FIRST BIENNIAL UPDATE REPORT OF BOSNIA AND HERZEGOVINA UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

SEPTEMBER 2014

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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) as well as 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:	According to the preliminary results of the 2013 population census, the population of BiH is 3,791,622, with approximately 1,326,991 (35%) in the Republic of Srpska, 2,371,603 (63%) in the Federation of Bosnia and Herzegovina and 93,028 (2%) in Brčko District.
Economy:	GDP – KM 25,734 million; GDP per capita 6,709 KM[1] (2012)
International cooperation:	Ratified conventions: UNFCCC, the UN Convention on 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)

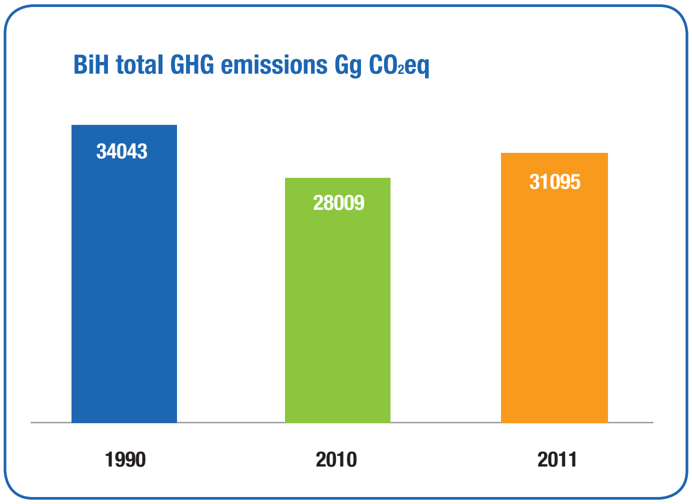
Calculation of greenhouse gas emissions

The inventory of greenhouse gases in this Report covers the years 2010 and 2011. It has been compiled in line with the UNFCCC Biennial Update Reporting Guidelines for Parties not included in Annex I to the Convention, CoP Decision 17 (2/CP.17, Annex III, Chapter 3).

For the purposes of this BUR, emissions were calculated using the IPCC methodology defined by the Convention, based on the reference manual *The Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, *the 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry*, and *the 2000 Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. The emission factors used were those recommended by IPCC.

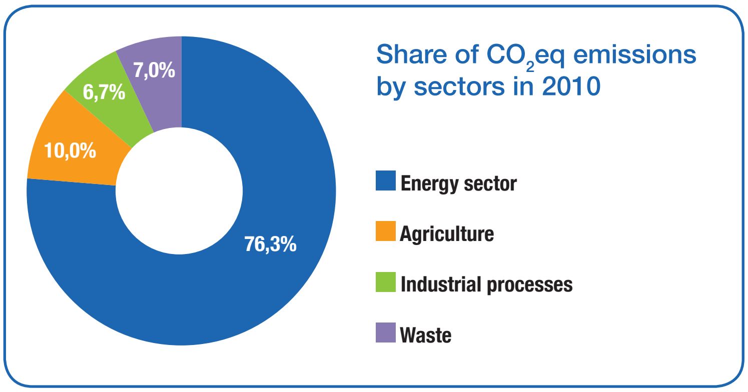
The database was built using Non-Annex I Inventory Software (NAAIS) software, which was developed by the UNFCCC Secretariat for Parties not included in Annex I to the Convention. Total emissions of CO_2eq amounted to 28,009 Gg CO_2eq in 2010 and 31,095 Gg CO_2eq in 2011, reaching 82% and 91%, respectively, of the level of emissions recorded in the baseline year 1990.

1 1 EUR equals 1.95583 KM, BiH Central Bank, June 2014



Total CO_2eq emission by years

The largest source of CO_2 emissions is by far the energy sector, which in 2010 contributed 76.3% of total CO_2eq emissions, followed by agriculture (10.05%), waste (6.99%)and industrial processes (6.67%).



Share of CO_{2eq} emissions by sector (%) for the year 2010.

Climate change mitigation

This section focuses on the sectors identified as having the greatest potential for GHG emission reductions: electricity generation, district heating, buildings, transport, waste management, agriculture, and forestry. Scenarios modelling possible pathways of GHG emissions until 2040 were developed for each of these sectors, and the financial effects of the scenarios were analysed (without analysing measures that would lead to these results). Specific modelling involved a quantitative evaluation of time-series GHG emissions and considered three development scenarios: S1 – a baseline scenario ("business as usual"), S2 – a scenario that assumed partial implementation of mitigation actions, and S3 – an advanced scenario that assumed the implementation of a comprehensive set of mitigation actions.

Energy sector

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

Analyses were completed of all three GHG emission reduction scenarios, each of which assumed an increase in energy efficiency in line with the scenarios developed within the SNC.

National Energy Efficiency Action Plan (NEEAP):

- The S1 scenario assumes a moderate increase in the share of electric power generated from RES, with the majority of power still being generated from fossil fuels;
- The S2 scenario assumes the construction of power generation plants in accordance with the relevant strategies and other data collected on planned activities;

- The S3 scenario assumes the intensive use of renewable energy sources (RES) and energy efficiency (EE) measures as a result of obligations assumed under international agreements.

The S1 and S2 scenarios assume that CO_2 emissions from the BiH energy sector will increase in the period 2010–2040, with the increase exceeding 100% in the S2 scenario. Under the S3 scenario, however, emission in 2040 will be similar to those in 2010. In addition, financial analysis for the S3 scenario indicates a benefit that is16% higher than in the S1 scenario.

Renewable energy sources

Mitigation scenarios related to the utilisation of RES are based on the estimated reserves and potentials of individual forms of RES, as well as technological, social, political and economic opportunities for their exploitation.

- The S1 scenario assumes that no mitigation actions are taken; i.e., there is no increase in the use of renewable energy;
- The S2 scenario assumes the gradual introduction of new technologies;
- The S3 scenario assumes a high level of climate change mitigation actions and an increase in the use of RES.

Based on an anticipated reduction in CO_2 emissions, which would be achieved through the increased use of RES and by avoiding external costs, the average annual benefit is calculated to be € 12.3 million for the S2 scenario, and € 82 million for the S3 scenario, which clearly shows the potential for investment in renewable energy technologies.

District heating sector

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

- The S1 scenario assumes a higher rate of economic growth as well as a corresponding increase in energy consumption for heating.

- The S2 scenario assumes a lower rate of economic growth with a lower growth of energy consumption.

- The S3 scenario also assumes a higher rate of economic growth, but that growth is accompanied by the extensive use of energy efficiency measures, resulting in a considerable reduction in energy consumption.

As the S3 scenario assumes extensive employment of energy efficiency measures, both in heating systems and in the end use of heat, the anticipated reduction in emissions is around 30% compared to the S1 scenario. In addition, financial analysis of the S2 and S3 scenarios indicates an average annual benefit of € 0.67 million and € 1.6 million, respectively, by 2040 compared to the S1 scenario.

Buildings sector

Buildings are responsible for the highest share of end-use energy consumption in the country. Due to their age and low energy efficiency, buildings offer great potential for savings resulting from reduced consumption of energy-generating fuels and corresponding reductions in CO_2 emissions.

- The S1 scenario 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, and no implementation of energy efficiency measures;
- The S2 scenario assumes a moderately rapid increase in GDP and energy consumption, without additional energy efficiency measures;
- The S3 scenario assumes a moderately rapid increase in GDP and implementation of energy efficiency measures resulting in considerable savings.

Due to a projected increase in energy consumption, scenarios in the buildings sector do not assume emission reductions. However, due to the introduction of energy efficiency measures, the S3 scenario assumes that by 2040 emissions will remain comparable to those in the S1 scenario, resulting in overall savings of approximately € 3.3 billion in reduced heating costs for buildings that are not connected to the district heating network.

Transport sector

Scenarios for the transport sector acknowledged the fact that road transport in BiH accounts for 90% of total annual energy consumption (diesel and petrol) in the sector overall:

- The S1 scenario is based on previously established trends of an increasing number of road 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 of 3.7%;
- The S2 scenario assumes the introduction of additional technical measures for road motor vehicles supporting improved motor energy efficiency and reductions in fuel consumption; it also assumes the same rate of increase in the number of road motor vehicles as the S1 scenario, but with improvements in the quality of fuels and in the quality of road infrastructure;
- The S3 scenario is based on the assumption that by 2025 BiH will become an EU member state, implying the compulsory implementation of EU Directives regulating this sector.

The S1 scenario envisages an increase in emissions from this sector of approximately 123% by 2040 compared to 2010; the S2 scenario envisages an increase of 72%; and the S3 scenario envisages a reduction in emissions of approximately 37%. This reduction would help avoid external costs totalling approximately € 1.4 billion in the period under review.

Forestry sector

The sink potential for forest soil in 2010 in BiH was 6,475.33 Gg CO_2.

- The S1 scenario is based on the established trend of reductions in areas under forest cover which began in the post-war period, and it does not assume any additional measures aimed at stopping or reversing this trend;
- The S2 scenario is based on the implementation of specific stimulus measures intended to preserve existing forest cover;
- The S3 scenario is based on the assumption that by 2025 BiH will have joined the EU, implying the compulsory implementation of all of the corresponding obligations and directives regulating the forestry sector.

According to the S1 scenario, the average annual sink capacity of BiH forests would be reduced by approximately 80 Gg CO_2 in comparison to the year 2010, while in the S3 scenario it would increase by approximately 300 Gg CO_2; i.e., by around 4.6%. Total benefits for the reference period under the S2 and S3 scenarios would reach € 76 million and € 108 million, respectively, which represents significant potential for the sustainable development of the forestry sector by 2040.

Agricultural sector

Mitigation potential in the agricultural sector in BiH can be observed in two ways: 1) the potential for GHG sinks; and 2) the potential to reduce sources of greenhouse gas emissions.

- The S1 scenario does not assume any major changes in the sector, and the share of agriculture in total economy remains at the same level;
- The S2 scenario assumes positive changes in agricultural land use and a moderate increase in average returns and the share of agriculture in the economy;
- The S3 scenario, as in most other sectors, is based on the expectation that by 2025 BiH will become an EU member.

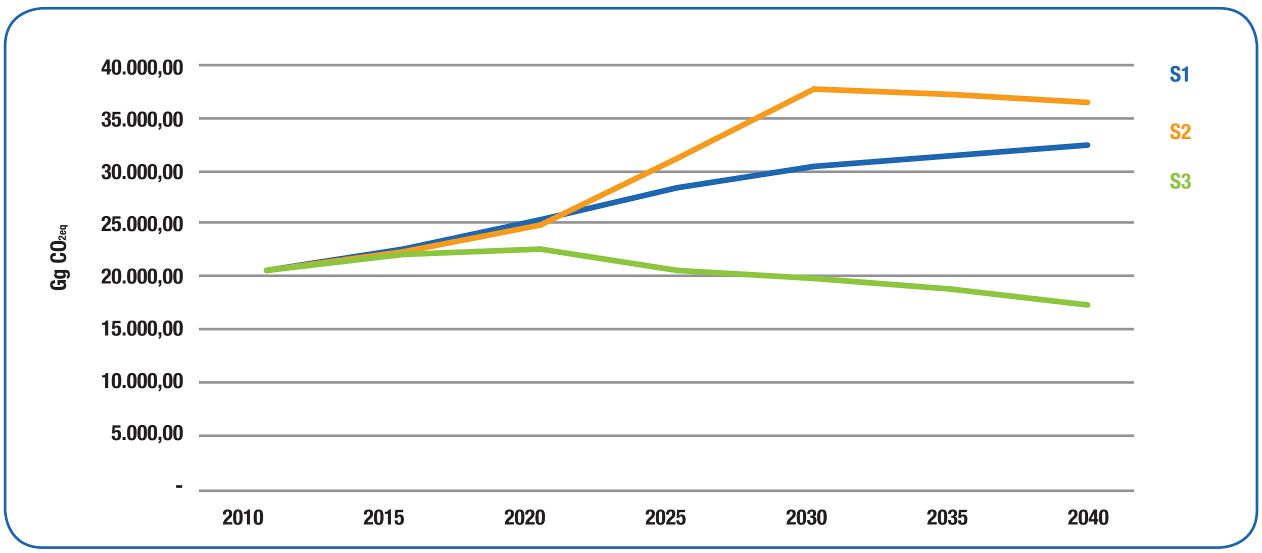
Based on these assumptions, the S1 scenario envisages that total GHG emissions in the agricultural sector will reach 4,600 Gg CO_2e by 2040. The S3 scenario shows that climate change mitigation potential in the agricultural sector in BiH may lead to a reduction of over 50% compared to 2010, thus helping to avoid average annual external costs of approximately € 33 million.

Waste management sector

Given that the waste management sector accounts for approximately 6% of total emissions in BiH, its direct impact in terms of GHG emission reductions is not very high. However, measures such as the reduction of waste, recycling, and energy generation from waste can have a significant impact on emission reductions in general.

- The S1 scenario is based on the long-term continuation of existing practices in production and the overall organisation of waste collection and disposal in the country;
- The S2 scenario assumes the construction of regional sanitary landfills with biogas collection and flaring systems in the entire territory of BiH, and an increase in the recycling rate of up to 30% by 2040;
- The S3 scenario assumes the implementation of technologies and legislation applied in EU countries, increased levels of recycling at source and at landfills (including batteries and accumulators, tyres, glass and other waste from specific streams that currently ends up at landfills), and the transition to a billing system based on the volume of waste generated.

While the S1 and S2 scenarios envisage an increase in CO_2e emissions from the waste management sector by 2040 (with an increase of more than 130% compared to 2010 under the S1 scenario), the S3 scenario envisages a decrease of nearly 50%. Total external costs in the S2 and S3 scenarios are lower by € 339.5 million and € 583 million, respectively, compared to the baseline scenario S1.



Total annual CO_2eq emissions from the energy sector, RES, district heating, transport, agriculture, and waste in BiH for the period 2010–2040, according to the S1, S2 and S3 scenarios (Gg CO_2eq)

Establishment of an institutional framework for measuring, reporting and verification of Nationally Appropriate Mitigation Actions

Bosnia and Herzegovina has not yet established a mechanism for approving and submitting NAMAs (Nationally Appropriate Mitigation Actions) to the UNFCCC registry, but an initiative has been submitted to the Council of Ministers seeking to amend the Decision establishing the Designated National Authority (DNA) for the implementation of Clean Development Mechanism (CDM) projects under the Kyoto Protocol to the UNFCCC in Bosnia and Herzegovina. This initiative would add the development, receipt and approval/rejection of NAMAs to the existing activities of the current DNA for BiH.

In parallel, an MRV (measurement, reporting and verification) system for NAMA projects will be established. The establishment of MRV in BiH will follow the existing state structure and will seek to embed its activities into existing institutions to the maximum extent possible. At the same time, local capacities will be strengthened in this field.

1. NATIONAL CIRCUMSTANCES

1.1. Structure and institutional arrangements

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

Decision-making involves the Council of Ministers, the governments of two Entities (the Federation of Bosnia and Herzegovina and the Republic of Srpska) and Brčko District government. The Federation of Bosnia and Herzegovina is further 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 harmonising entity plans at the international level, but the responsibility for environmental issues in BiH rests with the entity governments. The corresponding authorities are the Ministry of Environment and Tourism of the Federation of BiH (FBiH), the Ministry of Spatial Planning, Civil Engineering and Ecology of the Republic of Srpska (RS) (the UNFCCC Focal Point), and the Department for Spatial Planning and Property Affairs of Brčko District (BD). The Council of Ministers of Bosnia and Herzegovina is a party to a number of international environmental agreements and conventions,[2] and it is fully committed to meeting the requirements laid down 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 agreement ratified in the area of environmental protection is the 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 series of efforts to establish appropriate political, institutional and legal frameworks to meet the commitments stemming from the Convention. Based on the mutual agreement of both entities, the BiH Focal Point for the UNFCCC is the Ministry of Spatial Planning, Civil Engineering and Ecology of RS. In addition, the Kyoto Protocol was ratified on 16 April 2007.

In 2010, BiH submitted its Initial National Communication under the United Nations Framework Convention on Climate Change to the UNFCCC Secretariat. The Second National Communication under UNFCCC was adopted and submitted to the UNFCCC Secretariat in October 2013.

1.1.1. Legal framework

Environmental protection and the development of an emissions inventory in Bosnia and Herzegovina is primarily regulated by relevant environmental and air protection laws in FBiH and RS. This legislation covers the following activities:

Federation of BiH

The FBiH Ministry of Environment and Tourism establishes and manages an environmental information system in FBiH and enables environmental monitoring as well as the measuring, collecting, processing and recording of data on the use of environment and environmental burdens. Cantonal ministries responsible for environmental

2 SNC BiH, 2013, Annex I

protection are obliged to submit the data required for the operation of the environmental information system.

The FBiH Ministry of Environment and Tourism maintains the Register of Plants and the Pollutant Release and Transfer Register (which also includes the air emissions register) in accordance with the Regulation on Plant and Pollution Registers. Cantonal ministries responsible for environmental protection prepare annual reports on permits issued to plants and facilities, and they submit them to the Ministry along with data for the Register.

The Federal Hydrometeorological Institute of FBiH, which establishes and performs air quality monitoring, maintains a database of air quality measurements and prepares annual air quality reports and submits them to the FBiH Ministry of Environment and Tourism and the FBiH Ministry of Health for publication.

Republic of Srpska

The RS Ministry of Spatial Planning, Civil Engineering and Ecology is responsible for the overall quality of environmental protection in RS. This ministry maintains the Pollutant Release and Transfer Register, in accordance with the Regulation on the Methodology and Manner of Keeping the Plant and Pollution Register.

The Republic Hydrometeorological Institute of RS maintains an air quality information system and prepares and releases monthly and annual air quality reports in RS. This institution is also responsible for compiling an inventory of GHG emissions.

Polluters, specialised institutions and competent authorities in both entities are required to submit the data necessary for distribution, assessment and/or monitoring to ministries. While not directly involved, the entity-level statistical institutes and the state-level Agency for Statistics also play a key role in environmental monitoring.

1.2. Geographical characteristics

Bosnia and Herzegovina has a total surface area of 51,209.2 km^2, composed 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. Based on its geographical position on the Balkan Peninsula, it belongs to the Adriatic basin and the Black Sea Basin.

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), and it has 23.5 km of sea border on the Adriatic Sea. The land is mainly hilly to mountainous, with an average altitude of 500 metres. 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.

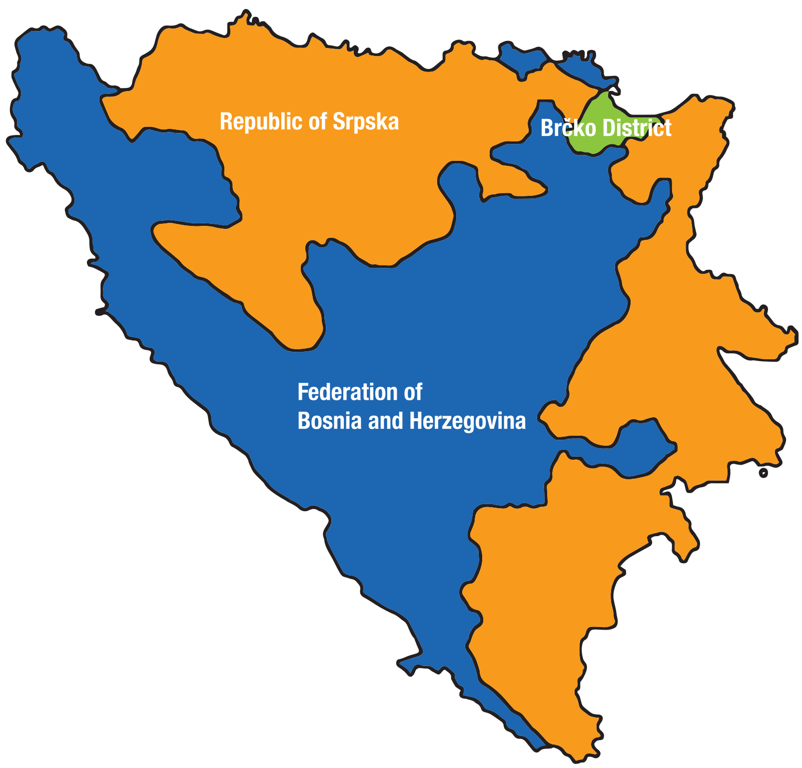


Figure 1: Map of Bosnia and Herzegovina

1.3. Population

According to the preliminary results of the 2013 population census, Bosnia and Herzegovina has a total population of 3,791,622.[3] Compared to the last census, conducted in 1991, the population has decreased by 585,411 (the population in 1991 was 4,377,033). The reasons for the population decline include armed conflicts, migration and a marked decrease in the birth rate. Preliminary results of the 2013 population census indicate that the total number of residents counted in the Republic of Srpska is 1,326,991[4] (35%), in the Federation of Bosnia and Herzegovina 2,371,603[5] (63%) and in Brčko District 93,028[6] (2%).

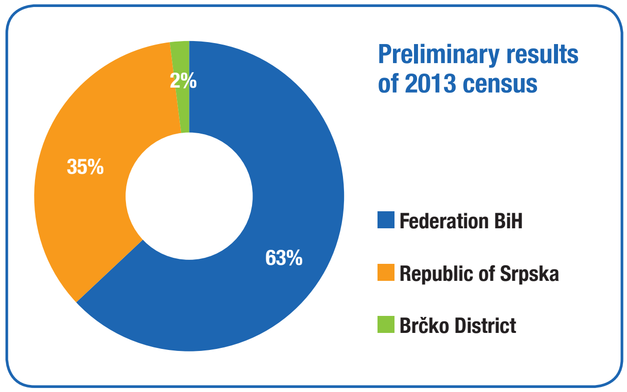


Chart 1: Population in Bosnia and Herzegovina, by entities and Brčko District (Preliminary results of the 2013 census, %)[7]

In recent years, there has been a marked decline in the natural increase rate in Bosnia and Herzegovina, and this decline was particularly large in 2011 and 2012.

	Life births			Deaths			Net population growth
	Total	Men	Women	Total	Men	Women	
2007	33,835	17,534	16,301	35,044	18,154	16,890	-1,209
2008	34,176	17,585	16,591	34,026	17,687	16,339	150
2009	34,550	18,001	16,549	34,904	17,884	17,020	-354
2010	33,528	17,277	16,251	35,118	17,900	17,218	-1,590
2011	31,811	16,531	15,280	35,028	17,965	17,063	-3,217
2012	32,547	16,790	15,757	35,817	18,436	17,381	-3,270

Table 1: Population trends in Bosnia and Herzegovina from 2007 to 2012[8]

1.4. Climate characteristics

Bosnia and Herzegovina has several climate types: the temperate continental climate type (northern and central parts of the country), the sub-mountainous type, the mountainous type, and the Adriatic and modified Adriatic climate type. Mean annual temperatures in the period 1981–2010 ranged from 1.6°C (Bjelašnica) to 15.2°C (Mostar). Winter temperatures are in the range of -6.0°C to 6.2°C, and summer temperatures 9.8°C to 24.7°C. There has been an observable rise in the annual temperatures in the entire territory of Bosnia and Herzegovina by as much as more than 1.5°C in the north-western part of the country (Banja Luka).

Annual precipitation ranges from 792 mm in the northeast (Semberija – Bijeljina) to 1,707 mm (Herzegovina – Trebinje). There has been an evident decrease in precipitation during the summer. In the last two decades, the amounts of precipitation across the seasons and the distribution of precipitation have been thrown out of kilter, which, in addition to the temperature increase, has given rise to droughts and floods.

3 Preliminary results of the 2013 Census of Population, Households and Dwellings in Bosnia and Herzegovina, BHAS, 2013
4 Republic of Srpska Institute of Statistics, 2013
5 Institute for Statistics of FBiH, 2013
6 Preliminary results of the 2013 Census of Population, Households and Dwellings in Bosnia and Herzegovina, BHAS, 2013
7 *Ibid.*
8 Bosnia and Herzegovina in Numbers, 2013

The duration of sunshine (insolation) is on the increase. The average insolation for the period 1961–2011 is 1,806 in Sarajevo, 1,821 in Banja Luka, and highest in Mostar at 2,337 hours. In extremely warm years, the insolation value has been as high as 2,630 hours in Mostar.

Extreme climate events in Bosnia and Herzegovina have become increasingly frequent. Of the last 12 years, six were very dry to extremely dry (2003, 2007, 2008, 2011, 2012 and 2013). In addition, years with large to catastrophic floods have been very frequent (2001, 2002, 2009, 2010 and 2014). Extreme climate events have been particularly pronounced over the last five years, with great floods in 2009 and 2010; severe droughts in 2001, 2012 and 2013; heat waves / tropical temperatures in early 2012; a wave of intense cold in early 2012; and gale-force winds in mid-2012.

In April and May 2014, the northern part of the country experienced record rainfall (more than 420 mm), which caused catastrophic flooding in the Vrbas and Bosna catchment areas and the Semberija region.

1.5. Sector analysis

A detailed sector analysis was provided in the SNC, which was finalised in June 2013. This document therefore presents data that have become available since then.

1.5.1. Economy and industry

Despite comprehensive efforts, the pace of post-war economic recovery has been much slower than initially anticipated. Data from the BiH Agency for Statistics for the year 2012 show that GDP was KM 25,734 million, while average GDP per capita was KM 6,709.[9] In 2012, the share of GDP by sector was as follows: 6.24% agriculture, forestry and fishery; 21.7% industry and construction; and 56.32% services.

Indicators	2004	2005	2006	2007	2008	2009	2010	2011	2012
Nominal GDP (EUR billion)	8.1	8.7	9.8	11.1	12.6	12.3	12.6	13.0	13.158
GDP per capita (EUR)	2,101	2,279	2,562	2,896	3,287	3,192	3.271	3.392	3.419
Real growth rate of GDP (%)	6.3	3.9	6.1	6.2	5.7	-2.9	0.7	1.3	-1.10
Average net salary (EUR)	258	275	300	322	385	404	408	417	420
Annual inflation (%)	0.4	3.8	6.1	1.5	7.4	- 0.4	2.1	3.7	2.1
Annual unemployment rate (%)	43.2	43.0	31.0	29.0	23.4	24.1	27.2	27.6	28.0
Foreign currency reserves (EUR million)	1,779	2,160	2,787	3,425	3,219	3,176	3,301	3,284	3.322
Balance of trade (EUR billion)	-3.68	-3.96	-3.41	-4.14	-4.82	-3.48	-3.33	-3.73	-3.78
Total FDI (EUR million)	567	478	564	1.628	701	452	307	355	285

Table 2: Main economic indicators for BiH, 2004–2012

	2005	2006	2007	2008	2009	2010	2011	2012
Republic of Srpska	33.59	33.95	33.75	34.35	34.26	33.93	33.78	33.36
Federation of BiH	63.79	63.62	63.73	63.30	63.45	63.77	63.91	64.33
Brčko District	2.62	2.42	2.52	2.35	2.29	2.30	2.32	2.31

Table 3: Share of GDP in Bosnia and Herzegovina by entity (%)[10]

9 First Release: Gross Domestic Product of Bosnia and Herzegovina 2012. Production approach, BHAS, 2013
10 First Release: Gross Domestic Product of Bosnia and Herzegovina 2012. Production approach, BHAS, 2013

GDP per capita, expressed as Purchasing Power Standards (PPS), was 28% of the EU-27 average in 2012, while consumption per capita in PPS for the same year was 37% of the EU-27 average. According to a report of the Central Bank of Bosnia and Herzegovina, inflationary trends in 2012 were limited and stable, with an average price increase of 2.1%, which is 1.6% less than the average price increase in 2011. The slowing of inflation which started in early 2011 continued in 2013, when the annual inflation rate as measured by the consumer price index (CPI) was -1.2%.[11]

According to the preliminary results of the Labour Force Survey,[12] which was undertaken in April 2013, the unemployment rate was 27.5% (26.5% for men and 29.0% for women), while in the same period in 2012 it was 28% (26.4% for men and 30.7% for women). The unemployment rate was highest among young people aged 15 to 24 years at 59.1%. Distribution of employees by sector shows that the largest proportion of employees work in the service sector (51.3%), followed by the industrial sector and the agricultural sector (29.8% and 18.9%, respectively).

