilitate more optimal planning for adapting water resources to climate change in BiH.

8. Improvement of the BiH UNFCCC Website (www.unfccc.ba) (Development of an interactive Atlas of Bosnia and Herzegovina Climate) – this measure is directly focused on capacity strengthening and the promotion of completed activities and public information in the area of climate change,

9. Sector Strategy (Plan) Development for Climate Change Adaptation in sectors in which the consequences of climate change are the most prominent (agriculture, water resources, biodiversity, human health, tourism and forestry and sensitive areas)

10. Awareness raising and education on climate change in educational institutions (primary, secondary, and tertiary).

4. ESTIMATING THE POTENTIAL FOR MITIGATING CLIMATE CHANGE

The following description of the implementation of strategic objectives and tasks to mitigate climate change pursuant to the UN Framework Convention on Climate Change is based on the results of current scientific research on emission scenarios, mitigation potentials, and mitigation measures undertaken at both the international and country level.

In addition to the 7/CP.8 Decision "Instructions for Development of National Communications of non Annex 1 Parties," this section draws upon the Fourth Report of Intergovernmental Panel on Climate Change. The basis for the analysis of the mitigation measures was the BiH Initial National Communication. The INC identifies and describes potential and planned mitigation measures by sector, and it also provides recommendations and proposed next steps.

For the SNC, the description and analysis of mitigation measures has been expanded, with additional chapters on climate change mitigation measures by sector, mitigation scenarios that will model potential trajectories of greenhouse gas emissions through 2025, and the identification of proposed investment projects with mitigation benefits.

Quantitative modeling of greenhouse gas emissions trajectories over time has been accomplished using three development scenarios: S1 – a Business as Usual scenario with no changes; S2 – a mitigation scenario with the partial application of measures; and S3 – an advanced scenario with the application of a comprehensive set of measures. Initial data for the year 2010 are used to calculate emissions in five-year periods (2015, 2020 and 2025). Activities have been additionally supported by data collection and intensive participation by the relevant state ministries, entity ministries, and Brčko District.

One improvement with respect to the INC is that the SNC has utilized a software tool for analyzing energy policy and assessing mitigation potential by sector. The study analyzes different policy approaches for mitigating GHG emissions and reducing climate change impacts using LEAP (Long Range Energy Alternatives Planning System), a widely-used software tool.

4.1. Power sector

4.1.1. Electric power

4.1.1.1. Electric power sector overview

Coal and hydropower are the main sources of energy generation and the main sources of emissions in BiH. Close to 50% of electricity in BiH is generated in thermal power plants using local coal with a relatively high specific emission factor (1.3 tCO_2/MWh). The remainder of electricity is produced mostly by large hydropower plants, and a fraction comes from small hydropower plants. Natural gas and oil imports are also an important source of energy.

Total energy consumption in BiH in 2005 was as follows: 45.3% coal and coke, 9.6% hydro 21.1% liquid fuel, 5.6% natural gas and 20.5% wood, showing that BiH[11] is highly dependent on imports, as certain energy resources cannot be supplied locally at present. Regardless of the type of energy resource, BiH has very low energy efficiency, resulting in high energy consumption relative to its GDP. The natural gas sector is particularly inefficient due to an inadequate transmission and distribution structure and consumption patterns, which result in extremely high prices. In addition, natural gas supply is limited to a single pipeline, causing instability in supply, especially during the winter when consumption is at its highest. Therefore, a relatively large number of households in BiH use electricity from the grid for heating (although there are some natural gas-fired district heating systems in BiH). Biomass from wood is also a significant source of energy, and wood fuel continues to be the primary source of heating in smaller towns and rural areas.

In 2010, emissions in the electrical power sector in BiH totaled 12,432 10^6 tons of CO_2.

4.1.1.2. Reduction of GHG emissions in the electric power sector

In order to analyze potential GHG reductions to 2025, three mitigation scenarios have been created. All three scenarios assume an increase in energy efficiency that is in line with draft NEEAP.

S1 scenario: This scenario presumes that greenhouse gas emissions will increase proportionally with electricity consumption. This scenario also assumes that the share of domestic energy resources in electricity production will remain constant.

The S1 scenario features a relatively low degree of electrical energy efficiency. The main sources of electricity production are thermal power plants (60%) and large hydropower plants (40%). When considering renewable energy capacity, there are small hydropower plants and some capacity from solar energy (photovoltaic cells). The S1 scenario assumes that the carbon dioxide coefficient in the power grid will remain the same for the whole period. According to the scenario with lower energy consumption from the BiH Energy Sector Study, electrical energy consumption in 2015 will amount to 78.05 PJ and in 2020 it will be 80.44 PJ. Production in 2025 is calculated using the same annual growth rate as in the period from 2015 to 2020.

In the S1 scenario, CO_2 emissions from the utilities sector in BiH in 2010 totaled 12.5 million tons. Due to planned increases in production, emissions will amount to approximately 16 million

11 Bosnia and Herzegovina INC, 2010: 31.

tons in 2015 and 16.7 million tons in 2025 (see Chart 24). Therefore, according to the S1 scenario, the increase in emissions over the observed period is nearly 34%.

S2 scenario: The S2 scenario assumes the construction of additional electrical power plants. This scenario was based on relevant entity strategies and data on planned investments obtained via questionnaire.[12] According to the data from the three relevant energy providers (SPP FBiH,[13] BiH Electricity Company, and HZHB Electricity Company) construction of the following facilities is planned for the period under study: a 2,300 MW thermal power plant, a wind power plant with 460 MW capacity, large hydropower plants totaling 254 MW capacity and small hydropower plants totaling 37 MW (see Table 23). Simultaneously, utilities are planning to close several thermal power units. Other plants will be reconstructed, which will improve capacity; for example, the capacity of the Rama Hydropower Plant is expected to increase from 160 to 180 MW due to improved technology.

Table 23 provides an overview of power generation investments planned for the FBiH entity that will not contribute to GHG emissions.

Energy source	Power (MW)	Anticipated production (GWh)
Wind power plants	460	1,185
Large hydropower plants	254	1,017
Small hydropower plants	37	145

Table 23. Planned utility construction of zero-emission plants for electricity generation in FBiH through 2025

In the Republic of Srpska, the Energy Sector Development Strategy for 2012 stipulates the construction of new power plants with a generation capacity of 920 MW and an expected production of 4,550 GWh per year. In addition, it envisages building small hydropower plants with total generation capacity of 160 MW and expected production of 500 GWh per year. The construction of these facilities will lead to a net increase in the carbon dioxide coefficient for the power grid of approximately 10% in the period following 2015. Electric power production in 2015 is the same as in the S1 scenario, and from 2015, it increases moderately according to demand.[14] In 2025, the assumed increase in electric power is 20% compared to 2015. Chart 24 shows emissions of carbon dioxide in the electric power sector in BiH for 2010–2025 for the S2 scenario.

According to the S2 scenario, carbon dioxide emissions in 2015 will be the same as in the S1 scenario. After 2015, emissions will increase due to increases in electricity production and an increased coefficient of carbon dioxide of electricity network in BiH (Chart 24). The increase in carbon dioxide emissions for the period 2010-2025 in the S2 scenario is close to 70%.

S3 scenario This scenario predicts intensive utilisation of renewable energy sources (RES) and energy efficiency (EE), including the entry of BiH into the EU Emissions Trading System (EU ETS), which stipulates the purchase of emission permits (partially or totally) for greenhouse gas

12 Aiming to collect input data for analyses of potential of greenhouse gas emissions, suitable questionnaires were sent to relevant institutions and companies in BiH. Filled- in questionnaires were delivered by electrical energy enterprises of BiH and HZHB.

13 Strategic plan and program for develpoment of electric power sector of FBiH.

14 Energy sector Study in BiH , EIHP et all, 2008

emissions in the electric power sector. Participation in the EU ETS would provide strong incentives for using low-carbon and no-carbon sources of energy. It is anticipated that an emission permit (for 1 ton of CO_2) will cost 25 EUR. As the combustion of 1 ton of BiH coal generates approximately 1.3 tons of CO_2, the cost of electrical energy, according to the S3, will increase to over 30 EUR per ton of coal.[15] Therefore, the S3 scenario presumes the utilization of lower-cost sources of renewable energy. According to the Initial National Communication, the economic potential of small hydropower plants is approximately 3,520 GWh per year, wind power potential is 1,950 GWh per year, and wood biomass potential is 1,200 GWh per year. The S3 scenario also assumes the use of natural gas for electricity production because of its lower specific emissions of CO_2, and it includes plans to increase the capacity of coal-powered plants. Utilization of low-cost and renewable energy sources and the use of natural gas for electricity production will decrease the coefficient of CO_2 emissions in electricity network by a factor of two.

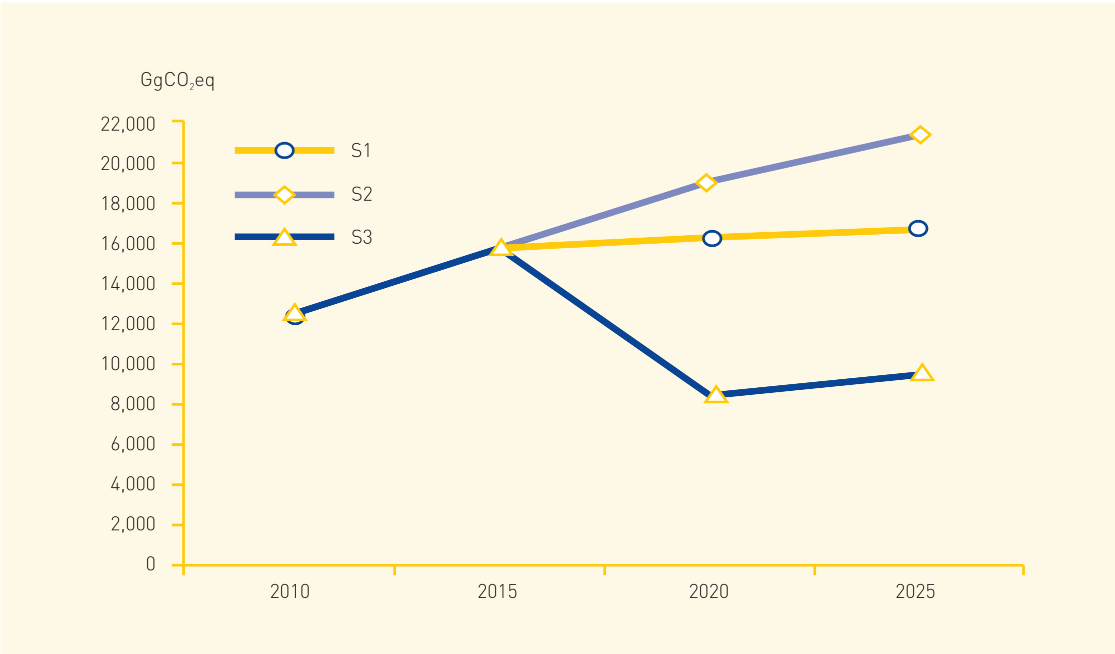


Chart 24: Total CO_2 emissions from the electric power sector in BiH, according to the S1, S2 and S3 scenarios (2010–2025)

Electricity production in the S3 scenario is the same as in the S2 scenario. CO_2 emissions in 2015 are also the same in the S2 and S3 scenarios. After 2015, however, emissions in the S3 scenario decrease due to the increased role of low-carbon / no-carbon sources of energy in total production as well as an increase in the use of natural gas (Chart 24). Carbon dioxide emission reductions for 2010– 2025 under the S3 scenario are close to 24%.

In the S1 and S2 scenarios, carbon dioxide emissions in the electric power sector will increase in the period 2010- 2025. The S3 scenario, however, will lead to significant emission reductions of more than 20% compared to 2010. All three scenarios described assume an increase in energy efficiency in accordance with the draft National Energy Efficiency Action Plan for BiH.

15 This is the case of paying full amount of emission permits. New members of EU will pay a share of emission permits for certain period of time.

4.1.1.3. Reduction of methane emissions from coal mines

There are several ways to reduce methane (CH_4) emissions from coal mines in BiH, Commercial technology using ventilation air from underground coal mines can be used if the methane concentration in the ventilation air is between 0.2% and 1.2%. The mixture oxidizes in a hermetically sealed chamber with a ceramic filling. Methane released from coal mines can also be captured and used for the production of thermal and/or electrical energy. During the process of oxidation, methane is converted to carbon dioxide and steam. This technology could potentially be applied in the brown coal mines in Central Bosnian Basin (Zenica, Kakanj, Breza, "Abid Lolić") as well as in the Kamengrad mine. According to the available data, by using the described technology in the brown coal mine in Zenica, emissions could be reduced by 100,000 tons equivalent carbon dioxide annually, and in the Breza coal mine by up to 50,000 t CO_2 e annually (Feasibility study of application of VAM Technology in Zenica coal mine, 2009). Table 24 shows the assessment of methane emissions reduction (expressed as CO_2e) for the aforementioned mines, the potential values of certified emission reductions (CERs), and the total investment value of the projects.

Mine	Emission reduction ($GgCO_2e$ per year)	CER loan (million EUR)	Investment value (million EUR)
Zenica	100	1.4	4.0
Breza	50	0.7	2.5

Table 24: Potential reduction of methane in brown coal mines in the central Bosnia, value of certified emission reductions and investment requirements

Based on these figures, the cost of mitigation for methane emission reduction projects in mines in the central Bosnian Basin using VAM technology is close to 43.3 EUR/tCO_2. With an expected price of CER of EUR 20, these projects could be paid for in two to three years. Additional income for these projects will be generated from the sale of the energy (thermal and/or electrical) generated by the methane combustion.

4.1.1.4. GHG reduction measures in the electric power sector

Measures and projects to reduce greenhouse gas emissions in BiH should be viewed in the context of the sustainable development of BiH. Therefore, priority should be given to measures that contribute to employment and the development of priority sectors, such as mining and agriculture. Following that, preference should be given to projects with the lowest unit cost of avoided emissions. The benefits from implementing projects to reduce greenhouse gas emissions in BiH are as follows:

1. Increases employment;
2. Attraction of foreign investment;
3. Transfer of best available technologies (BAT);
4. Increases in energy efficiency (EE) and resultant increases in competitiveness;

5. Generation of additional income from GHG emission reductions; and

6. Acquisition of experience with GHG reduction options that will inform regulations on climate change.

Recommended Measures in the Electric Power Sector

- Increases in energy efficiency in the production and distribution of electrical energy
- Construction of renewable energy generation facilities
- Replacement of existing thermal power plants with best available technologies and practices
- Increases in the use of biomass and other less-carbon-intensive fossil fuels
- Utilization of coal mine methane for energy production

It should be noted that the most important goal of the measures listed is not only GHG emissions mitigation but simultaneous economic development and improved competitiveness of the economy in BiH. For the time being, BiH does not have an obligation to regulate GHG emissions; hence, GHG reductions represent an additional benefit gained in project implementation.

4.1.2. Renewable energy sources

4.1.2.1. Hydropower

River networks constitute the foundation of hydropower in Bosnia and Herzegovina. The total length of water flow (for waterways longer than 10 km) amounts to 9000 km, out of which 930 km is a border waterway. The average density of the river network in BiH amounts to 220 m/km^2, which is very unevenly distributed between the continental and Mediterranean parts of the country. The average density of the water network in the continental part of BiH totals 300 m/km^2, while in the Mediterranean part of BiH it amounts to less than 30 m/km^2. A significant share of the fresh water balance comes from lakes in BiH. Water supply in BiH is a direct function of the pluviometric regime.

Based on research results, it is estimated that total theoretical hydropower potential is approximately 99,256 GWh per year, of which technical hydropower potential is 23,500 GWh per year, which translates into approximately 360 large and small hydropower plants (Nikolic et al. 2009: 10). This hydropower potential can be separately structured at the level of the hydropower potential of large and small streams, and from large and small hydropower plants. According to data from the INC, the economic hydropower potential of major waterways in BiH is around 18,000 GWh/year and for small streams it is 3,500 GWh/year. Only 40% (7,182 GWh/year) of the total economic potential is currently realized. The degree of utilization of small hydropower plants is much smaller - 4.4 % of available power, or 5.7 % of available energy -- and the economic potential for hydropower is very low compared to other European countries.

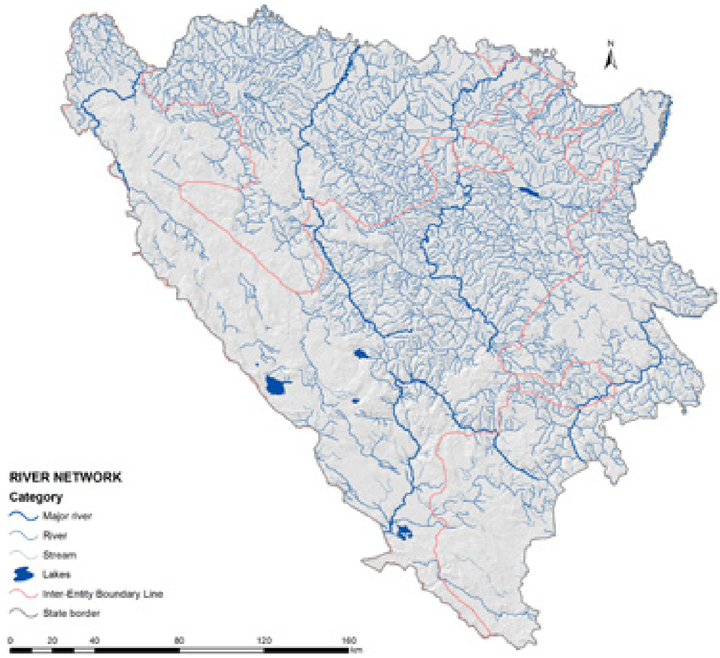


Figure 12: River network in BiH

The potential for the utilization of hydropower resources in BiH is considerably limited due to uncontrolled urbanization, environmental concerns, and economic constraints. The research results contained in energy development studies indicate that, due to these reasons, the portion of the total exploitable hydropower potential that is economically feasible is about 13,000 GWh per year, or 56.5% of what would be technically achievable.

GHG Mitigation and the Role of Hydropower

The starting point for scenario development in this area is based on changes in annual temperature and pluviometric regimes, which in practical terms mean that climate change will affect all water management systems. The lack of a unified sectoral strategy that would encompass all aspects of the water balance and optimal utilization of water resources makes it very difficult to assess potential climate change impacts on existing hydropower infrastructure. The lack of a unified strategy also hinders hydrological data collection and analysis, and it also negatively affects hydropower management and planning at the entity level.

The S1 scenario is based on observations regarding annual changes in the temperature and pluviometric regimes, according to which there will be a reduction in the intra-annual quantity of precipitation. The stated trend would undoubtedly reflect negatively on the existing total annual water balance; that is, it would cause additional reductions in existing accumulated quantities of water in water flows and existing hydro accumulations. Taking into consideration that the implementation of adequate response measures is not planned, electricity production would decrease in the subsequent period. A quantitative reduction in overall hydropower potential is directly related to the applied climate scenario, but the negative effect on energy would be pronounced, which would result in an increase in electricity production from fossil fuels and a significant increase in GHG emissions.

The S2 scenario is based on the application of specific measures contained in the various government entities and strategies on water supply, which should be introduced in the next few years. All strategies except for the defined trend of reducing the total amount of intra-annual precipitation will encompass its spatial distribution by different geographical regions. This refers to the sustainable management of water resources but it is primarily related to the sustainable management of water resources in catchment areas at the entity level, which includes a number of measures for a balanced operation of hydropower plants by characteristic hydrological seasons. This approach would result in a slight increase in the existing level of production of hydropower. Under this scenario, the level of energy utilization from the reduced water resources will increase, and the process is based on energy efficiency increases in hydropower plants by restructuring existing hydropower plants and by applying new technologies for electricity generation. According to the data from the Initial National Communication for BiH, the planned growth of hydropower production is projected to be 2,205 GWh, which would result in GHG emission reductions in the energy sector of 2,425 Gg CO_2e.

The S3 scenario is based on BiH joining EU during the second scenario period, thus applying all directives contained in the EU Water Framework Directive. This primarily refers to implementation of all guidelines for integrated water resource management in catchment areas, which would integrate existing entity management system of regional catchment areas into a unified management system. Successful implementation of these guidelines would improve all aspects of water management, especially with the utilization of water resources in the existing and planned hydro accumulations, for both hydropower production and water supply. This is particularly evident in terms of recent climate change and related to increasingly frequent extreme hydrological events, so the need for a safe water supply and hydropower plants is growing. Under this scenario, integrated water management will reflect positively on total hydropower potential and the related increase in hydropower generation. The result of this approach would be to increase hydropower generation in small hydropower plants to 3,600 GWh, with total emission reductions of approximately 3960 Gg CO_2e.

Recommended Measures in the Hydropower Sector in BiH

- Develop an integrated study on the development of hydropower potential in BiH;
- Develop a water inventory and identify potential threats;
- Protect water resources from uncontrolled exploitation;
- Define the main sources of water supply and their vulnerability, including mapping the climate change vulnerability of water resources;
- Increase the efficiency of water supply and introduce a system of water demand management;
- Establish institutions that will be responsible for establishing an automated measurement and control system for water resources management and a unified system of hydrological data management for all relevant institutions.

4.1.2.2. Wind Power

Wind power has one of the most significant energy potentials in Bosnia and Herzegovina. Given the land configuration of BiH, wind power potential has been assessed in two geographical macro-regions:

- The Mediterranean region of BiH, where the impact of cyclo-genetic activities on orbit Vc, combined with contour predispositions of terrain, result in intense regional circulation;

- The Mountainous Basin region of Bosnia and Herzegovina, where orthographic factors positively influence the increased intensity of regional and local circulation.

Both regions provide favourable preconditions for wind power generation; however, the Mediterranean region has greater wind potential. One of the representative sites is the Podveležje area, which has a position and topography that is potentially favourable for wind power turbine installations. For more thorough analyses of wind power at all potential sites, it will be necessary to conduct further measurements of wind potential so as to decide whether to invest in this area or not.