The average fluctuation of the Producer Price Index in BiH in 2012 compared to 2011 saw an increase of 2.7% in the mining and quarrying sector and 3.8% in the electricity, gas and steam generation and supply sector. However, a decline in prices was recorded in processing industries (by 0.5%) and water supply (by 9.4%). Compared to the 2011 average, 2013 saw a decline in the Producer Price Index of 1.4%.[13] A price increase of 3.2% was recorded only in the mining and quarrying sector, while all other sectors saw a reduction in prices. Total value of the sale/delivery of industrial products in BiH in 2012 increased slightly over the preceding year.

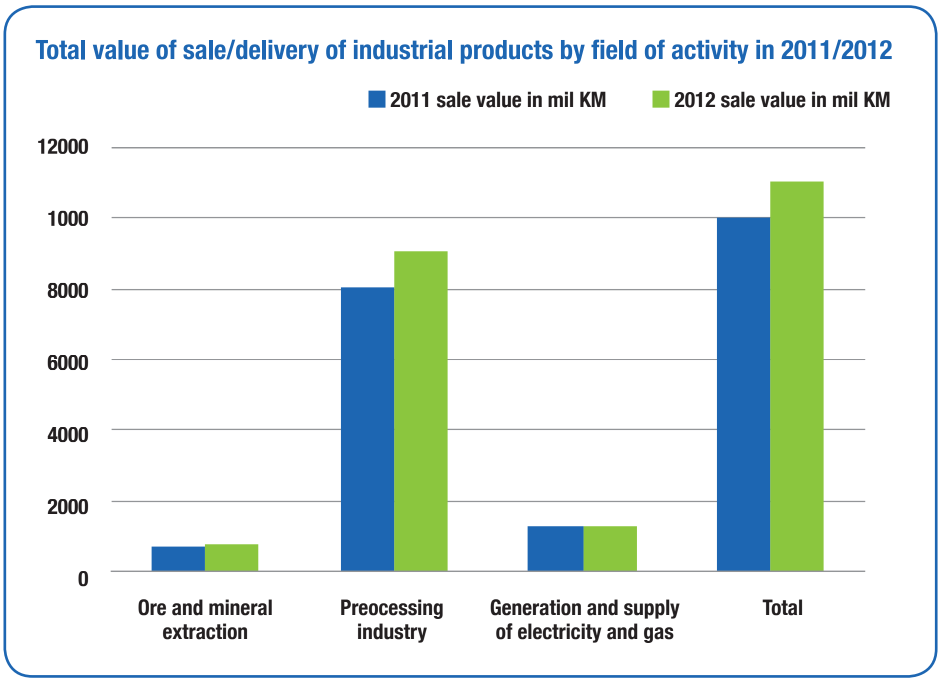


Chart 2. Total value of sale/delivery of industrial products by field of activity in 2011/2012

1.5.2. Energy

Total electricity generation in BiH in the year 2012 was 14,082 GWh, while consumption was approximately 11,097 GWh,[14] which represented an increase of around 7% over the preceding year. Production of electricity in 2012 amounted to 4,215 GWh (29.9%) from hydroelectric power plants, 9,524 GWh (67.6%) from thermal power plants and 343 GWh (2.5%) from industrial power plants.

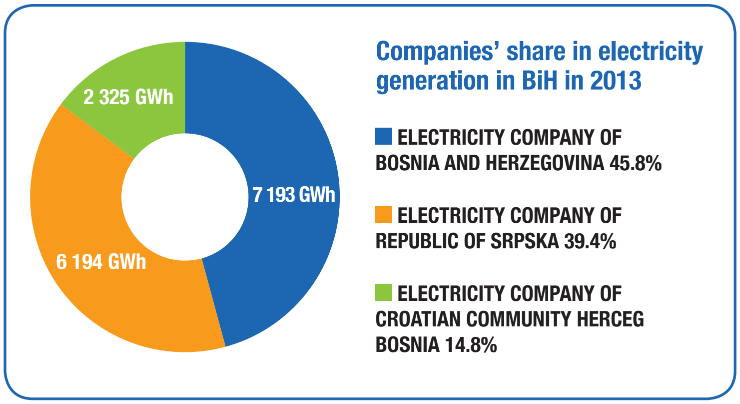
Total energy consumption in 2012 was divided among households (41.4%), industry (38.7%), and other consumers, which included the buildings sector, transport and agriculture (19.9%).

According to the latest data available from the Independent System Operator in BiH, of the total 15,712 GWh of electricity generated in the transmission network in 2013, hydroelectric power plants produced 6,971

11 Central Bank of Bosnia and Herzegovina, 2013 Annual Report
12 LFS 2013 Preliminary, BHAS, 2013
13 Thematic Bulletin 12: Industrial Producer Price Index in Bosnia and Herzegovina 2013, BHAS 2014.
14 First Release: Energy Statistics, year V, number 5, BHAS 2014

GWh (44.4%) and thermal power plants produced 8,740 GWh (55.6%).[15] Favourable hydrological conditions, compared to the extremely unfavourable preceding year, helped boost energy production in hydroelectric power plants, including increases in some plants of more than 60%.

In 2012, the production of non-ferrous metals was responsible for the largest share of electricity consumption in the industrial sector (47.5%), followed by the iron and steel industry at 17.4%.



Total generation of thermal energy in Bosnia and Herzegovina in 2012 was 6,075 TJ, of which 3,757 TJ (61.8%) was generated in heating plants, 1,498 TJ (24.7%) in thermal power plants, and 820 TJ (13.5%) in industrial power plants.[16] Total thermal energy consumption in 2012 was divided among households (75.8%) and industry and other consumers (24.2%).

Chart 3: Companies' share in electricity generation in Bosnia and Herzegovina in 2013[17]

1.5.3. Transport

According to data gathered from the relevant authorities, the total length of the road network in Bosnia and Herzegovina is 22,871.96 km, comprising 83.50 km of motorways, 30.71 km of roads reserved for motor traffic, 3,843.20 km of trunk roads, 4,714.55 km of regional roads, and approximately 14,200 km of local roads.[18]

The total number of registered road motor vehicles in 2013 was 785,890, an increase of 0.8% over the preceding year. Of the total number of registered road motor vehicles in 2013, 85% were passenger vehicles, 9% were cargo vehicles, and 6% were from all other categories of vehicles. With respect to the type of fuel used, 61% of passenger vehicles use diesel, 36% use petrol, and 3% of vehicles use other forms of energy.[19] The number of road motor vehicles registered for the first time in 2013 was 74,568, an increase of 22.4% over the preceding year.
The overall volume of road transport in Bosnia and Herzegovina for 2012 is represented by two indicators: cargo transport and passenger transport. According to both of these indicators, the volume of transport increased compared to 2011 by approximately 3%. More detailed indicators on the volume of transport by type are presented in the table below.

Cargo transport	2010	2011	2012
Vehicle-kilometres travelled (thousands)	284,680	317,032	343,278
Tonnes of goods transported (thousands)	4,837	4,857	6,288
Tonne/km (thousands)	2,038,731	2,308,690	2,310,607
Passenger transport	**2010**	**2011**	**2012**
Vehicle-kilometres travelled (thousands)	97,663	93,823	94,376
Transported passengers (thousands)	28,702	29,303	31,399
Passenger-kilometres (thousands)	1,864,471	1,926,212	1,925,617

Table 4: Volume of transport by type, 2010–2012

15 Annual Report on Power Flows in the Transmission System of Bosnia and Herzegovina in 2013, NOSBIH, 2014
16 First Release: Energy Statistics, year V, number 5, BHAS 2014
17 Annual Report on Power Flows in the Transmission System of Bosnia and Herzegovina in 2013, NOSBIH, 2014
18 Information about the State of the Road Network in Bosnia and Herzegovina in 2013, BIHAMK, 2013
19 First Release: Transport, year IV, number 1, BHAS, 2014

The rail network of BiH consists of 1,031 km of railways, of which 425 km are in the RS and 616 in FBiH. 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 enough income to cover expenditures.

Unlike road transport, the volume of rail transport decreased compared to the year 2011. The overall volume of rail transport in BiH is represented by two indicators: cargo transport and passenger transport.

Cargo transport	2010	2011	2012
Tonnes of goods transported (thousands)	12,882	14,224	13,556
Tonne/km (thousands)	1,232,034	1,298,294	1,150,325
Passenger transport	**2010**	**2011**	**2012**
Transported passengers (thousands)	898	821	846
Passenger-kilometres (thousands)	58,559	54,811	54,468

Table 5: Volume of rail transport in Bosnia and Herzegovina 2010–2012

Of 27 officially registered airports in Bosnia and Herzegovina, only four are registered for international traffic – Sarajevo, Banja Luka, Mostar and Tuzla. [20] The annual number of passengers in 2012 was around 580,000 for the 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 2012, the total number of airport operations was 13,980, an increase of 77.5% over the preceding year. The number of transported passengers was 2.9% higher than in 2011.

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 seaports. 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 tonnes/year.

The Sava River is the main navigable river along its entire 333 km stretch through Bosnia and Herzegovina. 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

The share of agriculture, forestry and fishing comprised 6.24% of GDP in 2012.[21] Approximately 2.572 million ha (46%) in BiH is suitable for agriculture, of which only 0.65% is irrigated. Arable land covers 1,009,000 ha, of which 478,000 ha (47%) is not cultivated at present.

Forty-five percent 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) make up an additional 35% of farmland. However, high altitude, slopes, and aridity limit the use of mountain pastures to spring and summer months. Less than 20% 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.

20 Ministry of Communications and Transport of BiH, 2005
21 First Release: Gross Domestic Product of Bosnia and Herzegovina 2012. Production approach, BHAS, 2013

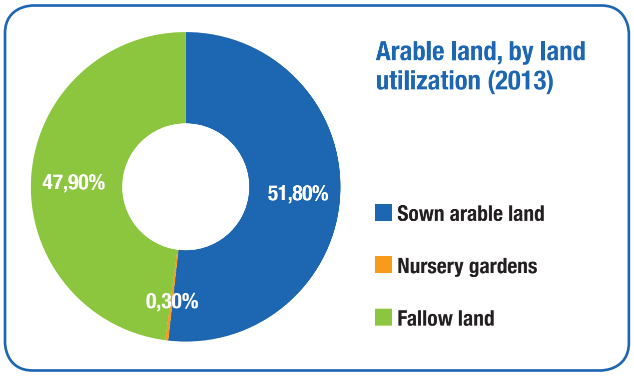


Chart 4: Arable land, by land utilisation (2013)

Commodity exchange in the agro-industrial sector (agricultural products classified according to WTO classification) in 2012 saw a 13.65% decrease in imports from the preceding year, while BiH exports increased by 2.45% in the same period. Imports of agricultural products comprise 16.06% of total BiH imports, while the share of agricultural exports totalled 8.98% of all BiH exports. The percentage of import coverage by the export of agricultural products for the observed period was 28.81%.

According to the data available from the 2012 BiH Foreign Trade Exchange Analysis, which was conducted by MOFTER, the total area in BiH sown with cereal crops was 304,000 ha, with fodder crops – 137,000 ha, with vegetable crops – 78,000 ha, and with industrial crops – 8,000 ha. Due to adverse weather conditions in 2012 (drought, severe spring frost), overall crop yields decreased relative to the preceding year. Total production in 2012 was as follows: 868,139 tonnes of cereals, 646,545 tonnes of fodder crops, 528,487 tonnes of vegetable crops, 203,937 tonnes of fruit and 8,764 tonnes of industrial crops.

1.5.5. Forestry

Bosnia and Herzegovina has seen an increase in forested areas of 6,730 ha during the 2010–2011 period and of 11,321 ha during the 2011–2012 period (18,051 ha in total). This is an increase of 0.7% relative to the year 2010. The total surface area of forests in BiH in 2012 was 2,573,113 ha. This may be expected to result in the increased importance of forests in terms of capturing existing carbon dioxide from the atmosphere.

At the same time, the volume of wood harvested in BiH was significantly higher in 2011 and 2012: the total gross volume of wood harvested in 2011 was more than 397,394 m^3, while the total volume harvested in 2012 was 411.027 m^3 (13,633 m^3 more than in 2011). Compared to the total volume harvested in 2010, this is an increase in the intensity of logging in the year 2012 of 8.29%. Newly afforested areas in Bosnia and Herzegovina amounted to 2,372 ha in 2010, 2,611 ha in 2011, and 1,925 ha in 2012. With regard to afforestation in Bosnia and Herzegovina, there are problems with record keeping and representation of afforested areas. More specifically, the afforested areas are officially recorded a year after seedlings are planted (as part of the acceptance procedure). At this point, most afforested land is recorded as "successfully afforested". However, due to lack of funds and insufficient attention to newly afforested areas (which are left to be outgrown by competitive vegetation), within five to ten years most of these areas are completely swallowed up by weeds, and afforestation efforts ultimately fail. Therefore, the information indicating an increase in the forested areas in Bosnia and Herzegovina should be should be used with caution.

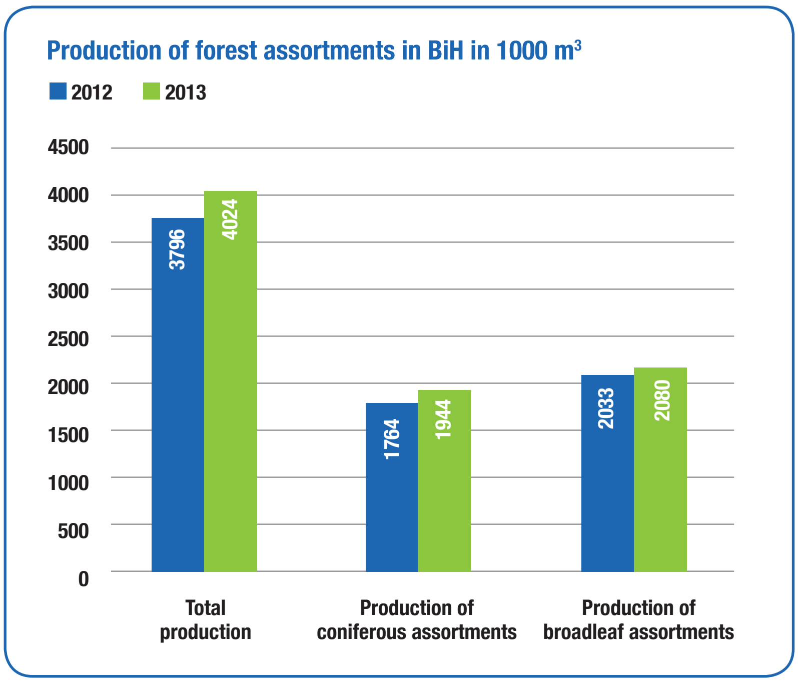
	Forest exploitation /thousand m^3/					Artificial afforestation /ha/			
	Gross volume of timber felled			Hardwood	Softwood	Classical			Plantation
	Total	State-owned	Privately-owned			Total	Hardwood	Softwood	
2010	2,550,341	2,314,476	235,865	1,522,681	1,027,660	1,152	214	938	/
2011	2,837,735	2,554,984	282,751	1,649,223	1,197,512	1,253	184	1,069	/
	2,853,368	2,557,554	295,814	1,584,677	1,268,691	918	110	808	/

Table 6a: Felling and afforestation volumes in the Republic of Srpska

	Forest exploitation /thousand m^3/					Artificial afforestation /ha/			
	Gross volume of timber felled			Hardwood	Softwood	Classical			Plantation
	Total	State-owned	Privately-owned			Total	Hardwood	Softwood	
2010	2,406,000	2,316,000	90,000	269,000	577,000	1,220	241	979	-
2011	2,516,000	2,397,000	118,000	293,000	623,000	1,358	268	1090	-
2012	2,514,000	2,445,000	68,000	304,000	623,000	1,007	199	808	-

Table 6b: Felling and afforestation volumes in the Federation of Bosnia and Herzegovina

One of the most important indicators in forestry linked to climate change is the number and size of areas damaged by forest fires. There is a significant difference in the size of forests affected by forest fires in 2010 (only 2,217 ha) and in 2012 (76,619 ha). The area of forests affected in 2012 indicates significant damage to forested areas. Damage caused by forest fires is multi-faceted and is reflected primarily in carbon emissions resulting from combustion of wood in those forests, the cost of fire fighting and subsequent rehabilitation of the affected areas, as well as the loss of the forested areas and future accumulation of CO_2 in these areas. Therefore, activities aimed at prevention of fire damage play a significant role in BiH.



Total production of forest assortments in Bosnia and Herzegovina in 2013 amounted to 4,024,171 m^3,[22] an increase of 6.00% over the preceding year. Production of coniferous (softwood) assortments increased by 10.24%, and production of broadleaf (hardwood) assortments increased by 2.32%. During the same period, the production of softwood logs increased by 6.77%, and the production of hardwood logs increased by 4.88%. The highest growth compared to the year 2012 was recorded in production of cord broadleaf wood (38.20%).

Chart 5: Production of forest assortments in 1000 m^3 in 2012 and 2013

1.5.6. Waste management

The estimated quantity of municipal waste generated in 2012 was 1,302,866 tonnes; i.e., 340 kg of waste per capita per year or 0.9 kg per capita per day. In 2012, the amount of municipal waste collected by public waste collection services was 964,121 tonnes, which was 6.2% less than in 2011. The percentage of the population covered by waste collection services averages 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 (86.5%), collected municipal waste separated at the source (7.3%), waste from gardens and parks (4.8%), and packaging waste (1.4%)[23].

22 First Release: Production, Sales and Stocks of Forest Assortments in Bosnia and Herzegovina in 2013, BHAS, 2014
23 First Release: Environment, year V, number 1, BHAS, 2013

The total amount of waste disposed of at landfills in 2012 was 925,740 tonnes, 13.8% less than in 2011. Data on flows of waste disposed of at landfills confirm the practice of full reliance on permanent disposal of municipal waste at landfills.

There are currently four operational regional landfills in BiH (Smiljevići Sarajevo, Mošćanica Zenica, EkoDep Bijeljina, DepOt Banja Luka). It is particularly important to note 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.

1.5.7. Water management

The territory of BiH covers two main river basins: the Black Sea 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%). 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 rivers of Sava, Vrbas, Bosna and Drina. 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, instead of two water agencies in RS (one for the Sava River basin and one for Trebišnjica River basin), one public institution was established to oversee water management in the Republic of Srpska: “Vode Srpske.”

In 2012, total water intake was 328,756,000 m^3, which is 0.4% less than in 2011. In the structure of total water intake, 46.7% of water came from underground sources, 36.1% from surface sources, 14.7% from river courses, 0.8% from reservoirs, and 1.7% from lakes. In 2012, the amount of water delivered from public water supply systems was 150,278,000 m^3, which is 0.36% less than in the preceding year. The structure of water consumption shows that households were the largest water consumers, consuming 77.2% 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.

1.5.8. Health

As of 2012, the leading causes of death in Bosnia and Herzegovina were still circulatory system diseases (50.62% in RS and 53.9% in FBiH) and malignant neoplasms (19.7% in RS and 19.7% in FBiH). In other words, nearly three quarters of all deaths could be grouped into these two categories. Respiratory system diseases ranked among the five leading causes of death. 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 impacts caused by climate change (e.g. reduced food yield due to drought or flooding, shortage of safe drinking water, etc.).

1.5.9. Education

In the 2012/2013 school year, there were 471,543 pupils and students in Bosnia and Herzegovina.[24] Of these, 304,881 pupils attended 1,881 primary schools, 3.7% fewer than in the preceding school year; and 166,662 students attended 309 secondary schools, 2.1% more than in the preceding school year. There are seven public universities (with 95 schools) and numerous private universities with a total of approximately 116,000 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, whereas in FBiH, education is regulated by legislation at the cantonal level.

At all levels of education, there is a noticeable lack of content covering environmental issues, and climate change issues are not integrated into curricula.

1.6. Other relevant information

1.6.1. The FBUR preparation process

The competent state institution responsible for the preparation of this report is the UNFCCC Focal Point of Bosnia and Herzegovina; i.e., the Ministry of Spatial Planning, Civil Engineering and Ecology of the Republic of Srpska, while the overall coordination of the project is the responsibility of the Project Board for the Preparation of FBUR, consisting of one representative from each of the following institutions: Ministry of Spatial Planning, Civil Engineering and Ecology of the Republic of Srpska, Ministry of Foreign Trade and Economic Relations of BiH, Ministry of Environment and Tourism of FBiH, and the Brčko District Government. The Project Board provided strategic guidance to the expert team working on the development of the FBUR, while the United National Development Program (UNDP) provided technical and organisational support to the BiH authorities.

The completion of the GHG emission inventory during the preparation of FBUR, as with the INC and SNC, was the result of the work of a number of individuals and institutions that were directly or indirectly involved in drawing up the Report and Communications. A key role in compiling the GHG inventory under the FBUR belonged to the Federal Hydrometeorological Institute of FBiH and the Republic Hydrometeorological Institute of RS. Wherever possible, data were collected not only from the Agency for Statistics of BiH and entity institutes of statistics, but also from the producers of emissions themselves.

Information on activities aimed at climate change mitigation and GHG emission reduction were collected from relevant ministries and institutions responsible for the implementation of these activities.

During the preparation of the FBUR, capacities of domestic institutions have been built in order to enable them to take a more active role in the preparation of the next reports.

1.6.2. Constraints and gaps

With regard to the review of the constraints and barriers related to institutional, legal, financial, technical and human capacity affecting the implementation of commitments under the UNFCCC that was provided in the SNC, progress has been observed only in the area of capacity building for individuals and institutions whose experts were trained and gained experience through their involvement in the preparation of the inventory. This document does not recapitulate information about the constraints and gaps as presented in SNC, as those findings are still valid. Instead, it focuses on the needs that are relevant to the preparation of the biennial greenhouse gas inventory.

Bosnia and Herzegovina does not have a clearly defined system for data collection and processing, quality assurance and control of input data, or a reporting and monitoring system. Such a system has not yet been

24 First Release: Education Statistics, year VIII, number 1, BHAS 2013

established due to lack of proper legal regulations that would fully define competences and responsibilities in this area. Also, there is no clear definition as to the competences and responsibilities of existing institutions involved in the preparation of the inventory. Furthermore, these institutions do not have sufficient technical equipment (in terms of appropriate software and hardware). In addition to being understaffed, relevant institutions (ministries, agencies, institutes) are faced with relatively low quality of training for their personnel working in this area.

Key shortcomings identified in the preparation and processing of data for the GHG inventory under the FBUR are as follows:

- missing data;
- incompatibility between the existing data and those required under the IPCC methodology;
- lack of legislative requirements on the type and scope of data to be collected;
- insufficient knowledge and experience regarding treaty obligations;
- lack of permanent funding sources;
- difficulties in ensuring data quality.

Recommendations for improvements in the GHG inventory are as follows:

- ensure implementation of institutional responsibilities for the systematic compilation of national GHG inventories;
- build capacity of the BiH Agency for Statistics and the entity institutes of statistics in data collection and statistics that are necessary for compiling GHG emissions inventories;
- increase the number of personnel and the amount of funding for the collection of basic data and emission data;
- ensure regular publication of national emission statistics;
- increase funding 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;
- provide continued investment in hardware and training of personnel for data collection, measurement and management with the aim of improving the quality of data on emissions associated with natural gas, waste and industrial processes;
- issue the necessary authorisations for the creation of individual emission databases in relevant institutions; and
- increase public awareness regarding problems associated with climate protection and the potential consequences of climate change.

Within entities, plant and pollution registers are maintained by ministries in charge of the environment. In FBiH, this responsibility is additionally shared between the entity ministry and environmental ministries at the cantonal level, which undoubtedly complicates the process of preparing the national GHG inventory in Bosnia and Herzegovina.

There is currently no environmental database or monitoring system in place that would form a basis for the preparation of the GHG inventory. In BiH practice, there is still no clear model of information flow between different sectors, competencies 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.

Pollutant Release and Transfer Registers (PRTRs) were created in the entity ministries responsible for the environment, and the necessary hardware and software were provided through the EU/CARDS project in 2007. Both entities have adopted regulations on the registration of plants and polluters. The reports submitted by companies to the authorities in charge of the environment generally lack a significant portion of the data. In this regard, certain measures need to be taken in the near future to improve the situation in this area.

One of the necessary preconditions for reducing the impact of climate change is capacity strengthening; i.e., institutional and staff training and professional development. In addition, it is necessary to enhance meteorological monitoring through further modernisation of the network of meteorological stations by installing automatic weather stations and linking them with hydrological stations in an automatic monitoring system, especially for the purpose of automatic monitoring and computer oversight of the situation in river basins as well as water use planning for hydropower, drinking water, irrigation, and other uses.

Another current problem is a lack of knowledge on the part of the majority of institutions responsible for establishment of the GHG inventory about BiH's commitments under the UNFCCC and Kyoto Protocol. Complementary activities amongst three UN Conventions – climate change, biodiversity and desertification – are necessary to harmonise activities in BiH, but they are also an excellent opportunity for international cooperation that would help BiH in achieving sustainable development.

As the implementation of various forms of research and construction of a climate change monitoring system are at a very low level, their implementation requires appropriate support. In this regard, 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. In parallel with developing research capacity, it is necessary to work on promoting understanding of the importance of climate change. It is especially important to ensure sustained functionality and efficiency of the established system and capacities. Capacity building in climate change impacts monitoring represents a priority; hence, it is necessary to undertake capacity building measures to manage development in the context of evident climate change.

For the purpose of high-quality data collection on climate change, it is essential to ensure effective coordination among relevant institutions, such as hydro-meteorological and statistical institutes, forestry and agricultural institutes and other institutions/ companies that are involved in emissions measurements and water and air quality monitoring.

To streamline the process of compiling the GHG inventory in Bosnia and Herzegovina, the following key needs have been extracted from the shortcomings listed above:

- **Technical assistance needs**: Procurement and linking of automatic monitoring stations; procurement of necessary hardware and software; transfer of knowledge – training and technical assistance for effective fulfilment of commitments under the UNFCCC; establishment of a single information system and GHG inventory; introduction of measures for data quality assurance and control; and increased, sustained funding for the collection of basic data and emission data.

- **Capacity building needs**: Building the capacity of the BiH Agency for Statistics and entity statistical institutes in data collection; building the capacity of hydro-meteorological institutes in preparation of the inventory; training for employees in the energy, industry, agriculture, forestry and other sectors involved in emissions measurement and reporting; development of regulations mandating data provision and collection; development and implementation of sectoral strategies and plans; support for strengthening research capacity to deal with the problem of climate change; improvement of PRTR operations in legal entities and authorities through training and education; and participation in international activities related to GHG inventories.

2. CALCULATION OF GREENHOUSE GAS EMISSIONS

2.1. Methodology

The inventory of greenhouse gas emissions in this Report covers the years 2010 and 2011. It has been compiled in line with the UNFCCC Biennial Update Reporting Guidelines for Parties not included in Annex I to the Convention, CoP Decision (2/CP.17, Annex III, Chapter 3).

The methodology used for calculating emissions in this Report is the methodology of the Intergovernmental Panel on Climate Change (IPCC) defined by the Convention, on the basis of the reference manual *The Revised IPCC Guidelines for National Greenhouse Gas Inventories* of 1996, *IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry* of 2003, and *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Emission Inventories* of 2000. The database was formed using the Non-Annex I Inventory Software (NAAIS) developed by the UNFCCC Secretariat for Parties not included in Annex I to the Convention.

The knowledge acquired, positive practice and data collected, together with calculations of GHG emissions for INC and SNC, formed a solid basis for the estimation of greenhouse emissions in this Report.

Quality control of the emissions inventory, which includes a careful verification of the accuracy of data, emission factors and an estimation of uncertainty in line with IPCC guidelines, was done by an international expert who was not involved in the preparation of the inventory.

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.

2.2. Results of 2010–2011 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.

Carbon dioxide (CO_2) is one of the most important greenhouse gases. It 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).

Calculations of emissions are given in the reporting tables in the format specified in Decision 17/CP.8: Guidelines for the Preparation of National Communications from Parties not Included in Annex I to the Convention. When appropriate data are not available; i.e., when emissions are not estimated, the abbreviation NE (*not estimated*) is used in the reporting tables. When emissions do not occur, the abbreviation NO (*not occurring*) is used.

As greenhouse gases contribute differently to the greenhouse effect, the emission of each gas is multiplied by its Global Warming Potential (GWP) in order to allow the aggregation and total overview of emissions in Gg CO_2e. For the purposes of this BUR, the following gases are important:

Greenhouse gas	Global warming potential
Carbon dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous oxide (N_2O)	310

Table 7. Global warming potentials for CO_2, CH_4 and N_20 for a period of 100 years

Tables 8 and 9 below show the total GHG emissions for 2010 and 2011.