Several studies that have been done for the Podveležje area have indicated that the economic potential of wind energy could reach 600 MW of electrical power by 2020. These stated estimates are based on the introduction of the most modern technologies for utilization of wind potential along with the proper incentives for wind power production. According to data from the BiH INC, preliminary research as well as selection of potential sites for wind energy production in BiH (the ADEG project) was conducted from 1999 to 2004. Project results identified 16 sites suitable for wind power turbines, with the estimated total installed capacity amounting to 720 to 950 MW, and an estimated annual production of 1,440 to 1,950 GWh. Taking into consideration installed capacities, it can be stated that wind power facilities have adequate conditions to be connected to the power grid.

Regardless of these findings, other than a few test sites, there is not a single wind power turbine in BiH that is connected to the existing high-voltage grid. According to the available data, there are several small wind turbines producing electricity for individual households; however their installed capacities are relatively small and insufficient to assess total wind potential in BiH.

Scenarios related to wind power utilization in BiH

The S1 scenario is based on the existing trend of utilization of wind power potentials in BiH, which in practice means that production of electricity from this energy sources does not exist. Taking into consideration that the S1 scenario does not foresee any application of stimulus measures, climate change mitigation measures using wind power are non-existent.

The S2 scenario involves the application of certain stimulus measures that would stimulate investments in wind energy in BiH. These measures should primarily include the implementation of projects to explore wind potential in specific locations that are, according to their geographical features, rated as potentially appropriate. Government measures to support investment in the wind power sector should also stimulate the purchase and construction of modern wind turbines that can operate at minimal wind speeds. Subject to the application of these measures, wind power production of 1,600 GWh per year could be expected, which would result in a corresponding reduction of non-renewable energy sources, fossil fuels in particular, and emissions reductions of about 1760 Gg CO_2e.

The S3 scenario assumes that EU standards will be applied to the utilization of renewable energy sources. Therefore, BiH would have access to a number of funds which will financially support the development of technical capacity and access to different sources of energy production. According to the results of the scenario, production capacity of wind power could increase to 2,400 GWh a year by 2025, which would result in additional mitigation potential in the energy sector of 2,600 Gg CO_2e.

Recommended Measures in the Wind Power Sector in BiH

- Preparation of a study of wind energy potential for the two identified geographic macro-regions in BiH and the definition of all basic indicators for specific remote locations;

- Regulatory and financial incentives to increase clean energy resources, including wind power;

- Support for projects that aim to purchase the most advanced wind turbines and establish wind farms;

- Support for projects aimed at training and transfer of knowledge on all aspects of the sustainable use of wind energy; and

- Legislative harmonization and adaptation of regulations with regard to grid connection for renewable energy.

4.1.2.3. Biogas

BiH has excellent natural conditions for cattle breeding and a very good economic basis for using manure for biogas production. The potential for using both liquid and solid manure from registered livestock on BiH farms for biogas production has been taken into consideration in the development of the scenarios below. Available biomass (20,100,000 m^3) in BiH for biogas production from manure on the farms has a potential of 0.508 PJ. Based on the data on livestock for 2010 and 2011, potential biogas production was calculated at 800,000 to 850,000 m^3/day. There is only one biogas facility designed and constructed in BiH. The installed generating capacity of the stated facility is 35 kW in electricity, and 70 kW of thermal energy, and expected annual production is 290,000 kW electricity and 560,000 kW thermal energy.

Scenarios related to biogas utilization in BiH

The S1 scenario does not consider any mitigation measures, which means that the use of modern forms of energy such as biomass, biogas are not expected to increase, as the price of energy from these sources is still uncompetitive compared to technologies that use conventional energy sources. This scenario does not include any changes to current trends in livestock growth rates or intake of nitrogen fertilizers on arable land. A significant feature of this scenario is the relatively low level of interest and activities of state and entity institutions in the energy sub-sector.

The S2 scenario, considering the current small share of biogas, is based on activities that are focused on the implementation of a system for collecting and burning biogas on farms in BiH. The most important characteristics of this scenario are: the gradual introduction of new technologies (orientation towards RES, greater use of renewable energy and biogas), planning the production and consumption of energy on farms to meet the needs of home heating and drying hay, grain, vegetables, etc., using simple biogas production plants, and the utilization of biogas to cover a significant share of household energy needs, even with a small number of cattle by using mini biogas plants.

The S3 scenario assumes a high degree of mitigation activities from authorities at both the state and entity level. It is expected to have more intensive use of biogas for production of thermal and electrical energy which will prove to be cost effective thanks to the improvement in equipment being used for those purposes. Biogas from agriculture (cattle breeding) is a significant source of energy in the S2 and S3 scenarios, using cogeneration and efficient siting. All electricity production will be transferred to the power grid so that its contribution cannot be divided by category but by total. Heat from agricultural plants will provide district heating in rural areas. The total installed power of agricultural cogeneration and biogas plants in the RS are defined by twice the power and by five-year periods. Plans for the Federation of Bosnia and Herzegovina are also defined, and the total value for BiH is presented in the table below.

BiH	Installed power (MW)	Electricity production (GWh/year) (PJ/year)	Thermal energy production (GWh/year) (PJ/year)
Total to 2015	2.5	5.77 (0.02)	11.17 (0.04)
Total to 2020	5	11.54 (0.04)	22.34 (0.08)
Total to 2025	7.5	17.31 (0.06)	33.51 (0.12)

Table 25. Total installed power from agricultural biogas and cogeneration plants in BiH assumed for the S2 and S3 Scenarios

Measures to encourage increased use of biogas energy

Basic measures to stimulate utilization of biogas will require investments in agricultural production through rural development policies. The application of such measures will result in energy savings in firewood, electricity, thermal energy delivered by district heating and especially in fossil fuel. On the other hand, the utilization of biomass (and biogas) increases cogeneration production of thermal energy and electricity. The stated improvements in industry are planned through energy measures, such as decreasing the intensity of electricity consumption and useful heat energy, increasing technological efficiency of thermal energy production, and increasing cogeneration in the production of heat and electricity whilst using also biomass (biogas) for fuel. Energy savings from the application of these measures in industry are shown in Table 26.

Biomass (with biogas)	2010	2015	2020	2025
Energy savings in industry (PJ)	0.049	0.608	1.114	0.506

Table 26: Energy savings in the biomass (biogas) industry from cogeneration

According to the scenario with measures - S3, final energy consumption in industry would be reduced by 9% in 2025 relative to the S2 scenario. During the same period, electrical energy consumption would decrease by 7%.

4.1.2.4. Solar energy

Results of research on the possibility of using solar energy to produce heat by using solar collectors for 15 cities in BiH, as well as for the production of electricity, are proving to be justified. It can be concluded from all the data and analyses that have been compiled that there is a significant potential of solar energy application on the BiH territory. The potential is 70.5 mil GWh of designated energy from total solar radiation in BiH annually. The technical potential totals 685 PJ, which is 6.2 times higher than the total primary energy needs in the energy balance of BiH.

According to the results of a calculation of the of potential coverage of heating needs for the average household, nearly 74% of needs for hot water in RS, that is 78% in the whole BiH, can be covered from solar collectors. The coverage degree depends on the buildings' heat insulation, but in average it totals 30%. The estimate show that solar energy could meet 5% of energy needs in BiH. During the summer months it could meet 80% of hot water needs, and in the winter 35 to 50%. These estimates show that there are close to 7,000 m^2 of installed collectors, and the annual increase is close to 28%.

Scenarios related to solar energy utilization in BiH

The S1 scenario does not presume introducing significant changes with regard to the current trend of using solar energy specifically situation according to which solar energy will not be used to a greater extent.

The S2 scenario and S3 scenarios assume that an initiative for using and producing solar energy equipment is launched in BiH. Prices are based on import prices from western countries and the Far East. When considering a standard system of 4 m^2, the price of the total system including assembly is estimated at 3,500 to 4,000 EUR. It is expected that the installed solar collector area will increase to 50,000 m^2 by 2020, which would total to 12.5 m^2 per 1,000 inhabitants. The application of co-financing measures for existing potentials would result in coverage of 200,000 m^2 by 2025, or 42,000 households, which is 11% of the total number of households in BiH. The relevance of this theory, looking at its cost effectiveness, is most applicable in facilities being used year-round with all aspects of hot water utilization. Public buildings meeting those criteria include: hospitals, facilities for pensioners, and sports facilities (if used year-round). Private facilities would include existing and new residential buildings with a minimum of five units. Application of this technology is cost-effective in residential buildings only where there is a centralized system of hot water supply. If hot water heating occurs at the level of individual residential units, the technology is not cost-effective.

Measures to encourage increased use of solar energy

Taking into consideration that BiH does not have sufficient capacities for solar energy production, it is possible to apply various measures to stimulate production. Using solar cells for electrical energy production in BiH has not yet been applicable. Solar collectors are analysed for central heating systems, heating oil, electrical energy LPG reservoir and natural gas where the collector is replaced by a traditional hot water boiler. Because of investment in solar collectors, annual costs grow, whilst the biggest increase in annual costs (in houses with central heating in the cold zone) is in houses that use a combination of electric boilers for central heating and hot water and collectors (5.1%), natural gas and collector (5.0%), LPG reservoir and collector, and fuel oil and collector (2.9%). The biggest savings were obtained when combining a boiler for central heating and hot water with electricity and collector (5.4%). Intensive development of solar cells may result increases in installed power from photovoltaic systems by the end of the 2025, i.e., a total of 60 MW of installed power. The technological development of solar cells is moving in two directions - the development of high-efficiency solar cells that transform solar energy into electricity, and the development of so-called low-cost solar cells.

The application of stated measures will result in savings in energy and firewood, electricity, thermal energy distributed by district heating and fossil fuels. On the other hand, the use of solar energy increases (Table 27). According to the S3 scenario, final energy consumption in industry would be reduced by 9% by 2025 when compared to the S1 baseline scenario. Electricity consumption would be reduced by 7%. The application of solar energy in households would increase five-fold by 2025.

Energy savings (PJ)	2010	2015	2020	2025
Solar energy–in industry	0.000	0.011	0.029	0.047
Solar energy–in households	0.000	0.009	0.056	0.103
Solar energy–in services	0.001	0.002	0.015	0.028

Table 27: Energy savings in major areas of consumption, using solar energy (in PJ)

Solar energy utilization for heating needs in the service sector will increase by 2.8% until 2025. It is also anticipated that final energy conversion into useful heat energy will accelerate and increase. The result for services in the scenario with measures is a reduction in final consumption of 9% by 2025. It totals close to 6% for electrical power and 10% for district heating, and fossil fuels for heating needs would then decrease by 10%. When compared to S1, solar energy utilization would more than double. Utilization of solar energy in the buildings sector could increase heating needs by 5 % until 2025. Application of solar energy in households by 2025 would increase more than three-fold.

4.1.2.5. Geothermal energy

According to surveys conducted to date, nearly 25% of BiH is considered as having potential geothermal resources in the form of hydrothermal systems, geo-pressurized zones and hot dry rocks. These areas cover mainly central and northern parts of BiH. Hydrothermal systems are the most interesting, because their exploitation is the most developed and the cheapest when compared to the two previous types. Total heating strength and geothermal energy were calculated for both RS and FBiH.

The total potential of installed capacity of geothermal sources on 42 sites amounts to 9.25 MWt for space heating, or 90.2 MWt for heating and recreational and balneological purposes (bathing). When using all of the stated resources with the utilization factor of 0.5, it is possible to produce 145.75 TJ in one year for space heating that is 1,421.75 TJ of energy for both heating space and bathing.

Scenarios related to the geothermal energy utilization in BiH

Scenarios related to the utilisation of geothermal energy are mainly based on the estimated reserves and technological potentials for its exploitation.

The S1 scenario is based on the current trends of potential utilization of geothermal energy without additional research on its potential and without changes in relation to this energy source (Table 28).

S1 scenario	2010	2015	2020	2025
Geothermal energy	GE Consumption (in PJ)			
	0.0	0.05	0.08	0.9
	GE share in the structure of RES (in %)			
	0.0	0.16	0.17	0.18

Table 28: GE consumption in BiH under scenario S1, 2010-2025

The highest consumption of geothermal energy is suggested in Scenario S1, for the period 2015-2020, and it amounts to about 2.5%.

The S2 and S3 scenarios are based on the introduction of support models where main activities are focused on the implementation of hydrothermal systems at the country level. In both scenarios, there are indicators of total energy consumption with average annual rates of increase or decrease in the five-year period and energy shares in the total final energy consumption. There is no geothermal energy as an energy source in S2 and S3, even though there are conditions provided and concessions are obtainable at some sites (Table 29 and 30).

S2 scenario	2010	2015	2020	2025
Geothermal energy	GE Consumption (in PJ)			
	0.0	0.04	0.06	0.06
	GE share in the structure of RES (in %)			
	0	0.1	0.2	0.2

Table 29: The structure of geothermal energy in BiH according to the S2 scenario, 2010-2025

The S3 scenario with the applied measures significantly assumes BiH accession to the EU between 2015 and 2020 and the assumption of obligations to decrease GHG emissions. The S2 and S3 scenarios envisage more frequent use of geothermal resources with water pumps in the household sector.

S3 scenario	2010	2015	2020	2025
Geothermal energy	GE Consumption (in PJ)			
	0.0	0.04	0.06	0.07
	GE share in the structure of RES (in %)			
	0.0	0.2	0.3	0.3

Table 30: The structure of geothermal energy in BiH according to the S3 scenario, 2010-2025

Measures to encourage increased use of geothermal energy in BiH

Bosnia and Herzegovina recognizes the significance of its geothermal resources. For a more serious approach to this energy source, additional research would be required on all boreholes that show potential for energy production. Taking into consideration that specific investments in geothermal plants are rather high and BiH is also rich in other energy sources and energy types, the production of electrical energy from other geothermal sources is not planned in the twenty-year period even though it is still difficult to say when considering initiatives and domestic and foreign investments. In the event that a specific legal framework promoting the production of electrical energy from this source is introduced, there is potential to improve cost- effectiveness and hence expect the development of these power plants.

4.2. District heating

4.2.1. District heating sector overview

District heating sectors in BiH are mainly concentrated in bigger cities. According to the available data, there are currently 25 district heating companies in BiH (12 in RS and 13 in FBiH) involved in supplying consumers with heat through 29 district heating systems (UNIS Energetika d.o.o. Sarajevo manages three district heating systems in Sarajevo, one in Travnik and one in Novi Travnik). According to the data from 2008 (ESS BiH, Module 1B, 2008), district heating encompasses 12% of households in BiH. In the meantime, two new district heating companies have started to work in Gradacac and Livno and a heating plant in Novi Travnik. Because newly installed capacities are rather insignificant when compared to the previous capacity (less than 3%), it can be said that percentage of household coverage by district heating has not significantly changed since then. The most recent analyses of district heating system are stated in the RS Energy Development Plan to 2030 (2010) and in the FBiH Energy Sector Strategy and Programme (2009). However, these documents mainly repeat the findings from the 2008 BiH Energy Sector Study Module 9, City District Heating.

Generally speaking, in the majority of district heating companies, especially in the RS, heating plants and accompanying equipment are predominantly 25 to 30 years old (one example is Banja Luka, which is the second biggest district heating system in BiH), the average age of boilers is close to 35 years old, and they will soon reach the end of their expected operating lifetime. Therefore, these systems are inefficient and prone to energy losses that can in some causes reach 60%. After the war, there were several reconstruction projects for existing systems, but major work was done only in Sarajevo while in the majority of other cities, only the most acute repairs were made to get the systems functioning again.

One of the major obstacles is billing for delivered heating services by setting heat tariffs. Even though energy tariffs have increased in the past several years, due to the difficult economic situation, prices do not reflect production costs, and so district heating companies require various municipal subsidies. This situation does not allow for investments in the maintenance of existing systems, especially capital investments for the upgrade and modernization of district heating systems.

The RS Energy Sector Study from 2010 provides detailed projections for district heating systems in the RS by 2030 for all three emission scenarios. In accordance with the recommendations from the RS Urban Plan by 2015, it is planned to have alternative sources of energy in city heating (wood waste, geothermal energy, and solar energy) as well as the reconstruction of large district heating systems by introducing cogeneration and modernizing existing systems. Taking into consideration that FBiH does not have a new scenario for district heating development other than those presented in the BiH Energy Study, Module 9 – City central heating from 2008, this scenario has been developed based on data on heat energy generation in FBiH (Federal Statistical Institute, Statistical Yearbook 2011) for 2010 and data delivered by the district heating systems in Gradačac and Livno (not included in those reports) and in accordance with the three scenarios of final energy consumption development in the RS.

All scenarios plan further heating and expansion of district heating networks (Table 31, Chart 25). Other individual characteristics include the following:

All three scenarios consider trends in the level of final energy consumption;

The **S1 scenario** assumes energy consumption without investing in new technologies and without the application of additional measures;

The **S2 scenario** involves the application of certain measures to reduce energy consumption;

The **S3 scenario** includes energy consumption in terms of intensive economic development and investment in new technology.

Scenario S1				
Admin unit	**2010**	**2015**	**2020**	**2025**
Republic of Srpska	1,753	2,240	2,580	2,885
Federation of BiH	3,926	4,678	5,486	6,294
Bosnia and Herzegovina	**5,680**	**6,918**	**8,067**	**9,180**
Scenario S2				
Admin unit	**2010**	**2015**	**2020**	**2025**
Republic of Srpska	1,753	2,152	2,289	2,385
Federation of BiH	3,926	4,236	4,515	4,763
Bosnia and Herzegovina	**5,680**	**6,388**	**6,802**	**7,147**
Scenario S3				
Admin unit	**2010**	**2015**	**2020**	**2025**
Republic of Srpska	1,753	2,158	2,378	2,562
Federation of BiH	3,926	4,449	4,997	5,546
Bosnia and Herzegovina	**5,680**	**6,609**	**7,376**	**8,109**

Table 31: Review of district heating development scenarios (in PJ)

These data imply that district heating systems in Bosnia and Herzegovina will be the most intensively developed under the S3 scenario, which presumes increased energy consumption in the conditions of intensified economic development.

4.2.2. Reduction of GHG emissions from various district heating systems

CO_2 emissions for all three emission scenarios for the period 2010-2025, were based on data on final energy consumption in the Republic of Srpska and the Federation of Bosnia and Herzegovina (Table 32).

S1				
Admin unit	**2010**	**2015**	**2020**	**2025**
Republic of Srpska	132,275.9	155,385.5	142,265.5	156,939.2
Federation of BiH	236,750.5	218,129.7	26,4043.5	311,547.4
Bosnia and Herzegovina	**369026.4**	**373515.2**	**406309.0**	**468486.6**
S2				
Admin unit	**2010**	**2015**	**2020**	**2025**
Republic of Srpska	132,275.9	149,268.9	120,738.8	123,593.2
Federation of BiH	236,750.5	196,916.4	211,617.8	226,096.6
Bosnia and Herzegovina	**369026.4**	**346185.284**	**332356.6**	**349689.8**
S3				
Admin unit	**2010**	**2015**	**2020**	**2025**
Republic of Srpska	132,275.9	149,831.2	131,096.0	139,383.7
Federation of BiH	236,750.5	204,565.1	236,249.5	269,565.8
Bosnia and Herzegovina	**369026.4**	**354396.3**	**367345.5**	**408949.5**

Table 32: Summary of CO_2 emissions from various district heating systems in all three scenarios (in tons)

The data for FBiH refer to values from the district heating systems from the thermal energy plant and industrial energy plants that also participate in the supply of thermal energy (Chart 25). Emissions from the thermal power stations supplying Tuzla, Lukavac and Kakanj with heat energy are encompassed by electrical energy sector emissions. From 2015, heat energy supply should be conducted from a gas-fired thermal power plant instead of the current industrial power-plant energy factory "Acelor Mittal Zenica" which uses coal as its primary fuel. There is a similar situation in the RS, where only CO_2 emissions are from the district heating system, which has its own heat energy production plants, whilst emissions from future co-generation plants and the thermal power plant Ugljevik will be covered under electrical energy sector emissions.

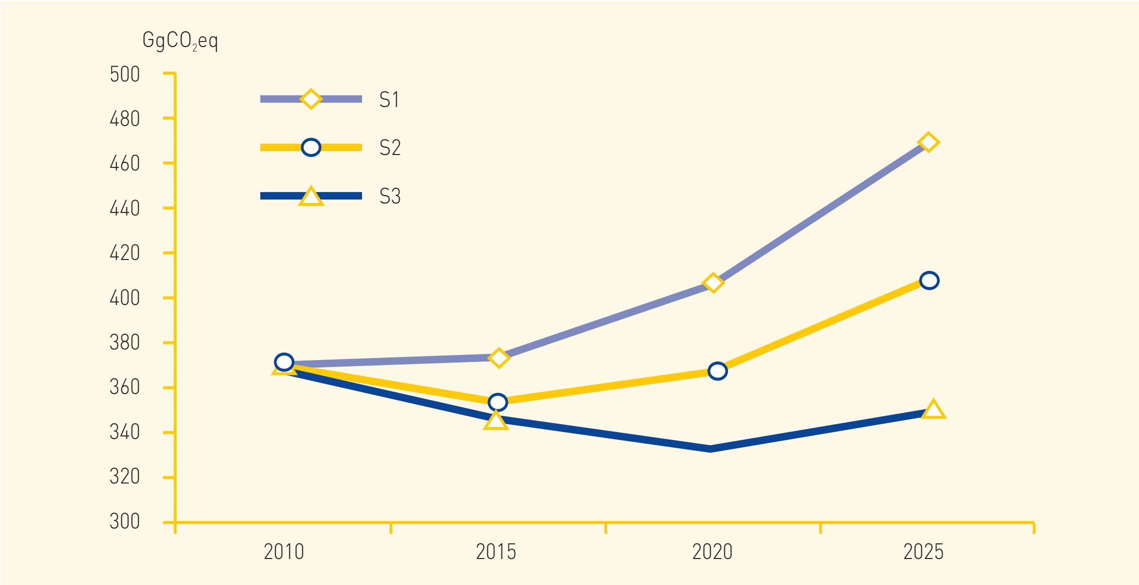


Chart 25: Total CO_2 emissions from the district heating sector in BiH for the S1, S2 and S3 scenarios, 2010-2025

4.2.3. Measures for reduction of GHG emissions from the district heating sector

Production and distributions measures

General measures:

- heating distant neighbourhoods, expanding networks, increasing the use of existing system capacity, and improving the efficiency of the systems by optimizing their operations.

Improving district heating networks infrastructure:

- pipeline repairs and replacement of old distribution networks in critical areas with insulated pipes; reconstruction of steam pipes and heat and hot water pipelines;

Improving transfer systems, distribution and supply: measures to decrease water loss, increasing capacities of circular pumps and general measures of system modernization, installation of appropriate control valves and introduction of frequency regulation pumps, introduction of balancing pipe networks, direct interventions in the substation, the introduction of compact substations.

Aggregates and regulation

- Introduction of systems to regulate district heating networks, such as temperature controls, management controls and metering, and remote monitoring;
- Upgrades in generation: rehabilitation and construction of boilers, procedures on heat exchangers, installation of condensing boilers with separate thermal networks, introduction of cogeneration.

Measures in terms of heating energy consumption

- Individual measurement of consumption: introducing thermal energy measuring adjusted to actual consumption: installing cumulative meters of thermal energy consumption for consumers, introduction of consumption-based billing;

- incentives for installation of thermostats, outreach to consumers regarding the potential for saving energy and money by adopting improvements.

4.3. Buildings

4.3.1. Buildings sector overview

4.3.1.1. Residential buildings

Considering the fact that since 1991 BiH has not conducted a population census, there are different estimates on the number of people in the country. Based on the survey conducted by the BiH Agency for Statistics, the estimated population is 3,447,156, and the number of households amounts to 1,054,613. The average number of inhabitants per household is 3.25 for BiH as a whole (RS 3.29, FBiH 3.14, DB 3.37). In urban areas, the average is 3.16 and in rural and semi-urban areas, there are 3.41 inhabitants per household.

Given that approximately 447,661 apartments were damaged during the war, some of which were reconstructed, and that a certain number of new apartments have been constructed, data on residential buildings are not exact. Statistical agencies monitor construction of apartments in residential units built by enterprises, whilst the number of family houses is not statistically monitored. Considering all statistical data and the BiH Energy Sector Study, as well as urban entities' plans, it may be assumed that there are close to 1,200,000 apartments, which is close to the pre-war number of 1,207,693 apartments (average space of 60.45 m²). Based on the available information, data from BiH Energy Development Sector Study's typology of residential housing can be taken as relevant (Table 33).

Admin unit	Buildings (%)	Family houses (%)
FBiH	31	69
RS	29	71
BD	5	95
Total for BiH	**29**	**71**

Table 33: Housing units by construction type

Apartment sizes have changed over time (with a tendency towards increasing apartment sizes with improvements in the standard of living), and they also depend on location (rural-urban).

Data from a survey conducted for the Energy Sector Study, noted a significant increase in average apartment space when compared to the size registered in the census in 1991, which amounted to 60.45 m² (Table 34).

Admin unit	Urban (in m²)	Rural (in m²)	Average (in m²)
FBiH	74.6	103.4	86.3
RS	82.0	81.8	81.9
BD	-	-	81.3
Total for BiH	**77.2**	**97.2**	**86.0**

Table 34: Approximate size of housing units by region

Housing units are predominantly old; i.e. more than 80% of the housing stock is older than 30 years, i.e. built prior to the adoption of regulations on thermal protection of buildings. One part of that housing stock was damaged during the war, and its quality has been improved through reconstruction (Table 35).

Admin unit	70 (%)	80 (%)	90 (%)	After 2000 (%)
FBiH	53	33	9	5
RS	58	29	5	8
BD	61	7	6	26
Total for BiH	**59.2**	**26.6**	**7.5**	**6.7**

Table 35: Housing stock age

Taking into consideration that until the end of the first decade of the 21st century there were no regulations on the thermal insulation of buildings, construction was done in accordance to JUS standards, which are outdated when it comes to new principles on thermal insulation of buildings and prescribed limits on energy consumption, which could serve as a resource for increasing energy efficiency; that is, decreasing energy consumed. Taking into consideration the low standard of living, heating area does not correspond to total habitable space. The data presented in ESSBiH must be taken with caution given the economic situation of the population. If the average heated area is smaller, then the average energy consumption per surface unit is higher. (Table 36).

Administrative Unit	Average heating area (m²)	Central heating area (m²)	Room heating (m²)	Split heating system (m²)
FBiH	57.84	74.01	45.90	34.13
RS	50.75	76.80	37.49	21.65
BD	58.66	84.87	54.92	0.00
BiH	55.72	75.15	43.85	29.25

Table 36: Average heating area and type of heating

Methods of heating:

- 30% of the houses have central heating: district heating 12%, steam boilers or furnaces 11%, self-heating 6%. Types of fuel for households that do not use DH: fuel wood 32%, electric energy 6%, natural gas 25%, fuel oil 18%, coal 19%.

- 70% of ambient house is heated with furnaces. Fuel types are: fuel wood 77%, electricity 12%, natural gas 2%, coal 9% (ESSBiH, 2008).

Based on the survey conducted for the BiH Energy Sector Study, the average annual amount of energy consumed for heating is 200 kWh / m² per heated area (Table 37). This number is approximate, i.e. average, as BiH lies in the different climatic zones.

	BiH	RS	FBiH	BD
Average quantity of heating energy (in kWh/m²)	200	216	199	224
Average heating surface (in m²)	55.72	50.75	57.84	58.66
Average annual energy consumption per household (in kWh/)	11,144	10,962	11,510	13,140

Table 37: Energy use for household heating

4.3.1.2. Public buildings (commerce and services)

It is assumed that the public building stock (commercial services and public services) averages 5 m² per resident, which totals 19,000,000 m² of public buildings in BiH (BiH Energy Development, 2008).

Public buildings are rather old, and majority of buildings were built before the late 1980s: services 64.5%, education 92.3%, commerce 74.4%, healthcare 82.6% and management and administration 78.5%. Public sector buildings are heated by centralized heating systems in 85% of cases, and only 15% of them are heated by room heaters/furnaces. The application of cooling systems is small and only a negligible number of buildings have cooling systems installed. Air conditioning is used to a somewhat greater extent (Table 38). Having in mind the age of these buildings and the manner of their maintenance (mostly poor), it can be assumed that energy consumption for heating in this sector is big. It is around 220 kWh/m² in public administration to 572 kWh/m² in the health sector. Energy consumption for cooling is not estimated due to the small number of air-conditioning systems, and the absence of statistics.

Sub-sector	BiH kWh/m²	FBiH kWh/m²	RS kWh/m²	DB kWh/m²
Tourism and catering	392	59	79	108
Education system	240	24	23	96
Commerce	345	90	85	119

Sub-sector	BiH kWh/m²	FBiH kWh/m²	RS kWh/m²	DB kWh/m²
Healthcare	605	30	37	47
Management and administration	267	45	51	75
Other	302	39	50	52

Table 38: Total energy consumption in the services sector

Based on energy consumption data in the sub-sectors, and the fact that energy consumption for heating is several times higher than the energy consumption for other purposes, it is evident that the greatest energy savings can be achieved in heating systems.

4.3.1.3. Industrial buildings

Industrial buildings have not been analysed because there are insufficient data on them. The privatization process is currently underway, and it is impossible to get more reliable data on construction facilities in the industrial sector.

4.3.2. Reduction of GHG emission from buildings sector

4.3.2.1. Residential buildings

The development of the buildings sector and energy consumption can be observed through three potential scenarios based on data in the sector from 2010:

The S1 scenario assumes a slight increase in GDP and energy consumption. The basic feature of this scenario is the continuation of the current trends, specifically in population increase, building construction and energy consumption, which could grow linearly. There are no measures for decreasing energy consumption planned in this scenario, as the economic power of the state is weak and there are, therefore, no funds to invest in any other measures.

The S2 scenario is based on a medium-fast increase in GDP without additional energy efficiency measures. Basic features are medium growth of GDP and increased energy consumption without implementation of energy efficiency measures. Taking into consideration that other energy efficiency measures are not implemented, energy consumption increases, since more buildings are being constructed simultaneously strengthening the economic power of population and increasing the need for energy on the household level (larger heating space, bigger number of household appliances).

The S3 scenario assumes medium-fast growth in GDP and the implementation of energy efficiency measures. If economic development is adjusted to a scenario of medium-fast development and GDP growth, energy consumption will increase, too. Implementing energy efficiency measures would slow down the trend of increasing use of energy resources, and significant savings could be achieved that would reduce energy consumption and CO_2 emissions.

4.3.2.2. Public buildings (commercial and services)

In public buildings, the greatest savings can be achieved by improving the central heating and air-conditioning and lighting systems, along with introducing measures to renovate building envelopes.

Because the majority of buildings are heated by central heating systems or heating plants, there is substantial potential for reducing energy consumption and CO_2 emissions. It is expected that there will be a significant increase in the number of new buildings in BiH; hence, new regulations and building codes limiting energy consumption for heating and total energy consumption will bring fast results. The application of energy efficiency measures in the heating and cooling systems, air-conditioning, and lighting in existing buildings will result in energy savings.

The S1 scenario is based on a slight increase in GDP and energy consumption. The basic feature of this scenario is the continuation of current trends; i.e., an increase in population and construction of public buildings following the current pace, and energy consumption which will increase linearly, too. This scenario does not foresee any measures for decreasing energy consumption, since the economic power of the state is weak ,and there are no funds to be invested in any measures.

The S2 scenario presumes moderate growth without any energy efficiency measures. Basic features of this scenario are faster growth of GDP and increased energy consumption without implementation of any energy efficiency measures.

The S3 scenario presumes faster growth and implementation of energy efficiency measures or energy saving measures. Basic characteristics of this model are faster GDP growth and increased energy consumption, which will be lower than in the S2 scenario.

4.3.3. Measures for improvement of energy efficiency in buildings sector

- Establishment of a legal framework for the introduction of energy efficiency in buildings;
- Public awareness campaigns and training for users and investors;
- Energy efficiency retrofits of existing facilities and the completion of partially renovated homes;
- The utilization of energy-efficient appliances in buildings.

4.4. Transport

4.4.1. Transport sector overview

4.4.1.1. Road transport

According to data collected from relevant institutions, the total length of the road traffic network in BiH amounts to 22,744.30 km, of which 37.60 km is highway, 39.50 km roads for motor vehicles only, 3,785.70 km of main roads, 4,681.50 km of regional roads, and 14,200 km of local roads.

The total density of road network in Bosnia and Herzegovina is 44 km per 100 km^2, and the density of main roads amounts to 7.4 per 100 km^2. Density of main roads in FBiH is 7.67 km/100 km^2, and 7.17 km/100 km^2 in the RS. In Bosnia and Herzegovina, the per capita density of road network is 5.68 km of roads/1,000 inhabitants in FBiH and 0.94 km of main roads/1,000 inhabitants in the RS.

Given that in 2011 a total of 1,026,254 vehicles were registered in Bosnia and Herzegovina and based on the available data, we can conclude that the average number of motor vehicles is 45,121 vehicles/1,000 km. Insufficient roadway width, steep slopes, sharp radii of curvature, and many other factors contribute to an operating speed on the roads of Bosnia and Herzegovina of 50 km/h, as well as to low-quality maintenance, which resulted in a large number of traffic accidents and increased costs.

The number of road motor vehicles registered in 2011 in comparison to 2010 (954,425 m/h), marked an increase of 71,829 vehicles, or 7.53%. This is practically the first time that the total number of registered road vehicles in Bosnia and Herzegovina surpassed one million (see Table 39).

Administrative and political unit	Total number of registered vehicles in 2010	Total number of registered vehicles in 2011	Difference in the number of registered vehicles (%)
Federation BiH	569.859	611.766	6,85
Republic of Srpska	292,831	306,229	4,37
District Brčko	30.614	32.920	7
Total in BiH	**893,304**	**950,915**	**6,07**

Table 39: Total number of registered motor vehicles in BiH, 2010-2011
(Sources: http://bihamk.ba and RS Ministry of Interior)

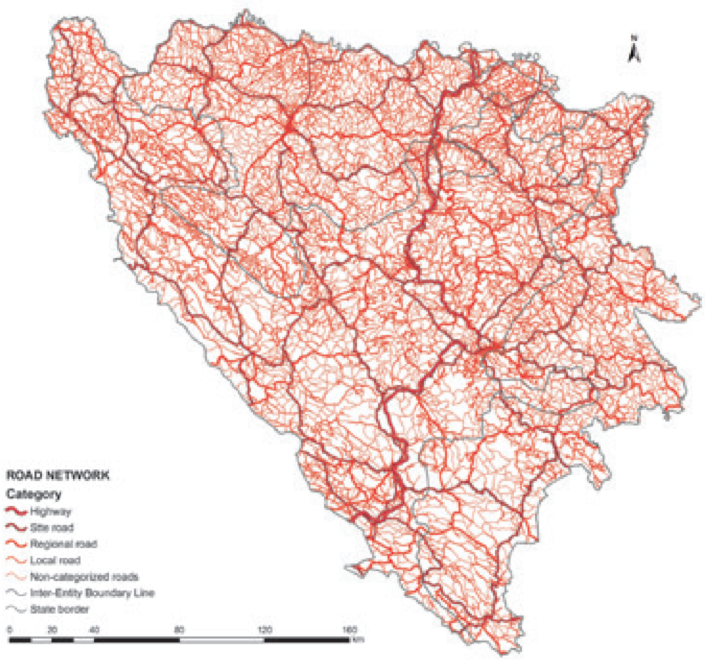


Figure 13. BiH road network

An overview of motor vehicles in BiH indicates that every fourth vehicle is up to 8 years old, while two thirds of the total number of registered vehicles are older than 15 years, and it is not cost effective to make any technical improvements that could have significant effects on the environment or on ergonomic, economic, and energy aspects of the vehicles. Cargo vehicles are also over ten years old, impacting and endangering public security, efficiency, decreased incurred income and potential for employment in the international transport market. If we consider the real annual rate of changes in the number of road motor vehicles for the period 2003-2011 and analogous changes in GDP, the average annual growth rate can be determined. Specifically, the expected total number of motor vehicles in BiH for 2010-2025 will grow by an average annual rate of 4%, and their total number will amount to 1.83 million.

CATEGORY	No. of vehicles	Relative share (in %)
Mopeds, motorbikes and quadbikes	3,515	6.10%
Passenger cars	44,294	76.92%
Buses	187	0.33%
Trucks	4,429	7.69%
Trailers	2,984	5.18%
Operating machine	383	0.66%
Tractors	2,061	3.58%
TOTAL	**57,853**	**100%**

Table 40: Structure of first-time registered road vehicles in BiH for 2011 by category (Source: www.ideea.gov.ba)

The volume of road transport in BiH for the baseline year of 2011 is represented by two indicators: freight transport and passenger transport. According to both indicators, transport volume increased by 3% when compared to 2010.

4.4.1.2. Railway transport

Railway transport in BiH is operated by two public enterprises: FBiH Railways and RS Railways. In addition to their primary activity of transporting freight and passengers, railway operators perform other, complementary activities, such as special transport, warehousing, combined transport, transhipment, etc. Centres for cargo transportation, transhipment, and storage of individual, group, and pallet shipments are already functioning in all major industrial centres in Bosnia and Herzegovina (Ploče, Mostar, Sarajevo, Doboj, Banja Luka, Tuzla, Zenica, Brčko District, Bosanski Šamac). The main beneficiaries of railway transport services include: the chemical industry in Tuzla, the steel plant and BH Steel in Zenica, coal mines in Zenica and Tuzla, the iron ore mine in Prijedor, the aluminium complex in Mostar, the industrial complex in Sarajevo, and distributors of petroleum products.

Data from 2010 show that the railway network consists of 1,031 km of railways, out of which 608.495 km is located in the FBiH. Industrial gauge rail to every important production facility should also be added to this network. Out of that, 440 km or 72% of electrified railways in FBiH and 79% or 336 km in RS. This enables railway operators to have direct access to downloading and delivery of all types of goods. 87 km are two-track railway. There are two major railway directions:

north-south (Šamac - Doboj - Sarajevo – Mostar - Čapljina - Ploče), and west-east (Bosanski Novi/ Novi Grad – Doboj – Tuzla – Zvornik).

Figure 14. Railway network in BiH

Railway transport volume in BiH for the baseline year of 2011 was also represented by two indicators: freight transport and passenger transport. Unlike road transport, the volume of railway transport decreased by 8.5% when compared to 2010. The stated indicators illustrate the best existing trends and the mitigation potential in BiH transport.

In order to fulfill European standards and play a more important role in the European railway networks, it is necessary to invest in new vehicles and infrastructure (along with providing better regular maintenance) on lines where transport volume demand is increasing and more demand is expected. Consequently, BiH railways would become more attractive and would provide better quality services to other European railway operators. This recommendation predominantly refers to railways on Corridor Vc and railways connecting to this corridor. This is underscored by the fact that passenger transport increased by 5.9% in 2007, following which there were discrepancies between 2010 and 2011 (an increase in FBiH Railways operations and a decrease in RS Railways). The aforementioned indicates that an average increase of 4.7% will impact passenger transport in the next 18 years (by 2030), which would increase by 84.6%, or 100 million passenger kilometres. At the same time, cargo transport would increase by 31%, or 900 million t/km.

4.4.1.3. Air transport

Four airports (Sarajevo, Banja Luka, Mostar, Tuzla) registered for international air transport are to be adjusted to correspond to the requirements as described in the ICAO standards. All airports have been reconstructed in the post-war period. Donor investments in the reconstructed airports totaled 70 million KM (approximately EUR 35 million). Equipment and installation costs pursuant to the CEATS contract are estimated at 14 million Euros with other significant investments necessary for the development of the four airports (expansion of the passenger terminals, cargo terminals, equipment and sections). Only Sarajevo airport has its own four airplanes (2 type ATR 72/212 and

Boeing 737), whilst other airports are functioning on an amateur, local basis. If certain state measures are undertaken to improve functionality, total transport from these airports will increase by 2% annually to reach a maximum of 62,000 passengers in the next 18 years. The increase of passengers at Sarajevo airport is relatively good under current circumstances, and an annual increase of 8% in the future is expected. Passenger numbers are expected to rise to 1,040,000 in 2030.

4.4.1.4. Sea and river transport

The network of waterways in inland waters and a short Adriatic coastline show the potential for the development and utilisation of water resources for transport. The main navigable waterways are the Sava (333 km), Drina (15 km), Bosna (5 km), Vrbas (3 km), and Una (15 km) Rivers, and some natural and artificial lakes. Because the navigable rivers are mostly borders with neighbouring countries, during the war, mines were deployed as obstacles on the waterways, on structures of destroyed bridges, drifts, sunken vessels, etc. This issue, combined with the unresolved legal status of the river, makes navigation almost impossible.

Bosnia and Herzegovina is also engaged in the Sava River Initiative. Sava River basin countries signed the Sava River Basin Framework Agreement, which is an integral part of the Protocol on the Navigation Regime. With this agreement, the Sava River was granted the status of International River, and both the Sava River and the Commission have received the authority to act on the rehabilitation of the waterway. Given the fact that transport on inland waterways in Bosnia has been neglected for a long time, the share of the river transport in the total transport in 2000 amounted to less than 1%. The basic characteristics of the situation in BiH river transport are neglected waterways, lack of a technologically modern fleet (towing instead of pushing), technical and technological obsolescence, and the devastation of ports and lack of shipyards with a slipway. Inland navigation has institutionally equal status with other transportation modes, which can be noted as a positive fact. Following the war, development of river transport was neglected since the legal status has not been resolved yet, and economic development at that time could not justify significant investments in the river navigation revival. Waterway of the river basin (E-80-12) in Bosnia and Herzegovina from Jasenovac to the border with Serbia (from rkm 507 to rkm 225), corresponds to the requirements of class III navigability, while the part from rkm 225 (Brčko) to 165 (Rača) corresponds to requirements of class IV navigability.

There are three ports on the river: Brčko, Bosanski Brod/Brod and Bosanski Šamac/Šamac. Bosnia and Herzegovina does not have a seaport, but it uses Adriatic ports in Croatia, primarily the port of Ploče. In order to use the Sava River, the waterway will have to reach its pre-war status as a Category IV waterway. In the post-war period, facilities in the port of Brčko have been repaired. Limited sources have been invested in the restoration of the Sava River waterway and port of Brčko and Bosanski Šamac/Šamac. Equipment in the Brčko port was partly restored with donor funds. By analysing the available capacity of water transport, as well as economic developments in the region, it can be assumed that water transport could rise by 20%, and this primarily refers to Ploče port, from the current 3.4 million tons to 11 million tons a year in 2030, while annual transport on the Sava River, amounting to 0.7 million tons, with a 2% annual increase could reach 0.952 million tons by 2030.

4.4.1.5. Postal transport

The legal framework for postal services in BiH is stipulated in the BiH Law on Postal Services (BiH Official Gazette no. 33/05), which establishes terms for unique and adjusted postal services on the state level. Postal transport in BiH is organized with three major post operators, two in FBiH (Public Enterprise BH Postal Services Sarajevo and Croatian postal services d.o.o. Mostar) and one in the RS (Public Enterprise RS Postal Services A.D. Banja Luka).

In addition to the three public postal operators, there are also seven private postal operators: DHL, International d.o.o; 24 VIP d.o.o.; FEDEX express d.o.o.; Intreuropa rtt d.o.o.; and Ivia d.o.o.; and Rhea d.o.o. In addition to traditional postal services, postal operators are also directing their services towards new markets; i.e., commodities exchange and financial markets.

4.4.2. GHG emissions projections for the transport sector

The basis for development of three scenarios for mitigation in the transport sector is the fact that road transport, compared to railway transport, comprises 90% of total annual energy consumption (diesel and gasoline) in this sector (according to the data for 2010, close to 923,500 tons of fuel). Given the fact that the estimated annual growth of motor vehicles is 4%, it can be expected that the average annual increase will amount to 3.5%, with total diesel consumption reaching 1,309,000 tons in 2030. Therefore, there is good potential for rational and economic consumption in this area. In vehicles less than 10 years old, there are certain calculations that indicate that energy loss and fuel consumption is by average 10-20% higher, whilst vehicles older than 15 years (which comprise 64% of all vehicles in the region), consume 20-40% more fuel per 100 km. This distribution indicates enormous environmental, energy and economic losses in the subsector of road transport and a possibility for savings in the overall transport sector.