Year	2010							
Greenhouse gas source and sink categories	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOCs (Gg)	SO_x (Gg)
Total national emissions and removals	**22,402.02**	**6,476.02**	**171.10**	**6.50**	**84.55**	**128.67**	**22.61**	**461.12**
1. Energy	**20,534.31**	**NE**	**36.05**	**0.26**	**84.24**	**119.71**	**21.58**	**459.43**
A. Fuel combustion (sectoral approach)	20,534.31		2.22	0.26	84.24	119.71	21.58	459.43
1. Energy Industries	15,151.37		0.17	0.21	46.20	3.11	0.79	406.73
2. Manufacturing industries and construction	1,331.44		0.13	0.02	3.98	1.76	0.24	29.84
3. Transport	3,222.98		0.49	0.03	33.24	101.36	19.21	4.93
4. Other sectors	828.52		1.43	NE	0.82	13.48	1.35	17.94
5. Other (please specify)	NE		NE	NE	NE	NE	NE	NE
B. Fugitive emissions from fuels	NE		33.84		NE	NE	NE	NE
1. Solid fuels			33.84		NE	NE	NE	NE
2. Oil and natural gas			NE		NE	NE	NE	NE
2. Industrial processes	**1,867.71**	**NE**	**NE**	**NE**	**0.32**	**8.96**	**1.02**	**1.69**
A. Mineral products	708.23				NE	NE	0.10	0.29
B. Chemical industry	NE		NE	NE	0.08	0.03	0.02	0.11
C. Metal production	1,159.49		NE	NE	0.16	8.64	0.02	0.94
D. Other production	NE		NE	NE	0.08	0.28	0.89	0.36
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)	NE		NE	NE	NE	NE	NE	NE
2. **Solvent and other product use**	**NE**			**NE**			**NE**	

3. Agriculture			**46.27**	**5.94**	**NE**	**NE**	**NE**	**NE**
A. Enteric fermentation			40.05					
B. Manure management			6.22	0.76			NE	
C. Rice cultivation			NO				NO	
D. Agricultural soils				5.19			NE	
E. Prescribed burning of savannahs			NO	NO	NO	NO	NO	
F. Field burning of agricultural residues			NE	NE	NE	NE	NE	
G. Other (please specify)			NE	NE	NE	NE	NE	
5. Land-use change and forestry (sinks)	**NE**	**-6,476.02**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A. Changes in forest and other woody biomass stocks	NE	-6,476.02						
B. Forest and grassland conversion	NE	NE	NE	NE	NE	NE		
C. Abandonment of managed lands		NE						
D. CO_2 emissions and removals from soil	NE	NE						
E. Other (please specify)	NE	NE	NE	NE	NE	NE		
6. Waste			**88.77**	**0.30**	**NE**	**NE**	**NE**	**NE**
A. Solid waste disposal on land			85.14		NE		NE	
B. Waste-water handling			3.63	0.30	NE	NE	NE	
C. Waste incineration					NE	NE	NE	NE
D. Other (please specify)			NE	NE	NE	NE	NE	

Table 8: Total GHG emissions in 2010 (Gg)

Year	**2011**							
Greenhouse gas source and sink categories	**CO_2 emissions (Gg)**	**CO_2 removals (Gg)**	**CH_4 (Gg)**	**N_2O (Gg)**	**NO_x (Gg)**	**CO (Gg)**	**NMVOCs (Gg)**	**SO_x (Gg)**
Total national emissions and removals	**25,297.36**	**-6,174.00**	**177.38**	**6.69**	**93.11**	**133.21**	**24.95**	**530.96**
1. Energy	**23,248.42**	**NE**	**38.56**	**0.30**	**92.74**	**123.42**	**22.17**	**529.02**
A. Fuel combustion (sectoral approach)	23,248.42		2.25	0.30	92.74	123.42	22.17	529.02
1. Energy Industries	17,558.13		0.18	0.25	53.61	3.61	0.91	472.65
2. Manufacturing industries and construction	1,492.20		0.14	0.02	4.40	1.79	0.25	30.98
3. Transport	3,274.03		0.49	0.03	33.81	102.84	19.49	5.03
4. Other sectors	924.06		1.44	0.01	0.93	15.18	1.52	20.36
5. Other (please specify)	NE		NE	NE	NE	NE	NE	NE
B. Fugitive emissions from fuels	NE		36.31		NE	NE	NE	NE
1. Solid fuels			36.31		NE	NE	NE	NE
2. Oil and natural gas			NE		NE	NE	NE	NE
2. Industrial processes	**2,048.95**	**NE**	**NE**	**NE**	**0.37**	**9.79**	**2.78**	**1.94**
A. Mineral products	781.52				NE	NE	0.10	0.27
B. Chemical industry	NE		NE	NE	0.08	0.03	0.01	0.11
C. Metal production	1,267.43		NE	NE	0.18	9.32	0.02	1.01

D. Other production	NE		NE	NE	0.12	0.44	2.65	0.55
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)	NE		NE	NE	NE	NE	NE	NE
3. Solvent and other product use	**NE**			**NE**			**NE**	
4. Agriculture			**45.20**	**6.08**	**NE**	**NE**	**NE**	**NE**
A. Enteric fermentation			39.15					
B. Manure management			6.04	0.73			NE	
C. Rice cultivation			NO				NO	
D. Agricultural soils				5.36			NE	
E. Prescribed burning of savannahs			NO	NO	NO	NO	NO	
F. Field burning of agricultural residues			NE	NE	NE	NE	NE	
G. Other (please specify)			NE	NE	NE	NE	NE	
5. Land-use change and forestry (sinks)	**NE**	**-6,174.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A. Changes in forest and other woody biomass stocks	NE	-6,174.00						
B. Forest and grassland conversion	NE	NE	NE	NE	NE	NE		
C. Abandonment of managed lands		NE						
D. CO_2 emissions and removals from soil	NE	NE						
E. Other (please specify)	NE	NE	NE	NE	NE	NE		
6. Waste			**93.63**	**0.30**	**NE**	**NE**	**NE**	**NE**
A. Solid waste disposal on land			89.70		NE		NE	
B. Waste-water handling			3.93	0.30	NE	NE	NE	
C. Waste incineration					NE	NE	NE	NE
D. Other (please specify)			NE	NE	NE	NE	NE	NE

Table 9: Total GHG emissions in 2011 (Gg)

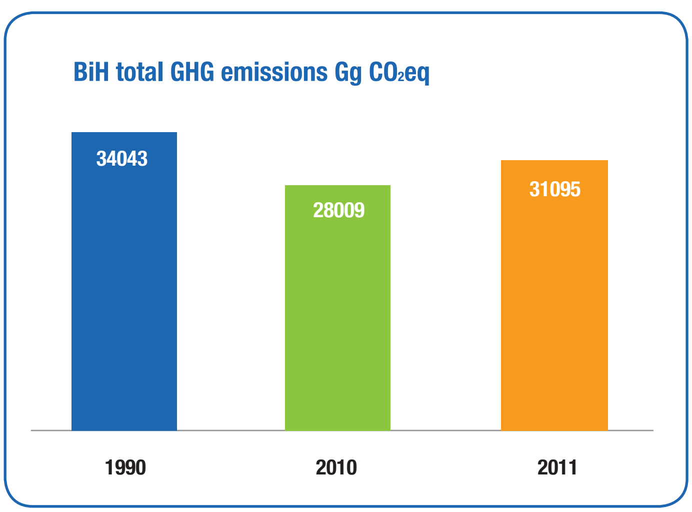


Chart 6 below shows overall CO_2e emissions in 2010 and 2011. Emissions in the year 1990 are shown for comparison.

Chart 6: Total GHG emissions by years (Gg CO_2eq)

In comparison with 1990, when emissions totalled 34,043 Gg CO_2eq, total emissions of CO_2eq amounted to 28,009 Gg CO_2eq in 2010 and 31,095 Gg CO_2eq in 2011, or 82% and 91% of 1990 emissions, respectively.

GHG source and sink category	2010 total emissions CO_2eq (Gg)	2011 total emissions CO_2eq (Gg)
Energy	21,371.07	24,151.10
Industrial processes	1,867.71	2,048.95
Solvent and other product use	0.00	0.00
Agriculture	2,813.60	2,835.33
LULUCF	-6,476.02	-6,174.00
Waste	1,956.44	2,059.93
Other	0.00	0.00
Total excluding LULUCF	28,008.83	31,095.30
Total including LULUCF	21,532.80	24,921.30

Table 10: Total GHG emissions in 2010 and 2011 by sector (GgCO_2eq)

Percentage breakdown of total emissions by sector is shown in Charts 7 and 8 below. The most significant source of CO_2 emissions is definitely the energy sector, which in 2010 contributed 76.3% of total CO_2eq emissions, followed by agriculture (10.05%), waste (6.99%), and industrial processes (6.67%). Almost the same share of emissions by sector was seen in 2011.

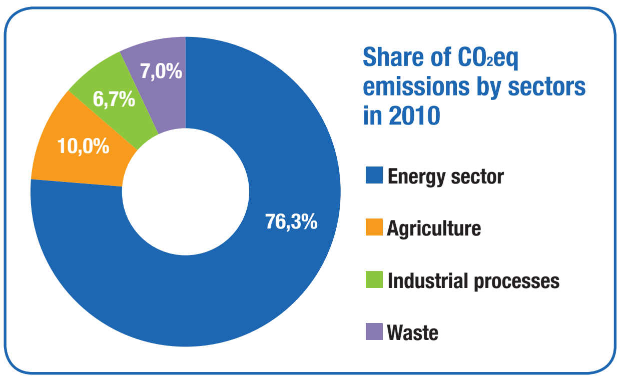


Chart 7: Overall emissions by sector (%), 2010

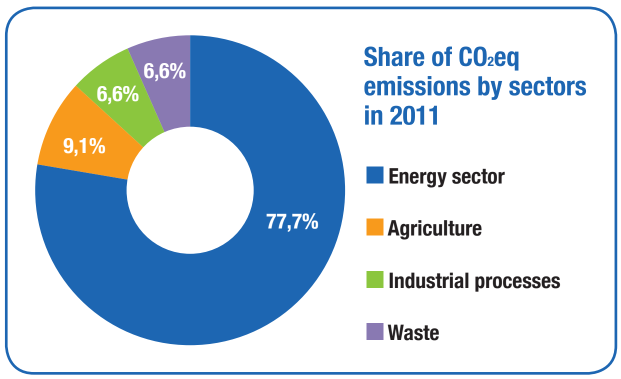


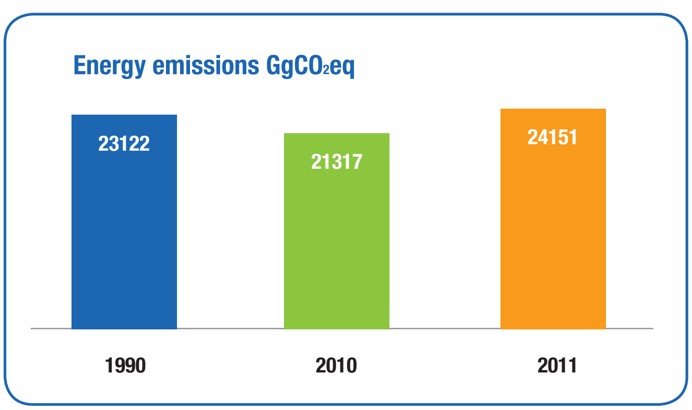
Chart 8: Overall emissions by sector (%), 2011

2.3. Emission of carbon dioxide (CO_2) by sector

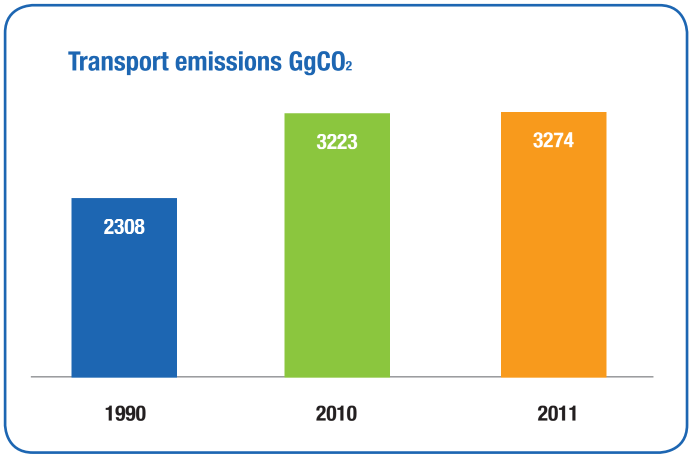
2.3.1. Energy

The main source of CO_2 is certainly the energy sector, which contributes more than 75% 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. Carbon dioxide emissions from the energy sector are dominant for the period under review, amounting to 92% of total CO_2 emissions in both 2010 and 2011.

Chart 9: Emissions from the energy production sector by year (GgCO_2)



Two of the most carbon-intensive energy sub-sectors are energy conversion (thermal power plants, heating plants) and industrial fuel combustion; in both 2010 and 2011, these subsectors contributed more than 80% of total CO_2 emissions from the energy production sector. Most of the CO_2 emissions in energy conversion result from fuel combustion in thermal power plants.



The share of the transport subsector (road transport) in emissions from the energy sector rose from 9% in 1990 to 15% in 2001. As for the period under review, in 2010 the share of the transport subsector was 15%, while in 2011 it dropped to 14%. This drop is due to increased production in the energy sector in 2011.

Chart 10: Emissions from the transport subsector for selected years ($GgCO_2$)

It is important to note that the number of vehicles in road traffic increased by approximately 80% compared to the baseline year of 1990.

2.3.2. 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

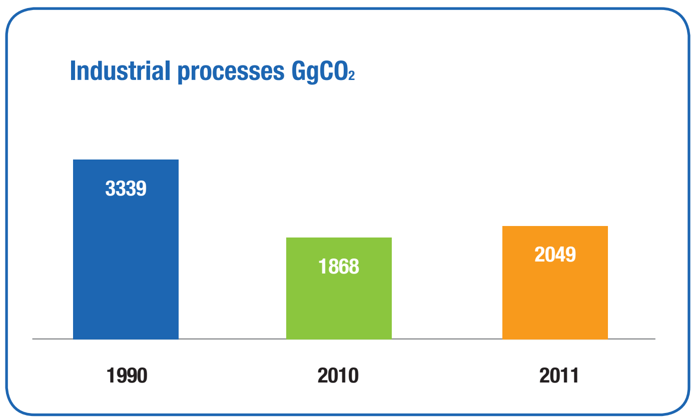


Chart 11: Emission from industrial processes by year ($GgCO_2$)

Chart 11 clearly shows the trend of emissions from industrial processes between 1990 and 2011. Carbon dioxide emissions in 1990 totalled 3,339 Gg CO_2, while in 2010 and 2011 they were a mere 1,868 Gg CO_2 and 2,049 Gg CO_2, respectively. Comparison of these years shows that emissions in 2010 and 2011 were only 56% and 61%, respectively, of the 1990 base year emissions. This negative trend clearly indicates the slow post-war recovery of the industry sector.

Although some anecdotal sources of HFC, PFC and SF_6 have been identified in Bosnia and Herzegovina, there are no data whatsoever on their emissions.

2.3.3. Sinks – LUCF

As mentioned above, greenhouse gas sinks occurs when these gases are absorbed (e.g. absorption of CO_2 due to an increase in forest wood biomass), 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 years 1991 and 2010/2011. According to the data collected, the results of the calculation indicate that forests in BiH represent a significant CO_2 sink, although a downward trend in sink capacities has been observed in recent years.

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 3,217.85 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 7,424 Gg CO_2eq, and for the years 2010 and 2011 is 6,476 and 6,174 Gg CO_2eq, respectively.

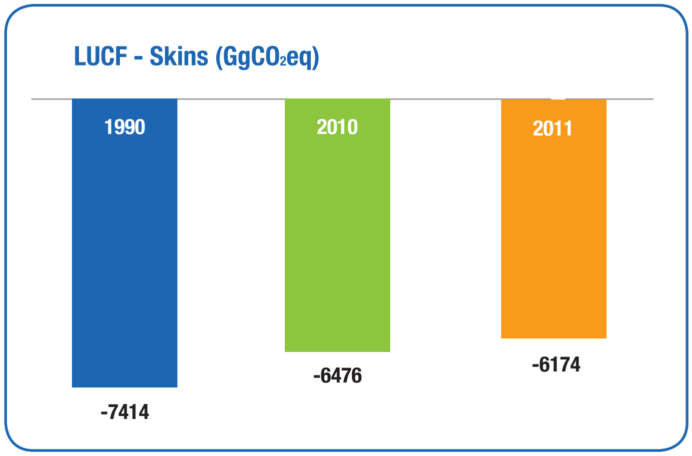


Chart 12: Sinks (GgCO_2eq)

Given the limited availability of data, data for the calculation of sinks and for 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. Emissions of methane (CH_4)

Chart 13 below shows methane (CH_4) emissions by sector. The main sources of methane in Bosnia and Herzegovina are agriculture (cattle breeding), fugitive emissions from coalmines, and waste disposal.

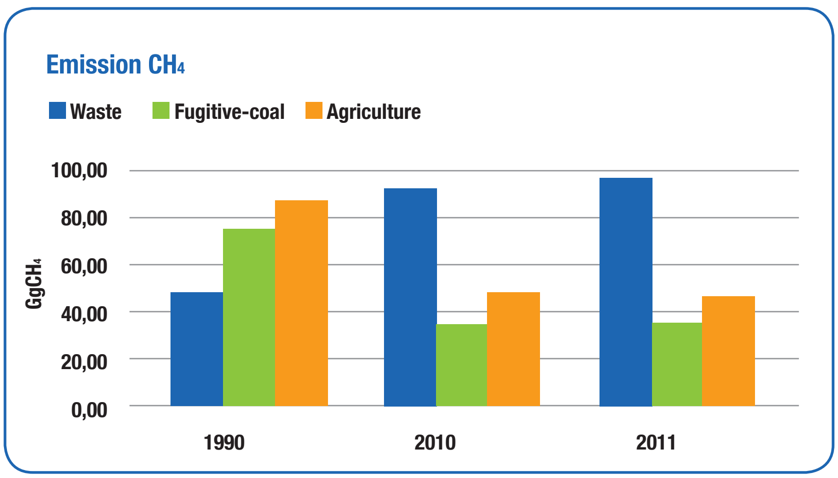


Chart 13: Methane emissions by sector (GgCH_4)

Methane is a direct product of the 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).

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.

Methane emissions from landfills have seen an increase of 90% from the base year 1990. The increase in methane emissions is partly a consequence of increased waste generation as well as change of the IPCC emission factor. Specifically, the base year calculation uses an emission factor for landfills less than 5 metres deep, while the calculations for 2010 and 2011 use factors for landfills deeper than 5 metres.

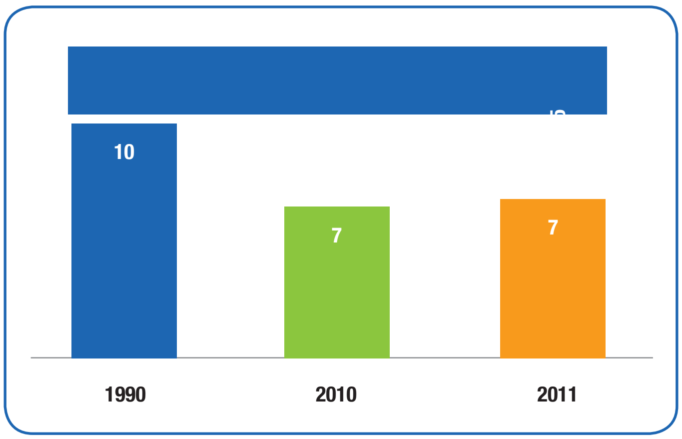
Fugitive emissions from coal have decreased compared to the base year 1990. According to the data, this is due to increased excavation of coal from surface mines in BiH, because the emission factor for surface mines is lower than the one for underground coalmines.

The reduction in methane emissions from agriculture is the consequence of a decrease in agricultural activities compared to the base year 1990.

Total CH_4 emissions from agriculture, waste disposal and fugitive emissions in 2010 amounted to 171 Gg CH_4, or 3,593 Gg CO_2eq, and in 2011 it totalled 177 Gg CH_4, or 3,725 Gg CO_2eq. Analysis indicates that in 2010 and 2011, methane was responsible for 13% and 12%, respectively, of total emissions, and it is considered a key source of greenhouse gas emissions.

2.5. 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 artificial fertilisers, nitrogen from animal manure, legume and soy farming (nitrogen fixation), and nitrogen from crop residues and peat-bog cultivation.

Chart 14: N_2O emissions for selected years (Gg N_2O)

In 1990, emissions from industry contributed only 10% of total N_2O emissions, which amounted to 10 Gg N_2O. Given the reduced rate of N_2O emissions from industry in 2010 and 2011, emissions of N_2O in this sector are almost negligible. On the other hand, emissions of N_2O from agriculture contribute almost 7% of total emissions of CO_2eq in Bosnia and Herzegovina, and they can be considered a key source of GHG emissions.

2.6. Emission of indirect greenhouse gases

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.

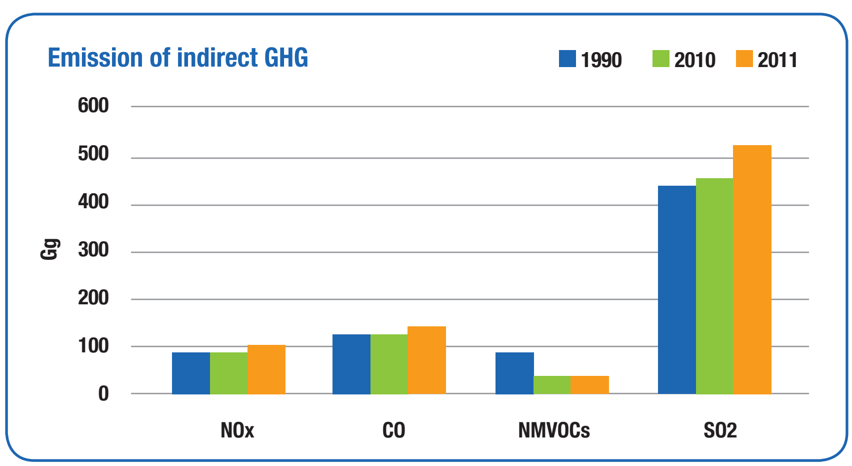


Chart 15: Emissions of indirect GHGs

Emissions of sulphur dioxide (SO_2) have followed the trend of CO_2 emissions, but it should be emphasised that a rise in SO_2 emissions in 2010 and 2011 was the consequence of increased fuel combustion in thermal power plants. The dominant contribution to SO_2 emissions comes from fuel combustion in the power production sector, which in 1990 amounted to 97.3% of these emissions, and in 2010 and 2011 around 99%.

This difference is the consequence of reduced emissions from industrial processes compared to the baseline year 1990. Similar trends are true of indirect greenhouse gases carbon monoxide (CO), nitrogen oxide (NO_X) and non-methane volatile organic compounds (NMVOC).

2.7. Key emissions sources

Analysis of key emissions sources for the year 2010

Key category	Gas	CO_2-eq (Gg)	Level assessment	Cumulative total
1A1 Energy Industries	CO_2	15,151.37	54.09%	54.09%
1A3b Road Transportation	CO_2	3,205.33	11.44%	65.53%
4D Agricultural Soils	N_2O	1,607.65	5.74%	71.27%
6A Solid Waste Disposal on Land	CH_4	1,787.95	6.38%	77.65%
1A2 Manufacturing Industries and Construction	CO_2	1,331.44	4.75%	82.40%
2C1 Iron and Steel Production	CO_2	993.50	3.55%	85.95%
4A Enteric Fermentation	CH_4	841.02	3.00%	88.95%
1B1a Coal Mining (fugitive emissions)	CH_4	710.59	2.54%	91.49%
1A4b Residential	CO_2	569.57	2.03%	93.52%
2A1Cement Production	CO_2	474,92	1,69%	95,21%

Table 11. Key sources of emissions by Common Reporting Format (CRF) categories – 2010

Analysis of key emissions sources for the year 2011

Key category	Gas	CO_2-eq (Gg)	Level assessment	Cumulative total
1A1 Energy Industries	CO_2	17,558.13	56.47%	56.47%
1A3b Road Transportation	CO_2	3,262.08	10.49%	66.96%
4D Agricultural Soils	N_2O	1,660.40	5.34%	72.30%
6A Solid Waste Disposal on Land	CH_4	1,883.61	6.06%	78.36%
1A2 Manufacturing Industries and Construction	CO_2	1,492.20	4.80%	83.16%
2C1 Iron and Steel Production	CO_2	1,095.57	3.52%	86.68%
4A Enteric Fermentation	CH_4	822.23	2.64%	89.32%
1B1a Coal Mining (fugitive emissions)	CH_4	762.47	2.45%	91.77%
1A4b Residential	CO_2	567.33	1.82%	93.59%
2A1Cement Production	CO_2	446.64	1.44%	95.03%

Table 12. Key sources of emissions by Common Reporting Format (CRF) categories – 2011

Key emissions sources were shown by CRF categories and clearly presented in the above tables. The total amount of emissions from key sources covered for 2010 was 95.21%. For the year 2011, 95.03% of emissions were covered.

A major share of these emissions comes from public electricity and heat production (1.A.1.a), followed by road transport (1.A.3.b) and categories 4.D, 6.A, etc.

2.8. Uncertainty estimate of calculations

The uncertainty estimate of calculations is one of the most important elements of a national emissions 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 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 the individual uncertainties of two elements of emissions calculations:

- uncertainties associated with emission factors (from published references or measurements); and
- uncertainties associated with activity data.

2.8.1. 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 oxidised carbon (typical IPCC value), and – in the case of non-energy fuel consumption – on the share of carbon stored in a product (typical IPCC value).

The energy balance 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.

Energy balances for Bosnia and Herzegovina were not prepared for the period 2010–2011. The report therefore used consumption estimates in the balances of entity governments and Brčko District as well as data provided directly by energy utilities.

Considering all the given circumstances, the estimated total uncertainty for the energy sector data is different for the wartime years and the first post-war years. This uncertainty is estimated to be ±8% and has somewhat improved since the release of the SNC, which included the compilation of an inventory for the period 1991–2001.

Other data required for calculations, such as carbon emission factors, the share of oxidised carbon and the share of stored carbon, were taken from IPCC Guidelines (*Revised 1996 IPCC Guidelines for National GHG Inventories*). In the IPCC Guidelines, the stated values are calculated with an uncertainty of ±5%. Our estimates of this uncertainty are somewhat higher at ±8%, mainly due to the fact that BiH uses more than ten types of coal with different and variable carbon values. In addition, inefficiencies in the combustion process are assumed, which can result in ash or soot that remains unoxidised for longer periods of time. All of these factors contribute to the uncertainty in the calculation of CO_2 emissions for solid fuels.

The uncertainty of activity data for liquid fuels is ±12%, and the uncertainty of emission factors (in line with IPCC Guidelines) is ±5%. The uncertainty level of activity data is 12% due to the absence of robust data on the quantity of liquid fuels that BiH imports.

IPCC uncertainty estimates were used for natural gas (±5% for both activity data and emission factors) as they were in the SNC, because the records for natural gas consumption were of sufficient quality.

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	12	5	13.00
1A	Fuel combustion – natural gas	CO_2	5	5	7.07

Table 13: Estimated uncertainty in the calculation of CO_2 emissions for 2010 and 2011

Naturally, it should be borne in mind that CO_2 emissions from the energy sector (CRF category 1.A…) account for more than 90% of total emissions.

2.8.2. 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. The verification process 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.

The inventory experts took the following steps to verify the calculations made in the BUR:

- After receiving activity data from various sources, they performed data checks and additional analyses;
- They used emission factors in accordance with 1996 IPCC Guidelines;
- They used the CORINAIR methodology and COLLECTER III software for data verification;
- In the energy sector, they used both the sectoral approach and the reference approach for the verification of the national estimates of CO_2 emissions from fuel combustion for 2010/2011.

Data calculated for 2010/2011 were also compared to statistical data from the International Energy Agency (IEA). Data are shown in the table below.