The S1 scenario is based on the existing trends of an increasing number of vehicles by 5.8%, for the average age of the vehicle fleet of between 12 to 15 years, an absence of homologation measures (catalytic converters), and an average annual increase rate of diesel and gasoline consumption by 3.7%. In accordance with the indicators presented, the number of motor vehicles will increase by annual rate of 4%, which means that the total number in 2025 will amount to 1.3 million, and fossil fuels consumption will increase to 1,592 million tons. In doing so, it is assumed that the greenhouse gas emissions produced by road motor vehicles will proportionally increase with the increased consumption of fossil fuels energy. In relation to the age of the vehicle fleet in BiH it is calculated that the average CO_2 emissions from motor vehicles is about 185 g CO_2/km. These data correspond to an average consumption of 6.5 l/100 km for diesel and about 7.0 l/100 km for petrol-fueled cars for the period 1998-2008. If we take into consideration presented data on road transport volume, the values of CO_2 emissions can be calculated. More precisely, emissions for the baseline year 2010 for road vehicles in BiH total 2.65 million t CO_2. Considering all stated trends in the number of motor vehicles and fuel consumption, emission values will amount to close to 5,086 Gg CO_2 in 2025.

The S2 scenario is based on the introduction of additional technical measures for road vehicles to improve the efficiency of motors and decrease fuel consumption. In this scenario, the growth rate is identical to the S1 scenario, and it is planned to improve the fuel quality and road infrastructure. An important element of this scenario is the decreasing average age of vehicles to 12 years by 2025. Basic objective of this scenario is reducing the emission coefficient from 185 g CO_2/km in the baseline year to 150 g CO_2/km in 2025. Results from this scenario indicate a positive trend of emissions by 2025 with the caveat that values are 20% less than the S1 scenario, which implies that emission reduction potential is great.

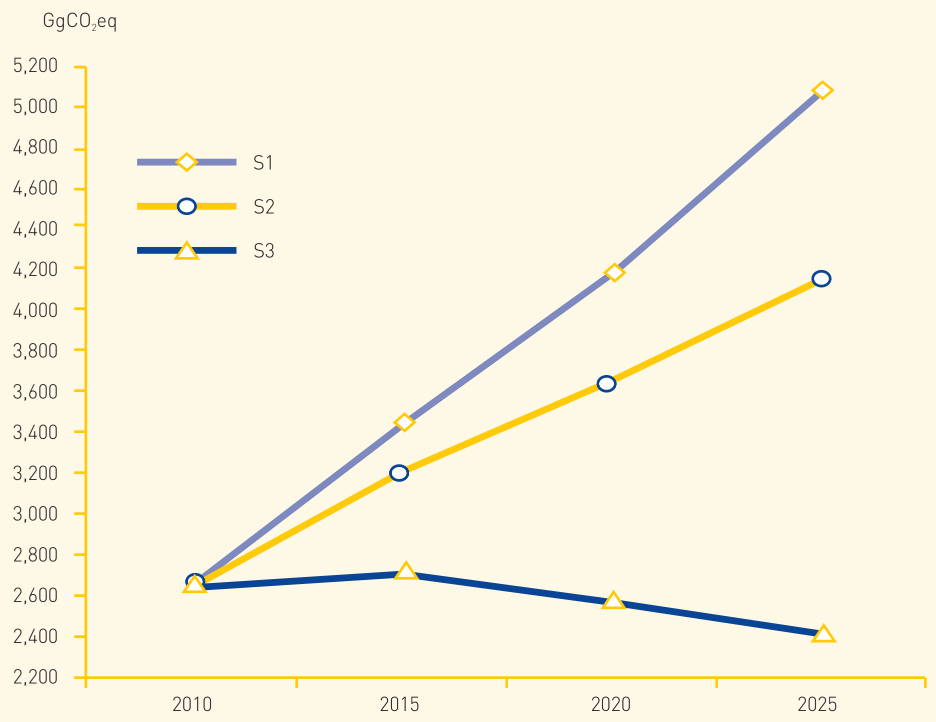


Chart 26. Total CO_2 emissions from the transport sector in BiH according to S1, S2 and S3 scenarios, 2010 - 2025

The S3 scenario is based on the assumption that BiH will by 2025 become an EU member state and will be required to implement EU Directive 443/2009/EZ on CO_2 emission reductions for light vehicles, which prescribes standard emission values for new passenger vehicles. This EU Directive set a target to reduce emissions in new vehicles to 130 g CO_2/km by 2012. An additional reduction of 10 g CO_2/km (120 g CO_2/km) is planned and can be accomplished by applying additional technical measures (better quality tires, good quality fuel, etc). The long-term objective is to reach emissions of only 95 g CO_2/km by 2020. The requirements for producers of motor vehicles are as follows: 65% of all new vehicles will have to be adjusted to the new Directive in 2012, 75% will have to adjust by 2013 and 80% in 2014, whilst by 2015 all new vehicles on the market will have to be adjusted to the regulations of this Directive. This scenario presumes significant change in the structure of transport of both passengers and goods, aiming to increase railway transport to over 50% by 2025. This would result in an annual decrease in motor vehicles. The important element in reducing emission according to this scenario is the introduction of new regulations on motor vehicle imports, such as the homologation of vehicles, thus reducing emission coefficients.

The results of these scenarios indicate that by decreasing real values of emission coefficients to an acceptable level of 100 g CO_2/km with adequate restructuring of transport structure from road to railway and water transport, transport sector emissions would decrease to an acceptable 2,431 Gg CO_2 by 2025. It can be observed that the application of these measures would have tangible effects after 2020, following a negligible increase in 2015, and this 10-year period could be seen as a kind of stabilization phase in transport sector gas emissions.

4.4.3. Measures for reduction of GHG emission from transport sector

- Establishment of efficient international and domestic transit railway transport (thus proportionally reducing road transport);
- An increase in the level of efficiency and capacities of river transport;
- Development of intermodal transport as the most environmental friendly and safest form of transport;
- Modernization of the vehicle fleet with energy-efficient road vehicles;
- Introduction of a ban on production and consumption of leaded petrol;
- Reconstruction and modernization of roads;
- Introduction of tax incentives for purchasing and using highly-efficient motor vehicles and increased tax duties for motor vehicles with low fuel efficiency.

4.5. Forestry

4.5.1. Forestry sector overview

Forests are one of the most significant natural resources in Bosnia and Herzegovina, gaining multifunctional significance in the last decades, from thermal energy production to their role in carbon storage. Generally speaking, it can be said that continental part of forests in BiH predominantly belongs to Euro Siberian North American region, whilst forests of the Mediterranean part belong to the Mediterranean region type.

The highest mountain tops in BiH are situated above the upper forest line and belong to Alpine High Nordic region. Distribution of major vegetation types is subject to the laws of horizontal zoning and altitude zoning. The lowest hypsometric levels form a belt of oak forest and lowland and highland areas of the Illyrian and Illyrian intermediate-Moesia provinces, in which the altitude and climate build a mountain belt of beech, fir and beech, fir and beech with spruce and subalpine belt of beech (order Fagetalia). The junipers belt (curve) encompasses special belt with emphasized high-mountain floristic diversity featured by numerous endemic species and relic types. Mediterranean region is divided to different vegetation zones i.e. Mediterranean zone of coniferous trees, then a sub-Mediterranean zone and Mediterranean-mountain belt of deciduous vegetation.

	Federation BiH (ha)			Republic of Srpska (ha)			Total (ha)
	State	Private	Total	State	Private	Total	
Forest	905.000	209.000	1.114.000	813.000	258.000	1.071.000	**2.185.000**
Forest land	301.000	69.000	370.000	160.000	19.000	179.000	**549.000**

Table 41: Total forest and forest land area cover in Bosnia and Herzegovina (Source: FRA 2010/026)

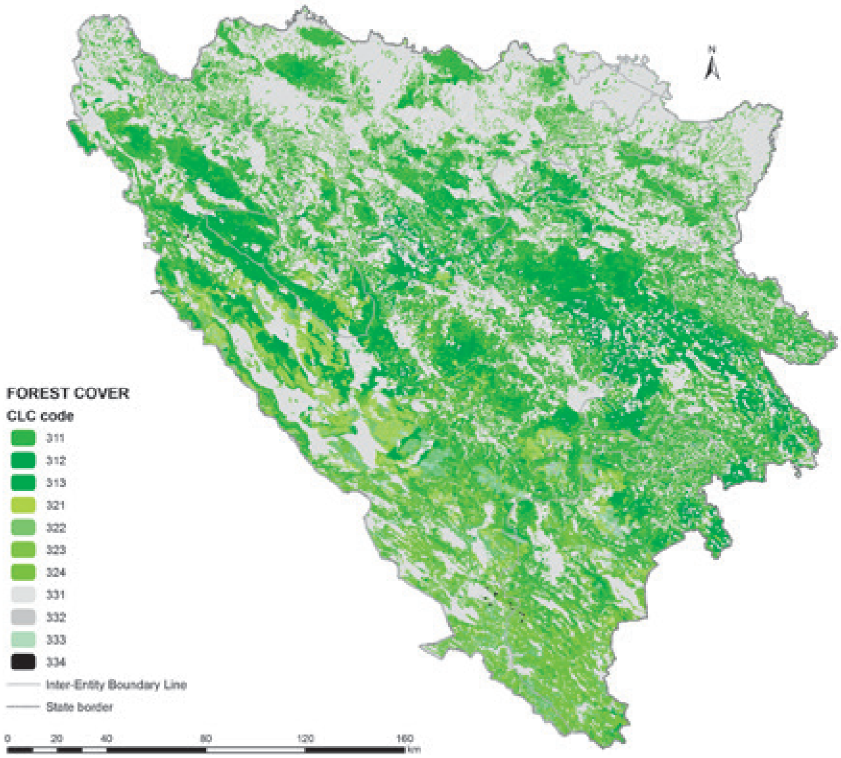


Figure 15. Forest cover in BiH (Source: CLC2000)

According to the same source, the total area under forest land in Brčko District amounts to 11,000 ha, with predominantly privately-owned forests (8,500 ha), while 2,500 ha is state-owned. In accordance with the presented data, close to 400,000 hectares (186,141 hectare FBiH and 207,719 hectare RS) is treated as barren with productive function and potentially able to be included in afforestation programs.

The European project CORINE Land Cover (OR CLC2000) contributed to forest research in BiH, the results of which represent significant support to activities with regard to protection of ecosystems, prevention of biodiversity loss, monitoring climate change impacts, assessment of agricultural development and implementation of Framework Water Agreement. CLC2000 represents a significant set of data for implementation of key priorities of the EU 6_{th} Environment Action Program. The stated project of land coverage defining had a task to define structure of using biophysical coverage of land surface; however, forest cover was taken as a special theme. CLC data for BiH have been additionally updated in 2006, based on which a GIS card has been used with the accompanying database (Card 5). Forest coverage in CLC2000 has sign 3 and is structurally differentiated into 6 subcategories with third level code. The GIS analyses resulted in quantitative data on forest distribution in BiH, which covers close to 53% of the country (Table 42).

The most common forest subcategories are deciduous-broadleaf forests, which account for 31.8% of the total land area. All other categories of forest cover have significantly lower surface distribution: mixed forests - 7.9%, transition forest and shrubs - 5.5%, coniferous forest - 4.8%, sclerophyllous vegetation - 1.4%, while the zones with sparse vegetation - 0.6% have the lowest incidence. The structure of the stated categories corresponds to the stated vegetation types and horizontal zoning in BiH. Beech trees dominate broad leaf deciduous forests (39%), followed by sessile oak (19%). Conifer forests are dominated by fir trees (12.8%), spruce fir (8.6%), pine (7.2%), white pine (2.5%), and other types (0.1%).

CODE, CATEGORY	P (ha)
3.1.1. Broadleaf deciduous forest	1627688.16
3.1.2. Coniferous forest	243805.59
3.1.3. Mixed forests	404219.37
3.2.3. Sclerophyllous vegetation	711.00
3.2.4. Transitional forest / scrub	278891.92
3.3.3. Areas with sparse vegetation	43296.87

Table 42: Forest structure in BiH

4.5.2. Mitigation scenarios for the forestry sector

The significance of forest cover in climate change mitigation is reflected in its capacity to absorb and accumulate carbon. According to the IPCC estimates, forests around the world have accumulated enormous quantities of carbon. While the atmosphere contains close to 750 billion tons of carbon as CO_2, world forests contain around 2,000 billion tons of sequestered carbon. Close to 500 billion tons of carbon is sequestered in trees and scrubs, and 1,500 billion tons in peat bogs, soils, and aboveground forest vegetation. 100 billion tons of the stated 500 billion tons of carbon is circulating in the atmosphere. These data indicate the importance preserving forest ecosystems to climate change mitigation.

Sequestering coefficients for forest cover by geographic zones are based on to date studies on biomass production according to the certain types of forest. More precisely, forest cover of moderate climate in BiH has the following sequestering capacity (see Table 43).

BIOME	Area (Mil. ha)	Sequestering capacity (Mt C)		
		Vegetation	Soil	Total
BiH forests in temperate climate area	2.7	153.65	260.67	**414.33**

Table 43: Sequestering capacity of forest cover in BiH

The data illustrate the importance of forest cover in BiH, especially when the aforementioned sequestering capacity totals 1.515 Mt CO_2e. It is also important to state that these values are not only significant at the country level, but also at the wider regional level. The three scenarios for climate change mitigation in the BiH forestry sector are based on data from the forest fund status, current forest management policies and future development trends. In accordance with calculations stated in the instructions for changes in forest system and other inventories of wood biomass, total participation of biomass in BiH is calculated and it amounts to 2,386.5 Gg of dry substance, whilst calculated net annual input of CO_2 totals to 2,024.60 Gg. Based on the IPCC values of carbon share in dry substance, total annual input of carbon in the forest cover in BiH for 1990 was 3,217.85 Gg. Based on the stated results and calculations of annual release/emission of carbon, total annual CO_2 sinks in forest ecosystems in BiH amounted to 7,423.53 GgCO_2. When compared to the state rate of average annual decrease of forest land in BiH to 2,500 ha, we have surface value of the total forest cover for baseline 2010 from 2,673,700 ha. Equivalent to the stated decrease of forest area, the value of annual sinks for 2010 amounted to 7327.5 GgCO_2. The abovementioned figures encompass CO_2 emissions made by wood biomass combustion, albeit there is a certain measure of uncertainty with regard to firewood data and proportion of emissions regarding illegal logging.

The S1 scenario is based on the detected trend of decreasing forest areas as observed in the postwar period, and it does not include any additional measures to change the existing trend. The basic reasons for this situation originated during the war when illegal logging was a way of securing firewood and other basic needs or as a source of income. A special aspect of the stated negative trend is using degraded forest land for other purposes; this specifically refers to land suitable for afforestation. This scenario does not foresee more significant changes in using wood biomass for heat energy production or wood industry (see Chart 27). Based on the data presented in the Chart 27, the negative trend of sequestration capacity reduction is quite clear, as consequence of forest fund losses of an annual average rate of -0.8%.

The S2 scenario is based on the application of certain stimulus measures for preserving existing forest cover. The basic measure involves increasing the sinks capacity through practical ways of applying certain silviculture methods to increase the carbon sequestration in tree biomass in existing forest areas. An important measure is the reforestation of bare lands, which would increase the total annual biomass increment. One of the important measures to S2 scenario represents an improvement of forest management, especially with aspects of permanent control and supervision over forest health, intensification of thinning and clearing of forests and planting of pioneer tree species in degraded forest lands. Another very important activity is related to the enhancement of fire protection measures aimed at preventing and reducing the number of forest fires, which in the past several decades have usually been caused by climate and are more frequent. Result of the application of these measures would affect the maintenance and would cause a slight increase in sinks capacity of forest cover in BiH.

According to the S2 scenario, sinks capacity would increase by an annual rate of 5 Gg CO_2. The total increase of sinks capacities for forest cover in 2025 would amount to 62 Gg CO_2 which is for current conditions in the forestry sector in BiH and from the point of legislation and concrete forest management a realistic and attainable objective. The S2 scenario incorporates data on CO_2 emissions from wood biomass combustion, given the fact that forest management plans incorporate harvesting and firewood consumption. However, there are some uncertainties with regards to firewood biomass quantities and participation of emissions from illegal logging category, since the data for 2010 were not official and calculations were based on estimates.

The S3 scenario is based on the assumption that BiH will become a member of the EU by 2025 and will thus be obliged to comply with directives related to the forestry sector. This refers to certification programs for the overall forest fund in BiH aiming to improve sustainable forest management. As stated previously, forest certification will contribute to the alleviation of climate change impacts by increasing the annual wood biomass increment, preservation of forest land and biodiversity, and general improvement of social and economic forest functions (Chart 27). One of the special measures that the S3 scenario assumes is the continued reforestation of degraded forest cover and afforestation of woodland barrens with the aim of combating the negative trend in forest area reduction by increasing the area under forest cover. Demining forest areas (10% forest areas are currently mined) will also enlarge forest storage potential in BiH.

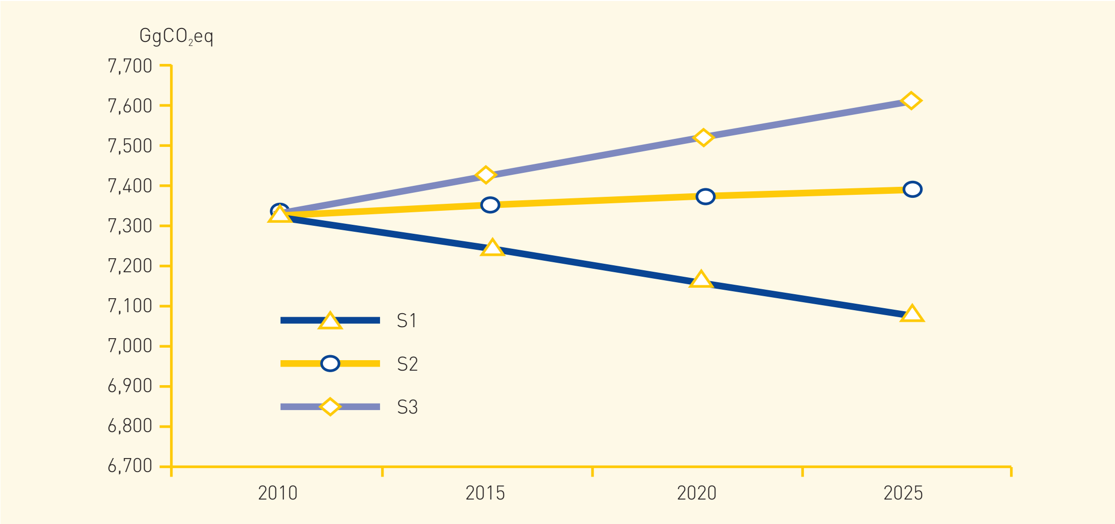


Chart 27: Net average annual sinks CO_2 in BiH forestry based on the S1, S2 and S3 scenarios, 2010-2025

Pursuant to the stated activities, estimated forest area would in S3 scenario increase for additional 33,000 ha and thus, with the application of all foreseen measures, would increase average annual sinks capacity in BiH for 285 Gg CO_2.

4.5.3. Climate change mitigation measures in forestry sector

- Maintaining the existing increment and increasing the future increment of carbon density per hectare (tC/ha) based on the applied method of silviculture;

- Continued afforestation/reforestation and rehabilitation to maintain and preserve existing and surface increase of forest areas in the future;

- Demining existing mined forest areas that have the additional option to increase storage potential for carbon;

- Improving the existing system of fire protection of forests from forest fires, which includes the mechanisms of permanent monitoring and surveillance, and rapid and effective intervention in cases of their occurrence;

- Establishment of effective mechanisms for prevention of illegal activities in the forestry sector in Bosnia and Herzegovina, which have recently had very significant negative implications;

- Certification of entire forests in BiH in order to improve the sustainable management of forest complexes;

- Continued increases in the use of wood biomass to replace more carbon-intensive fuels;

- Increasing the area of protected forest land.

4.5.4. Peat bogs

Peat bogs are especially important habitats that have accumulated enormous amounts of carbon on the global level. Coal mines of today used to be peat-bogs in the past. Without fossil peat bogs, there would be neither an industrial revolution nor anthropogenic emissions of CO_2, anthropogenic global warming, and interest in peat bogs for carbon storage.

According to numerous studies, peat bogs contain more carbon and can absorb more carbon dioxide per hectare on the annual level then all tropical rain forests. It is estimated that peat bogs contain an average of 5000 tons of carbon per hectare and absorb carbon from air at an average rate of 0.7 tons per hectare annually (Gray).

The total area of histosol (lower peat bog) in BiH totals approximately 9708 ha. The biggest areas are in Livno polje (Veliki and Mali Ždralovac), where flat, lowland, peat acid soil on alluvial sandy loam encompasses approximately 2663 hectares and peat, gley soils approximately 2049 hectares. In the southwestern part of the plains near the village of Grborezi, gley soils cover an area of approximately 1028 hectares, while flat, lowland, peat soil on alluvial sandy loam occupies an area of approximately 1048 ha. In the lower zone of Kazanci, a straight lowland, peat soil on alluvial sandy loam occupies an area of 326.59 hectares. The total area of peat bogs in the Livno plain is approximately 71148 hectares. 80,000 cubic meters of peat is excavated annually from July to September at the Ždralovac site, thus reducing the potential for carbon storage by about 376 tons.

In the area of Glamočko (gley peat fields), calcareous soil occupies an area of 801.54 hectares. In the area Hutovo blato flat, lowland, peat soil on alluvial sandy loam accounts for 973.64 hectares. In the wider area of Gabela, towards the border with Croatia, flat low peat soils occupy an area of 272.63 hectares. The Pliva River valley, stretching from piles until the Pliva lake flat, lowland, peat soil on alluvial sandy loam occupies an area of 418.41 hectares. In the area Loncar flat, lowland, peat soil on alluvial sandy loam occupies an area of 33.02 hectares. In the Bihac region, near the village of Orljani flat, lowland, peat soil non carbon on alluvial sandy loam covers an area of 28.33 hectares. In the wider area Miljevina straight, lowland, peat soil on alluvial sandy loam occupies an area of 3.45 hectares.

Based on data on the sink capacity of different types of biomass on earth, it is possible to estimate carbon stocks in soil and vegetation in peat soils in Bosnia and Herzegovina:

Soil: 9708.47 ha x 642.90 t/ha C= 6,241,575.36 t C

Vegetation: 9708.47 ha x 42.90 t/ha C= 416,493.36 t C

Based on the input data, it can be concluded that the total carbon stock in peat soils of Bosnia and Herzegovina is 6,658,068.72 tons of carbon, which is an extremely high value compared with the total annual value of emissions from all sectors.

4.6. Agriculture

4.6.1. Agriculture sector overview

Agriculture represents another strategic branch of economic development of BiH primarily because of the large number of people working in this sector (over 19% in 2011).

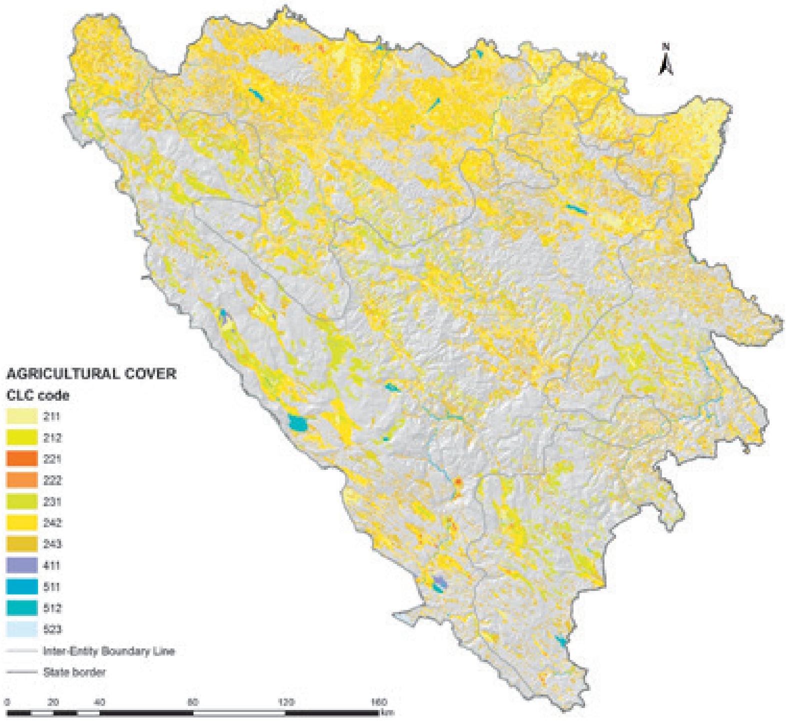


Figure 16. Agricultural land in BiH (Source: CLC2000)

According to current estimates, there are close to 515,000 agricultural management units. More than 50% of production units (250,000) are less than 2 hectares in size, and 80% (400,000) are less than 5 hectares. Somewhat more than 20,000 management units, or 4% of the total number, are larger than 10 hectares. Based on the stated data, it can be seen that agricultural management units in BiH are still small (average 3.3 ha) and divided into 7-9 smaller units, which is the cause of low productivity and modest total economic efficiency. Recent research indicates that management units that were successful in satisfying their needs were partly oriented towards market production, and those consuming most of their products and that have low extra production for sale, are the dominant types of management units in BiH.

2.3 million ha, or 46% of the total area of BiH, is suitable for agriculture, but only 0.65% is irrigated. Of the total agricultural land in Bosnia and Herzegovina, arable land accounts for 68%, and 32% is meadow. Fertile plains make up 16% of the agricultural land of Bosnia and Herzegovina, 62% are less fertile hilly and mountainous areas, and the Mediterranean area is about 22%.

In lowland areas, natural conditions are favorable for sustainable agricultural production and a modern market economy. The best quality of soil is in the valleys of the Sava, Una, Sana, Vrbas, Bosna and Drina Rivers. It is possible to organize sustainable production of cereals (wheat, barley, soybeans, corn), large-scale growing of fruits and vegetables, medicinal plants and industrial facilities in these valleys. Agricultural land is less valuable in the mountains of Bosnia and Herzegovina. In these areas, it is possible to organize additional livestock and agricultural production, then production of organic food and forage, cultivating barley for beer, potatoes, and other crops. Agricultural land in the Mediterranean region which is covered by karst fields occupies about 170,000 ha and is suitable for intensive greenhouses and outdoor cultivation of vines, citrus and vegetable farming, fish farming and beekeeping. More than 30% of the sub-Mediterranean area is under pastures, plains, suitable for livestock breeding (goats, sheep, and cattle).

4.6.2. Climate change mitigation scenarios in agriculture

The potential for climate change mitigation in agricultural production can be viewed from two aspects: as a sinks potential and as a source of GHG emissions. Greenhouse gas emissions sinks potential is defined by spatial coverage and type of agricultural land. Survey results of sinks capacities for BiH are presented in Table 44 below.

CATEGORY	Area (000.ha)	Sequestering capacity (Mt C)		
		Vegetation	Soil	Total
Ploughed land and gardens	1,018	1.94	81.44	**83.38**
Moderate climate zone meadows	1,160	8.35	273.76	**272.11**
				Total: 355.49

Table 44: Agricultural land sequestration capacities

Based on the data presented, it can be concluded that agricultural land in BiH similar to forest cover, has an exceptionally large capacity for carbon storage. More specifically, the existing sinks capacity for the primary greenhouse gases amounts to **1,305.3 Mt CO_2e**. Accordingly, it can be said that when it comes to mitigation potential, the importance of preserving or increasing the area of agricultural land is exceptionally big and does not have other alternatives.

Another aspect of mitigation potential refers to annual GHG emissions from the agricultural production sector. According to the data from the BiH postwar period, there is a continued trend of decreasing arable land whilst use of the existing arable land employ outdated, technologically inadequate and energy-inefficient machines and other accompanying technological equipment. The trend of inadequate disposal and utilization of manure and the use of bad types of mineral fertilizers is also evident. A similar situation exists in the subsector of livestock breeding where the existing trends indicate a decrease in production due to the poor quality and insufficient amount of fodder, which is being compensated for by increasing the number of animals.

The **S1 scenario** is based on the aforementioned post-war trend of turning arable land into construction land and does not presume additional measures for its preservation. According to this scenario, the terrible situation regarding the low level of mechanization in agriculture worsens both from the aspect of its production and aspect of energy efficiency, which results in increasing consumption of fossil fuels, azoth oxide being the most common. Low productivity in livestock breeding with a tendency to increase the number of cattle aiming to improve production results are featured in the S1 scenario, which would result in an increasing trend of average annual GHG emission from this subsector by 150 MgCO_2e. If we also consider emissions from soil caused by intensified use of mineral fertilizers, it is possible to estimate that the agricultural sector is marked by a general trend of GHG emission increases at an average rate amounting to 0.25 Gg CO_2e per year. According to the presented indicators, total GHG emissions in the agricultural sector under the **S1 Scenario** will double in 2025 (close to 180% of the value in the baseline year). It should also be noted that the emission values presented are minimum values, especially when considering the fact that they are calculated according to the figures for 1990, and it is quite certain that those figures are much higher today, since agriculture is one of the strategic orientation of BiH in the overall economic development.

The **S2 scenario** is based on the application of positive experiences and good production practice in the agricultural production from economic and agriculturally-developed European countries. This refers to the application of the most contemporary technologies so as to develop agricultural production in all subsectors. In the subsector of breeding and production of agricultural crop plants the use of adequate types of mineral fertilizers with high stimulating production values and low emission factors is foreseen, thus impacting emission reduction and especially azoth oxide. When referring to the livestock breeding sector, it is necessary to improve productivity and undertake measures for the appropriate disposal and application of manure. Therefore, it would reduce emissions of methane and other greenhouse gases. Results of conducted analyses imply that total annual GHG emissions will decrease significantly, a reduction that will by 2025 amount to 5%. Based on that, the general conclusion is that the applied measures in the agricultural sector must be broader and more efficient in an attempt to get more tangible effects.

The **S3 scenario** is, as in other sectors, based on the expectation that BiH will by 2025 become an EU member state. Therefore it is realistic to expect acceptance and application of all directives and other obligations with regard to agricultural activity. Such activities would include the application of European standards in all subsectors of agricultural production. Subsectors of cultivating and producing crop plants would encompass cultivating of the most adaptive and concurrently the most productive types especially at the level of organic farming, hence increasing yields. Application of artificial stimulus, particularly mineral fertilizers would be limited to ecologically acceptable types, resulting in significant reduction of GHG emissions. An important aspect of emission mitigation would be in the area of new and highly energy-efficient technologies on the level of agricultural mechanization and all other segments of applicable technology in the production process. The expected results would be quite obvious through multifold reductions in fossil fuel utilisation and improvements in quality. The livestock production subsector will achieve gains by breeding highly productive livestock, thus increasing the level of overall production. It is also important to emphasize that the production of forage would also be developed, thus mitigating intestinal fermentation of ruminants. Concrete closed pits, which will produce less methane, would be used when disposing and storing manure. It can be expected that manure disposal will enable utilisation of methane to generate thermal energy, which can be produced in farms for different purposes.

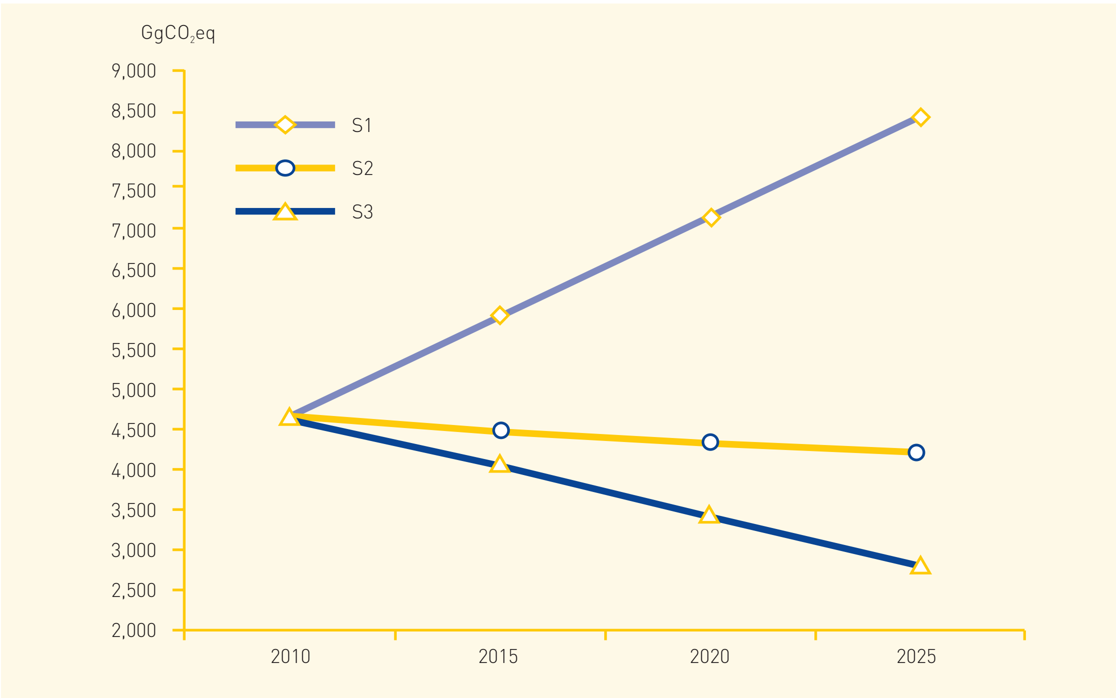


Chart 28: Total emission of CO_2e from the agricultural sector in BiH according to the S1, S2 and S3 scenario, 2010-2025

One of the expected activities according to this scenario is converting degraded agricultural land to arable land, thus increasing sinks capacity. The data presented indicate that mitigation potential in the agricultural sector in BiH with strict application of the most contemporary technologies and practices in all segments of production are rather large. However, in order to get exact scenario indicators, it is necessary to have data that can only be obtained in an official census, which BIH has not conducted since the wartime; at present, estimates are the only way to obtain output data.

4.6.3. Measures for reduction of GHG emissions from agriculture sector

- Sustainable and functional use of arable land and meadows so as to preserve its sequestration potential;
- Restoration of cultivated peat soils and degraded land;
- Development of techniques for storage, preparation, and use of manure to stabilize and decrease methane emissions;
- Introduction of new practices in breeding and feeding livestock to stabilize and decrease N_2O emissions;
- Reduced application of nitrate fertilizers and development of techniques for utilization of other types of mineral fertilizers for stabilization and reduction of N_2O emissions and emissions of other nitrogen oxides;
- Intensive breeding of agricultural crops for biofuels production so as to decrease use of fossil fuels;
- Improvements in energy efficiency at all levels of agricultural production;
- Utilization of methane and other GHGs in the sector for energy production.

4.7. Waste management sector

4.7.1. Waste management sector overview

In accordance with the statistical data and data from the BiH Agency for Statistics, the estimated quantity of municipal solid waste for 2010 amounted to 521,877 tons. This shows that the average annual production of municipal waste is about 389 kg, or 1.08 kg per capita per day. The proportion of people who are covered by municipal waste disposal systems at the state level amounts to 68%. The rest (32% of the population), are mostly located in rural areas. Collected waste is composed of the following: mixed municipal waste (92.4%), separately collected waste (6%), waste from gardens and parks (1.1%), and packaging waste (0.4%). 1,516,423 tons of waste is disposed in landfills. Collected data show that municipal solid waste is permanently disposed in landfills. According to the available data, there are over 600 registered illegal waste disposal sites.

However, estimates show that this number is significantly increased, as many of these sites have not been officially registered. Because they are located on topographically inadequate and unprotected sites (illegal landfills), they represent a serious threat to their surroundings and to public health in BiH and beyond. There is no processing or disposal facility for medical and other dangerous waste, whilst the recycling of industrial and municipal waste is still limited. Therefore, improving treatment of industrial and medical waste, municipal waste disposal and recycling are still challenges showing some progress signs.[16] In particular, in the last several years, there have been the construction of regional sanitary landfills has been initiated, close to 10 to 15% of registered illegal landfills have been closed down, and efforts have been made to remove accumulated, dangerous chemical waste. Framework laws have been passed as well as one section of secondary legislation on waste management, even though the level of implementation has still been very low.

By relying on the stated data, it is possible to calculate changes in the quantity of waste in the analysed period, 2010-2025. The initial basis for the stated calculation is a linear approach and a five-year annual rate of total waste estimated at 3%, which is done based on the population growth rate and quantity of waste produced per capita during 1999-2010. In the structure of solid waste, biodegradable waste accounts for 50%, and in the stated period, the assumed efficiency in waste collection and disposal does not change. The results of this analyses are presented in Table 45.

Production and structure of municipal waste in BiH (tons)	Annual quantity 2010	Estimated annual quantity 2015	Estimated annual quantity 2020	Estimated annual quantity 2025
Total quantity of municipal waste in RS	392,891.00	404,677.73	416,818.06	429,322.60
Estimated quantity of biodegradable waste	196,445.50	202,338.87	208,409.03	214,661.30
Total quantity of municipal waste in FBiH	1,128,986.00	1,219,577.68	1,256,165.01	1,293,849.96
Estimated quantity of biodegradable waste	561,766.00	514,852.71	530,298.29	546,207.24
Total quantity of municipal waste in BiH	**1,521,877.00**	**1,624,255.41**	**1,672,983.07**	**1,723,172.56**
Estimated quantity of biodegradable waste	**758,211.50**	**672,833.08**	**693,018.07**	**713,808.61**

Table 45: Changes in annual quantities of total and biodegradable municipal waste at the entity and state level (according to methodology from the Solid Waste Management Strategy)

Based on the presented data, it can be concluded that there is trend of continued growth in all three categories analysed, which results in a total average increase of 9%.

4.7.2. Climate change mitigation in the waste sector

GHG emissions in waste sector are related to methane emissions (CH_4) and in part CO_2, CO and other gasses released during the anaerobic decomposition of waste. Data on methane

16 Federal waste management plan for 2012-2017.

emissions from sanitary landfills in BiH could be calculated exactly based on results from the Moscanica regional landfill in Zenica. According to the data from this landfill, the average annual production of landfill gas from 1 t net municipal waste amounts to 6 m^3 while thermal value amounts to 5 kWh/m^3. In accordance with this data on net quantities of disposed biodegradable waste on landfills and taking into account approximate structure of landfill gas (55% - CH_4 and 44% - CO_2), it is possible to determine the specific average annual production of landfill gas in BiH. However, pursuant to the applied methodology in calculating GHG for 2001 for this sector (taken from GHG sector SNC for BiH) served as basis for calculation of emissions for 2010. More specifically, based on the average inter-annual growth rate amounting to 3% for 2010, it has been calculated, and it amounts to 1191.1 GgCO_2e.

The S1 scenario is based on unchanged practices in the production and overall organization of waste collection and disposal in the long-term period in BiH. Existing practice is that one part of waste is being disposed on the municipal (mainly illegal) landfills whilst the other part is disposed on regional landfills in Sarajevo, Zenica, Banja Luka and Bijeljina which are still not sanitary landfills. A particular problem is still a large number of illegal dumping sites (about 600), which are also a significant source of greenhouse gas emissions. Waste management is mainly confined to the fact that waste is being collected by municipal utilities, and then transported and disposed of at municipal landfills or regional landfill. Since the waste is collected and disposed of in a traditional way, it can be concluded that currently there is no significant progress in the treatment of organic waste and / or treatment of biogas generated its degradation (Chart 29). Accordingly, stated data of green house gas emissions in the BiH, with minimal reduction, will continue to grow in line with the growth of the amount of biodegradable waste that is deposited. Emission scenario is developed in relation to the rates of the time-quantitative development and the formation of landfill gas and report on emissions from 2001. Consequently, annual rates continue to increase hence in 2025 total emission will amount to 1339.8 Gg CO_2e.

The S2 scenario is based on the implementation of goals and objectives set in the BiH Solid Waste Management Strategy from 2000. The advanced scenario anticipate decrease of generating biodegradable waste which will be accomplished by changing the billing practice (per household, family member, or square meter residential or business space) to a billing system based on the volume of produced / disposed waste. These changes will reduce transport costs, additional emissions caused by transport, and the additional costs of waste disposal and extending the active lifetime of landfills. This scenario envisages continued construction of several new regional sanitary landfills out of the total of 16 planned and incorporating systems for the collection and burning of biogas. According to the numerical parameters set forth by the advanced scenario, total direct reduction of greenhouse gas emissions at the end of the period amounted to about 8%. Certainly, this value is even more pronounced if one takes into account indirect benefits, such as energy production, which is based on the landfill gas combustion, which replaces the use of fossil energy equivalent fuel. However, it should be noted that the limited financial and other resources are a serious obstacle to the realization of any of these waste management options that will definitely affect the efficiency of their implementation.

The S3 scenario is based on the application of existing technical achievements and legislation being applied in the countries of European Union. It is a result of effort and striving of BiH to become a member of EU, which means that it should intensify all activities planned in this area. The basis for this scenario is to build the 16 planned regional sanitary landfills by the end of the 2025. Consequently, the initial system for selective waste collection and disposal and its further use for recycling or energy production will be significantly improved. It is assumed that the recycling rate (and composting biodegradable waste) will amount to 10% by 2020 and 20% by the end of the 2025. Part of biodegradable waste, under this scenario, would be burned at waste incineration plants with energy production and utilization in CHP. According to the Solid Waste Management Strategy and the INC for BiH, it is reasonable to expect that 20% of the solid waste will be burned by 2020, and 25% by 2025. According to these data, approximately the same percentage of biodegradable waste will be burned in waste incinerators. The energy content of waste can be effectively exploited through thermal processes rather than through the production of biogas, because during ignition energy obtained directly from biomass (products of paper, wood, natural textiles, food) and sources of fossil carbon (plastics, synthetic fabrics). The rest of biodegradable waste, in this scenario, shall be disposed of in a sanitary landfill which will be constructed with systems for gas flaring and / or plants to generate electricity.

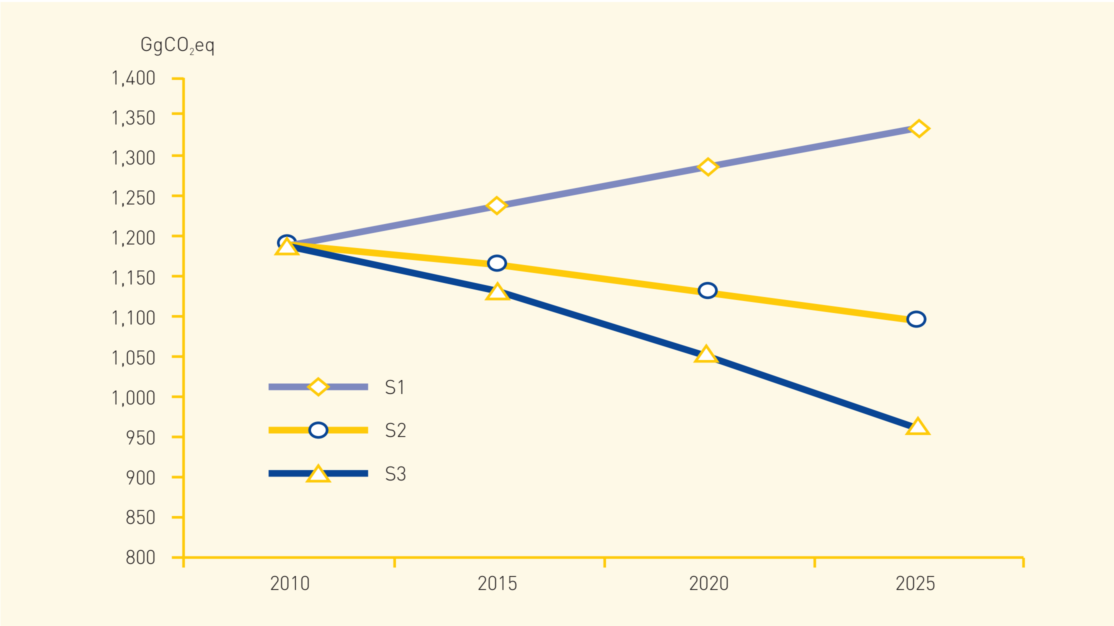


Chart 29: Annual CO_2e emission from the waste sector in BiH according to the S1, S2 and S3 scenarios, 2010-2025

Taking into consideration all of the facts stated, GHG emissions in the waste sector will decrease 20% from the baseline year in the S3 scenario.