	2010 BiH	2010 IEA	2011 BiH	2011 IEA
Reference Approach	20.65	20.70	23.43	23.60

Table 14: Comparison of calculations (*Reference Approach*) — (million tonnes of CO_2)

The difference between the calculations for the BUR and IEA calculations is less than 0.1%. The inventory experts also compared data on CO_2 emissions for the year 2011 by using COPERT IV software, and the resulting difference is also very small (0.1%). This difference is accounted for by the fact that the CO_2 emissions calculated from road traffic for BiH in 2011 totalled 3.25 million tonnes, while the corresponding IEA calculation totalled 3.40 million tonnes.

3. MITIGATING CLIMATE CHANGE IMPACTS

The following section on the reduction of GHG emissions; i.e., climate change mitigation, in the First Biennial Update Report of Bosnia and Herzegovina under the United Nations Framework Convention on Climate Change is based on the Biennial Update Reporting Guidelines for Parties not included in Annex I to the Convention, CoP Decision 17 (2/CP.17, Annex III, Chapter 4).

Along with the necessary information about climate change mitigation activities in tabular form, this section includes an overview of each sector and mitigation scenarios modelling possible GHG emissions pathways until 2040.

Specific modelling involved a quantitative evaluation of time-series GHG emissions and considered three development scenarios: S1 – a baseline ("business as usual") scenario, S2 – a scenario with partial implementation of mitigation actions, and S3 – an advanced scenario assuming implementation of a comprehensive set of mitigation actions. Initial data considered in the three scenarios were taken from the year 2010, and calculations of greenhouse gas emissions were made until 2040. This section will also look at the financial effects of the above scenarios; however, it will not analyse the specific measures that would contribute to these results.

The modelling and reporting activities were further supported by the systematic collection of data and intense involvement in the entire endeavour by relevant state and entity ministries, Brčko District, and relevant institutes and agencies.

3.1. Electric power

3.1.1. Electric power sector overview

Bosnia and Herzegovina is a net exporter of electricity. Total electricity generation of BiH in the year 2012 was 14,082 GWh, while consumption was approximately 11,097 GWh. Electricity consumption per capita in 2000 was 1,915 kWh, increasing to 2,920 kWh in 2012, a figure that exceeded the world average. Electricity consumption increased from 9,150 GWh to 11,097 GWh, or by slightly more than 20%, from 2002 to 2012. A further increase in electricity consumption is expected in the future, and in-country demand may reach the level of supply.

Approximately two thirds of electricity in BiH is generated by thermal power plants fuelled by local coal with relatively high carbon dioxide emissions (1.3 tCO_2/MWh). The remainder is mostly generated by large hydropower plants, and a fraction comes from small hydropower plants. The network emission factor for carbon dioxide is about 720 kg/MWh. A conservative estimate of the climate change mitigation potential of renewable energy sources (RES) by 2025 is 0.88 Mt for biomass, 0.11 Mt for hydro and 0.15 for wind.

According to strategic documents currently in force, local coal will remain the primary source of electricity production in Bosnia and Herzegovina, and production capacity could more than double. There are substantial reserves of coal available, and it is a sector that employs a large number of people. When all this is taken into account, GHG emissions from electricity generation are set to increase. As BiH is an electricity exporter, production trends are dependent not only on domestic needs for electricity but also on the needs in neighbouring countries. All energy providers continue to operate using existing capacity with only a slight increase in the share of RES from small plants. In such circumstances, carbon dioxide emissions primarily depend on the hydrological conditions and maintenance of individual plants, which determines the ratio of hydro to thermal power plants in total electricity production.

In 2013, both entities adopted legislation on renewable energy sources and cogeneration (the Law on the Use of Renewable Energy Sources and Efficient Cogeneration in FBiH and the Law on Renewable Energy Sources and Efficient Cogeneration in RS), which are designed to stimulate electricity production from renewable energy sources. These laws also prescribe the maximum installed capacity for each RES. In addition, they also provide the basis for determining feed-in tariffs for electricity generated from RES. During the period for which the GHG emission trend scenarios have been developed, these laws will contribute to an emission reduction of about 5% (not taking into account the possible increase in the maximum capacity of individual RES). In 2013, FBiH enacted the Law on Electricity. Among other things, this Law forms a basis for the adoption of the Electricity Sector Strategic Plan, which envisages measures for promoting RES and increasing energy efficiency. In January 2014, the Republic of Srpska adopted the Regulation on the Planning of Generation and Consumption of Energy from RES. The Regulation states that 230.80 kWh of energy from RES will be encouraged by 2020.

According to the Energy Community Treaty, Bosnia and Herzegovina is obliged to liberalise its electricity market by 2015. However, the implementation of these steps is expected to be delayed. Given existing production capacities, market liberalisation will not significantly contribute to reduction of carbon dioxide emissions in the short run. It is only after 2020 that a discernible impact can be expected.

According to the Energy Community Treaty, BiH is also obliged to increase the share of RES in total energy consumption to 40% (from the current level of 34%) by 2020. This target will help reduce greenhouse gas emissions in the electric power sector. Due to the complicated procedures for obtaining permits and the slow influx of funding, the implementation of projects envisaged by the current entity strategies is slower than anticipated. As a result of the Energy Community Treaty requirements and pressure from the EU, some of the planned projects that involve constructing new, coal-fired thermal power plants have come to a near halt. Due to slow progress towards EU accession, it is not realistic to expect BiH to become a member of the EU ETS before 2020.

Given the above circumstances, it can be concluded that the emissions from the electric power sector in BiH will follow the S1 scenario until at least 2025. Some power plants will have ceased operation by then, and newer plants that are somewhat more efficient will replace them. However, more efficient power plants will not necessarily result in lower overall emissions.

3.1.2. GHG emission reduction scenarios in the electric power sector

Given that in-country circumstances have not changed significantly since the preparation of the Climate Change Adaptation and Low-Emission Development Strategy of BiH, three scenarios similar to those developed under SNC have been assumed. The three scenarios developed for the electric power sector in Bosnia and Herzegovina until 2040 are as follows:

- The S1 "business as usual" scenario assumes a slight increase in the share of electricity from renewable energy sources as a result of tariff incentives (feed-in tariffs) and a reduction in investment costs for RES. However, most electricity is still generated from fossil fuels. In the period 2015–2025, the share of RES will grow by 3% every five years, after which the five-year growth rate will be 5%. This growth in RES will reduce the network factor. It then follows that the share of electricity from renewable energy sources will increase by 21% in the period 2015–2040.

- The S2 "baseline" scenario assumes the implementation of power plant construction projects in accordance with the relevant entity strategies and data collected on planned investments. Currently, there are these types of plans up to the year 2030. It is assumed that in the period 2030–2040 there will be no construction of plants using fossil fuels, but only those using RES. In addition, all currently existing thermal power plants in this scenario will have ceased operation by 2030. In this scenario, there will also be incentive mechanisms in place for RES in the form of feed-in tariffs, thanks to which the share of electricity from RES will increase. As electricity generation will grow faster than domestic consumption, electricity exports will grow.

- The S3 “advanced” scenario assumes the intensive utilisation of RES and EE as a result of targets set with the aim of reducing total emissions of Bosnia and Herzegovina by 50% in 2050 compared to 1990. During the greater part of the period under review, the dominant mechanism for stimulating energy generation from renewable energy sources in BiH is assumed to be the country’s entry into the European Union Emissions Trading Scheme (EU ETS), which would require purchasing GHG emission allowances for the energy sector. There is no significant increase in electricity production (as assumed under the S1 scenario).

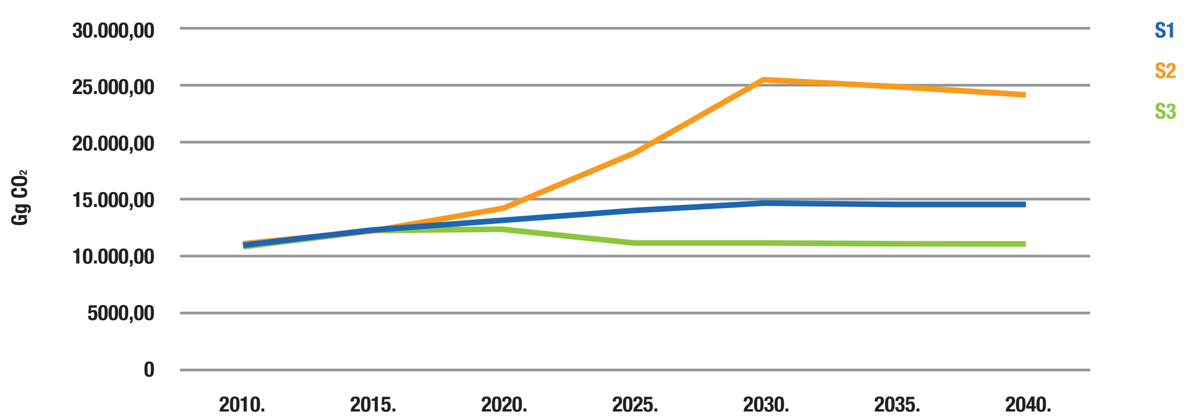


Chart 16: Comparison of CO_2 emissions from the electric power sector for the period 2010-2040 in BiH for the three scenarios (Gg CO_2)

In the S1 scenario, emissions increase during the period under review (see Chart 16). This increase is a consequence of the growth of electricity production (due to growth in consumption). Parallel to this, the share of electricity from renewable sources grows, and therefore the increase in emissions is slightly smaller than the increase in production. After 2030, there is a slight decline as the share of renewable energy sources increases. At the end of the period under review, the network factor will amount to 0.585 tCO_2/MWh, while the initial network factor was 0.726 tCO_2/MWh. The projected increase in emissions in the period under review for the S1 scenario is about 31%.

In the S2 scenario, emissions increase significantly as the share of electricity from coal-fired thermal power plants increases. Additionally, there is an increase in production volume. After existing thermal power plants go out of operation (by 2030), emissions will decrease because of the lower specific CO_2 emissions from newer thermal power plants. The growth in emissions in the period under review for S2 is nearly 120%.

In the S3 scenario, emissions increase until 2020 because no significant effect of RES policies can be expected before then. After that, the share of RES in electricity production increases as a result of policies and reductions in specific investment costs for RES. This increased share results in a reduction in the network factor. In absolute terms, emissions are much lower than in the S2 scenario, because there is no increase in electricity production (as electricity from BiH in this scenario is not competitive in regional and European markets). At the end of the period, emissions will be approximately equal to those at the beginning of the period.

In the S1 and S2 scenarios, carbon dioxide emissions from the electric power sector in BiH will increase in the period 2010–2040, and the increase in emissions in the S2 scenario will be more than 100%. According to the S3 scenario, however, emissions in 2040 will be close to those in 2010. Considering the 1990 emissions, the S3 scenario could possibly lead to meeting the goal of halving 1990 total emissions levels in Bosnia and Herzegovina by 2050.

3.2. Renewable energy sources

This section analyses the forms and amounts of energy obtained from solar and geothermal energy, which are used only for the purpose of generating thermal energy, as well as those obtained from biogas which are used for generating both thermal and electrical energy. This section does not look at the use of biomass in cogeneration systems or for the production of thermal energy in district heating systems, nor does it include other forms of renewable energy that are used solely for the purpose of electricity generation (wind and water).

3.2.1. RES sector overview

In view of the aforementioned legislation – primarily the Law on RES and Efficient Cogeneration ("Official Gazette of RS", no. 39/13), the Law on the Use of RES and Efficient Cogeneration ("Official Gazette of FBiH", no. 70/13), as well as the laws and regulations governing the area of energy efficiency, which contain provisions and obligations requiring the increased use of RES, especially where this is technically and economically viable – RES projects are expected to experience considerable expansion in the coming period. However, in the absence of an incentive scheme, the application of these projects on the ground will be delayed.

Biogas
Based on the available livestock data for 2010 and 2011, biogas production potential was calculated at 800,000 to 850,000 m^3/day. Currently, only one biogas plant has been designed and constructed in BiH, and it is located in the municipality of Srbac. Another biogas plant, which is located in Donji Žabar near Brčko, is in the final testing phase before entering into operation. The installed generating capacity of the first plant is 35 kW of electricity and 70 kW of thermal energy. While there are several farms producing biogas for use in individual households, these facilities are very small, with low outputs and very low or negligible impacts on energy use.

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. Estimates show that there are close to 7,000 m^2 of installed collectors, and the annual increase is close to 28%. There is a growing interest and increase in the use of solar collectors in all sectors. A large number of projects are being implemented in this field. Of particular importance are those in the public sector (e.g. solar roofs on schools, hospitals, etc.), which involve the production of electricity as well as thermal energy as needed. The use of solar collectors in households and public buildings is expected to increase in parallel with the introduction of incentive and subsidy schemes.

Geothermal energy
Geothermal resources in BiH come in three forms: hydrothermal systems, geo-pressurised zones and hot dry rocks. These resources are mainly located in the central and northern parts of the country. Of the three types of resources, hydrothermal systems are the most interesting because their exploitation is the most developed and least expensive when compared to the other two types. Total heating strength and geothermal energy in BiH was calculated by adding up potentials from both RS and FBiH. The total potential of installed capacity of geothermal sources at 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 a utilisation factor of 0.5, it is possible to produce 145.75 TJ in one year for space heating or 1,421.75 TJ of energy for both space heating and bathing. Research has shown that geothermal waters are found in many parts of RS, mostly in Posavina, Semberija, Banja Luka Valley and Lijevče Polje. Energy potential is estimated at 1,260 TJ. The greatest potential for using this energy source is in aquaculture, agriculture and district heating. Previous research has found that about 25% of the country's territory is considered a potential geothermal resource. However, there are virtually no major projects in terms of installed capacity. There is limited use of heat pump systems in small and medium sized facilities, albeit with a modest upward trend. Also, some progress has been made in that concession policies have begun to be implemented. The realization of concessions is taking place in the cities of Banja Luka, Sarajevo, Bijeljina and Doboj, and the preparation of plans for drilling deep boreholes for district heating purposes is underway.

3.2.2. GHG emission reduction scenarios in the RES sector

Mitigation scenarios related to the utilisation of RES are based on estimated reserves and the potential of individual renewable energy sources as well as technological, social, political and economic potential for their exploitation.

- The S1 scenario does not consider any mitigation actions and assumes "business as usual" practice (BAU), which means that the use of energy from RES is 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 envisage the introduction of any changes, incentives or special additional research related to RES potential, nor does it assume any changes in current practice regarding RES. A significant feature of this scenario is the relatively low level of interest and activities undertaken on the part of state and entity institutions in the energy sub-sector.
- The S2 scenario is characterised by the gradual introduction of new technologies (increased orientation towards RES); the launch of initiatives for large-scale use and domestic production of RES equipment (e.g. for solar energy); a closer and more systematic analysis of cost-effectiveness, sustainability and energy efficiency improvements; and the use of limited support and incentive schemes.
- The S3 scenario assumes the following: a high degree of climate change mitigation activities from authorities at different levels of government; full implementation of legislative provisions requiring the use of RES in new buildings larger than 500m^2 where this is technically and economically viable; accession of BiH to the EU by 2025 (i.e., assuming and fulfilling the obligations to reduce GHG emissions); efficient use of newly-developed incentives and funding schemes for the use of RES; extensive use of biogas from cattle breeding using strategically located co-generation plants (doubling the installed capacity over five-year periods up to 2040); extensive use of solar energy with planned coverage of about 200,000 m^2 by 2025 and proportionally by 2040; as well as increased use of geothermal resources with heat pumps in the household sector and SMEs.

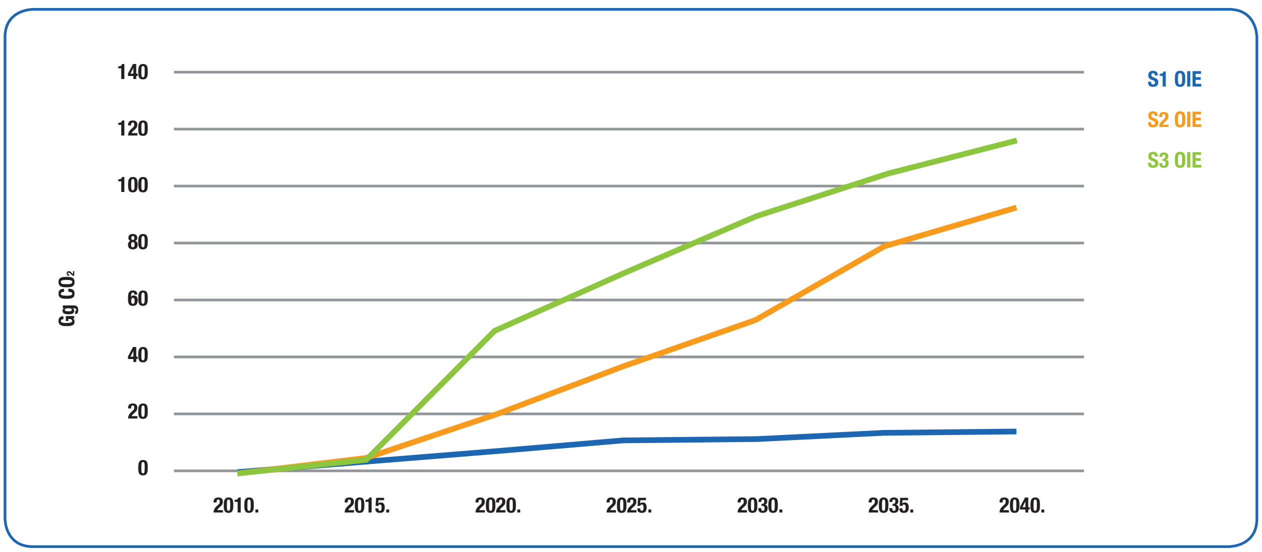


Chart 17: Comparison of CO_2 emission savings for the period 2010-2040 in BiH resulting from the use of RES in BiH for the three scenarios (Gg CO_2)

The chart above shows the results of different scenarios of RES use for the production of heat and electricity from biogas. The S1 scenario shows a very modest upward trend in the effects on CO_2 emissions, resulting from fairly limited use of RES in the period 2010–2040. Compared with the emission reductions achieved in the most emission-efficient sectors (electric power, heating, etc.), the savings obtained under the S1 scenario can be considered almost negligible. Given that the S2 and S3 scenarios assume more extensive use of RES, the effects on CO_2 emissions are stronger than in the case of the S1 scenario. Although the growth rates of installed capacity for individual renewable energy sources in the S2 and S3 scenarios are linear in nature, the projected CO_2 effects show a certain deviation from this linearity. This is due to the parallel development of relevant scenarios in the district heating, building and electric power sectors, where emission factors in the period under review decrease over time.

3.3. District heating

3.3.1. District heating sector overview

According to available data, there are currently 26 district heating companies in BiH (12 in RS and 14 in FBiH) involved in supplying consumers with heat through 30 district heating systems. According to the data from 2008 (ESS BiH, Module 1B, 2008), district heating encompasses 12% of households in BiH. In the meantime, four new district heating companies have come into operation in Gradačac, Livno, Novi Travnik and Zenica. However, because newly installed capacities are relatively insignificant when compared to existing systems, the percentage of households covered by district heating has not significantly changed since 2008.

In the majority of district heating companies, especially in RS, heating plants and their equipment are generally more than 25 years old and will soon reach the end of their expected operating lifetimes. Therefore, these systems are inefficient and prone to energy losses that may reach as high as 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 critical repairs were made to get the systems functioning again. One of the major obstacles to modernisation of district heating systems in BiH (i.e., achieving the full implementation of measures envisaged in strategy documents for the sector), is the dire economic situation, which hampers the operation of all district heating companies in the country.

The prices of thermal energy from district heating systems are mainly determined in consultation with local governments and are not based on actual costs of production and delivery of thermal energy. The majority of district heating companies are subsidised by local governments. Such a state of affairs does not allow for any major investment in the modernisation of district heating systems; instead, only emergency intervention measures are undertaken, such as pipeline repairs and replacements in the most critical areas. Other investment in district heating systems has all but completely ceased. Consumption-based billing systems based on heat meter readings have been implemented only where this is technically feasible, whereas the vast majority of buildings are still covered by lump-sum billing systems based on the total surface area of the space heated (m^2) is still used. These billing systems are contrary to the 2006 Consumer Protection Law, which stipulates that producers of thermal energy are obliged to charge for heating services delivered based on consumption rather than the surface area of the space heated. The Law on Production, Distribution and Supply of Thermal Energy has not yet been adopted at the entity level, although its adoption has been proposed by a number of relevant strategies (ESSBiH Module 9, 2008; the Energy Sector Strategic Plan and Development Programme of FBiH, 2009; SESRS, 2010; and the Climate Change Adaptation and Low-Emission Development Strategy, 2013). The Law should regulate the production, distribution and supply of thermal energy, the rights and obligations of service providers, and the rights and obligations of thermal energy consumers.

In 2013, three very important laws related to energy efficiency and renewable energy sources came into effect in the Republic of Srpska. These laws are expected to contribute substantially to the further development of district heating systems. They are: 1) the Law on Spatial Planning and Construction, transposing the provisions of Directive 2010/31/EC – Energy Performance of Buildings Directive into the legislation of the Republic of Srpska; 2) the Law on Energy Efficiency, transposing the provisions of Directives 2006/32/EC – Energy End-Use Efficiency and Energy Services Directive and 2010/30/EC – Energy Labelling Directive into the legislation of the Republic of Srpska; and 3) the Law on Renewable Energy Sources and Efficient Cogeneration, transposing the provisions of Directives 2009/28/EC – Directive on the Promotion of the Use of Energy from Renewable Sources and 2004/08/EC – Directive on the Promotion of Cogeneration into the legislation of the Republic of Srpska. The adoption of appropriate regulations on thermal insulation in buildings is expected in the course of 2014. New regulations have been in force in the Federation of BiH since 2010 with the aim of implementing

Directive 2002/91 – the Energy Performance of Buildings Directive. In 2013, the Federation of BiH adopted the Law on Use of Renewable Energy Sources and Efficient Cogeneration, transposing the provisions of Directives 2009/28/EC – Directive on the Promotion of the Use of Energy from Renewable Sources and 2004/08/EC – Directive on the Promotion of Cogeneration into the legislation of the Federation of BiH. A Draft Law on Energy Efficiency is currently being prepared. This law should provide for the implementation of the provisions of Directives 2006/32/EC – the Energy End-Use Efficiency and Energy Services Directive, 2010/30/EC – Energy Labelling Directive, and 2010/31/EC – the Energy Performance of Buildings Directive (along with the Law on Spatial Planning and Land Use of the Federation of BiH). All of these laws are also supposed to have a significant impact on the future development of district heating systems.

3.3.2. GHG emission reduction scenarios in the district heating sector

The three scenarios modeling the development of the district heating sector by 2040 were based on the analysis of data available from the SNC, the Energy Sector Study in the Republic of Srpska until 2030, the Energy Sector Study of BiH (Module 9 – District Heating), and the Energy Sector Strategic Plan and Development Programme of the Federation of BiH. They also take into account the current situation as well as projects that are planned but not yet implemented and projects that are to be implemented in the future,

All three scenarios assume the use of a certain share of alternative energy sources (wood waste, geothermal energy, etc.) for district heating, the introduction of cogeneration into major district heating systems, and modernisation of existing systems. For all of these activities, the degree of implementation will depend on the rate of economic growth in Bosnia and Herzegovina.

- The S1 scenario assumes a higher economic growth rate and a corresponding increase in energy consumption for heating.
- The S2 scenario assumes a lower economic growth rate, with a lower increase in energy consumption.
- The S3 scenario envisages a higher economic growth rate, but it also assumes extensive use of energy efficiency measures, resulting in a significant reduction in energy consumption.

Some adjustments were made to the scenarios for both RS and FBiH compared to the energy consumption/ CO_2 emission scenarios for the district heating sector presented in the Second National Communication. The new scenarios for the Republic of Srpska use official statistics on the consumption of thermal energy in 2010 as the basis for the projection of thermal energy consumption by 2040. In the meantime, the district heating plant in Gradiška has started to use biomass as a primary fuel and fuel oil as an auxiliary fuel (as of the 2013/2014 heating season). This trend is expected to continue, but with natural gas rather than fuel oil being used as an auxiliary fuel. The SNC envisaged a geothermal district heating plant becoming operational in Bijeljina by 2015, but it is now evident that the plant will become operational only in 2020. All of these developments, as well as the planned introduction of stricter technical regulations related to the thermal insulation of buildings and the adoption of local, entity and state plans to increase the efficiency of energy use, were taken into account in the preparation of the new scenarios for final energy consumption in the district heating sector in the Republic of Srpska.

Analysis of energy consumption data for the district heating sector in the Federation of BiH presented in the SNC shows that the data for the baseline year 2010 are in line with the statistics for the district heating sector, the only difference being that the statistics did not include data from the biomass district heating plants in Gračanica and Livno. In the meantime, a 3 MW biomass district heating plant has been put into operation in the Nemila neighbourhood of Zenica. It should be noted that the plan to put a cogeneration gas-fired plant in Zenica into operation by 2015 will not come to fruition, and this delay has also affected the value of projected CO_2 emissions in the Federation of BiH, as well as BiH as a whole. Therefore, new projections of energy consumption in the district heating sector through 2040 have been made for the Federation of BiH.

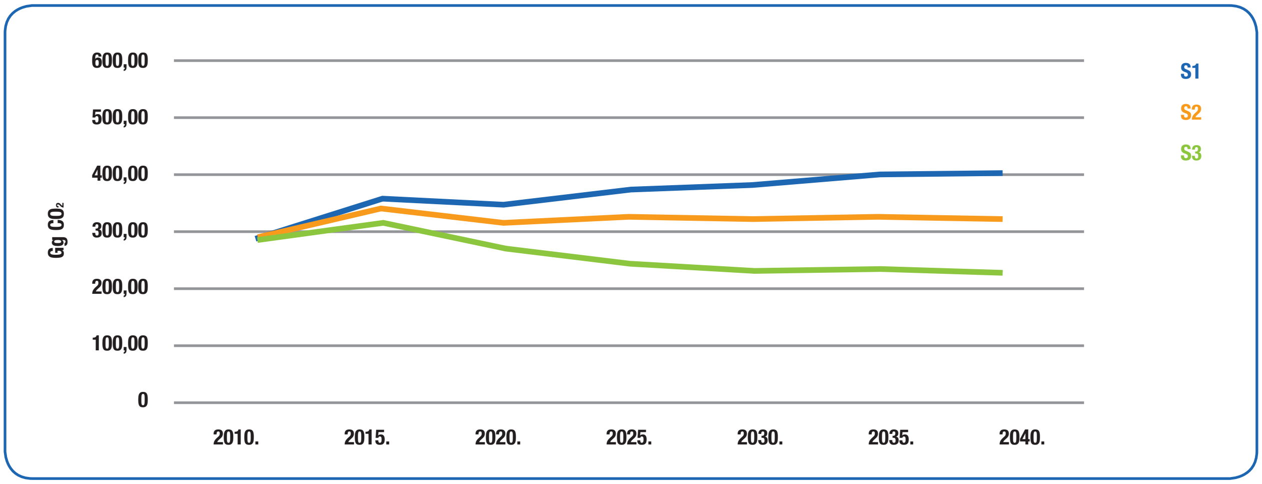


Chart 18: CO_2 emissions in district heating systems for the 2010-2040 period for the three scenarios (Gg CO_2)

The S1 scenario envisages a steady increase in CO_2 emissions by 2040, except for the 2015–2020 period. During that time, CO_2 emissions are expected to decrease somewhat with no reduction in energy consumption for heating due to gasification (the large-scale expansion of the natural gas distribution network). The S2 and S3 scenarios assume an increase in CO_2 emissions by 2015, when they are predicted to reach a maximum level for these two scenarios, followed by a decrease in CO_2 emissions until 2020 in both scenarios, as a result of extensive gasification. After 2020, the downward CO_2 emission trend continues in the S3 scenario as a consequence of gasification and intensive implementation of energy efficiency measures in both district heating systems and users of heating services, as well as a greater share of renewable energy sources in district heating systems. The S2 scenario assumes that CO_2 emissions will reach a minimum level in 2020, followed by a slight increase as a result of the anticipated lower economic growth rate, resulting in lower investment in energy efficiency measures and fewer new users connecting to district heating systems.

The realisation of the S3 scenario would mean reduced emissions of approximately 153 Gg CO_2 in 2040 compared to the S1 scenario. The largest share of CO_2 emission reductions is expected to result from the modernisation of the systems for the production and distribution of thermal energy (approximately 80 Gg CO_2). The remaining reduction in CO_2 emissions is expected to result from the introduction of consumption-based billing systems, as well as a greater share of renewable energy sources (biomass, geothermal energy) in existing and new district heating systems.