4.7.3. Measures for reduction of GHG emissions in the waste sector

- Reduction in the quantity of biodegradable solid municipal waste;
- Increased quantity of selected and recycled waste in the total waste mass;
- Construction of new regional sanitary landfills and a reduction in the number of illegal landfills;
- Combustion of landfill gas and energy production;
- Incineration of selected municipal waste to produce energy;

- Removal and cleaning of illegal landfills and rehabilitation of degraded areas;
- Increasing number of inhabitants covered by the service or public utility company in charge of municipal solid waste collection;
- Introduction of private companies in the waste collection and disposal sector;
- Decreased production of all types of municipal waste;
- Strengthening existing legislation in the area of waste management at the entity and state level.

4.8. Total potential for GHG reduction

Referring to the indicators on sectoral emissions, it can be concluded that total emissions from the stated sectors amount to 21,249 GgCO_2e for the baseline 2010. Sink capacities are not incorporated in the stated value, amounting to 7,327.5 GgCO_2e.

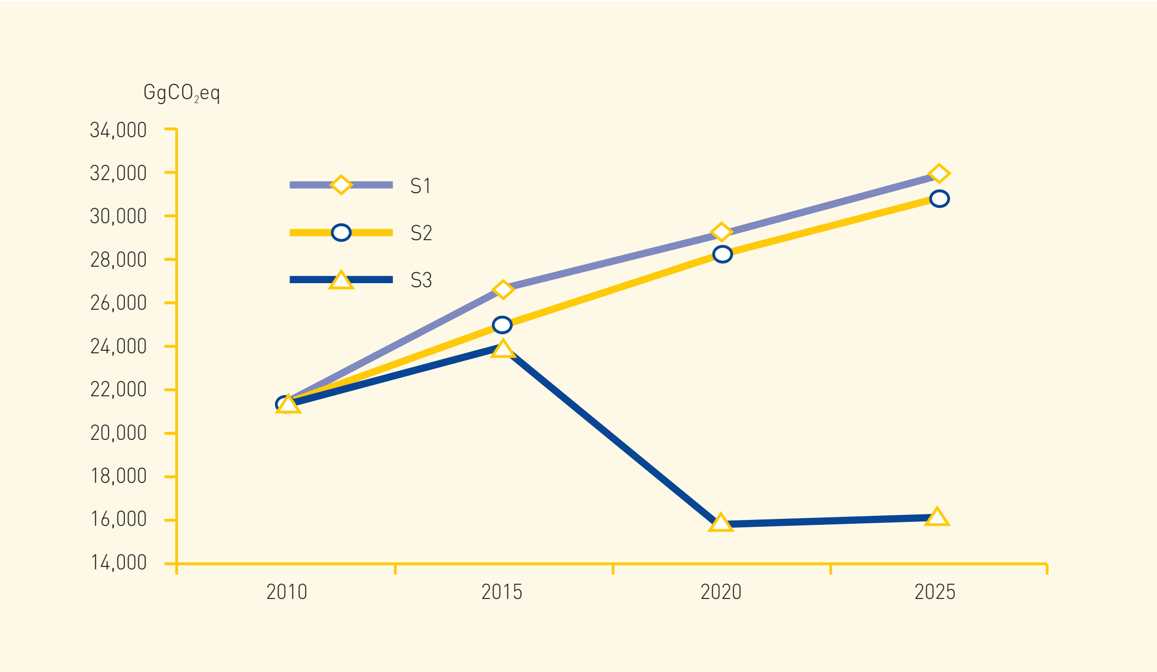


Chart 30: Total annual emissions of CO_2e from the energy sector, district heating, transport, agriculture and waste in BiH according to the S1, S2 and S3 scenarios, 2010-2025

Chart 30 shows GHG emission scenarios in BiH for the period 2010-2025. As the chart illustrates, scenarios S1 and S2 show continued increases in emissions amount to 31,956, or more specifically to 31,077 Gg CO_2e at the end of the period. The S3 scenario has features of mitigation scenario, resulting in a total reduction in emissions to 16,055 Gg CO_2e at the end of the period.

5. OTHER RELEVANT ACTIVITIES

This chapter provides an overview of activities undertaken with the aim of fulfilling BiH's requirements under the UNFCCC. It updates the status of relevant activities noted in the Initial National Communication, and it analyses the current status and subsequent needs for technology transfer related to climate change mitigation and adaptation. It also describes the current status of research, climate monitoring and systematic observation, and recent developments in meteorology and hydrology. Finally, the chapter discusses shortcomings, needs and priorities in the area of strengthening education, training, and public awareness, as well as proposed activities related to the implementation of Article 6, the corresponding section of the UNFCCC.

5.1. Assessment of technological needs for mitigation and adaptation

5.1.1. Approach within the UNFCCC

5.1.1.1. Clean Development Mechanism

Bosnia and Herzegovina has established a Designated National Authority (DNA) for the implementation of Clean Development Mechanism projects under the Kyoto Protocol of the UNFCCC, and to date it has approved three CDM projects that are estimated to reduce up to 2-3 million tons of CO_2e. These projects will also introduce new technologies and foreign investments worth EUR 300 million. Convention mechanisms are not the only means of supporting technology transfer, but they are a first step.

The country should undertake practical steps to gradually adopt objectives for limiting/reducing GHG emissions so as to comply with the acquis communitaire, especially the EU program for emissions trading, so as to join EU efforts to reduce emissions.

5.1.1.2. Climate Change Adaptation and the Low-Emission Development Strategy

A Climate Change Adaptation and Low-Emission Development Strategy was initiated based on the climate and mitigation scenarios developed under the SNC. The strategy has the following objectives: (1) increase resilience to climate variability and climate change, thereby securing development gains; and (2) reach a peak in greenhouse gas emissions around 2025 at a level that is below the EU27 average per capita emissions. The strategy clearly defines results and activities, as well as the level of funds necessary for its implementation.

5.1.2. Assessment of technological needs for mitigation and adaptation

Bosnia and Herzegovina is a European country that is significantly threatened by climate change and that has few resources for addressing the resultant problems. With a few exceptions, it is also relatively under-developed in terms of international cooperation in climate change. Taking into consideration that non-Annex 1 countries are suffering the greatest impacts from climate change, it is important that BiH undertake activities on development scenarios and formulate policies supporting sustainable development that contain adaptation and mitigation measures. An assessment of the SRES (Special Report on Emissions Scenarios) and the scenario features was conducted while developing climate projections for the SNC, and it identified possibilities for development under each scenario. These opportunities depend on how the development strategies undertaken in some countries may or may not fit into global development scenarios.

5.1.3. Technology transfer

Bosnia and Herzegovina, is a country in transition and reconstruction, but it has largely finalized the process of ownership transformation and organizational restructuring. However, technology transfer has been limited to large enterprises owned by multinational companies. Technology transfer in most of these cases has also included measures to reduce environmental impact. Only a little has been done to increase energy efficiency and to support the use of renewables. Companies in BiH need a technological transition. Implementing measures to reduce GHG emissions provides a real opportunity to initiate this transition and attract international professional and financial support. However, there are numerous obstacles, ranging from a lack of knowledge to mistrust and inadequate legal regulations. Therefore, it is important to demonstrate best available technologies (BAT) in BiH in a way that addresses all aspects of technology transfer: technical, economic, ecological, market-related, legal and social. It is also important to monitor how this technology will be implemented. Monitoring would allow stakeholders to revise and introduce new projects taking into account the lessons learned during the introduction of new technologies. The Initial National Communication (INC) for BiH identified numerous measures that would introduce new technologies in different sectors to reduce the impacts of climate change in Bosnia and Herzegovina. However, very little has been done to implement these measures in the subsequent reporting period.

Bosnia and Herzegovina does not have a well-developed infrastructure for identification of technology needs and the collection of information on available technologies, nor does it have a separate system of incentives. There are no special privileges introduced for importing technology in BiH. However, it is possible to exempt technology (knowledge and equipment) from customs and duties if it is classified as foreign investment. Limitations due to a lack of incentives should be taken into account when developing models for technology transfer in BiH.

In the energy sector, energy efficiency and renewable energy technologies could not only lead to a reduction in energy independence and improvements in environmental quality, but could also increase the competitiveness of the BiH economy. With a well-designed program, these measures could result in the development of a segment of the economy with a long tradition of producing HVAC equipment in BiH. In recent years, several companies in BiH have focused their activities on manufacturing equipment and systems using renewable energy resources.

The proposed projects in BiH would also enable technology transfer. The projects are designed to reduce emissions of N_2O (coke industry), CH_4 (mines), SF_6 (thermo-electric power plant) and CO_2 (small hydropower plants). The project on reducing N_2O emissions in the coke industry was finalized in 2012 and introduced a new technology for reducing N_2O, through the installation of a catalytic process that is expected to reduce between 80 and 90 % of current N_2O emissions.

The adoption of National Energy Efficiency Action Plan, which would support the increased use of energy-efficient technologies to fulfill obligations from the Contract on Energy Community, has been postponed. A team of experts has prepared a draft plan, which has not been adopted as yet.

There has also been little progress in renewable energy. The entities have introduced incentives in the form of feed-in tariffs for power producers using renewables. However, they are not complying with these decisions. There is no strategic approach to promote renewable energy, and the complexity of organizational structures and decision-making systems has hampered the effective promotion of renewable energy at the state level. It will take more effort to create a regulatory environment that will encourage the greater use of renewables in all sectors. Bosnia and Herzegovina needs to invest further efforts to improve the share of renewable energy in energy consumption in the country.

5.2. Overview of plans and programs for systematic observing

One of the most important ways to reduce the impact of climate change is strengthening capacities; i.e., institutional and staff training, development and improving of meteorological monitoring.

As specified in INC, modernizing and developing the network of meteorological stations in Bosnia and Herzegovina would do more than improve weather monitoring; it would significantly improve the base of climate information available to researchers and policy-makers. In addition, many data sets from before 1992 would be digitalized. It is necessary to modernize the network of meteorological stations by installing automatic weather stations and linking them with hydrological stations in an automatic monitoring system. Automatic monitoring and computer oversight would provide beneficial information in river basins and allow for water use planning for hydropower, drinking water, irrigation, and other uses.

Nonetheless, it is important to note that the first steps towards fulfilling these plans have been taken since the INC was published. These steps include installation of new equipment in hydrometeorological institutes, education of staff in these institutes, development of climate scenarios etc.

5.3. Education, training and raising awareness

Under Article 6 of the UNFCCC, each party is strongly encouraged to build a system for promoting and reporting on activities related to education, training and public awareness regarding climate change. These activities can support the realization of long-term strategies and policies, and it is important to organize activities that are implemented by different stakeholders, including government and civil society.

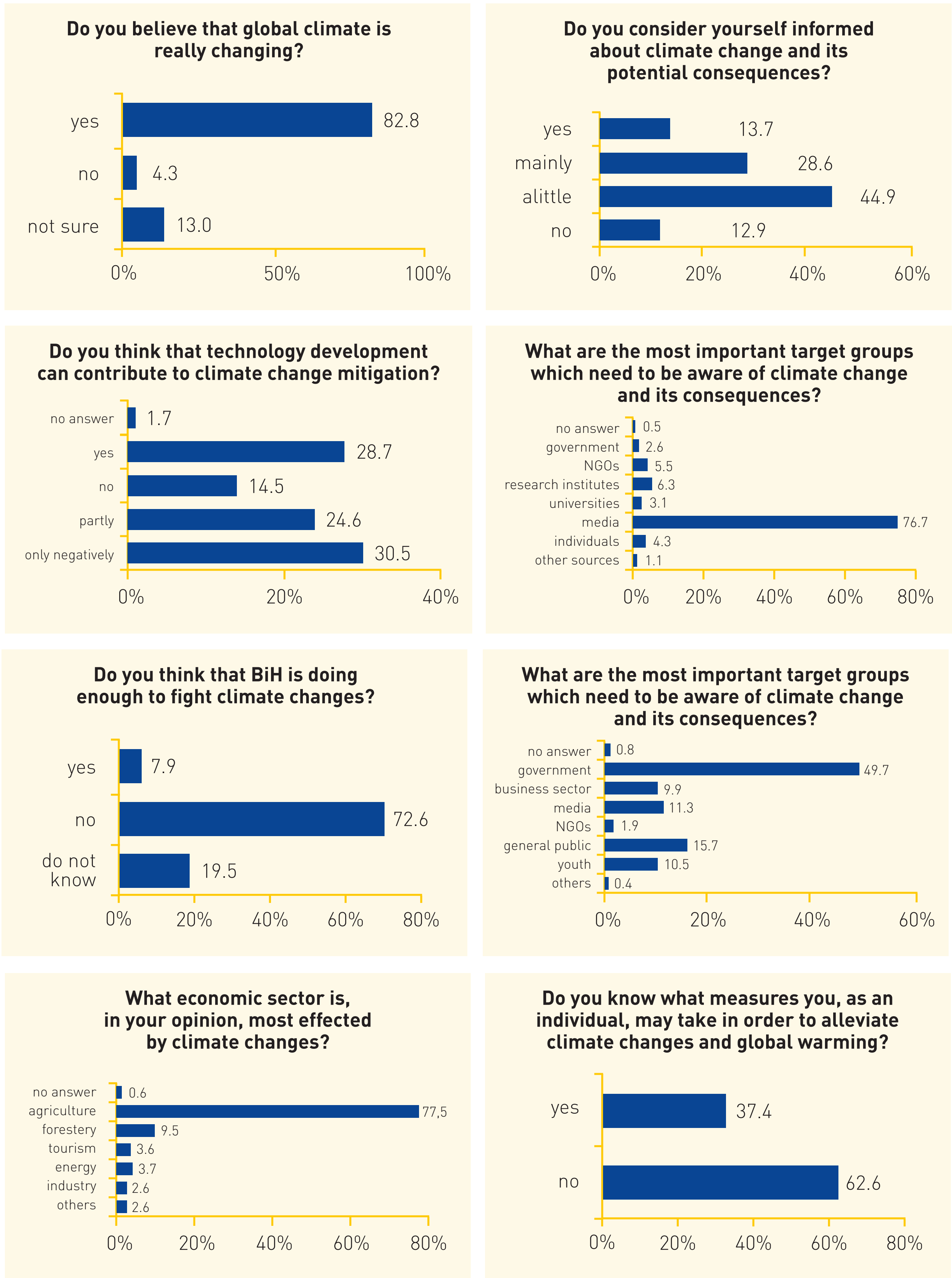


Chart 31. Results of the public survey on climate change

Current activities related to education and awareness raising have not been well organized, and the results have been modest. However, a public opinion survey on climate change was conducted under the preparation of the SNC. This survey marks an important step in launching public awareness activities, because it establishes a baseline for public knowledge and awareness regarding climate change issues. A selection of survey findings is shown in the following charts.

The largest number of respondents (82.8%) believes that global climate change is evident, while only 4.3% are sceptical about it. 13% of respondents are not sure. Almost half of those interviewed (44.9%) believe that there is not enough information on climate change and its potential impacts, while 12.9% of respondents report that they do not know much about the topic. In addition, most respondents believe that climate change will directly affect agriculture (about 81%), forestry (48%), tourism (about 16%), energy (15%) and industry (about 10%).

Respondents appear to have divided opinions on steps to be taken to address climate change: 35.1% respondents think that it is necessary to undertake certain measures in the next several years, while 34.3% think that due to the seriousness of problems, it is necessary to undertake powerful measures as soon as possible. One in five respondents (21.9%) report that they do not know enough about climate change and believe that it is necessary to continue research, while only 7.2% think that it is not necessary to do anything.

When asked whether technological development could contribute to climate change mitigation, 53.3 % of the respondents think that it could, while 24.6% of the respondents consider that its influence is limited. In contrast, 45% of respondents doubt that technological developments can affect GHG mitigation, and 30.5% believe that it can actually worsen the current situation. Respondents obtain their information on climate change mainly from the media (76.7%), while a significantly smaller number receive information from research institutes (6.3%), non-governmental organizations (5.5%), individuals (4.3%) and universities (3.1%).

One fifth of respondents were not aware of the measures taken by BiH to reduce the impact of climate change. A little less than three quarters (72.6%) are of the opinion that BiH is not doing enough to address climate change, while only 7.9% think that enough is being done. According to the survey respondents, the most important target groups who need to be aware of the importance and impact of climate change on earth are state officials (about 54%), the general public (30%), youth (26%), the business sector (about 19%), media (18%) and NGOs (about 8%).

One half of respondents believed in the power of the individual and community activism, and that the organized actions of individuals could significantly reduce the impact of climate change. Of this group, 37.4% of respondents have concrete proposals for measures that individuals can undertake in order to reduce climate change and global warming, and these measures are most related to programs that encourage environmental protection (4.8%), programs to strengthen eco consciousness (4.3%), the safe disposal of waste (3.7%), and the use of alternative energy sources (2.3%). Only those who believe in the power of activism have been actively involved in combating climate change. It is likely that they are the ones who show optimism and faith in the collective action of individuals and who are motivated to do something concrete. On the other hand, 14.7% thought they could not possibly be involved in this type of activity, while 40% thought they might participate if the activity were carried out on a large scale.

The survey results clearly support the fact that education, training and public awareness in all areas related to climate change, have the potential to inform the public on measures to take for reducing the impacts of climate change and also to inform the public about the climate change impacts and about the measures that the country could implement to mitigate and adapt to climate change. This area should remain a priority for Bosnia and Herzegovina in the future.

5.3.1. Gaps and needs in education and capacity strengthening

In the BiH education system, none of the entity governments paid much attention to environment or climate change, even though the Constitution clearly emphasizes this issue. Unfortunately, entity-level education strategies, where environment and climate change should be integrated into the curriculum at all levels, have not been passed yet.

Southeast European countries allocate low funds per capita for basic and applied research. Therefore, it is suggested to establish certain scientific cooperation among them in order to achieve sustainable development. Priorities for capacity development in Bosnia and Herzegovina are described in the Initial National Communication and as such they have remained unchanged during the development of the Second National Communication. There is a need to strengthen the capacity of existing staff in the environmental protection sector at all levels and to develop annual staff training programs to enhance the skills of existing staff and to train new staff. Training should be organized in cooperation with one or more professional institutions capable of providing these programs.

On the other hand, environmental officials should organize training for industries, such as training programs with a focus on pollution prevention and IPCC concepts, Environmental Management Systems (EMS), and the introduction of standards to establish adequate and efficient cooperation in the economy.

The introduction of environmental and climate change educational programs on a yearly basis for employees at all administrative levels would increase the capacities of existing staff and would educate new staff. Capacity strengthening and training officials, predominantly at the local level, has been conducted in the past by international organizations such as UNDP and GIZ, primarily for developing and monitoring sustainable energy action plans.

5.3.2. Strengthening public awareness

All stated activities, formal or informal education should be conducted in the presence of media as the fastest tool impacting public opinion. Strengthening public awareness has been undertaken by entity-level ministries, in some public discussions, in information for the broader public published in the media, and in individual civil society initiatives.

Regardless of the fact that media are the main source of information on climate change, so far the media has not been sufficiently active in strengthening public awareness about climate change; hence, more should be done in that direction. It is necessary to provide a greater number of documentary programs on climate change, public discussions and discussion on state TV stations with politicians, and representatives of public enterprises and private enterprises; i.e., decision makers for strategic decisions and projects. The need for additional training for journalists, public sector employees in the domain of their contribution to sustainable development, including low-cost development and adjustment to risks from climate change, is evident.

When talking about climate change and adaptation, it is necessary to avoid negative and intimidating jargon and create a positive image about needs and possibilities to present results. Research shows that people respond better to positive messages that enable local action and recommended a common symbol (logo), and a slogan that would be the backbone of the campaign and a recognisable motif of the state's commitment.

Currently, more than 100 non-governmental organizations in BiH said that they are primarily oriented towards environmental protection, as well as climate change. At the end of May 2012, BiH opened its first Aarhus Centre. The Aarhus Centre promotes the understanding and application of the Aarhus Convention, as well as cooperation between the relevant authorities, civil society, the judiciary, the private sector, the media and the public regarding environmental issues, and it has achieved significant cooperation with many environmental non-governmental organizations which provided support for establishment of the Green Parliamentary Group in the Parliamentary Assembly of Bosnia and Herzegovina.

5.3.3. Objectives to be fulfilled in education, training and awareness raising

Climate change priorities in education, training and awareness raising are as follows:

- Education on the effects and causes of climate change, as well as mitigation measures and adaptation, should be raised to a higher level;

- Professional meetings should be held on the introduction of climate change in the curriculum at all levels of formal education (using regional best practice), and it is necessary to select the best model for BiH;

- Educational institutions should adopt a strategy on climate change in formal education at all levels;

- Conduct outreach to state officials, including representatives of ministries of education, on climate change effects and their integration into curriculum and standards;

- Implement teacher training on the need to introduce climate change into the curriculum and on appropriate methods;

- Nominate an expert group in education and economic sectors to introduce education on climate change in each sector;

- Organize scientific gatherings on linking informal education and private enterprises aiming to adjust to climate change and alleviate its impacts;

- Politicians, businessmen, and journalists should be educated about the causes and effects of climate change through projects in accordance with strategies on climate change education;

- Politicians, businessmen, and journalists should be educated on the international mechanisms for financing projects in the areas of mitigation and adaptation to climate change, as well as project submission;

- A campaign on climate change and its impacts should be adopted with an identifying logo and slogan in the short term.

5.4. Preparation for operational programs to inform the public

Knowledge and awareness of climate change in BiH is not sufficient, and this was confirmed by survey results conducted during the development of the Second National Communication. Neither the public nor the business community nor politicians are aware that the territory of BiH is vulnerable to climate change and that the impacts of climate change will affect the quality of life and work. That is why the provision of relevant information to all stakeholders should be a high-priority task.

Basic information that needs to reach the public is as follows:

1. Bosnia and Herzegovina is vulnerable to climate change,

2. There are adaptation methods (coping with, partial or complete adaptation) and adaptation through the application of measures to decrease of global emissions (mitigation),

3. Developed countries are ready and have committed through international agreements to help developing countries to adapt to climate change.

In order to implement adaptation programs, it is necessary for the information to reach all levels, types, and profile of education of all citizens, economic organizations, and all employees in state bodies.

Basic concept for the overall information system remains unchanged when compared to the Initial National Communication and additional effort should be invested for this concept to become active.

5.4.1. Functioning of the climate web portal and establishment of an integrated information system

In the period between the INC and the SNC, the website www.unfccc.ba continued to inform the public about the state of climate change in the world and in Bosnia and Herzegovina. Nevertheless, it is necessary to expand the existing information system to include additional information sources, primarily meteorological institutes and research institutions, as well as expanding the number of users.

In addition to existing content, the climate web portal should contain the following information:

- data and forecasts of climate change in BiH,

- vulnerability of BiH, vulnerable natural resources, and impacts on living conditions, all related to climate change,
- climate change adaptation programs in BiH and abroad,
- information on incentive mechanisms for mitigation measures (domestic and foreign),
- information on CDM projects and initiatives in BiH,
- information on "activity data" for the country.

5.5. International cooperation

5.5.1. International cooperation within global environmental agreements

With the signing and ratification of the UNFCCC in 2000, Bosnia and Herzegovina officially became a part of international cooperation in the area of climate change. The first conference attended by a BiH delegation was CoP 7 (Marrakesh), after which the delegation has been regularly present at all conferences, professional bodies' meetings, and the UNFCCC Secretariat.

In addition to active participation in UNFCCC activities, it would be good to emphasize cooperation among countries in Southeast Europe in environmental protection and climate change. BiH participated actively in the Belgrade Conference, which was held in 2007 to discuss regional activities related to climate change adaptation.

Bosnia and Herzegovina ratified the Beijing amendments of the Montreal Protocol of the Vienna Convention on Ozone Layer Protection, thus joining the decision made at the 22nd meeting on the global phase-out of hydrochlorofluorocarbons (HCFCs) and chlorofluorocarbons (CFCs). However, it is necessary to undertake further steps in harmonising with EU legislation on ozone depleting substances and fluorinated gases. Even though BiH is a party to the Copenhagen Agreement, BiH does not have plans to formulate requests for GHG emissions.

Complementary activities amongst three UN Conventions – climate change, biodiversity and desertification -- are necessary to harmonize activities in BiH, but they are also an excellent opportunity for international cooperation that would help BiH in achieving sustainable development.

5.5.2. Regional cooperation

Regional cooperation is defined here as cooperation that takes place within the framework of Southeastern Europe and the Western Balkans (the description does not include the EU member states Bulgaria and Romania). Regionalism is a strategic way of adapting to global changes, as an increasing number of countries do not have the capacity and resources to independently address the challenges that these changes impose. The creation of regional networks and structures can increase economic stability and establish an open and stimulating business environment. The creation of a regional economic zone can also contribute to the removal of investment barriers and facilitate conflict resolution in the business sector (SEE-FAP, 2008).

Generally speaking, regional cooperation simplifies securing "public goods;" i.e., water, energy, transportation or free movement. Regional cooperation encompasses many areas of economic and social life, political structure, internal security, environmental protection, culture, etc. It is a complex and multifaceted process of building links within the region that is not limited to relations amongst governments but also includes other stakeholders such as the business community and civil society.

Regional cooperation and neighbourhood relations constitute the core process of Bosnia and Herzegovina's relations with the European Union. Bosnia and Herzegovina still actively participates in regional initiatives, including the Cooperation Process in Southeast Europe (SEECP), Regional Cooperation Council (RCC), Central European Free Trade Agreement (CEFTA), Agreement on Energy Community, Belgrade Initiative on Climate Change, Igman Initiative, EU Strategy for Danube Region, and EU Agreement on Joint Airspace. BiH was a host of the RCC Secretariat, which organized many regional activities.

The most significant activities related to regional cooperation in this reporting period are as follows: the Contract on Joint Energy Market of South East Europe, Regional Cooperation Council, Belgrade Initiative for Climate Change and Igman Initiative, which are all described in detail in the Initial National Communication. In addition, BiH participation in RENA (Regional Environmental Network for Accession) should be noted, as that project intensified in 2011 and BiH actively participated in 2012.

Finally, one more successful network that should be noted and that is constantly developing is the Covenant of Mayors. The Covenant of Mayors was initiated in 2008 by the European Commission, and its main task was to support local authorities in the implementation of sustainable energy policies. Local authorities play an important role in CO_2 emission reductions. Covenant signatories aim to accomplish the objectives stipulated by the European Union: to reduce CO_2 emissions by 20% by 2020 (Agenda 20-20-20). In the reporting period for the SNC, the following cities in Bosnia and Herzegovina signed the Covenant of Mayors: Banja Luka, Bihać, Bijeljina, Gradiška, Kakanj, Laktaši, Livno, Prijedor, Sarajevo, Travnik, Trebinje, Tuzla and Zvornik, which had all submitted their action plans in the reporting period covered by the INC.

6. CONSTRAINTS AND GAPS

This chapter provides an overview of limitations and obstacles related to institutional, legal, financial, technical, and human resource capacities in BiH that affect the implementation of obligations under the UNFCCC.

Information about these obstacles and limitations is based on the findings of previous studies and projects in BiH.

Some of the suggested measures to improve capacity rely on information that can only be obtained as the result of applied research or monitoring, and it is therefore necessary to provide support for systems that can provide these inputs. It is necessary to provide financial resources as one of the first steps in implementing these measures. Another important area of focus is to improve insufficiently developed research capacity to understand climate change impacts and address climate change adaptation. It is also important to define the roles of various stakeholders tackling these issues. At the same time, it is necessary to work on promoting understanding of the importance of climate change.

6.1. Institutional constraints

Pursuant to the Dayton Agreement, the implementation of the environmental policy in Bosnia and Herzegovina (BiH) is within the competence of the Entities and the District Government in Brčko District. The BiH Coordinating Committee for Environment was established in 1998 by the decisions of the Entity Governments. It had the task of harmonizing and coordinating environmental policy at the level of Bosnia and Herzegovina. Pursuant to the Law on Ministries, the Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina is responsible, along with the entity-level ministries, for the international obligations of BiH in the field of environmental protection. However, the responsibility for obligations under the UNFCCC and development of the INC rests with the UNFCCC Focal Point, a position that is located at the Ministry of Physical Planning, Civil Engineering and Ecology of RS.

Jurisdiction of the state administration in environmental matters is quite limited and reduced to functions that are mainly related to international cooperation and coordination. There is an evident lack of both vertical and horizontal cooperation and coordination among competent institutions, and these mechanisms are of particular importance for international activities.

Pursuant to the valid laws, preparation of numerous strategies and plans is necessary. Implementation of measures planned in previously prepared plans is low, while many other documents, strategies and policies still need to be adopted, and their adoption needs to be adjusted to the corresponding laws.

Environmental protection in BiH has been is neglected due to the insufficient utilization of economic and financial resources. Policies for introducing new economic instruments and using existing ones must be strengthened so as to change the behaviour of both people and institutions respectively towards better environmental protection and provision of incentives for reduction of pollution and allocation of resources for investments and improvement of environmental quality. Currently, some economic instruments do not function as they are supposed to, while other instruments do not function at all. For example, there are no emission fees charged to companies that emit air pollution, nor is there any oversight of their activities. In short, the institutional capacity to implement effective and forceful policies remains weak.

There is no overall supervision of environment data collection systems, resulting in a lack of systematic information on environmental protection. For the time being, different institutions are collecting different data without sufficiently developed coordination and unique databases. Data exchange and communication between institutions collecting data and governmental organizations is insufficiently developed, and there is no information exchange on existing data. Even though there are some data on environmental issues, those figures are either outdated, incompatible or inapplicable. Current data on the environment, as well as statistical data more generally, are not shared between the entities, which prevents them from getting the most complete picture of links between development activities and environment quality or of indicators that could support and improve decision making on the state level.

Preparation of the Initial and Second National Communications presented a comprehensive overview of all available documents developed for BiH and entities with financial support from abroad (UN, WB, and other bilateral and multilateral donors) or from the entities' budgets. These documents are important, because they contain necessary information for the preparation of national reports; however, many documents have not been endorsed using the standard BiH political procedures, and hence cannot be considered as official state documents. Statistical data, which are necessary and collected on the entity level (i.e. last census conducted in 1991), present a special problem. These substantial challenges require constant improvements and updates with the engagement of entity governments and the Council of Ministers.

6.2. Financial constraints

There is a lack of transparency in the environmental sector. Data on administrative costs in the environmental sector are obscure. Because administrative activities in this field are widespread and are predominantly are assigned to units responsible for other sectors, it is rather difficult to calculate separate environmental protection costs.

Two funds are active in BiH – the RS Environmental Fund (2002) and the FBiH Environmental Fund (2003) – as financial institutions for the collection and distribution of environmental funds. However, they still do not deliver expected results. A new RS Law on Environmental Fund and Energy Efficiency was adopted in November 2011 that introduced the allocation of funds for supporting the implementation of energy efficiency projects and renamed the Environmental Fund the RS Fund for Environmental Protection and Energy Efficiency. Changes in the law on funds both in FBiH and Brčko District are in progress.

6.3. Human resource constraints

Administrative capacities in the environmental sector are still low. State bodies tackling environmental issues do not have the capacity to apply and/or implement legislative regulations at cantonal, entity and local level. Administrative capacities for environmental issues have not been developed, and there is no staff or funding allocated for this purpose.

6.4. Addressing gaps and constraints: mitigation and adaptation measures and projects

A lack of knowledge and awareness regarding climate change risks has resulted in insufficiently developed capacity to identify climate change adaptation measures in BiH. Having in mind different climates in BiH, climate change adaptation must rely on specific features of climate in specific regions.

In order to implement the adaptation measures identified, it is necessary to develop an indicator system compatible with EU standards that will be adjusted to the specific needs of Bosnia and Herzegovina. Capacity building in climate change impacts monitoring represents a priority; hence, it is necessary to undertake capacity building measures to manage development in climate change:

1. It is necessary to choose one stable system of statistical data on climate change that uses an internationally recognized assessment methodology and is able to monitor sustainable development in spite of adverse climate change impacts. The components described in this Communication can be expanded and integrated into the existing system of meteorological information or regular statistical reports of entity institutions and the state-level Agency for Statistics.

2. It is necessary to improve the existing system of meteorological observation – observing climate change and adaptation results, including an early warning system. Professional capacity development should be integrated into the international observation system (this should be developed in a separate project establishing a Climate Change Adaptation System).

3. It is necessary to nominate professional and political bodies to be in charge of development management in unstable climate conditions. Professional bodies at the state and entity levels (besides the classic planning and proposing of economic measures in the parliament structures) should be capable of developing measures to prevent adverse impacts from climate change (BiH Council of Ministers, entity government, institutions in charge of economic and urban planning, water management agencies, legal entities, civil protection etc.). It is necessary to determine the responsibilities of political bodies regarding sustainable development in variable climate conditions.

4. It is necessary to raise the awareness of the general public about the importance of the active engagement of society in climate change issues, and it is necessary to invest financial and human resources for the implementation of sustainable development so that climate change becomes tolerable within a larger context of stable development. Key

initiatives, policies and adaptation measures can be established at the state level and in the framework of international cooperation.

Simultaneously, mitigation measures should be based on decreasing the existing trend of GHG emissions and on preserving existing sinks.

Primary mitigation measures are based on the reduction of existing GHG emissions growth. They include increasing energy efficiency in all production sectors; applying contemporary technologies in all production areas; increasing the share of electricity supply from contemporary technologies in all production areas; and stimulating employment in sectors where mitigation measures are implemented.

Additional mitigation measures are based on the preservation of major sequestration capacity, among which the most important areas are peat-bog (histosol) forests and woodlands, fields and meadows.

The sectors most affected by climate change in BiH are as follows: agriculture, water resources, human health, forestry and biodiversity and sensitive ecosystems. Therefore, the SNC performed detailed analyses of long-term climate change impacts on these sectors. The assessments were based on the climate A1B and A2 scenarios developed for the needs of the Second National Communication. Bosnia and Herzegovina is a developing state, and its GHG emissions are significantly lower than they were in its reference year (1991) due to the war (1992-1995) and the resulting destruction of industry. However, even though the impact of BiH on global emissions is rather small, its economy is suffering significant pressure due to the climate change. Therefore, adaptation measures in the sectors analyzed should represent an imperative in combating climate change. The economy of BiH is at a low level, and in order to adaptat to climate change, it will be necessary to provide international assistance; i.e., financing, knowledge, technology and good practice.

6.5. Multilateral/bilateral contributions to address constraints

From the moment that BiH signed and ratified the UNFCCC and designated an focal point institution, the establishment of the body that would harmonize all environmental issues, including climate change, was initiated. The designation of the focal point institution for UNFCCC (RS Ministry of Urban Planning, Construction and Ecology) directed all efforts having BiH become a non-Annex I party to the UNFCCC as soon as possible.

In practice, BiH lacked professional and scientific institutions that were sufficiently developed to assume the role of organizing the work on development of the Initial National Communication and supporting research. Aiming to overcome perceived issues and with the full support of entity and state bodies as well as GEF and UNFCCC Secretariat, UNDP BiH organized the preparation of the Initial National Communication. The work was initiated in 2008, and the Initial National Communication was finalized and submitted to the UNFCCC Secretariat in 2010. Leaning heavily on instructions 17/CP8, with technical support and coordination of UNDP, the Initial National Communication was prepared by more than 45 local experts. The INC was adopted by both entity governments and the Council of Ministers, and the UNFCCC contact institution RS

Ministry of Urban Planning, Construction and Ecology submitted the report to UNFCCC Secretariat.

The preparation of the Second National Communication, which followed a similar approach, has been a means of developing important skills and capacity in BiH in key areas. The SNC project team aims to integrate all of the findings into the process of long-term development and sectoral planning. Members of the interdisciplinary expert group that conducted the supporting research and analysis are in constant contact, and this group represents the seed of future institutions that will be able to implement the activities defined in the report. Work on the SNC has also been carried out to support capacity building in in-country institutions so that they will be able to assume an increasing role in the preparation and management of subsequent National Communications.

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List of Acronyms

BHAS	Bosnia and Herzegovina Agency for Statistics
BiH	Bosnia and Herzegovina
CDM	Clean Development Mechanism
CEFTA	Central European Free Trade Agreement
CER	Certified Emission Reduction
COP	Conference of the Parties (to the UNFCCC)
CORINAIR	CORE INventory of AIR Emissions (CORE Inventory of Air Emissions)
CRF	Common Reporting Format
DNA	Designated National Authority for CDM projects
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EE	Energy Efficiency
EEA	European Environment Agency
EEC	European Energy Community
EU ETS	European Union Emission Trading System
EU	European Union
FBiH	Federation of Bosnia and Herzegovina
FDI	Foreign Direct Investments
FEPEE	Foundation for Environmental Protection and Energy Efficiency
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse gases
IMF	International Monetary Fund
INC	Initial National Communication
IPA	Instrument for Pre-Accession Assistance (European Union)

IPCC	Inter-governmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
KM	Convertible Mark
LCPD	Large Combustion Plant Directive
LEAP	Long Range Energy Alternative Planning System
M&E	Monitoring and Evaluation
MDG	Millennium Development Goals
MRV	Measurement, Reporting and Verification
NAO	North Atlantic Oscillation
NEAP	National Environmental Action Plan
NEEAP	National Energy Efficiency Action Plan
NGO	Non-governmental organization
OECD	Organisation for Economic Cooperation and Development
PET	Potential Evapotranspiration
PPA	Public Procurement Agency
QA	Quality Assurance
QC	Quality Control
R&D	Research and Development
RCC	Regional Cooperation Council
REC	Regional Environmental Centre (for Central and Eastern Europe)
REEEP	Renewable Energy and Energy Efficiency Partnership
RES	Renewable Energy Sources
RS	Republic of Srpska
SAA	Stability and Association Agreement
SEAP	Sustainable Energy Action Plan
SEE	Southeastern Europe
SEECP	Cooperation Process in Southeastern Europe
SHPP	Small Hydropower Plant

SMEs	Small and Medium Enterprises
SNC	Second national Communication
SPI	Standardized Precipitation Index
SRES	Special Report on Emission Scenarios
UN	United Nations
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WMO	World Meteorological Organization

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ANNEX I

MULTILATERAL ENVIRONMENTAL AGREEMENTS

Multilateral environmental contracts that BiH ratified upon succession

MULTILATERAL ENVIRONMENTAL CONTRACTS	PLACE AND DATE OF ADOPTION	RATIFICATION DATE (upon succession)
Convention on Wetlands of International Importance Especially as Waterfowl Habitat	Ramsar, 1971	1-Mar-92
Convention on Long-range Transboundary Air Pollution	Geneva, 1979	1-Sep-93
Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP)	Geneva, 1984	1-Sep-93
Convention on International Maritime Organizations	Geneva, 1948	16-Jul-93
Convention on International Civil Aviation, annex 16 - aircraft noise	Chicago, 1944	13-Jan-93
Convention on Ozone Protection	Vienna, 1985	1-Sep-93
Protocol on Substances that Deplete the Ozone Layer	Montreal, 1987	1-Sep-93
Amendments to Montreal protocol agreed by the parties at the second meeting	London, 1990	11-Aug-03
Amendments to Montreal protocol agreed by the parties at the fourth meeting	Copenhagen, 1992	11-Aug-03
Amendments to Montreal protocol agreed by the parties at the ninth meeting	Montreal, 1997	11-Aug-03
Amendments to Montreal protocol agreed by the parties at the eleventh meeting	Beijing, 1999	Not adopted
UN Convention on the Law of the Sea	Montego Bay, 1982	12-Jan-94
Convention for the Protection of the Mediterranean Sea Against Pollution	Barcelona, 1976	1-Mar-92
Protocol for the prevention of pollution of the Mediterranean Sea by dumping from ships and aircraft.	Barcelona, 1976	1-Mar-92
Protocol concerning cooperation in combating pollution of the Mediterranean Sea by oil and other harmful substances in cases of emergency.	Kuwait, 1978	1-Mar-92
Protocol for the protection of the Mediterranean Sea against pollution from land-based sources. (LBS)	Athens, 1980	22-Oct-94
Protocol concerning Mediterranean specially protected areas.	Geneva, 1982	22-Oct-94
Protocol concerning specially protected areas and biological diversity in the Mediterranean	Barcelona, 1995	12-Dec-99

MULTILATERAL ENVIRONMENTAL CONTRACTS	PLACE AND DATE OF ADOPTION	RATIFICATION DATE (upon succession)
Convention on Protection of the World Cultural and Natural Heritage	Paris, 1972	12-Jul-93
Convention Concerning the Use of White Lead in Painting	Geneva, 1921	2-Jun-93
European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR)	Geneva, 1957	1-Sep-93
Protocol Amending Article 14 of the European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR)	New York, 1975	1-Sep-93
Convention on the Physical Protection of Nuclear Material	Vienna, 1979	30-Jun-98
Convention on Fishing and Conservation of Living Resources of the High Seas	Geneva, 1958	12-Jan-94
Convention on the Territorial Sea and the Contiguous Zone	Geneva, 1958	1-Sep-93
Convention on Continental Shelf	Geneva, 1958	12-Jan-94
Convention on the High Seas	Geneva, 1958	1-Sep-93
Convention on Protection of Employees against Occupational Hazards in the Working Environment Due to Air Pollution, Noise and Vibration	Geneva, 1977	2-Jun-93
Treaty on the Prohibition of the Emplacement of Nuclear Weapons and other Weapons of Mass Destruction on the Sea-Bed and the Ocean Floor and in the Subsoil Thereof.	London, Moscow, Washington D.C., 1971	15-Aug-94
Treaty on the Non-proliferation of Nuclear Weapons	New York, 1968	15-Aug-94
Convention on Early Notification of a Nuclear Accident	Vienna, 1986	30-Jun-98
Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency	Vienna, 1986	30-Jun-98
Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction	London, Moscow, Washington D.C., 1972	15-Aug-94

Multilateral environmental contracts ratified in BiH

MULTILATERAL ENVIRONMENTAL CONTRACTS	PLACE AND DATE OF ADOPTION	RATIFICATION DATE IN BiH
UN Framework Convention on Climate Change	Rio de Janeiro, 1992	2000
Kyoto Protocol	Kyoto, 1997	2007
International Convention on Plant Protection	Rome, 1951	2003
Convention on Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Basel, 1989	2001
UN Convention on Biological Diversity	Rio de Janeiro, 1992	2002
Cartagena Protocol on Biosafety	Cartagena, 2000	2009
UN Convention on Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa	Paris, 1994	2002
Convention on co-operation for the protection and sustainable use of the Danube river	Sofia, 1994	2005
Convention for the Establishment of the European and Mediterranean Plant Protection Organization	Paris, 1955	2005
UNECE Convention on Access to information, Public Participation in Decision-making and Access to Justice in Environmental Matters	Aarhus, 1998	2008
Protocol on Pollutant Release and Transfer Registers (PRTR)	Kiev, 2003	2003
Convention on Persistent Organic Pollutants	Stockholm, 2001	2010
Convention on international Trade in Endangered Species of Wild Fauna and Flora (CiTES)	Washington DC, 1973	2009
Convention on Environmental impact Assessment in Transboundary Context	Espoo, 1991	2009
Protocol on Strategic Environmental Assessment	Kiev, 2003	2003
Convention on the Conservation of European Wildlife and Natural Habitats	Bern, 1979	2008
Framework Agreement on the Sava River Basin	Kranjska Gora, 2002	2003
Convention on the Protection and Use of Transboundary Watercourses and international Lakes	Helsinki, 1992	2009
Changes to Articles 25 and 26 of the Convention on the Protection and Use of Transboundary Watercourses and international Lakes	Madrid, 2003	2010