3.4. Buildings

3.4.1. Buildings sector overview

The Second National Communication used building sector data from the BiH Agency for Statistics that were based on a 2007 survey. On the basis of these data, it was assumed that there were 1.2 million dwellings in BiH. According to the preliminary results of the 2013 Census, BiH has 1,163,387 households and 1,617,308 dwellings. The housing distribution data have not been released yet, so the existing data will be retained for the purposes of this report: 29% of dwellings are in residential buildings and 71% in family houses. The average floor area of dwellings is 86.00 m^2 (97.2 m^2 in rural areas and 77.2 m^2 in urban areas). The age of dwellings has changed somewhat, with an increasing percentage of new dwellings built after 2000. Given that the regulations governing improved energy efficiency of buildings were adopted only after the 1980s, there is an extremely high percentage of buildings with high energy consumption. Furthermore, there are many new family houses that are occupied even though they are unfinished (e.g., un-insulated walls, roofs). While the number of dwellings has increased, not all are used all year round. Hence, the average heated area of 55.72 m^2, as calculated in SNC, is considered to have decreased in the meantime, now totalling

30-40 m^2. Given that reconstruction work undertaken on existing buildings has not been carried out on a large scale and that only a fraction of new buildings conform with building codes, while a large number of new family houses remain unfinished (without thermal insulation), the average annual energy consumption for heating remains high at about 200 kWh/m^2, as was calculated in the SNC.

Progress on key documents that regulate energy consumption and GHG emissions, such as the BiH NEEAP, Entity EEAPs, and sector strategies, has been very slow, and the implementation of these policies is not a political priority at present.

In the Republic of Srpska, the new Law on Spatial Planning and Construction of RS entered into force on 16 May 2013 ("Official Gazette of RS", no. 40/13). This law has allowed for partial transposition of the updated Energy Performance of Buildings Directive (2010/31/EU) into the RS legislation. The full implementation will be possible after the adoption of implementing regulations, which are still being drafted. Following the adoption of the new Law on the Environmental Protection Fund of RS in November 2011, the Fund became responsible for energy efficiency and has taken over some of the responsibilities of the Energy Efficiency Agency. The Law on Energy Efficiency ("Official Gazette of RS", no. 59/13) entered into force on 15 July 2013. In the Federation of BiH, the Law on Spatial Planning and Land Use of FBiH ("Official Gazette of FBiH" nos. 2/06, 72/07 32/08, 4/10, 13/10 and 45/10), as amended in 2010, transposed the 2002 Energy Performance of Buildings Directive into the FBiH legislation. This was followed by adoption of a set of implementing regulations and training of a large number of experts in energy certification procedures, but the actual certification of buildings and enforcement of the provisions of the Law are not satisfactory. The Law on Energy Efficiency of FBiH (draft May 2012, currently under public review) regulates energy efficiency of buildings in more detail than the legislation in RS, where the majority of the 2010/31 Directive was directly transposed through the Law on Spatial Planning and Construction.

The first National Energy Efficiency Action Plan (NEEAP) of Bosnia and Herzegovina until 2018 has been prepared and approved by the Energy Community Secretariat; the Republic of Srpska has adopted an Energy Efficiency Action Plan until 2018, and FBiH is expected to prepare and adopt its own. Given that the NEEAP has not yet been accepted by the entities and that its implementation has not yet started, it is expected that reductions in energy consumption will be slow.

Recent years have seen an increasing number of projects aimed at raising the awareness of citizens, municipal staff and experts of opportunities to save energy in the buildings sector. As many as 14 of the largest cities in BiH have joined the list of European cities that have signed the Covenant of Mayors. Thirteen cities have prepared Sustainable Energy Action Plans (SEAPs) and started implementing certain activities. However, projects to improve energy efficiency in buildings (thermal insulation projects) are still very few in number. Several of these projects were launched in the Sarajevo Canton, but they have been delayed due to financial problems. In addition, as a result of the activities of international organisations such as UNDP, USAID and GIZ, funding has been secured for energy audits, studies, and renovation work in some public buildings. However, considering the total number of public buildings, this support is negligible. Significant progress has been made in the field of energy management in public buildings, and more than 1,100 public buildings have already been included in an Energy Management Information System (EMIS), which is a software application for the monitoring and analysis of energy consumption in public sector buildings, and is an essential tool for systematic energy management. Data entered into the EMIS are used for a range of calculations, analyses and controls that help experts understand how energy and water are consumed in each building and for what purposes, which enables comparison with similar buildings, as well as the identification of unwanted and excessive consumption. The Environmental Protection Fund of FBiH is also involved in financing energy efficiency projects. One of these projects, a five-year project in collaboration with the UNDP entitled *Capacity Building and Reduction in Energy Costs within the Public Sector Buildings in FBiH by Increasing Energy Efficiency, Streamlining Energy Management and Reducing Air Emissions*, is currently under implementation.

3.4.2. GHG emission reduction scenarios in the buildings sector

Three potential scenarios have been prepared for the period up to 2040 based on documents available on energy consumption in the buildings sector in Bosnia and Herzegovina, sectoral strategies, and international obligations assumed by the State of Bosnia and Herzegovina, as well as an assessment of the economic situation and the expectation that BiH will accede to the EU by 2025.

Of the data on total energy consumption in the buildings sector, this section uses only those relating to the use of fossil fuels for heating buildings that are not covered by a district heating system; the consumption of energy-generating fuels as well as CO_2 emissions originating from district heating systems and electricity consumption are covered in previous sections dealing with the district heating and electric power sectors.

- The S1 scenario assumes that buildings sector development by 2025, as anticipated in the SNC, will continue until 2040 with no significant changes. After 2025, the scenario assumes a slightly faster growth in energy consumption, but not by a significant percentage. Construction of new buildings will proceed at the same pace, as there will be no significant increase in the standard of living. No major changes in the growth of energy consumption or in the share of energy-generating fuels used for heating are expected in households or in the commercial sector.

- The S2 scenario assumes that the country will develop rapidly after 2025 as the result of its anticipated accession to the EU and medium-fast increase in GDP. Energy consumption will grow considerably amid the extensive construction of buildings resulting from an increased standard of living. This increasing standard of living will be followed by increased demand for energy, especially in the heating sector, as the heated space in family homes will increase. Use of firewood will decrease, but it will still be dominant in family houses, while a significant increase in the share of natural gas as an energy source is expected (due to the construction of the South Stream gas pipeline). In addition, the percentage of buildings heated by central district heating plants will increase. Extensive construction is expected in the commercial buildings and public services sector, in parallel with GDP growth, so by the end of the period it will more than double, while the number of dwellings is expected to rise much more slowly; i.e., by 40% (based on anticipated growth in housing stock according to the Energy Development Strategy of RS until 2030 and the Energy Sector Study of BiH, Module 12). New buildings will be built according to European standards, but in existing buildings energy consumption will remain high because of their old age and poor energy characteristics.

- The S3 scenario is based on a medium-fast increase in GDP, the implementation of energy efficiency measures and full transposition of EU directives into domestic legislation. New buildings will be built according to European standards and existing buildings will undergo extensive reconstruction, including improvements to the energy characteristics of building envelopes. At the same time, the total area of commercial buildings will more than double, while the construction of residential buildings will increase by about 40%. The share of firewood as energy source in family houses will decrease, while the use of natural gas will increase as a result of more extensive gasification after 2020. As the standard of living increases, so will the average heated space in family residential buildings. In addition, an increase in the standard of living will be accompanied by an increase in the total area of all types of buildings that are heated by central district heating plants.

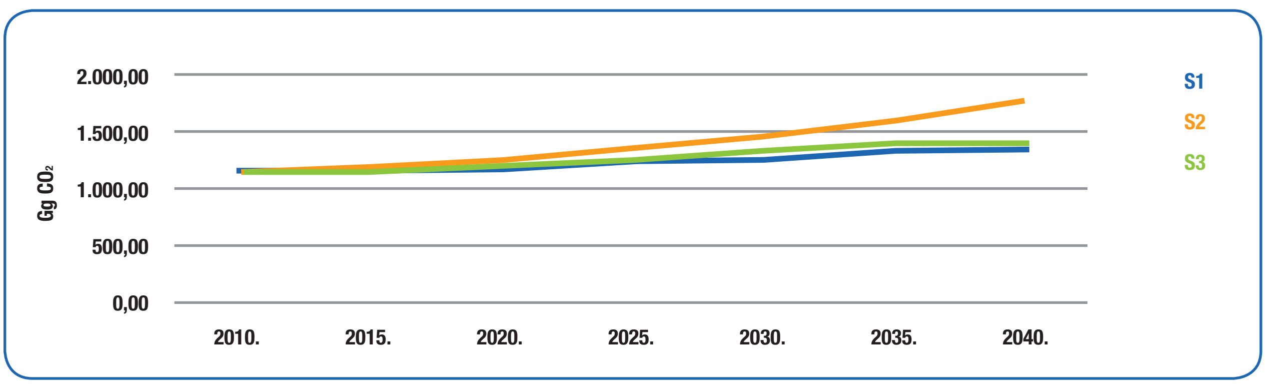


Chart 19: CO_2 emissions in the buildings sector (heating needs without the participation of the district heating systems/plants) for the three scenarios from 2010 to 2040 (Gg CO_2)

Initially, the increase in CO_2 emissions in all three scenarios will be gradual compared to the base year 2010, as all activities are happening slowly and with delays relative to the policies and strategies that have been adopted and accepted. It is only after 2020 or 2025 that the results from these activities can be expected.

There can be no significant reduction in CO_2 emissions in the buildings sector connected to district heating systems, because the structure of energy sources used for heating is expected to change, especially in family houses, where firewood is expected to be increasingly replaced by other sources of energy as a result of gasification and expansion of district heating systems. At the same time, the number of buildings that are heated by district heating systems will increase and it is not realistic to expect that all of them will use non-fossil fuels; i.e., RES and biomass. These trends will lead to increased CO_2 emissions even as the average energy consumption per unit of area decreases as a result of the implementation of energy efficiency measures.

According to the S1 scenario, which does not assume any significant changes in relation to the current situation, emissions will continue to rise at the current pace almost linearly. In the S2 scenario, on the other hand, emissions will increase rapidly until 2040, when they are projected to reach an increase of 27.67% compared to the S1 scenario. Implementation of energy efficiency measures in the S3 scenario would lead to a reduction in emissions comparing to S2 scenario. Emissions in the S3 scenario would be significantly lower than those predicted under the S2 scenario (by nearly 20%) and greater than levels predicted under the S1 scenario (by less than 3%).

3.5. Transport

3.5.1. Transport sector overview

As the road transport subsector is responsible for more than 90% of all GHG emissions from the transport sector in BiH, this section will focus only on this subsector. The road network in BiH is among the less developed networks in Europe, as evidenced by its density of 45 km/100 km^2, or 5.7 km per 1,000 inhabitants, which is 2.5 to 4 times lower than in Western European countries. The density of main roads is 7.77 km/100 km^2 in the Federation of BiH and 7.11 km/100 km^2 in the Republic of Srpska. Given that in 2013 a total of 785,890[25] motor vehicles were registered in Bosnia and Herzegovina, and based on the available data, it can be concluded that the average number of motor vehicles is 34,360 vehicles/1,000 km.

In Bosnia and Herzegovina there are currently no significant programmes or projects focusing on reducing emissions in the transport sector. However, state and entity legislation regulating the fields of transport (e.g. the Law on the Basics of Traffic Safety on Roads in BiH and other laws) and environmental protection (the Air Protection Law and associated secondary legislation) sets a framework for the import, purchase, registration and homologation of motor vehicles, fuel quality, and mandatory regular annual inspection of motor vehicles (roadworthiness test), and provides that owners cannot register motor vehicles that exceed a certain emission threshold. Additionally, owners of motor vehicles in the Federation of BiH are required to pay a special fee when they register their vehicles or when they have their vehicles checked for roadworthiness, depending on the type of engine, fuel, engine size and age of the vehicle. The same mechanism is being considered for introduction in the Republic of Srpska. These activities contribute directly and indirectly to reducing CO_2 emissions in the transport sector. It is expected that further, more effective implementation of EU directives on emission reductions, efficiency of motor vehicles and fuel quality will contribute to reducing emissions in the transport sector in BiH. Regular maintenance activities and construction of new transport infrastructure by the relevant institutions also contribute to reducing emissions.

3.5.2. GHG emission reduction scenarios in the transport sector

Three CO_2 emission scenarios in the transport sector for the period 2010–2040 were developed as follows:

- The S1 scenario is based on the trends of an increasing number of motor vehicles at an average annual rate of around 5.8% for the average age of the vehicle fleet of between 12 and 15 years, an absence of homologation measures, and an average annual increase rate of diesel and petrol consumption by 3.7%. The present scenario assumes that the greenhouse gas emissions produced by road motor vehicles

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will increase proportionately with the increase in consumption of fossil fuels. With regard to the age of the vehicle fleet in BiH, it has been calculated that CO_2 emissions from road motor vehicles average approximately 185 g CO_2/km (assuming an average consumption of 6.5 litres/100 km for diesel- and about 7.0 litres/100 km for petrol-fuelled cars, for the period 1998–2008). This scenario is also based on existing domestic legislation and trends from other transport subsectors in BiH.

- The S2 scenario is based on the introduction of additional technical measures for road motor vehicles to improve the efficiency of motors and reduce fuel consumption. Under this scenario, the rate of increase in the number of road motor vehicles is identical to the S1 scenario, with an anticipated improvement in the quality of fuel used and the road infrastructure. An important element of this scenario is the decreasing average age of road motor vehicles to 12 years by 2025. The main 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, with a further reduction to 130 g CO_2/km by 2040. In addition, this scenario assumes the introduction, implementation and enforcement of EU directives in the field of transport after 2025.

- The S3 scenario assumes significant mitigation: i.e., significant emission reductions in the transport sector through the implementation of EU directives in BiH by 2025 (better fuel quality, efficient vehicles, better tires, mandatory installation of catalytic converters, introduction of new regulations on the importation of motor vehicles, introduction of EURO 6 standards, compliance with EU Regulation 443/2009 on the limitation of CO_2 emissions from new passenger cars to 95 g CO_2/km by 2021); the construction of more efficient road infrastructure and steps to ensure efficient flow of vehicles; the introduction of urban traffic measures resulting in reduced emissions; the influence of the ETS Directive on air traffic; and a significant increase in railway transport (50% by 2025 and stabilisation by 2040).

Based on the factors and assumptions under the above scenarios, the chart below provides an overview of projections of total CO_2 emissions from the transport sector in Bosnia and Herzegovina for the period 2010–2040.

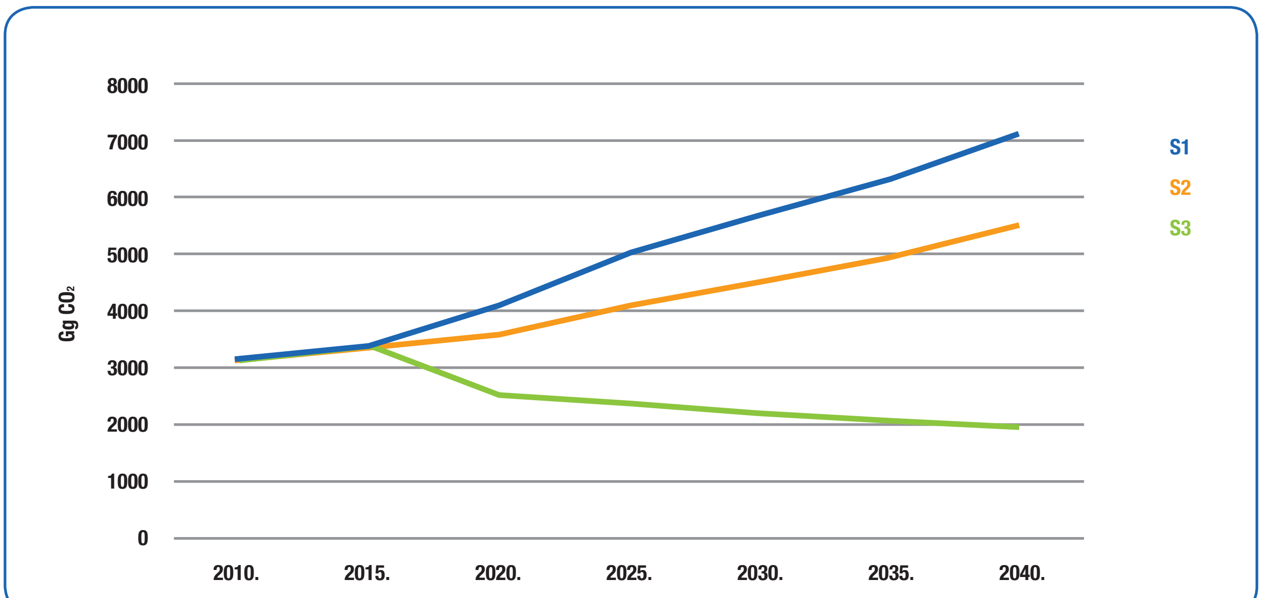

Chart 20: Projections of CO_2 emissions in the transport sector in BiH for the period 2010–2040 (Gg CO_2)

According to the projection of the total CO_2 emissions from the transport sector in the S1 scenario (BAU), it is anticipated that CO_2 emissions will increase by 7,145 Gg CO_2 by 2040, with an average growth rate of about 2.8% per annum in the period 2010–2025 and about 2.14% in the period 2025–2040. We can conclude that the S1 scenario follows the historical trend of increasing CO_2 emissions in the transport sector characteristic of the previous decade and results in an increase in CO_2 emissions of 123% compared to 2010.

The S2 scenario also results in continued growth in CO_2 emissions in the period 2010–2040, but in relation to the S1 scenario (BAU), there is a relatively mild increase of 20% in total CO_2 emissions in the period under review. Total CO_2 emissions are anticipated to increase by 5,520 Gg CO_2 by 2040, with an average emission growth rate of about 1.65% per annum in the period 2010–2025, and about 1.8% in the period 2025–2040. The S2 scenario results in an increase in CO_2 emissions of 72% compared to 2010.

In the S3 scenario, the effects of CO_2 mitigation measures will gradually become visible, resulting in a decrease in total CO_2 emissions from this sector to 2,019 Gg CO_2 by 2040. The average annual decline throughout the period under review is about 1%, while for the period during which emission reduction effects are achieved (2015–2040), the average annual emission reduction is achieved at an indexing rate of about 1.28%. The S3 scenario results in a reduction in CO_2 emissions of 37% compared to 2010.

3.6. Forestry

3.6.1. Forestry sector overview

Due to their natural and varied structure, as well as a high rate of natural regeneration (about 93%), forests in Bosnia and Herzegovina represent a key natural resource in mitigating climate change. Forests store enormous amounts of carbon. At the same time, changes in the climate such as increased average temperatures and changing precipitation regimes may affect the structure, distribution and amount of forests in BiH, and carbon dioxide can act as a "fertiliser" promoting the growth and development of plants. Thus, forests can grow faster due to increased levels of CO_2 in the atmosphere.

The Constitution of Bosnia and Herzegovina, as well as relevant laws and regulations, provide that the management of forests (as a natural resource in Bosnia and Herzegovina) is the responsibility of the entities. The Republic of Srpska recently adopted amendments to its Law on Forests ("Official Gazette of the Republic of Srpska", no. 60/13). However, even with the new amendments, the Law still fails to take into account the effects of climate change in terms of providing for mandatory activities. The amendments mostly focus on defining the organisational structure of forestry institutions in the Republic of Srpska (abolishment of the Forest Agency), and do not include any climate change considerations. Also, the Forestry Development Strategy of the Republic of Srpska 2012–2020 has been adopted, and in some sections it indicates the importance of climate change. For example, in the section on the multi-functionality of forests, one of ten planned criteria is the role of forests in mitigating climate change and their importance in storing CO_2. Among the 11 identified strategic objectives, the strategic objective *Ecosystemic Forest Management, Environmental Protection, Nature and Biodiversity Conservation* envisages measures that are largely dedicated to climate change. In 2013, the Government of the Republic of Srpska adopted the Forest Genetic Resources Programme of the Republic of Srpska 2013–2025. This programme recognises the importance of climate change in terms of the conservation of genetic resources (biodiversity) in forest ecosystems, where one of the planned partial measures is: *Assessment (development of scenarios) of climate change impacts on forest genetic resources, as well as clearer (more specific) affirmation of the importance of genetic resources conservation in terms of adaptation of forest ecosystems to anticipated climate change*.

In 2011, the Federal Ministry of Agriculture, Water Management and Forestry of FBiH prepared a Preliminary Draft Law on Forests, which is now pending parliamentary passage. Similar to the legislation of the Republic of Srpska, there are no clearly defined requirements in terms of forest management under climate change. In 2011, the *Forest and Climate Change Study* was undertaken as part of the process of developing a forestry programme of the Federation of Bosnia and Herzegovina. This document provides an overview of relevant international conventions, agreements, programmes, resolutions and declarations, as well as the *Climate Change Adaptation Plan of Bosnia and Herzegovina according to INC* through the *Climate Change Mitigation Plan* and *Assessment of the Afforestation Development Potential*, as well as the *Proposed Strategy and Plan for Addressing Possible Future/Expected EU Obligations*.

The results of these and other documents that define the state of forests and CO_2 sinks in BiH, indicate that a sectoral strategy in this area is long overdue and that developments in the forestry sector fail to recognise the importance of climate change considerations with regard to forests in BiH. There is a lack of capacity and strategic documents that would recognise the potential of forests in mitigating climate change in BiH. The negative consequences of extreme climate change in forests and forest ecosystems are difficult to identify. Their identification requires long-term research and monitoring, which is the only way to identify and define the cumulative effects of rising temperatures and changing precipitation regimes.

3.6.2. GHG emission reduction scenarios in the forestry sector

Sequestering coefficients for forest cover by geographic zone are based on studies conducted to date on biomass production by forest type. More precisely, the forest cover in the moderate climate zone in BiH has a sequestering capacity of 153.65 MtC in vegetation and 260.67 MtC in soil; i.e., in total 414.33 MtC.

These data best illustrate the importance of forest cover in BiH, especially when the aforementioned sequestering capacity is expressed as its GHG content, which totals 1,515 Mt CO_2eq. It is also important to state that these values have not only national importance, but also broader regional importance.

The three climate change mitigation scenarios in the BiH forestry sector are based on data on the status of forest reserves, current forest management policies and future development trends. The collected data and calculations of CO_2 sinks in the forests of BiH clearly show that forests in BiH represent a significant CO_2 sink. Based on these indicators and the annual increment of 10.5 million m^3 (GTZ, 2001), the annual increment factor in tonnes of dry matter per hectare has been determined at 2.375. Noble broadleaves and wild fruit trees have also been included in the calculations. The total proportion of biomass is 2,386.5 Gg of dry matter, while the net annual amount of carbon dioxide is 2,024.60 Gg, which has been 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, total carbon uptake has been calculated at 3,217.85 Gg. Based on these results and calculations of the annual release/emission of carbon, the final annual sink of carbon dioxide in forest ecosystems in BiH for 2010 has been calculated at 6,475.33 Gg CO_2. The SNC included an estimate of sinks only for 2010, and it was only in 2013/14, as part of this BUR, that calculations were made according to the IPCC methodology. These calculations have revealed a continuing decline in sinks, which in 2011 amounted to 6,174.67 Gg CO_2. These data have been used as the basis for calculating further scenarios.

The SNC envisaged three possible scenarios for the forestry sector. The scenarios have not changed significantly, but their implementation has slowed somewhat due to the economic crisis as well as the slow pace of implementation of State obligations regarding the Energy Community (i.e. harmonisation of domestic legislation with the EU). The following three scenarios are based on available documents in the forestry sector in Bosnia and Herzegovina, sectoral strategies, and international obligations assumed by the State of Bosnia and Herzegovina, as well as the economic situation and the assumption that BiH will accede to the EU by 2025.

- The S1 scenario is based on the observed trend of decreasing forest areas in the post-war period, and it does not include any additional measures aimed at counteracting this existing trend. This scenario assumes a downward trend in sequestration capacity, resulting from the loss of forest reserves at an average annual rate of about 0.8%. After 2025, all forests will be managed in accordance with the recommendations of certifying institutions, and felling volumes will be fully brought into line with the increment levels. There will be no excessive or illegal logging, and the areas under forest cover will not decrease. Afforestation volumes and success will remain equal to the current activities.

- The S2 scenario is based on the introduction of specific measures designed to stimulate preservation of existing forest cover. The primary measure involves increasing the sinks capacity through the practical application of specific silviculture methods to increase carbon sequestration in tree biomass in existing forest areas. Another important measure is the reforestation of barren tracts of lands, which would increase the total annual biomass increment. An additional very important activity relates to the enhancement of fire protection measures aimed at preventing and reducing the number of forest fires, which have in recent decades seen a manifold increase in frequency as a result of climate change. The above measures would result in maintaining the current level and a mild increase in sinks capacity of forest cover in BiH. Volumes of all forms of felling will immediately revert to 2010 levels. Afforestation will take place at a rate of 2,500 ha per year, but with a 100% success rate of the planting and development of newly established forests.

- 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 primarily refers to certification programmes for overall forest reserves in BiH, which aim to improve sustainable forest management. One of the special measures under the S3 scenario is the continued reforestation of degraded forest cover and afforestation of woodland barrens with the aim of maintaining and preserving the existing forested areas, as well as increasing the area under forest cover in the future. The full mine clearance of forest areas will play an important role in this regard, as approximately 10% of forests are currently mined. This will additionally increase carbon storage potential of forests in BiH. Felling volumes will remain at 2010 levels, with no increase in intensity. Afforestation will take place at a rate of 2,500 ha per year, with a 100% success rate. In the next 20 years, each year a new 100 ha of plantations will be established in the form of energy plantations with fast growing species. Activities and investments in fire protection will be introduced from the first year of the period under review and will remain constant. These activities will contribute to an estimated decrease in the size of areas damaged by forest fires by 1,000 ha per year. Protected areas will grow at a rate of 100 ha per year.

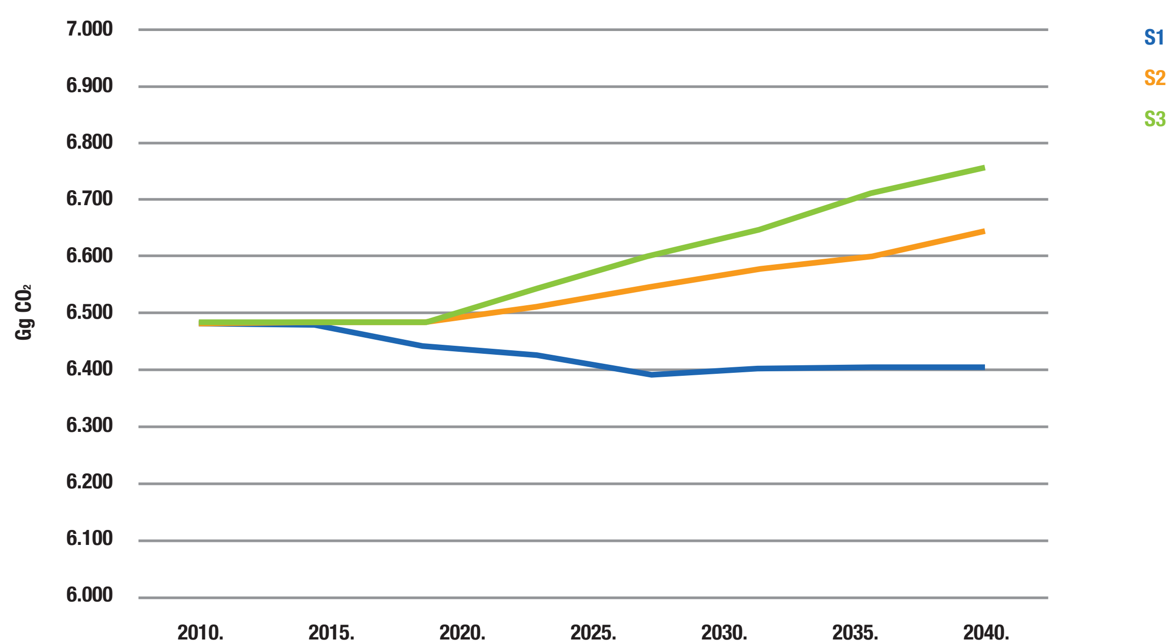

Chart 21: CO_2 sink projections (Gg) in the forestry sector by 2040

According to the S1 scenario, the sequestering capacity will decline through 2025, after which it will enter a period of near stagnation. According to this scenario, sinks will decrease to 6,394.39 Gg CO_2 by 2040.