MULTILATERAL ENVIRONMENTAL CONTRACTS	PLACE AND DATE OF ADOPTION	RATIFICATION DATE IN BiH
Convention on the Transboundary Effects of industrial Accidents	Helsinki, 1992	Not adopted
Protocol on Civil Liability and Compensation for Damage Caused by the Transboundary Effects of industrial Accidents on Transboundary Waters to the 1992 Convention on the Protection and Use of Transboundary Watercourses and international Lakes and to the 1992 Convention on the Transboundary Effects of industrial Accidents	Kiev, 2003	2003
Council of Europe Framework Convention on the Value of Cultural Heritage for Society	Faro, 2005	2009
Agreement on Energy Charter	Lisbon, 1994	2001
Energy Charter - Protocol on Energy Efficiency and Related Environmental Aspects	Lisbon, 1994	2001
Convention on Safety and Health in Mines	Geneva, 1995	2010
Convention on Safety and Health in Agriculture	Geneva, 2001	2010
Convention Concerning Work in the Fishing Sector	Geneva, 2007	2010
Convention Concerning the Prevention of Major Industrial Accidents	Geneva, 1993	2010
The European Landscape Convention	Florence, 2000	2010
Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction	Oslo, 1997	1998
Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	Rotterdam, 1998	2007
Convention on International Trade in Endangered Species of Wild Fauna and Flora	Washington DC, 1973	2009
Amendment to Convention on International Trade in Endangered Species of Wild Fauna and Flora (Article XI)	Bonn, 1979	2009
European Framework Convention on Transboundary Cooperation between Territorial Communities or Authorities	Madrid, 1980	2008
Convention Concerning International Carriage of Goods by Rail	Bern, 1980	1996

Source: UN Environment Programme, Desk Review of the Legal and Institutional Framework of Environmental Protection in BiH, 2011

ANNEX II

SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORY 1991-2001

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B) BOSNIA AND HERZEGOVINA - Year 1991 - Submission 2013

GREENHOUSE GAS SOURCE AND SINK		CO_2	CO_2	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
CATEGORIES		emissions	removals			P	A	P	A	P	A				
		(Gg)				CO_2 equivalent (Gg)				(Gg)					
Total National Emissions and Removals		23,850.30	-7,689.00	206.93	8.39	NE	NE	NE	NE	NE	NE	77.15	138.48	23.76	397.98
1. Energy		21,350.45		75.88	1.09							76.80	126.76	23.17	393.75
A. Fuel Combustion	Reference Approach[2]	NE													
	Sectoral Approach[2]	21,350.45		0.52	1.09							76.80	126.76	23.17	393.75
B. Fugitive Emissions from Fuels		0.00		75.36	0.00							0.00	0.00	0.00	0.00
2. Industrial Processes		2,499.85		0.00	0.00	NE	NE	NE	NE	NE	NE	0.35	11.72	0.59	4.23
3. Solvent and Other Product Use		NE			NE							NE	NE	NE	NE
4. Agriculture [3]		0.00	0.00	83.79	7.30							NE	NE	NE	NE
5. Land-Use Change and Forestry		0.00	-7,689.00	0.00	0.00							NE	NE	NE	NE
6. Waste		0.00		47.26	0.00							NE	NE	NE	NE
7. Other		0.00	0.00	0.00	0.00	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Memo Items:															
International Bunkers		NE		NE	NE							NE	NE	NE	NE
Aviation		NE		NE	NE							NE	NE	NE	NE
Marine		NE		NE	NE							NE	NE	NE	NE
Multilateral Operations		NE		NE	NE							NE	NE	NE	NE
CO_2 Emissions from Biomass		NE													

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B)
BOSNIA AND HERZEGOVINA - Year 1992 - Submission 2013

GREENHOUSE GAS SOURCE AND SINK		CO_2	CO_2	CH_4	N_2O	HFCs[1]		$PFCs_{(1)}$		SF_6		NO_x	CO	NMVOC	SO_2
CATEGORIES		emissions	removals			P	A	P	A	P	A				
		(Gg)				CO_2 equivalent (Gg)				(Gg)					
Total National Emissions and Removals		**5,933.32**	**-10,147.00**	**144.62**	**5.15**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**27.43**	**61.55**	**9.32**	**124.80**
1. Energy		**5,891.28**		**22.88**	**0.11**							**27.43**	**61.55**	**9.32**	**124.77**
A. Fuel Combustion	Reference Approach[2]	NE													
	Sectoral Approach[2]	5,891.28		1.64	0.11							27.43	61.55	9.32	124.77
B. Fugitive Emissions from Fuels		0.00		21.24	0.00							0.00	0.00	0.00	0.00
2. Industrial Processes		**42.04**		**0.00**	**0.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.00**	**0.00**	**0.00**	**0.03**
3. Solvent and Other Product Use		**NE**			**NE**							**NE**	**NE**	**NE**	**NE**
4. Agriculture [3]		**0.00**	**0.00**	**89.34**	**5.04**							**NE**	**NE**	**NE**	**NE**
5. Land-Use Change and Forestry		**0.00**	**-10,147.00**	**0.00**	**0.00**							**NE**	**NE**	**NE**	**NE**
6. Waste		**0.00**		**32.40**	**0.00**							**NE**	**NE**	**NE**	**NE**
7. Other		**0.00**	0.00	**0.00**	**0.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Memo Items:															
International Bunkers		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation		NE		NE	NE							NE	NE	NE	NE
Marine		NE		NE	NE							NE	NE	NE	NE
Multilateral Operations		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass		**NE**													

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B) BOSNIA AND HERZEGOVINA - Year 1993 - Submission 2013

GREENHOUSE GAS SOURCE AND SINK		CO_2	CO_2	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
CATEGORIES		emissions	removals			P	A	P	A	P	A				
		(Gg)				CO_2 equivalent (Gg)				(Gg)					
Total National Emissions and Removals		**2,208.48**	**-10,568.00**	**50.19**	**2.41**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**6.00**	**0.67**	**0.48**	**29.19**
1. Energy		**2,208.48**		**8.05**	**0.05**							**6.00**	**0.67**	**0.48**	**29.19**
A. Fuel Combustion	Reference Approach[2]	NE													
	Sectoral Approach[2]	2,208.48		0.60	0.05							6.00	0.67	0.48	29.19
B. Fugitive Emissions from Fuels		0.00		7.45	0.00							0.00	0.00	0.00	0.00
2. Industrial Processes		**0.00**		**0.00**	**0.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.00**	**0.00**	**0.00**	**0.00**
3. Solvent and Other Product Use		**NE**			**NE**							**NE**	**NE**	**NE**	**NE**
4. Agriculture [3]		**0.00**	**0.00**	**24.24**	**2.36**							**NE**	**NE**	**NE**	**NE**
5. Land-Use Change and Forestry		**0.00**	**-10,568.00**	**0.00**	**0.00**							**NE**	**NE**	**NE**	**NE**
6. Waste		**0.00**		**17.90**	**0.00**							**NE**	**NE**	**NE**	**NE**
7. Other		**0.00**	0.00	**0.00**	**0.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Memo Items:															
International Bunkers		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation		NE		NE	NE							NE	NE	NE	NE
Marine		NE		NE	NE							NE	NE	NE	NE
Multilateral Operations		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass		**NE**													

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B) BOSNIA AND HERZEGOVINA - Year 1994 - Submission 2013

GREENHOUSE GAS SOURCE AND SINK		CO_2	CO_2	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
CATEGORIES		**emissions**	**removals**			**P**	**A**	**P**	**A**	**P**	**A**				
		(Gg)				**CO_2 equivalent (Gg)**				**(Gg)**					
Total National Emissions and Removals		**2,426.14**	**-10,081.00**	**56.91**	**2.75**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**6.57**	**0.65**	**0.52**	**31.66**
1. Energy		**2,426.14**		**8.27**	**0.05**							**6.57**	**0.65**	**0.52**	**31.66**
A. Fuel Combustion	Reference Approach[2]	NE													
	Sectoral Approach[2]	2,426.14		0.64	0.05							6.57	0.65	0.52	31.66
B. Fugitive Emissions from Fuels		0.00		7.63	0.00							0.00	0.00	0.00	0.00
2. Industrial Processes		**0.00**		**0.00**	**0.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.00**	**0.00**	**0.00**	**0.00**
3. Solvent and Other Product Use		**NE**			**NE**							**NE**	**NE**	**NE**	**NE**
4. Agriculture [3]		**0.00**	**0.00**	**27.04**	**2.70**							**NE**	**NE**	**NE**	**NE**
5. Land-Use Change and Forestry		**0.00**	**-10,081.00**	**0.00**	**0.00**							**NE**	**NE**	**NE**	**NE**
6. Waste		**0.00**		**21.60**	**0.00**							**NE**	**NE**	**NE**	**NE**
7. Other		**0.00**	0.00	**0.00**	**0.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Memo Items:															
International Bunkers		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation		NE		NE	NE							NE	NE	NE	NE
Marine		NE		NE	NE							NE	NE	NE	NE
Multilateral Operations		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass		**NE**													

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B) BOSNIA AND HERZEGOVINA - Year 1995 - Submission 2013

GREENHOUSE GAS SOURCE AND SINK		CO_2	CO_2	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
CATEGORIES		emissions	removals			P	A	P	A	P	A				
		(Gg)				CO_2 equivalent (Gg)				(Gg)					
Total National Emissions and Removals		**2,140.56**	**-10,240.00**	**65.75**	**3.02**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**5.80**	**0.58**	**0.51**	**33.72**
1. Energy		**2,119.50**		**8.20**	**0.04**							**5.80**	**0.58**	**0.51**	**33.71**
A. Fuel Combustion	Reference Approach[2]	NE													
	Sectoral Approach[2]	2,119.50		0.64	0.04							5.80	0.58	0.51	33.71
B. Fugitive Emissions from Fuels		0.00		7.56	0.00							0.00	0.00	0.00	0.00
2. Industrial Processes		**21.06**		**0.00**	**0.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.00**	**0.00**	**0.00**	**0.01**
3. Solvent and Other Product Use		**NE**			**NE**							**NE**	**NE**	**NE**	**NE**
4. Agriculture [3]		**0.00**	**0.00**	**33.35**	**2.98**							**NE**	**NE**	**NE**	**NE**
5. Land-Use Change and Forestry		**0.00**	**-10,240.00**	**0.00**	**0.00**							**NE**	**NE**	**NE**	**NE**
6. Waste		**0.00**		**24.20**	**0.00**							**NE**	**NE**	**NE**	**NE**
7. Other		**0.00**	0.00	**0.00**	**0.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Memo Items:															
International Bunkers		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation		NE		NE	NE							NE	NE	NE	NE
Marine		NE		NE	NE							NE	NE	NE	NE
Multilateral Operations		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass		**NE**													

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B)
BOSNIA AND HERZEGOVINA - Year 1996 - Submission 2013

GREENHOUSE GAS SOURCE AND SINK		CO_2	CO_2	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
CATEGORIES		emissions	removals			P	A	P	A	P	A				
		(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals		**4,429.62**	**-9,367.00**	**88.84**	**3.53**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**12.04**	**1.23**	**1.01**	**126.11**
1. Energy		**4,340.64**		**15.63**	**0.11**							**12.03**	**1.21**	**1.00**	**126.06**
A. Fuel Combustion	Reference Approach[2]	NE													
	Sectoral Approach[2]	4,340.64		1.25	0.11							12.03	1.21	1.00	126.06
B. Fugitive Emissions from Fuels		0.00		14.38	0.00							0.00	0.00	0.00	0.00
2. Industrial Processes		**88.98**		**0.00**	**0.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.01**	**0.02**	**0.01**	**0.05**
3. Solvent and Other Product Use		**NE**			**NE**							**NE**	**NE**	**NE**	**NE**
4. Agriculture [3]		**0.00**	**0.00**	**37.71**	**3.42**							**NE**	**NE**	**NE**	**NE**
5. Land-Use Change and Forestry		**0.00**	**-9,367.00**	**0.00**	**0.00**							**NE**	**NE**	**NE**	**NE**
6. Waste		**0.00**		**35.50**	**0.00**							**NE**	**NE**	**NE**	**NE**
7. Other		**0.00**	0.00	**0.00**	**0.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Memo Items:															
International Bunkers		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation		NE		NE	NE							NE	NE	NE	NE
Marine		NE		NE	NE							NE	NE	NE	NE
Multilateral Operations		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass		**NE**													

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B)
BOSNIA AND HERZEGOVINA - Year 1997 - Submission 2013

GREENHOUSE GAS SOURCE AND SINK		CO_2	CO_2	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
CATEGORIES		emissions	removals			P	A	P	A	P	A				
		(Gg)				CO_2 equivalent (Gg)				(Gg)					
Total National Emissions and Removals		**7,022.49**	**-8,483.00**	**99.06**	**3.68**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**19.66**	**2.78**	**1.56**	**178.17**
1. Energy		**6,831.88**		**23.12**	**0.13**							**19.64**	**1.94**	**1.53**	**177.98**
A. Fuel Combustion	Reference Approach[2]	NE													
	Sectoral Approach[2]	6,831.88		1.86	0.13							19.64	1.94	1.53	177.98
B. Fugitive Emissions from Fuels		0.00		21.26	0.00							0.00	0.00	0.00	0.00
2. Industrial Processes		**190.61**		**0.00**	**0.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.02**	**0.84**	**0.03**	**0.19**
3. Solvent and Other Product Use		**NE**			**NE**							**NE**	**NE**	**NE**	**NE**
4. Agriculture [3]		**0.00**	**0.00**	**40.74**	**3.55**							**NE**	**NE**	**NE**	**NE**
5. Land-Use Change and Forestry		**0.00**	**-8,483.00**	**0.00**	**0.00**							**NE**	**NE**	**NE**	**NE**
6. Waste		**0.00**		**35.20**	**0.00**							**NE**	**NE**	**NE**	**NE**
7. Other		**0.00**	0.00	**0.00**	**0.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Memo Items:															
International Bunkers		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation		NE		NE	NE							NE	NE	NE	NE
Marine		NE		NE	NE							NE	NE	NE	NE
Multilateral Operations		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass		**NE**													

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B)
BOSNIA AND HERZEGOVINA - Year 1998 - Submission 2013

GREENHOUSE GAS SOURCE AND SINK		CO_2	CO_2	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
CATEGORIES		emissions	removals			P	A	P	A	P	A				
		(Gg)				CO_2 equivalent (Gg)				(Gg)					
Total National Emissions and Removals		10,776.92	-8,307.00	108.52	3.77	NE	NE	NE	NE	NE	NE	38.46	98.04	14.02	230.91
1. Energy		10,469.65		28.09	0.16							38.37	92.86	13.99	230.22
A. Fuel Combustion	Reference Approach[2]	NE													
	Sectoral Approach[2]	10,469.65		2.33	0.16							38.37	92.86	13.99	230.22
B. Fugitive Emissions from Fuels		0.00		25.76	0.00							0.00	0.00	0.00	0.00
2. Industrial Processes		307.27		0.00	0.00	NE	NE	NE	NE	NE	NE	0.09	5.18	0.03	0.69
3. Solvent and Other Product Use		NE			NE							NE	NE	NE	NE
4. Agriculture [3]		0.00	0.00	41.43	3.61							NE	NE	NE	NE
5. Land-Use Change and Forestry		0.00	-8,307.00	0.00	0.00							NE	NE	NE	NE
6. Waste		0.00		39.00	0.00							NE	NE	NE	NE
7. Other		0.00	0.00	0.00	0.00	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Memo Items:															
International Bunkers		NE		NE	NE							NE	NE	NE	NE
Aviation		NE		NE	NE							NE	NE	NE	NE
Marine		NE		NE	NE							NE	NE	NE	NE
Multilateral Operations		NE		NE	NE							NE	NE	NE	NE
CO_2 Emissions from Biomass		NE													

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B) BOSNIA AND HERZEGOVINA - Year 1999 - Submission 2013

GREENHOUSE GAS SOURCE AND SINK		CO_2	CO_2	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
CATEGORIES		emissions	removals			P	A	P	A	P	A				
		(Gg)				CO_2 equivalent (Gg)				(Gg)					
Total National Emissions and Removals		**10,968.00**	**-7,297.00**	**112.80**	**4.07**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**37.92**	**126.70**	**14.65**	**236.28**
1. Energy		**10,573.51**		**26.81**	**0.18**							**37.76**	**117.42**	**14.62**	**235.13**
A. Fuel Combustion	Reference Approach[2]	NE													
	Sectoral Approach[2]	10,573.51		2.30	0.18							37.76	117.42	14.62	235.13
B. Fugitive Emissions from Fuels		0.00		24.51	0.00							0.00	0.00	0.00	0.00
2. Industrial Processes		**394.49**		**0.00**	**0.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.16**	**9.28**	**0.03**	**1.15**
3. Solvent and Other Product Use		**NE**			**NE**							**NE**	**NE**	**NE**	**NE**
4. Agriculture [3]		**0.00**	**0.00**	**42.69**	**3.89**							**NE**	**NE**	**NE**	**NE**
5. Land-Use Change and Forestry		**0.00**	**-7,297.00**	**0.00**	**0.00**							**NE**	**NE**	**NE**	**NE**
6. Waste		**0.00**		**43.30**	**0.00**							**NE**	**NE**	**NE**	**NE**
7. Other		**0.00**	0.00	**0.00**	**0.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Memo Items:															
International Bunkers		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation		NE		NE	NE							NE	NE	NE	NE
Marine		NE		NE	NE							NE	NE	NE	NE
Multilateral Operations		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass		**NE**													

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B) BOSNIA AND HERZEGOVINA - Year 2000 - Submission 2013

GREENHOUSE GAS SOURCE AND SINK		CO_2	CO_2	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
CATEGORIES		**emissions**	**removals**			**P**	**A**	**P**	**A**	**P**	**A**				
		(Gg)				**CO_2 equivalent (Gg)**				**(Gg)**					
Total National Emissions and Removals		**11,633.23**	**-7,302.00**	**113.45**	**3.98**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**39.32**	**128.08**	**14.42**	**223.37**
1. Energy		**11,177.58**		**26.87**	**0.20**							**39.10**	**115.22**	**14.37**	**221.82**
A. Fuel Combustion	Reference Approach[2]	NE													
	Sectoral Approach[2]	11,177.58		2.39	0.20							39.10	115.22	14.37	221.82
B. Fugitive Emissions from Fuels		0.00		24.48	0.00							0.00	0.00	0.00	0.00
2. Industrial Processes		**455.65**		**0.00**	**0.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.22**	**12.86**	**0.05**	**1.55**
3. Solvent and Other Product Use		**NE**			**NE**							**NE**	**NE**	**NE**	**NE**
4. Agriculture [3]		**0.00**	**0.00**	**40.68**	**3.78**							**NE**	**NE**	**NE**	**NE**
5. Land-Use Change and Forestry		**0.00**	**-7,302.00**	**0.00**	**0.00**							**NE**	**NE**	**NE**	**NE**
6. Waste		**0.00**		**45.90**	**0.00**							**NE**	**NE**	**NE**	**NE**
7. Other		**0.00**	0.00	**0.00**	**0.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Memo Items:															
International Bunkers		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation		NE		NE	NE							NE	NE	NE	NE
Marine		NE		NE	NE							NE	NE	NE	NE
Multilateral Operations		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass		**NE**													

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B) BOSNIA AND HERZEGOVINA - Year 2001 - Submission 2013

GREENHOUSE GAS SOURCE AND SINK		CO_2	CO_2	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
CATEGORIES		emissions	removals			P	A	P	A	P	A				
		(Gg)				CO_2 equivalent (Gg)				(Gg)					
Total National Emissions and Removals		12,239.58	-7,212.00	115.18	4.71	0.00	0.00	0.00	0.00	0.00	0.00	40.07	134.54	15.35	213.74
1. Energy		11,642.95		27.28	0.37							39.83	121.52	14.94	212.16
A. Fuel Combustion	Reference Approach[2]	12,526.71													
	Sectoral Approach[2]	11,642.95		3.20	0.37							39.83	121.52	14.94	212.16
B. Fugitive Emissions from Fuels		0.00		24.08	0.00							0.00	0.00	0.00	0.00
2. Industrial Processes		596.63		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	13.02	0.41	1.58
3. Solvent and Other Product Use		0.00			0.00							0.00	0.00	0.00	0.00
4. Agriculture [3]		0.00	0.00	40.83	4.34							0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry		0.00	-7,212.00	0.00	0.00							0.00	0.00	0.00	0.00
6. Waste		0.00		47.07	0.00							0.00	0.00	0.00	0.00
7. Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items:															
International Bunkers		0.00		0.00	0.00							0.00	0.00	0.00	0.00
Aviation		0.00		0.00	0.00							0.00	0.00	0.00	0.00
Marine		0.00		0.00	0.00							0.00	0.00	0.00	0.00
Multilateral Operations		0.00		0.00	0.00							0.00	0.00	0.00	0.00
CO_2 Emissions from Biomass		0.00													

SECOND NATIONAL COMMUNICATION
OF BOSNIA AND HERZEGOVINA
UNDER THE UNITED NATIONS FRAMEWORK
CONVENTION ON CLIMATE CHANGE

MINISTRY OF FOREIGN TRADE
AND ECONOMIC RELATIONSHIP BIH

FEDERAL MINISTRY OF
ENVIRONMENT AND TOURISM

MINISTRY OF SPATIAL PLANNING,
CONSTRUCTION AND ECOLOGY RS

UNDP
Empowered lives.
Resilient nations.

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INVESTING IN OUR PLANET