According to the S2 scenario, the constant forest growth and afforestation activities and improved fire protection measures will result in the increase in the projected value of sinks by approximately 2.4% by 2040 compared to 2010, reaching 6,630.99 Gg CO_2.

If all activities assumed under the advanced S3 scenario are implemented, the sink will increase in size by nearly 300 Gg CO_2 compared to 2010.

3.7. Agriculture

3.7.1. Agricultural sector overview

The potential for climate change mitigation in agricultural production in BiH can be viewed from two aspects: as a potential sink and as a source of GHG emissions reductions. Greenhouse gas emissions sequestration potential is defined by spatial coverage and type of agricultural land. The existing sequestration capacity of land and land use in BiH for the main greenhouse gases is about 1,305.3 Mt CO_2eq.

Another aspect of mitigation potential refers to annual GHG emissions from the agricultural production sector. According to the available data, there has been a continued trend of decreasing arable land in the post-war period in BiH coupled with the use of out-dated, technologically inadequate and energy-inefficient machines and other accompanying equipment for crop production on existing arable land. A trend of inappropriate disposal and utilisation of manure and the use of inferior types of artificial fertilisers is also evident. The same is true of the livestock production subsector, where current trends indicate a decline in production results due to the poor quality and insufficient amount of fodder, which is being offset by an increase in the number of animals.

Albeit one of the most important economic sectors in BiH, agriculture is going through a very slow recovery and is experiencing a period of stagnation compared to other economic sectors. The share of agriculture in the gross national income of Bosnia and Herzegovina decreased from 9.24% in 2000 to 6.24% in 2012.

Climate change mitigation and adaptation policies and measures are almost non-existent in this sector. Climate change mitigation actions have not yet been introduced in the agricultural sector because there are still no harmonised agricultural strategies at the national, entity, regional or local levels, let alone climate change adaptation strategies for this sector. Therefore, it can be rightly argued that the public awareness of climate change as it relates to agriculture is underdeveloped, and that any measures and investments in this area are implemented on an *ad hoc* basis and possibly only at the local level. In its annual progress reports, the European Commission has repeatedly stated that the country has made very little progress in aligning with European standards in the field of agriculture and rural development.[26] The reports also state that climate change considerations are not integrated into sectoral policies and strategies and that there is no comprehensive countrywide climate change strategy, and it notes that considerable further efforts are needed in the areas of information dissemination, alignment with and implementation of the *acquis,* and strengthening administrative capacity.

3.7.2. GHG emission reduction scenarios in the agricultural sector

The scenario analysis concentrates on two types of factors that influence the development of the agricultural sector – external and internal factors. External factors, in addition to climate change, primarily include general trends at the global, EU and regional level, the country's accession to the EU and the liberalisation of trade. Important internal factors include the lack of a shared vision of the development of agriculture and rural areas, lack of and/or an unharmonised legal framework in the country, unharmonised incentive schemes and measures for agricultural production, production trends and levels, application of technical and technological innovations, and demand for domestic products.

The three mitigation scenarios developed for the agricultural sector are analysed below.

- The S1 scenario is based on the fundamental assumption that there will be no major changes in the development of the agricultural sector and its sectoral policies. Another assumption under this scenario is that the share of agriculture in the BiH economy as a whole will remain the same or at a similar level. The trend of increasing land use for non-agricultural purposes will also continue at the same rate. Agricultural production and average yields will remain the same or similar, with the same or similar level of applied technical and technological measures. The livestock subsector will see a slight

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increase, albeit with poor breed and productive structure, while the production of forage crops and grazing will increase. Degraded land area will remain without reclamation measures. Best practices in farming will remain at very low levels of dissemination. Furthermore, the Nitrates Directive will not be applied. Also, there is no common vision of development, no harmonised agricultural and/or rural policies, legislation and programmes, incentives or measures. Budgetary support for agriculture will remain at the same level. Climate change considerations will not be integrated in sectoral policies and strategies, and there will be no comprehensive climate change strategy.

- The S2 scenario is based on the fundamental assumption that the agricultural sector will undergo positive change and advancements. Another assumption under this scenario is that the share of agriculture in the overall economy of Bosnia and Herzegovina will increase and that the trends of agricultural land use and agricultural production will improve, with a mild increase in average yields, which will nonetheless remain modest. Enhanced technical and technological measures are applied. A modest number of farmers will follow the Code of Good Practice. The Nitrates Directive will be partially applied. The number of cattle will grow slightly, and livestock productivity will increase. Degraded land areas will gradually be reduced. Agricultural and rural policies and legislation will be partially harmonised, and policy documents will be implemented. Incentive schemes and measures will be partially harmonised, funding will increase slightly and will be targeted at farmers officially registered in the Register of Farms and Clients, which will improve their position. Climate change considerations will be integrated in sectoral policies and strategies, as well as in incentive schemes. The Climate Change Adaptation and Low-Emission Development Strategy will be implemented, and the awareness of climate change will increase among all stakeholders. The interest and support of donors will decline, but the use of pre-accession funds will increase.

- The S3 scenario is based on the assumption that BiH will become an EU member state by 2025. After accession, the agricultural policy of BiH will develop in accordance with the Common Agricultural Policy and will use available funding to boost the development of the sector, thus ensuring sustainable development of the agricultural sector and the environment. Degraded land areas will be successfully rehabilitated using re-cultivation and remediation measures. Farms will be modernised, and high technical and technological measures and standards as well as codes of good agricultural practice will be applied. Awareness of climate change will be highly developed.

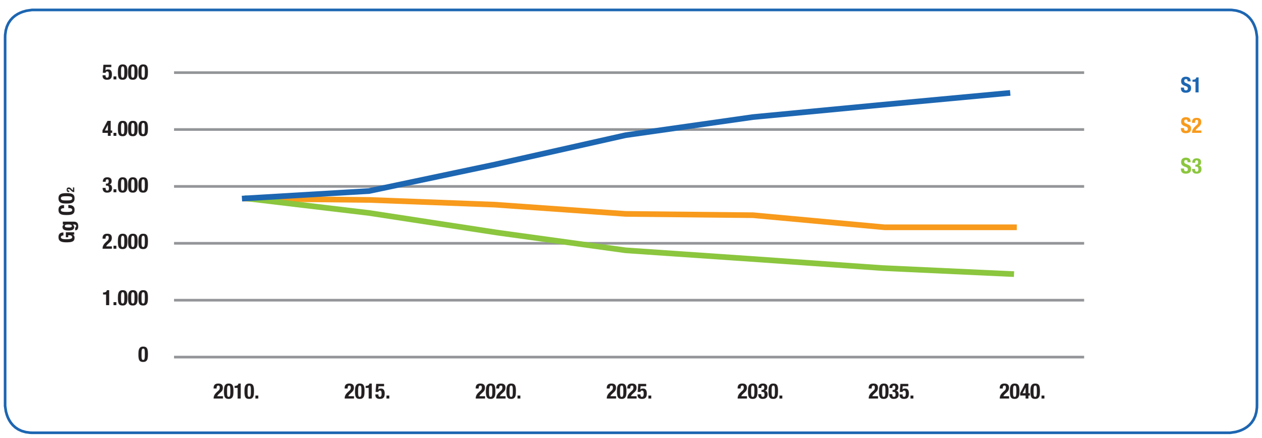

Chart 22: Total CO_2 emissions from the agricultural sector for the 2010-2040 period for three scenarios (Gg CO_2eq)

The data presented above indicate that total greenhouse gas emissions in the agricultural production sector under the S1 scenario will rise by 2040, when they will amount to 4,600 Gg CO_2eq (about 64% of the emissions in the baseline year, when they totalled 2.814 Gg CO_2eq). However, it should be noted that as of 2025, a slight decrease in negative trends in the development of agriculture is expected regardless of the given environment.

According to the S2 scenario, total annual GHG emissions will decrease, dropping to 2,250 Gg CO_2eq in 2040, which is an overall decrease of about 20%, or 0.67% per annum, compared to 2010. Overall, it can be concluded that the measures implemented in the agricultural sector must be much broader and more efficient if more tangible results are to be achieved.

Under the S3 scenario, estimated emissions from the agriculture sector in 2040 total 1,468 Gg CO_2eq, which represents a decrease of about 48% compared to 2010. However, under this scenario, only a slight reduction in emissions can be expected after 2025, and so the biggest part of the problem will be addressed immediately before and after EU accession.

The data presented indicate that mitigation potentials in the agricultural sector in BiH, with strict application of the most contemporary technologies and practices in all aspects of production, are very large. However, to obtain more exact scenario indicators, precise data are needed. There are currently no data on the actual number of households engaged in agriculture (e.g. the number of farmers, livestock etc.), significantly affects the final results of the analysis and scenarios.

3.8. Waste management

3.8.1. Waste management sector overview

The quantity of waste generated in 2012 (1,302,866 tonnes) saw a slight decrease from the preceding year (1,306,663 tonnes). The largest proportion of waste was collected from households (759,782 tonnes), followed by manufacturing and service industries (183,325 tonnes) and public utilities (21,014 tonnes).

Per capita wastewater from households/commercial services, assuming the default value for degradable organic matter, totalled 169.23 Gg CO_2eq/yr. in 2010 and 175.53 Gg CO_2eq/yr. in 2011. Due to the lack of necessary data on the treatment of industrial wastewater, its corresponding emissions cannot be estimated reliably.

In the period before 2010, the waste management sector underwent major changes, which had a considerable impact on the state of the waste management sector and the reliability of data on the quantities of waste generated and treated. In the field of legislation, the most important developments took place in the period 2010–2011, with the exception of the *Rules on Electric and Electronic Waste* ("Official Gazette of FBiH", no. 87/12), which was adopted in 2012. The implementation of this legislation and the level of implementation brought about change in the waste management sector. The legislation is not harmonised among entities (the level of transposition of directives is not the same), and the legal acts adopted are not the same (e.g. regulations on specific waste streams), making it difficult to prepare scenarios for the entire country. As regards strategic documents, the majority of action plans, management plans, adaptation plans etc. were developed before 2011, with the exception of the FBiH Waste Management Plan, which was adopted in 2012.

In addition to small projects, which were financed by domestic institutions, development institutions such as the World Bank, the Czech Development Agency and SIDA have implemented a series of important projects aimed at establishing an integrated waste management system. Among these projects, the most important ones are: Municipal Waste Management Programmes in Bosnia and Herzegovina (2010–2014) — the first phase included Zenica and Bijeljina, and the second phase 13 other municipalities; a Waste Management System project integrated with an Urban Waste project (2011–2012); and the Waste Management Development in Doboj and Maglaj (2011–2014).

3.8.2. GHG emission reduction scenarios in the waste management sector

- The S1 scenario assumes the disposal of waste in unregulated landfills. About 65%–70% of the total waste generated is collected and landfilled in largely unregulated municipal landfills (except Mošćanica, Bijeljina and Sarajevo), while the rest ends in illegal dumping sites. The recycling rate is negligible (currently about 0.5%), but is expected to increase to 1% as of 2015. The scenario also assumes an increase in the amount of waste generated as well as in the coverage by municipal solid waste collection services.

- The S2 scenario envisages the construction of regional sanitary landfills with biogas collection and flaring systems throughout BiH by 2025. Furthermore, this scenario assumes the collection of all types of waste and an increase in recycling in accordance with the Waste Management Strategy in FBiH / Waste Management Plan of FBiH 2012–2017 (with the same level to be applied for the entire country, also taking into account RS, which has not yet developed a new plan), as well as recycling of a portion of packaging waste and electric and electronic waste (for which regulations are already in force in FBiH), in line with the waste management plans of operators of these types of waste. As in the baseline scenario, the S2 scenario also assumes an increase in the quantity of waste generated, but it envisages a significant increase in recycling (of up to 30% by 2040) and other methods of treatment such as biological treatment or incineration (of up to 27% by 2040). Also, it assumes that residual waste will be disposed only in regional sanitary landfills as of 2025.

- For the purposes of this report, the S3 scenario will use the SNC assumptions and will introduce an increased recycling rate at source and at landfills (including batteries and accumulators, tyres, glass and other waste from specific waste streams which currently ends in landfills), as well as a transition from the current billing practice to a billing system based on the quantity of waste produced. This phase did not take into account the construction of incinerators for mixed municipal waste (i.e. for treatment after recycling). Like the baseline scenario, the S3 scenario also assumes an increase in the quantity of generated waste, but it also envisages a significant increase in recycling (of up to 40% by 2040) and other methods of treatment such as biological treatment or incineration (of up to 40% by 2040). Also, it assumes that residual waste is disposed only in regional sanitary landfills as of 2020.

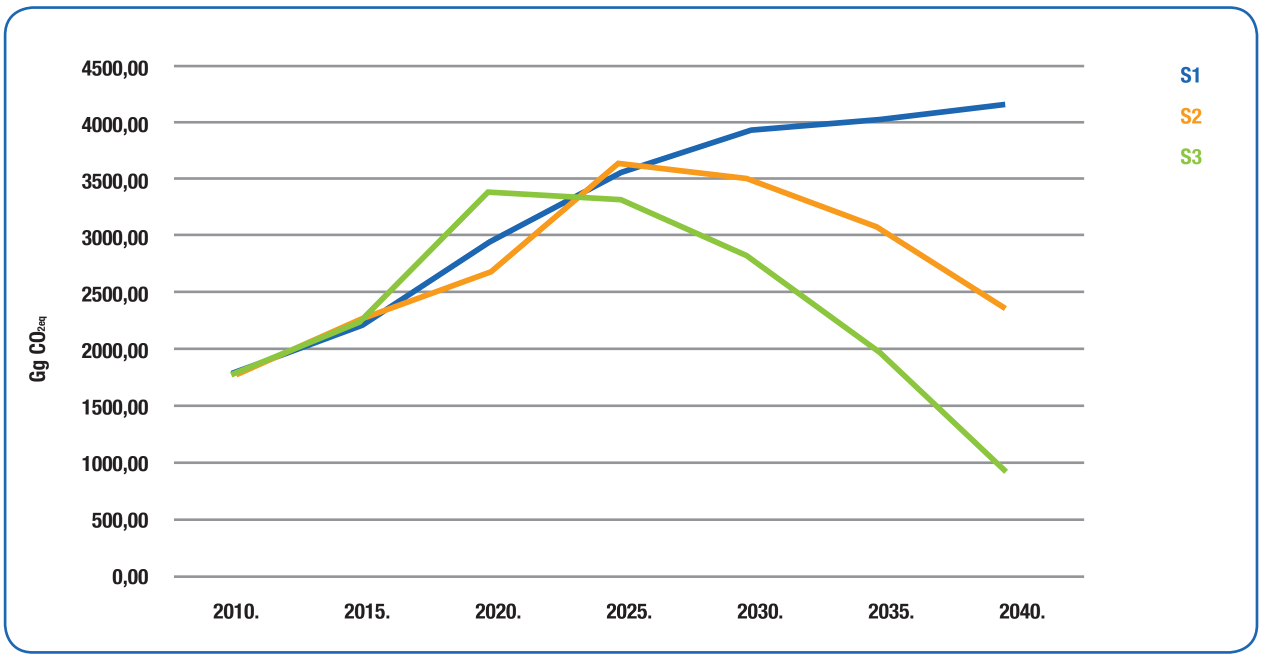

Chart 23: Total CO_2 emissions from waste by scenario for the period 2010-2040 (Gg CO_2eq)

It is clear from the above scenarios that no significant reduction in methane emissions (expressed as CO_2eq) is expected by 2020, although some measures have been undertaken. The S3 scenario even indicates a greater increase, which is caused by the assumption that regional landfills will be constructed earlier, which will increase the quantity of waste coming to the landfills. Maintaining the current waste management policy and slow recycling growth will lead to a mild increase in the quantity of methane produced, but it is evident that the measures are insufficient to lead to a reduction. Introduction of higher recycling and reuse rates in scenarios S2 and S3 will lead to a reduction, as the amounts of landfilled waste will also be reduced. The S3 scenario envisages a relatively high percentage of recycling (about 50% by 2040) and composting, resulting in a greater decrease in emissions.

3.9. Summary overview of GHG emission reduction scenarios

Based on the results of the scenarios for individual sectors, a summary overview was produced incorporating all effects of individual scenarios. The overview makes a projection of the total mitigation potential for each of the scenarios, not including the effects of sinks (i.e. the forestry sector).

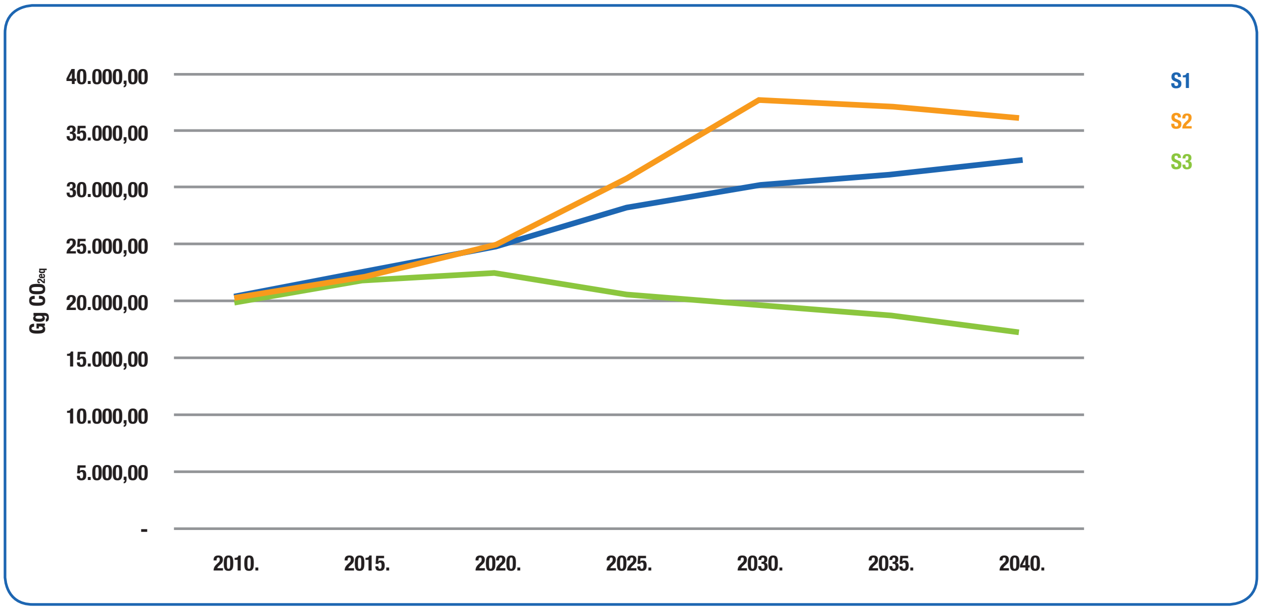

Chart 24: Total annual emissions from the electric power, renewable energy, district heating, transport, agriculture and waste sectors in BiH according to the S1, S2 and S3 scenarios, 2010–2040 (Gg CO_2eq)

The most influential sector in the emission projections is the electric power sector, which is responsible for 40%–65% of total emissions, depending on the scenario and the observed period. It is therefore clear why the trend of individual scenarios is the same as the trend the electric power sector scenarios.

According to the projected emissions, the S1 scenario ("business as usual") leads to slow but sustained growth, resulting in an expected increase in emissions of approximately 65% by 2040 compared to the baseline year 2010. The S2 scenario is characterised by a moderate rate of development and capacity building in line with relevant plans and strategies. Given the significant increase in production and use of RES, particularly after 2030, and due to the reduced emission factor, the curve has a decreasing trend, resulting in an expected increase in emissions of approximately 83% by 2030 compared to the baseline year. This will be followed by a decline, so by the end of the period under review, emissions in the S1 and S2 scenarios will be almost equalised. According to the advanced S3 scenario, the emissions will follow an upward trend to 2020, whereupon they are expected to start steadily declining, finally reaching a level 17% lower than that in the base year (2010) in 2040.

3.10. Financial analysis of the scenarios

This section discusses the financial and economic effects of different GHG emission scenarios (without analysing measures that would lead to these results) in the following sectors: electric power, renewable energy sources, buildings, district heating, transport, forestry, agriculture and waste. This report was prepared on the basis of the above scenarios on the potential of reducing greenhouse gas emissions, and it includes corresponding calculations for each of the sectors. Findings from the analysis are presented by sector. The analysis also includes the financial impact of each scenario, which is based on the product of predicted CO_2 emissions from each sector and avoidance costs[27] (see Table 14).

3.10.1. Electric power

According to the 2010–2040 scenarios presented above, average annual electricity output would amount to 20,931 GWh, which has a corresponding market value on an annual basis of approximately € 890 million[28] (the average price used for the purposes of this analysis is € 42,500 per GWh). Based on the average unit revenue and expenditure of electric power companies for the period 2010–2012, we can conclude that the companies' annual benefit would amount to € 7,642,000. After external costs are deducted from this benefit (the external cost for electricity production is € 0.07 per kWh from thermal power plants and € 0.005 per kWh from hydropower plants[29]), the annual cost of electricity production in BiH is approximately € 206 million lower than the amount needed to purchase energy. It can therefore be concluded that even when BiH produces electric energy, which is an activity that creates external costs, the country still achieves a greater economic effect than it would if it were to purchase electricity on the market. The above calculations and amounts constitute the S1 baseline (BAU) scenario.

According to the S2 scenario, due to the high share of fossil fuels in electricity production, which creates higher external costs, the benefit (the difference between the purchase and production of electricity) would amount to an average of € 117 million a year, which is 43% less than in the S1 baseline scenario.

According to the S3 scenario, external costs are lowered as a result of a significant share of advanced technologies and renewable energy sources (RES) used in the production of electric power. The benefit (the difference between the purchase and production of electricity) in this case would amount to an average of € 239 million a year, which is 16% more than in the S1 baseline (BAU) scenario.

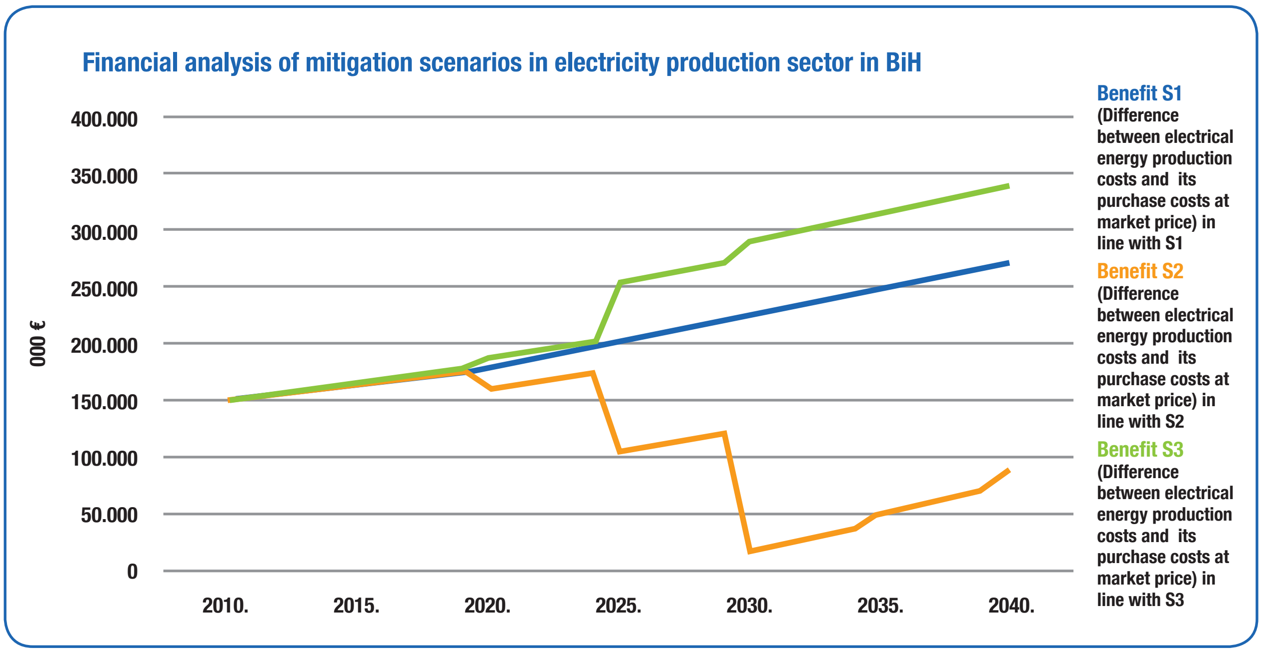

Chart 25: Benefits in the production of electricity in BiH according to the proposed scenarios, 2010–2040 (thousand €)

27 External costs or externalities are uncalculated costs which arise from impact on human health and mortality, global warming, agriculture, building materials and buildings, ecosystems, etc.

28 2013 Report of the State Electricity Regulatory Commission. December 2013, Tuzla

29 External Costs: "*Research results on socio-environmental damages due to electricity and transport*", EC, Brussels, 2003

3.10.2. Renewable energy sources (RES)

Under the S1 baseline scenario, which does not assume any significant changes in the current trend of RES use, the benefit consists of average annual avoidance costs in the amount of € 4 million. This amount represents the product of the average annual reduction in CO_2 emissions for the period under review and the avoidance cost of € 19 per tonne of carbon dioxide.

According to the S2 scenario, the average annual benefit, based on the same principle, is € 12.3 million, which is significantly higher than in the baseline scenario. This amount could be viewed as a rationale for investing in RES technologies. According to the S3 scenario, the average annual benefit amounts to € 82 million, which is as much as 20 times higher than in the baseline scenario. This holds enormous potential for growth and employment, especially in the construction, metal and electrical industry sectors.

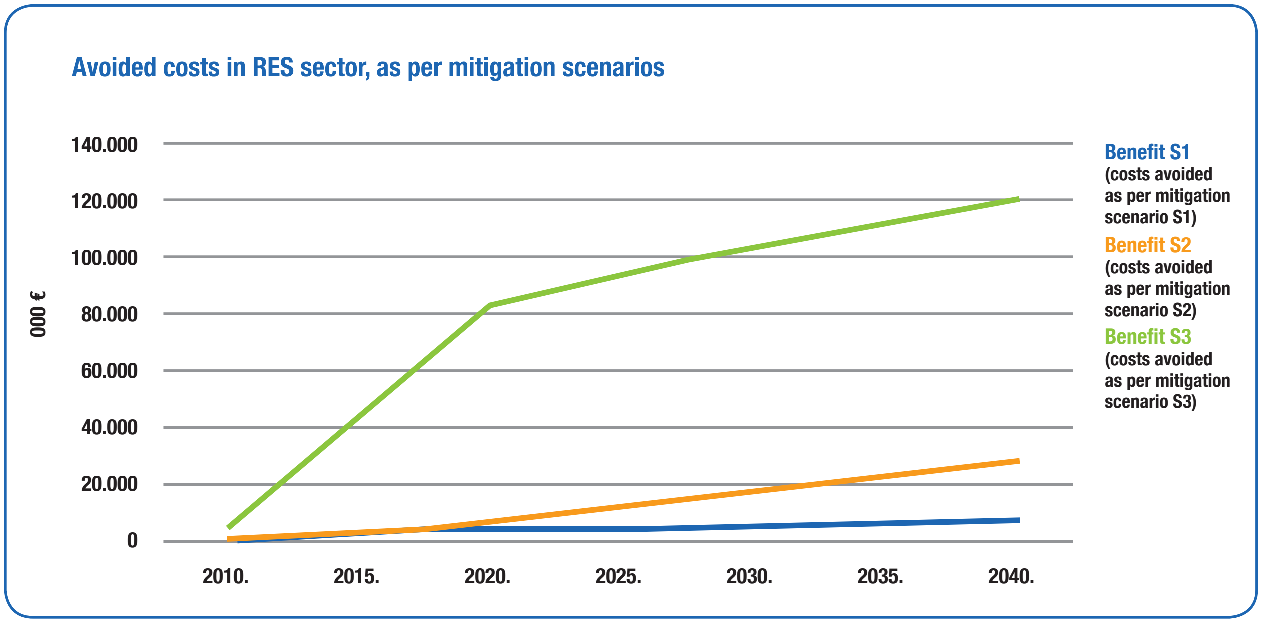

Chart 26: Benefits in the production of electricity from RES in BiH according to the proposed scenarios, 2010–2040 (thousand €)

3.10.3. District heating

Cost-benefit analysis for the district heating sector relies to a certain degree on the analysis of the buildings sector. Based on the reference period under review and given the aforementioned assumptions and calculations, it can be concluded that the average annual energy cost for district heating in BiH is € 149 million. In addition to the basic costs of energy for heating, there are external costs, depending on the district heating system and technology, which, on average, amount to € 119 million per year. Both types of costs together give a total cost for district heating systems of approximately € 268 million per year. The above data on average annual costs, including external costs, constitute calculations for the S1 scenario.

In the S2 scenario, the total average cost of energy for district heating, including external costs, amounts to € 267.3 million, which is € 0.67 million less than in the baseline scenario.

The total average cost of energy for district heating, according to the S3 scenario, also represents the sum of the basic cost of heat energy and external costs, and it amounts to € 266.4 million, which is € 1.6 million less than in the baseline scenario. Under the S3 scenario, during the period under review (2010–2040), potential savings of around € 50 million are generated that could be used for planned investment in the sector.

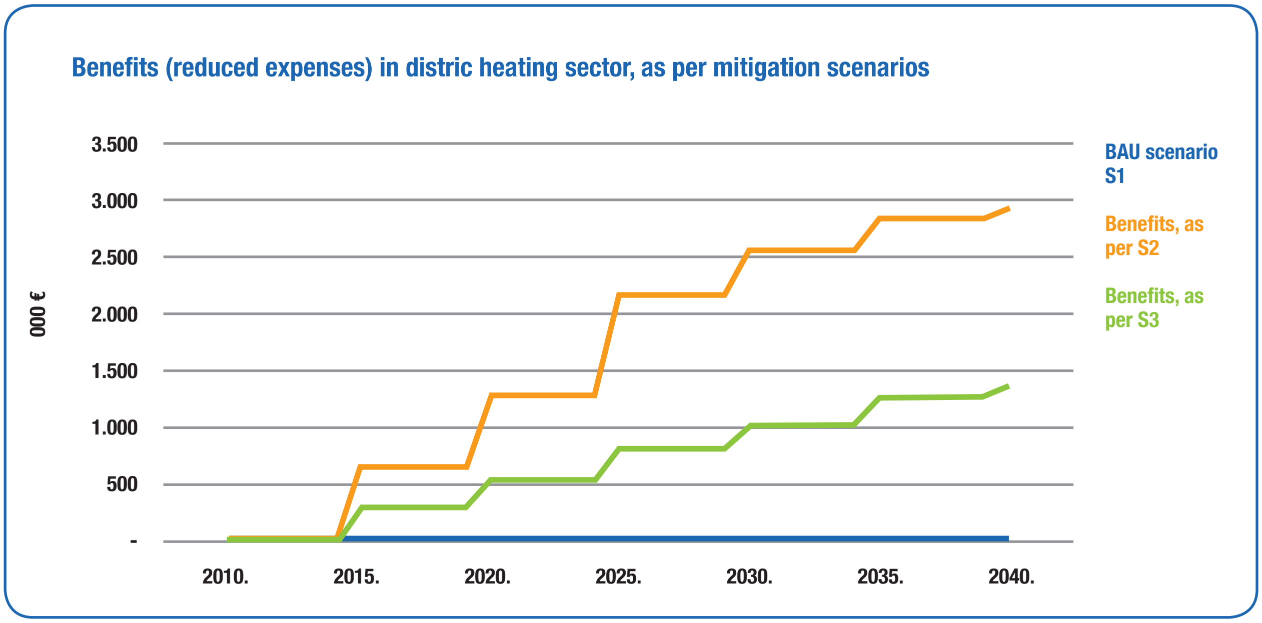

Chart 27. Benefits in the district heating sector according to the proposed scenarios, 2010–2040 (thousand €)

3.10.4. Buildings

The total cost of energy for heating in buildings in BiH was calculated based on the share of individual heating systems and methods used (DH, individual heating systems, firewood, gas, coal, etc.), and their unit costs. Based on this estimate, the average weighted cost of final heating energy per GWh in BiH is calculated to be € 66,267. If we assume that the structure of heating methods and systems in BiH will not change and that the current trend of population growth and average annual heating energy consumption per household will be sustained, the average annual cost of heat energy in BiH under the baseline scenario S1 is calculated to be € 736 million. In addition to the basic cost of heat energy, there are external costs. Taking into account the aforementioned heating systems and methods, the average external costs caused by the buildings sector in BiH amount to € 520 million per year. When we add up the basic costs of heat energy and external costs, the final amount is € 1.257 billion.

Given that the S2 scenario implies a significant increase in energy consumption, the average annual cost of heat energy in BiH grows at an average rate of 13%, and with the external costs factored in, the average annual cost is calculated to be € 1.326 billion; i.e., about € 70 million more than in the baseline scenario. Hence, under this scenario, there would be no benefit, but additional costs would be created, which are on average 6% higher than those in the baseline scenario S1 .

The S3 scenario is also based on medium-fast GDP growth, but it assumes the implementation of energy efficiency measures, which contribute to the reduction in average annual cost of heating energy in BiH. When external costs are factored in, the average annual costs are calculated to be € 1.15 billion; i.e., approximately € 107 million less than in the baseline scenario. In this case, the benefit is the difference represented by the average reduction in cost of 9% on an annual basis compared to the S1 baseline scenario. Looking at the period under review (2010–2040) and the S3 scenario relative to the S1 scenario, the overall benefit arising from reduced costs is calculated to be € 3.323 billion. This is the amount that would be saved if the development of the buildings sector were to follow the S3 scenario. In addition, this amount represents the financial potential of the entire period, and activities that will significantly reduce emissions in the building sector can certainly be recommended to state and entity authorities for implementation..

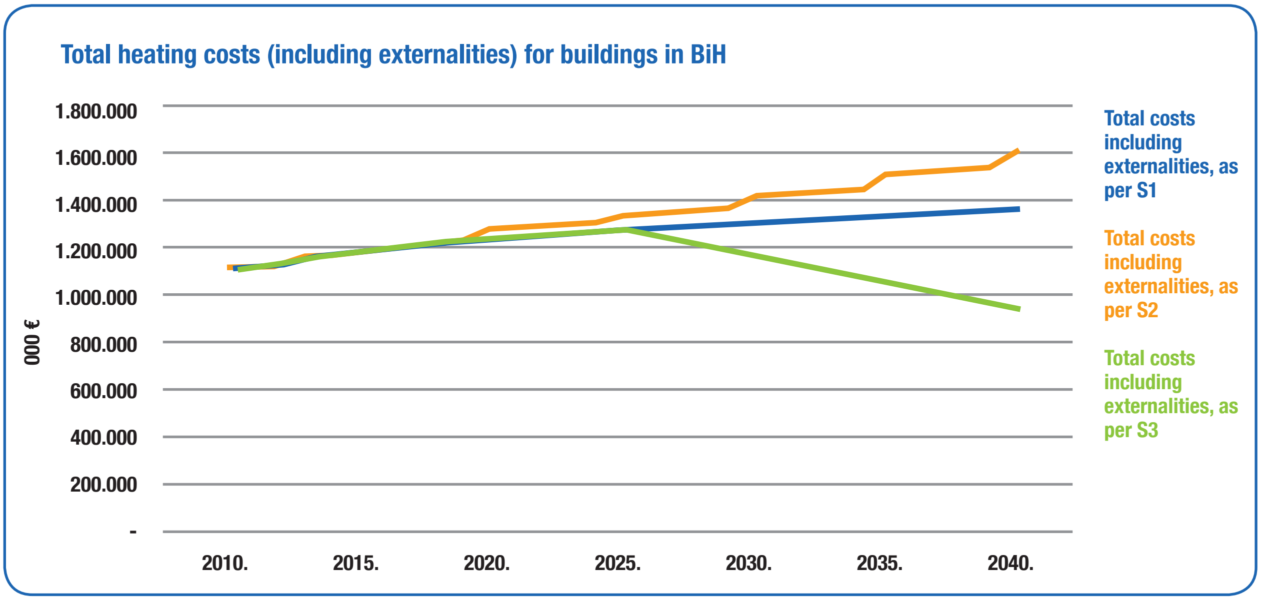

Chart 28: Trends of the total cost of heating energy (including external costs) in BiH (thousand €)

3.10.5. Transport

Taking into account the sub-sectors in transport, as well as the types of fuel used, according to the S1 scenario average annual amount of external costs for the reference period is € 95 million (€ 19 per tonne of generated CO_2).[30] According to the S2 scenario, average annual external costs amount to € 80 million, which is € 15 million less than in the baseline scenario; i.e., there is a 16% reduction in external costs. When we look at the entire reference period, the external costs calculated according to the S2 scenario are reduced by a total of € 469 million. Average annual external costs for the S3 scenario are € 49 million, which is 48% less than in the baseline scenario, or in absolute amount slightly less than € 46 million. For the entire reference period, the external costs in the S3 scenario are reduced by 1.4 € billion.

If we look at the reference period and development scenarios, the S2 and S3 scenarios have total external costs that are lower by € 0.47 billion and 1.4 billion, respectively. Based on this financial potential, it may be recommended that state and entity authorities implement activities that will significantly reduce emissions in the transport sector through implementation of EU directives; i.e., introduction of legal requirements relating to fuel quality, efficiency of motor vehicles, construction of more efficient road infrastructure, introduction of urban traffic measures, and a significant increase in rail traffic.

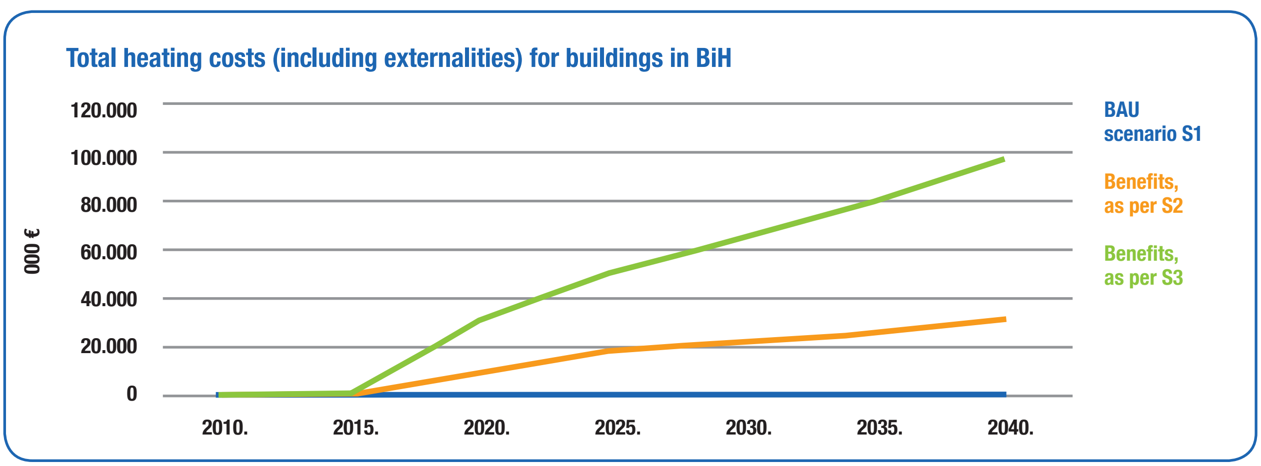

Chart 29: Benefits in the transport sector according to the proposed scenarios, 2010–2040 (thousand €)

30 External Costs: „*Research results on socio-environmental damages due to electricity and transport*“, EC, Brussels, 2003.

3.10.6. Forestry

The S1 baseline scenario assumes the continuation of the current trend of reduction in areas under forest cover and does not include any additional measures to stop or reverse that trend. In the reference period, as a result of CO_2 sinks, the benefit consists of average avoidance costs, amounting to € 122 million[31] per annum. According to the S2 scenario, the benefit is represented by average annual avoidance costs of approximately € 124 million. Under this scenario, the benefit is 2% higher than in the S1 baseline scenario. This benefit in the amount of € 2.5 million per annum could be seen as a potential for investment in the forestry sector. According to the S3 scenario, the average annual avoidance costs amount to € 125 million. Under this scenario, the benefit is 3% higher than in the S1 baseline scenario; i.e., € 3.5 million per annum. This benefit of nearly € 3.5 million a year indicates the investment potential in the forestry sector.

In the S2 and S3 scenarios, the total benefits for the reference period total approximately € 76 million and € 108 million, respectively, representing a significant potential for the sustainable development of the forestry sector by 2040.

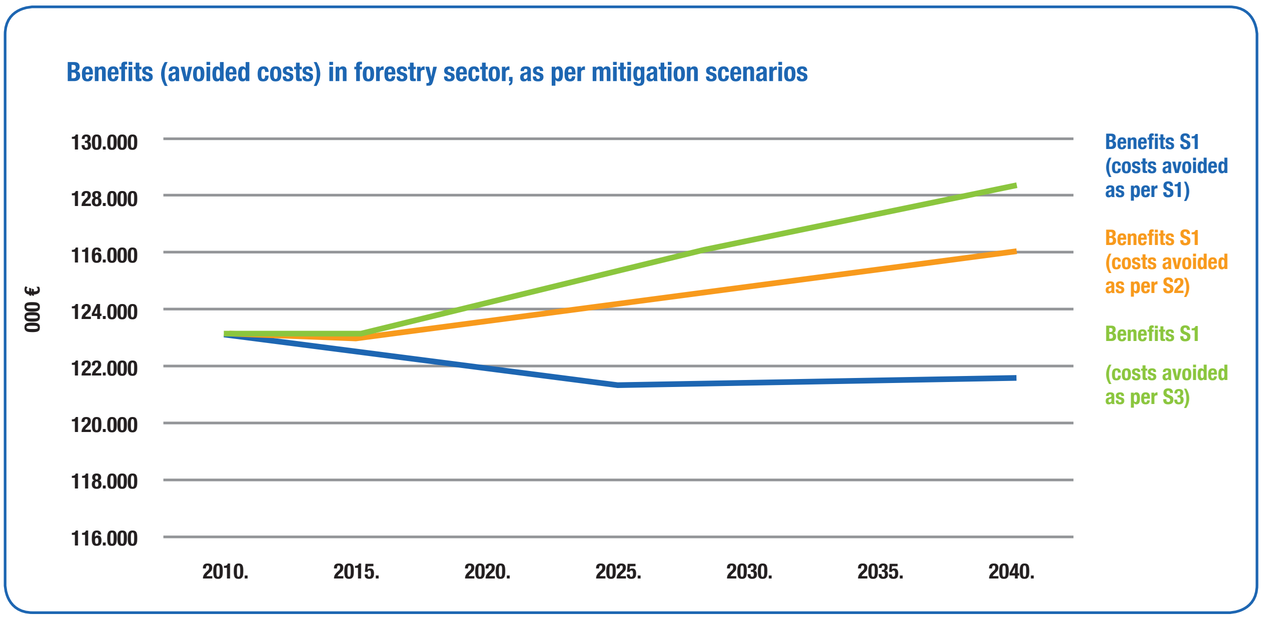

Chart 30: Benefits in the forestry sector in BiH according to the proposed scenarios, 2010–2040 (thousand €)

3.10.7. Agriculture

In agriculture the average annual external costs amount to € 71 million[32] in total for the reference period and for the S1 baseline scenario. According to the S2 scenario, these costs amount to € 48 million, which is € 23 million less than in the baseline scenario; i.e., a significant reduction of 32%. When we look at the entire reference period, the external costs under the S2 scenario decrease by € 0.71 billion. Average annual external costs for the S3 scenario amount to € 38.5 million, which is 46% less than in the baseline scenario or, in absolute amounts, slightly less than € 33 million per year. When considering the entire reference period, the external costs in scenario S3 decrease by € 1.02 billion.

During the reference period and compared to the S1 baseline scenario, scenarios S2 and S3 have total external costs reduced by € 0.71 billion and 1.02 billion, respectively. Based on this financial potential, it may be recommended that the state and entity authorities implement activities that will significantly reduce greenhouse gas emissions in the agricultural sector through modernisation of farms and employment of modern technical and technological measures and EU standards.

31 Ibid.
32 Ibid.

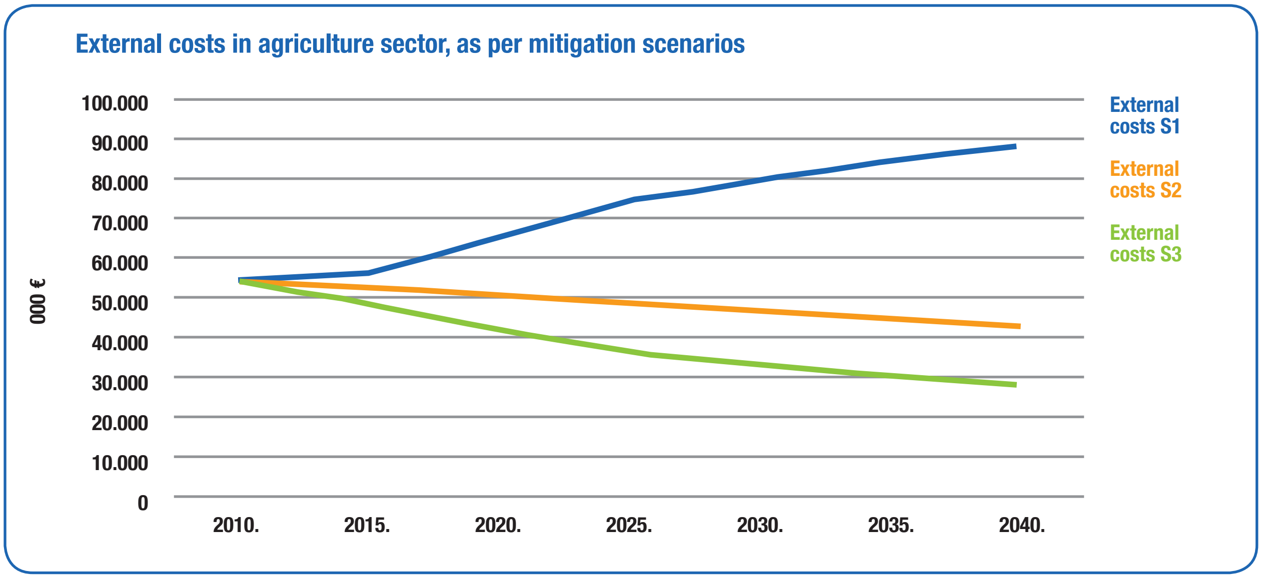

Chart 31: External costs in the agricultural sector in BiH, 2010–2040 (thousand €)

3.10.8. Waste Management

Cost-benefit analysis for the waste sector was done on the basis of external costs generated by this sector. Taking into account the collection and disposal methods, as well as the number of illegal dumping sites, the average annual external costs in the waste sector for the reference period in BiH is € 74.4 million.[33] This data on average annual external cost constitutes the calculation for the S1 scenario. Average annual external cost, according to the S2 scenario, amounts to € 63.54 million, which is almost € 11 million less than in the baseline scenario; i.e., this scenario leads to a reduction of 15%. For the entire reference period, the external costs in the S2 scenario decrease by € 339.5 million. Average annual external cost for the S3 scenario is € 55.6 million, which is 25% less than in the baseline scenario, or in absolute amounts about € 18.8 million. For the entire reference period, the external costs in the S3 scenario decrease by approximately € 583 million.

Total external costs in the S2 and S3 scenarios are lower by € 339.5 million and € 583 million, respectively, when compared to the S1 baseline scenario. Based on this financial potential, it may be recommended that the state and entity authorities implement activities that will significantly reduce emissions in the waste sector.

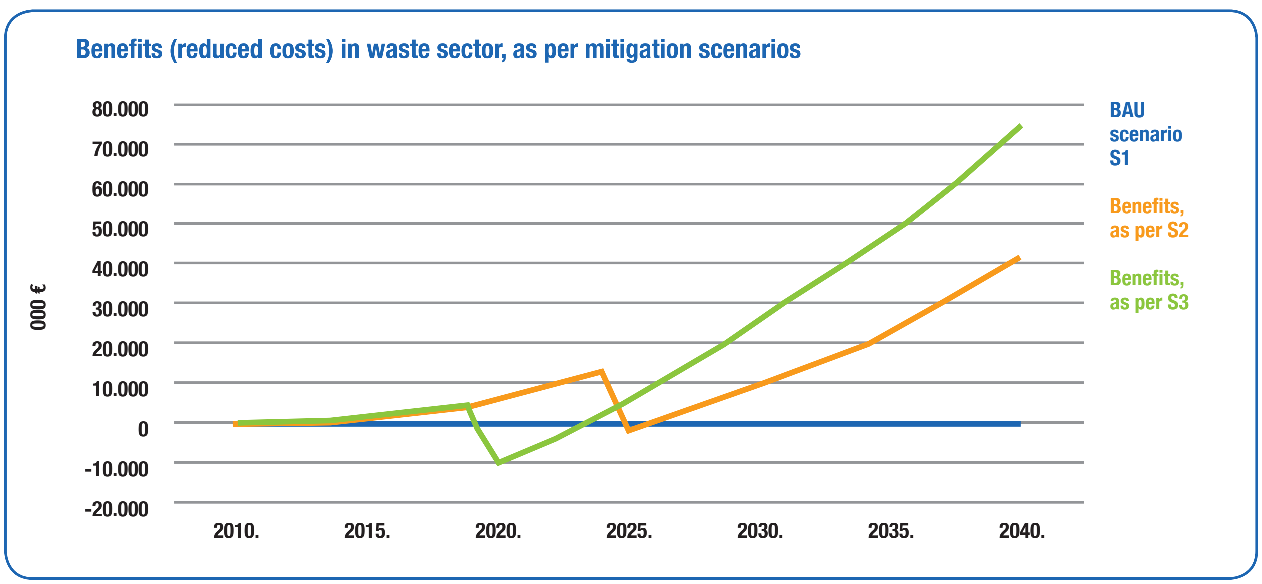

Chart 32: Benefits in the waste management sector according to the proposed scenarios, 2010–2040 (thousand €)

33 Ibid.

External costs in the energy sector[34]		
Impact Category	**Pollutant / Burden**	**Effects**
Human Health – mortality	• PM10, SO_2, NO_x, O_3 • Benzene, Benzo-[a]-pyrene 1,3-butadiene, diesel particles • Noise • Accident risk	• Reduction in life expectancy • Cancers • Loss of well-being, impact on health • Fatality risk from traffic and workplace accidents
Human Health – morbidity	• PM_{10}, O_3, SO_2 • PM_{10}, O_3 • PM_{10}, CO • Benzene, Benzo-[a]-pyrene 1,3-butadiene, diesel particles • PM_{10} • O_3 • Noise • Accident risk	• Respiratory hospital admissions • Restricted activity days • Congestive heart failure • Cancer risk (non-fatal) • Cerebro-vascular hospital admissions, cases of chronic bronchitis, cases of chronic cough in children, cough in asthmatics, lower respiratory symptoms • Asthma attacks, symptom days • Myocardial infarction, angina pectoris, hypertension, sleep disturbance • Risk of injuries from traffic and workplace accidents
Building material	• SO_2, acid deposition • Combustion particles	• Ageing of galvanised steel, limestone, mortar, sand-stone, paint, rendering, and zinc for utilitarian buildings • Soiling of buildings
Crops	• NO_x, SO_2, O_3 • Acid deposition	• Yield change for wheat, barley, rye, oats, potato, sugar beet, tobacco, sunflower seed • Increased need for liming
Global warming	• CO_2, CH_4, N_2O, N, S	• World-wide effects on mortality, morbidity, coastal impacts, agriculture, energy demand, and economic impacts due to temperature change and sea level rise
Losses in Well-Being	• Noise	• Reductions in well-being due to noise exposure
Ecosystems	• Acid deposition, nitrogen deposition	• Acidity and eutrophication

Table 15: External costs in the energy sector

34 Ibid. 4, p 7

3.11. Tabular presentation of climate change mitigation activities

Climate change mitigation activities	Sector	Status (planned/ ongoing/ completed)	Objective	Description (type of activity, mitigation method, gas, timeframe)
Construction of biomass-fired cogeneration (CHP) plants	Energy production	Planned	Reduction of heating costs, local revenues from the sale of electrical energy	Construction of cogeneration plants fired by wood cuttings from forest wood residues and wood waste from wood processing industry, with individual capacity of several MWe and total capacity of 200 MWe in the period 2013–2025
Improving the efficiency of coal-fired thermal power plants (construction of new ones)	Energy production	Planned	Reduction of electric energy production costs and reduction of emissions from the electric power sector	Replacement of the existing thermal power plants having average efficiency of 30% with 40% for newer plants (total power 1800 MW). Period 2018–2030
Using methane from underground coal mines	Energy production Industry	Planned	Energy production from methane and reduction of methane emissions	Installation of equipment for energy production from methane from two underground mines (five pits)
Construction of thermal power plants fired by natural gas	Energy production	Planned	Production of thermal energy for heating and reduction of specific CO_2 emissions from the electric power network	Construction of a modern thermal power fired by natural gas with combined cycle and cogeneration capacity of around 250 MW, and fuel efficiency of over 80%.
Construction of small hydropower plants	Energy production	On-going	Exploitation of hydropower potential	Installation of small hydropower plants up to 10 MW for a total capacity of 170 MW, in the period 2014–2040
Construction of wind power plants	Energy production	Planned	Exploitation of wind power potential	Installation of 500 MW of wind power plants in the period 2015–2040
Construction of solar power plants	Energy production	Planned	Exploitation of solar power potential	Installation of 20 MW of PV modules in the period 2015–2040
Using biofuels, geothermal and solar energy	Energy production	On-going	Exploitation of RES for heating and hot water	Installation of plants using biogas, geothermal energy and solar energy to produce heating and hot water. Continued implementation 2010–2040
Installation of heat meters in buildings that are connected to the district heating system	Energy production	On-going	Reduction in energy consumption and resultant reduction in CO_2 emissions	Installation of cumulative and individual heat meters in all buildings connected to district heating systems. Implementation of this measure is to take place in the period 2015–2020

	Coordination and management	Estimated emission reduction Gg CO_2	Other effects	Mode / type of support	Preparation and implementation costs
	Entity ministries of energy, municipalities with biomass potential and forest management companies	1,080 (880 from electricity production and 200 from production of thermal energy)	2,500 new permanent jobs created, Improved air quality, development of an industry that needs thermal energy, sustainability of forest management companies	International development banks have on-going projects related to financial support (IFC, EBRD)	Preparation: € 100.000 per MWe Implementation: € 4 mil. per MWe (investment in plant and primary line)
	Entity ministries of energy and power companies	4,800	Maintaining jobs in mining and thermal power production, Improved air quality	For on-going projects, the financing model is through strategic partnership	Preparation € 50 mil. Implementation € 4.5 billioni
	Ministry of Energy, Mining and Industry of FBiH, Electrical Energy Enterprise of BiH (*Elektroprivreda BiH*)	150 (100 from electricity production and 50 from production of thermal energy)	Additional revenue for mines, new jobs, Increased safety at work in mines	Technical support for the preparation of the feasibility study	Preparation € 1 mil. Implementation € 15 mil. (in five pits)
	Ministry of Energy, Mining and Industry of FBiH and MoFTER	700 (650 from electricity production and 50 from production of thermal energy)	Reduction of heating costs, Reduction of local pollution	Project is implemented on a commercial basis	Preparation € 3 mil., Implementation € 150 mil.
	Entity ministries of energy, FMET, MSPCEE RS	250	Development of rural regions (infrastructure), Technology transfer, potential for tourism	Technical support from IFC for drafting legislation	Preparation € 20 mil. Implementation € 300 mil.
	Entity ministries of energy	600	Development of rural regions (infrastructure), Technology transfer	Technical support from KfW	Preparation € 20 million Implementation € 400 mil.
	Entity ministries of energy	30	Technology transfer	There has been no support	Preparation € 0,5 mil. Implementation € 20 mil.
	Entity ministries of energy, Ministry of Physical Planning of FBiH, MSPCEE RS	6	Encouraging domestic production (solar collectors), reduction in price of thermal energy, technology transfer	Loans under favourable conditions	
	Entity ministries of energy cantonal and municipal authorities, district heating companies	40.00	Improved performance of district heating companies, reduced dependance of BiH on imported fuels		€ 105.00 mil.

Introduction of RES in existing district heating systems, as well as construction of new plants fired by RES	Energy production	On-going	Reduction in the price of thermal energy, reduction in CO_2 emissions	Introduction of biomass as a primary or auxiliary fuel in district heating companies that use fossil fuels, and construction of new biomass-powered plants. Implement continuously until 2040, with the largest part to be implemented by 2025
Reconstruction and modernisation of district heating systems, boilers and heating substations	Energy production	On-going	Increase in the overall system efficiency	Reconstruction and modernisation of district heating networks, boilers and heating substations. Implement continuously until 2040
Creation and implementation of a legal framework for the introduction of energy efficiency in buildings	Energy production	On-going	Reduction in heat demands of buildings, reduced energy consumption, i.e., energy-generating fuels, for heating	Improving energy efficiency in new and existing buildings, adoption and implementation of laws that regulate this area: - limit energy consumption per m^2 - introduce mandatory certification - introduce mandatory energy efficiency retrofits when making major building renovations
Awareness campaigns and education	Energy production	On-going	Raising awareness of multiple effects of energy saving, greater use of renewable energy and benefits for individuals and society as a whole.	- Training of professionals: architects, contractors, employees in administrative bodies (implementation of legislation) - Various campaigns aimed at raising awareness and educating investors and users of buildings (energy days), NGO-led campaigns, etc.
Application of directives pertaining to emission reductions, efficiency of motor vehicles and fuel quality	Transport	Planned	Use of better-quality fuel, reduction of emissions from light-duty vehicles, prescribing standard emission values for new motor vehicles	Transposition, implementation and application of EU directives into national legislation, 2010–2020.
Fees for car registration and excise tax on the use of inefficient motor vehicle	Transport	On-going	Introduction of air pollution fees and creation of an incentive fund for the implementation of activities aimed at more efficient use of transport fuels; use of renewable energy in transport	Putting in place a “polluter pays” mechanism in the transport sector, gradually tightening up the criteria and increasing the amount of the fee, 2012–2015
Periodic roadworthiness tests for motor vehicles	Transport	On-going	Exclusion from traffic of vehicles not meeting technical standards, reduction in CO_2 emissions	Systematic implementation of activities resulting in the exclusion from traffic of motor vehicles that do not meet the minimum technical standards required by law
Shortening sections through construction and modernisation of road infrastructure	Transport	On-going	Increasing transport efficiency	Construction of a motorway network throughout the country, modernisation and optimisation of road signs, 2010–2025

	Entity ministries of energy cantonal and municipal authorities, district heating companies	45.00	Employment of new workers, Reduced dependence of BiH on imported fuels		€ 75.00 mil.
	Cantonal and municipal authorities, district heating companies	80.00	Lower heating bills, Improved performance of district heating companies		€ 520.00
	Entity and cantonal line ministries for spatial planning, ministries of energy, environmental protection funds	.	Greener economy, Lower costs of building use –economic and social benefits, better comfort...	Technical support	
	Governments and competent entity ministries Donor support from UNDP, GIZ; USAID, and other international organisations and NGO sector		Energy savings, GHG emission reduction, economic and social benefits, Development of green jobs	Financial and technical support	€ 11.026 mil.
	Entity ministries of transport		Reduced air pollution, Increased safety in the transport sector and in road traffic		
	Entity ministries of finance, FMET, MSPCEE RS, Environmental Protection Funds	30	Reduced air pollution, co-financing emission reduction projects through activities of environmental funds, support to innovative projects and solutions to reduce CO_2 emissions	Entity budgets	€ 200,000
	Entity ministries of transport, ministries of the interior	80	Reduced air pollution, Increased road safety		€ 10 mil.
	Entity ministries of transport	120	Reduced air pollution, increased employment, reduced fuel consumption in cars, Increased road safety	Development banks, self-financing through collection of road tolls, budget	> € 400,000,000

Increasing the area under forest cover 2.500 ha/yr	Forestry	On-going	Afforestation of barren tracts of land suitable for afforestation, as well as of coppice forests with more valuable species which have a higher increment rate and thus a higher CO_2 absorption rate	Increase in the area under forest cover through afforestation of significant areas rated as suitable for afforestation. In BiH there are over 300,000 hectares of barren tracts of land suitable for afforestation and about 450,000 hectares of coppice forests.
Establishment of intensive plantations (energy crops and plantations)	Forestry	Planned	Provision of significant amounts of biomass	Raising intensive poplar plantations in the basins of major rivers. Possible biomass production of 20-40 m^3/ha. Area suitable for planting fast growing species 2,000 ha.
Protection of forests against fire (as well as diseases, pests and illegal logging)	Forestry	On-going	Reducing loss of areas under forest cover	Developing fire services for the prevention of fire over large areas; large-scale preventive measures against dying of forests
Increasing the area of protective forests	Forestry	On-going	Reduction in the volume of felling	Reduction in the volume of felling by imposing a special protection regime ensures accumulation of CO_2 through increase in forest wood biomass. The aim is to designate about 7% of the total area covered by forests, and thus approach the European average.
Improvements in the use of organic and artificial fertilisers	Agriculture	Planned	Reduction in nitric oxide emissions and increase in energy efficiency, Prevention of volatilisation and seepage to surface water and groundwater	Adoption and implementation of laws and implementing regulations on good agricultural practices in accordance with the Water Directive, Nitrogen Directive and Waste Materials Directive Continuous activity until 2025
Rehabilitation of existing landfills	Waste	On-going	Reduction of CH_4 emissions	Construction of systems for degassing and reuse of gas, or flaring; Prevention of emissions
Construction of regional landfills, without gas recovery	Waste	On-going	Control and reduction of CH_4 emissions	Construction of degassing systems, and flaring
Increasing levels of recycling and composting – alternative waste management practices	Waste	On-going	Reduction in emissions (through reduction in landfilled waste)	Adoption of legislation (special waste streams), establishment of systems for recycling and reuse (operators for special waste streams)

Table 16: Tabular presentation of climate change mitigation activities

	Entity ministries of forestry, public companies, private owners	180	New jobs. Increased stocks of wood assortments		KM 5-8,000 per hectare
	Entity ministries of forestry, public companies, river basin management enterprises, companies	56	New jobs. Increased stocks of wood assortments, production of biomass (chips)		Establishment: about KM 5,000 per hectare plus costs of regular maintenance
	Entity ministries of forestry and public companies	70	Forest ecosystems that are simultaneously stable and tolerant to climate change		€ 1.5 mil.
	Entity ministries of forestry	5	Conservation of biodiversity and genetic resources in our forests		
	MOFTER, entity ministries of agriculture, entity ministries of environment, institutes for agriculture and agricultural land		Quality of production, safety of production, steady supply, water protection, healthier environment and general contribution to rural development	Programmatic measures and incentives, EU funds	€ 5–10 mil.
	Municipalities	40	Reduced environmental impact	IPA funds, DCF grants, WB loan	€ 0.75 mil. per landfill
	MSPCEE RS and FMET, municipalities (PUC)	50	Landfills making a profit from the sale or use of landfill gas, reduced amounts of waste in landfills and reduced pressure on the environment	IPA grants and IFI loans	Min € 5 mil. per landfill (16 landfills are planned)
	MSPCEE RS and FMET, and municipalities (PUC)	80	Creation of new jobs, Extended active lifetime of landfills, reduced environmental impact	DCF grants and investments by the system operators	€ 0.6 mil. per landfill

4. ESTABLISHMENT OF INSTITUTIONAL FRAMEWORK FOR MEASURING, REPORTING AND VERIFICATION OF NATIONALLY APPROPRIATE MITIGATION ACTIONS

4.1. The NAMA mechanism in BiH

Bosnia and Herzegovina has not yet established a mechanism for approving and submitting NAMAs (*Nationally Appropriate Mitigation Actions*) to the UNFCCC NAMA registry. The purpose of this mechanism is to record the demand for international support for the implementation of NAMAs and to facilitate the matching of financial resources, technology and capacity building support with these measures.

An initiative was submitted to Council of Ministers of BiH seeking to amend the Decision establishing the Designated National Authority (DNA) for the implementation of Clean Development Mechanism (CDM) projects under the Kyoto Protocol to the UNFCCC in Bosnia and Herzegovina. The amendment would add the development, receipt and approval/rejection of NAMAs to the existing activities of the DNA. Amendments to the DNA's Rules of Procedure would be passed at the next session of the Executive Board.

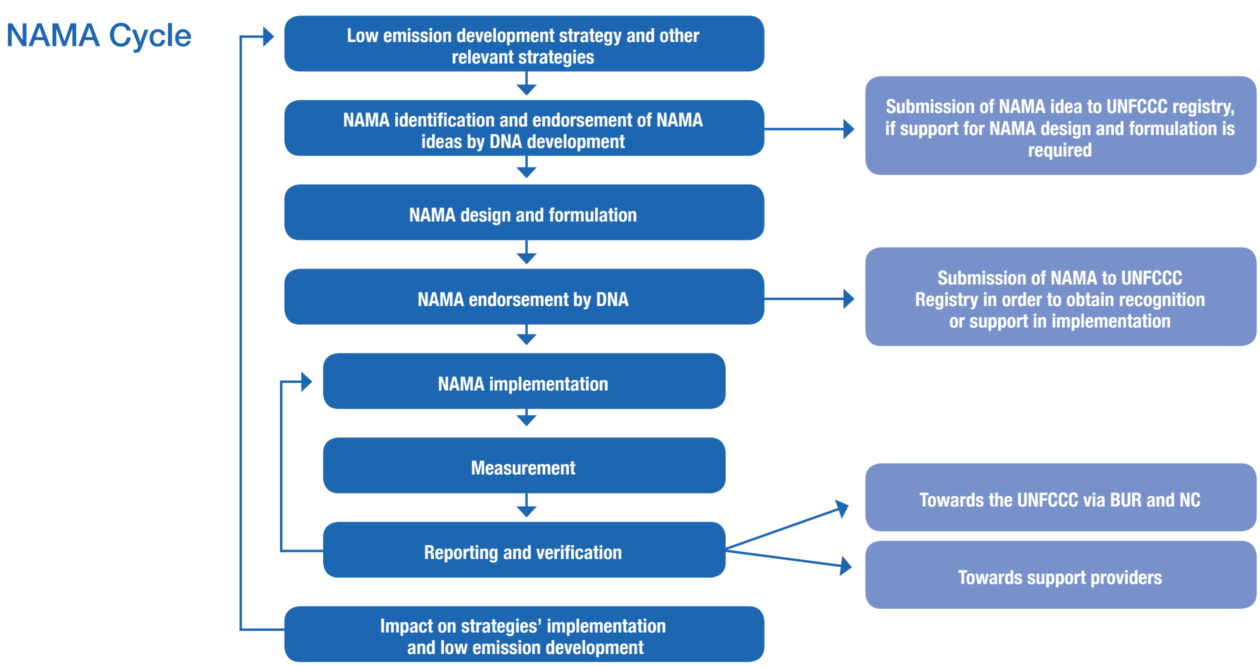

Figure 2: The NAMA cycle

The proposed amendments to the Decision provide that the NAMA DNA's structure would be composed of the Executive Board, the DNA Secretariats and the Expert Councils, each with different but closely-related functions.

The Executive Board of the NAMA DNA is to consist of appointed representatives from the Ministry of Foreign Trade and Economic Relations of BiH, the Ministry of Spatial Planning, Civil Engineering and Ecology of RS, the Ministry of Environment and Tourism of FBiH, and the Department for Spatial Planning and Property Affairs of Brčko District.

The Technical Secretariat of the NAMA DNA shall be established as part of the Executive Board, within the Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina, to support the work of the Executive Board.

The NAMA DNA Secretariats shall be formed at the entity and Brčko District levels and shall conduct the following activities: define and implement their respective NAMA policies; receive NAMA project proposals to be implemented in the territories of the entities and Brčko District in accordance with their jurisdiction; evaluate and adopt NAMA project documentation; submit NAMA project proposals to the Expert Council and seek expert assessment of project documents; and approve or reject NAMA projects.

The Expert Councils of the DNA Secretariats in the entities and Brčko District consist of one expert representative for the area that is the subject of the NAMA project from each relevant ministry responsible for following sectors: environmental affairs, energy, industry, mining, agriculture, forestry and water management, economic relations and regional cooperation, transport and finance, etc.

It is important to note that the areas with the greatest potential for climate change mitigation are defined, along with the identified NAMAs, in the Climate Change Adaptation and Low Emission Development Strategy for Bosnia and Herzegovina, which also represents the first comprehensive NAMA plan for BiH.

NAMA DNA Structure

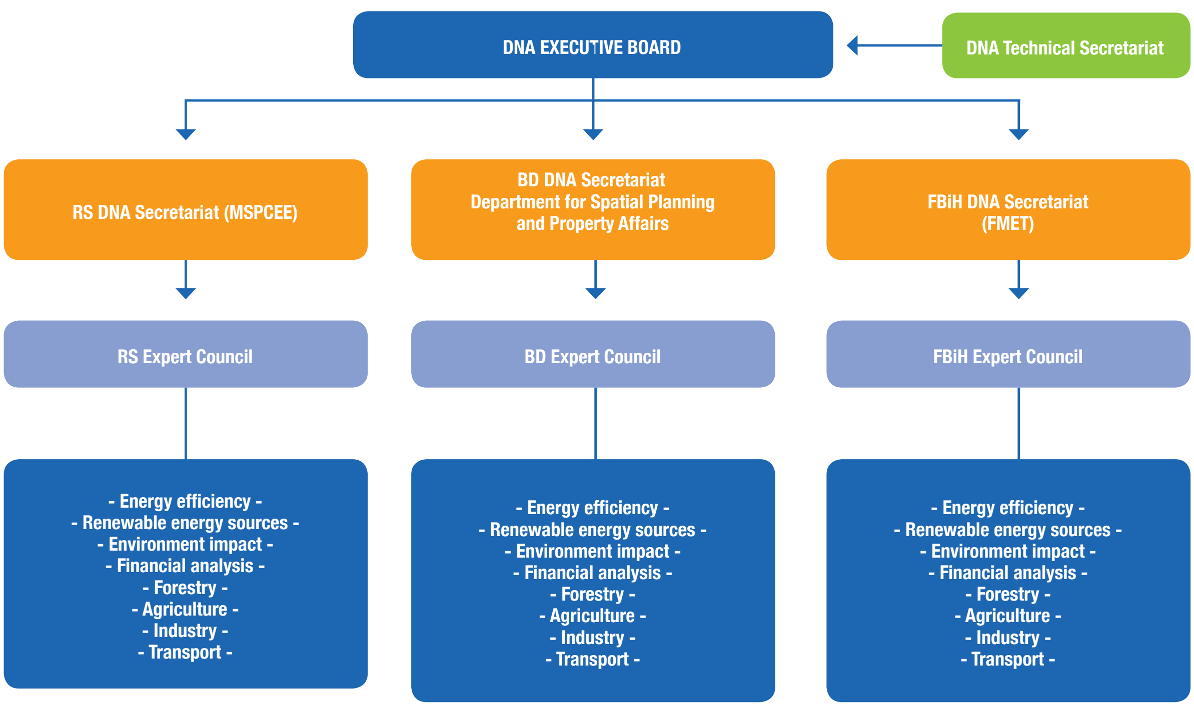

Figure 3: NAMA DNA structure in BiH

NAMA endorsement process in BiH

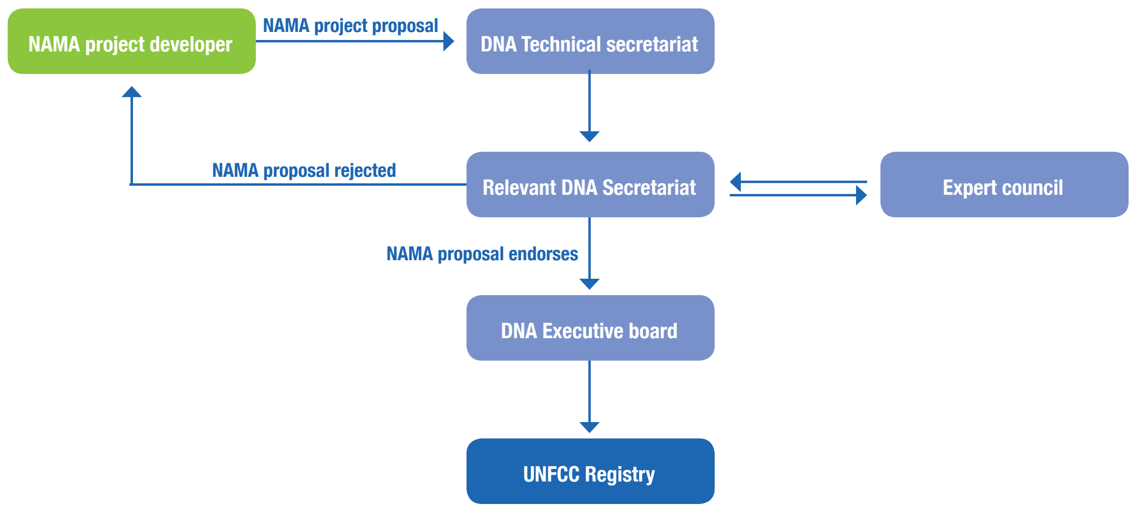

Figure 4: Process of approving NAMA projects in BiH

4.2. Measuring, reporting and verifying NAMA projects

In accordance with the COP Decision 17 (2/CP.17, Annex III), the Parties not included in Annex I to the UNFCCC should establish a transparent system for the measuring, reporting and verification (MRV) of data and information on nationally-appropriate mitigation actions (NAMAs) that are implemented.

The establishment of MRV in BiH should follow the country's existing constitutional structure, and its activities should be embedded, to the maximum extent possible, in existing institutions. Although BiH, like many other developing countries, lacks the required capacity, which hinders the MRV process, an analysis of the existing legislative and institutional framework has shown that there are institutions in BiH with legally defined competences that could report on the implementation of mitigation actions. In order to ensure that the institutions in BiH measure, report and verify in accordance with international standards, it is necessary to build and strengthen the capacity of these existing institutions.

MRV should not be seen only as a tool for calculating GHG emission reduction, but rather as a tool for managing processes that are envisaged under the NAMA programme. The MRV system should be an integral part of generally accepted dynamic project management, which includes transparency, reliability and responsibility, but above all continuous project adaptability.

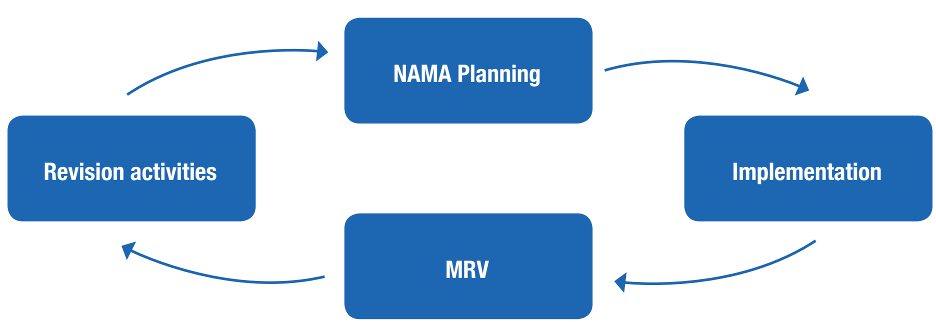

Figure 5: MRV as part of the dynamic NAMA implementation cycle

4.2.1. Measurement

Measurement is collection of quantitative data that form a basis for monitoring progress and results of activities. Measuring involves direct physical measurement of GHG emission reduction or a calculation of emission reductions based on the measurement of activities and the use of emission factors. It may also involve monitoring performance indicators, depending on the nature of the given NAMA (e.g. the amount of energy produced from renewable sources, the number of new jobs, etc.).

A distinctive element of the MRV system in NAMA programmes is its comprehensiveness, whereas the existing systems for collecting emissions data at the national, entity, sectoral, company and plant levels fail to establish a link between the technical indicators of GHG emissions and non-technical influences such as legislation, social and political stability, fuel prices, etc.

Measurement should provide information about the results achieved from project, including the reduction of GHG emissions. A monitoring plan, which should be an integral part of each NAMA and is prepared in parallel with the development of the project proposal, should contain the following:

- defined indicators,
- description of measurement and data collection methods and procedures,
- data sources,
- frequency of measurement,
- accuracy and levels of uncertainty of the measurement process and estimates made,
- sampling method (if applicable),
- methods for generating, storing and collecting data and for reporting on monitored parameters,
- databases and tools (e.g. software) to be used,
- name(s) of the group or individuals responsible for monitoring, their tasks and responsibilities, and
- procedures for internal auditing and quality control.

The measurement and reporting system is based on a reliable GHG inventory, which provides information on emissions in each economic sector or sub-sector. Apart from compiling a GHG inventory at the entity level, and its aggregation, it is also necessary to develop a data collection approach at the corporate level and at the grassroots level where energy is consumed and emissions are produced (billing based on measurements in buildings, factory plants, etc.) or direct measurements of emissions at the source. In BiH there is already monitoring of energy consumption by companies / organisations. However, it is necessary to improve the current practice and increase the number of sites where consumption and emissions are measured accurately and reliably. Furthermore, it is extremely important at this point to ensure reliable and timely data processing and conversion of these data into information that would be distributed both horizontally and vertically to all users.

Apart from the GHG inventory, depending on the nature of the project, monitoring NAMAs also involves the use of other relevant indicators, such as annual energy consumption, number of thermally insulated houses, re-forested areas, etc. As regards NAMAs that entail economic and fiscal policies, monitoring can be a very complicated process, as they do not reduce emissions directly but encourage legal entities or individuals to change their behaviour. In these types of NAMAs, it is difficult to identify what has to be measured. Therefore, it has been suggested that in such cases, instead of focusing only on emissions, MRV should also focus on other relevant indicators, such as the number of new jobs created, tax revenues, the level of activities in the implementation of the planned measures, etc.

4.2.2. Reporting

Reporting entails the transparent and standardised compilation of measured values and their public presentation.

The biggest problem in implementing NAMA programmes is the lack of effective information networks, as well as standards for the processing and preparation of information to be fed into the network. Therefore, it is necessary to establish a system of information exchange, measurement sites in the state/entity and local network, measurement techniques, and systems for the exchange of data obtained by monitoring GHG emissions in these networks.

To establish an effective and efficient reporting system, it is primarily necessary to utilise the existing communications infrastructure as well as to upgrade this infrastructure by introducing information standards (technical specifications or other criteria necessary to ensure that the materials or methods will consistently meet the needs specified). The minimum information necessary for the BUR already exists, but the flow of information is very poor. To remedy this, it is first necessary to work on the establishment of an information network between NAMA projects and relevant line ministries within the entities[35] in order to gather information about NAMA activities. The first necessary step is to inform the relevant line ministries of their obligations under the UNFCCC, then prepare a decree/decision introducing mandatory reporting on the mitigation activities implemented (the decision of the Government of RS, FBiH and BD) and develop a reporting form. These reports are to be submitted to the statistical institutes, which can then supply users with all of the data related to these activities. The statistical system should be actively involved and be part of the MRV system in BiH and should supply all users with information relating to environmental protection, energy efficiency, renewable energy, etc. This information is used for monitoring emissions reduction and producing a GHG inventory by the hydro-meteorological services, which are also the only institutions in BiH that have the internal capacity to produce a GHG inventory. It is proposed that a working group composed of the two entity hydro-meteorological institutes be established with the aim of drafting these reports. All information collected in this way in the Federation of BiH, the Republic of Srpska and Brčko District should be used as inputs for producing the Biennial Report of Bosnia and Herzegovina under the United Nations Framework Convention on Climate Change.

NAMA reporting

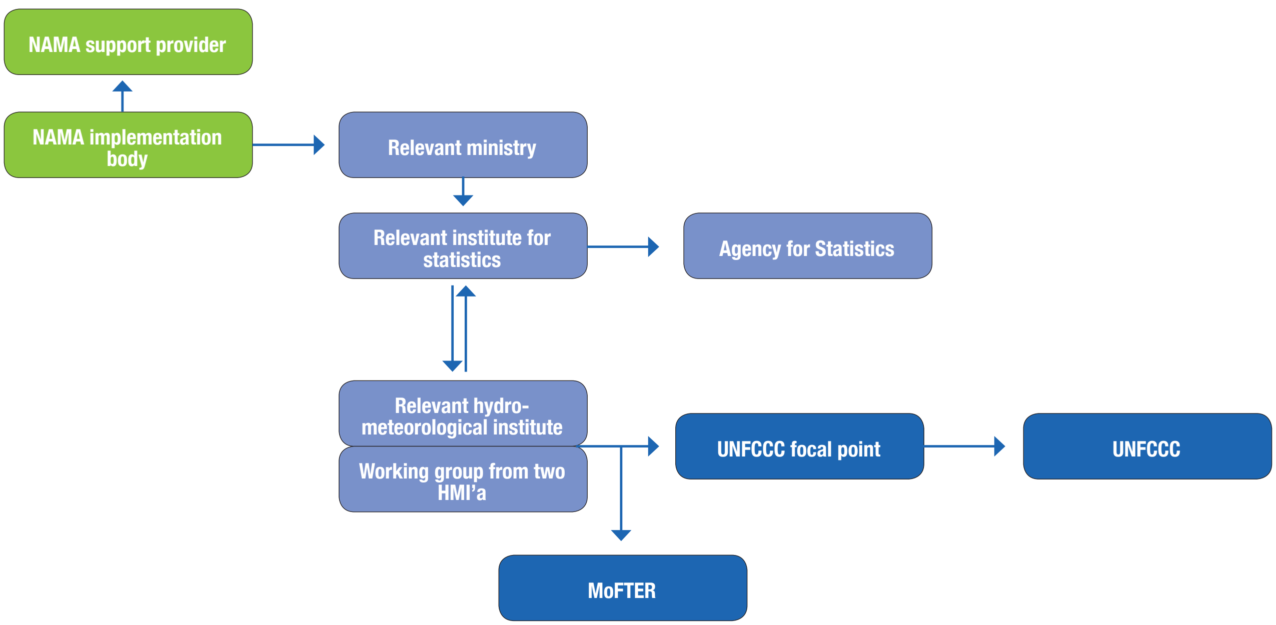

Figure 6: NAMA reporting scheme

Communication with the UNFCCC Secretariat and the delivery of all reports is the responsibility of the Ministry of Spatial Planning, Civil Engineering and Ecology of the Republic of Srpska, which is the designated national focal point for coordination of cooperation with international structures and institutions of the UNFCCC and the Kyoto Protocol.

4.2.3. Verification

Verification is an independent assessment of the accuracy and reliability of the information presented.

A list of legal entities (universities, institutes, companies) accredited to verify the information on the impact of NAMA's, including the reduction of GHG emissions, will be drawn up for the purpose of verifying NAMA results.

35 Depending on the type of activities, these include ministries responsible for energy, industry, mining, agriculture, forestry, water management, transport, finance...

LIST OF CHARTS, TABLES AND FIGURES

LIST OF ACRONYMS

BD	Brčko District
BHAS	Agency for Statistics of Bosnia and Herzegovina
BiH	Bosnia and Herzegovina
CDM	Clean Development Mechanism
CoP	Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC)
CORINAIR	CORE Inventory of Air Emissions
CRF	Case Report Form
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
EMIS	Energy Management Information System
EU	European Union
EU ETS	European Union Emission Trading Scheme
FBiH	Federation of Bosnia and Herzegovina
FBUR	First Biennial Updated Report
FDI	Foreign Direct Investment
FMET	Ministry of Environment and Tourism of the Federation of BiH
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gases
IMF	International Monetary Fund
INC	Initial National Communication
IPA	Instrument for Pre-accession Assistance (European Union)
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control

KM	Convertible Mark
M&E	Monitoring and Evaluation
MDG	Millennium Development Goals
MOFTER	Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina
MRV	Measurement, Reporting and Verification
MSPCEE, RS	Ministry of Spatial Planning, Civil Engineering and Ecology of the Republic of Srpska
NAMA	Nationally Appropriate Mitigation Action
NEAP	National Environmental Action Plan
NEEAP	National Energy Efficiency Action Plan
NGO	Nongovernmental Organisation
OECD	Organisation for Economic Co-operation and Development
PPS	Purchasing Power Standard
PRTR	Pollutant Release and Transfer Register
PUC	Public Utility Company
QA	Quality Assurance
QC	Quality Control
RES	Renewable Energy Source(s)
RS	Republic of Srpska
SAA	Stabilisation and Association Agreement
SEAP	Sustainable Energy Action Plan
SEE	South-East Europe
SHP	Small Hydropower Plant
SMEs	Small and Medium Enterprises
SNC	Second National Communication
SRES	Special Report on Emissions 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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