THIRD NATIONAL COMMUNICATION AND SECOND BIENNIAL UPDATE REPORT ON GREENHOUSE GAS EMISSIONS OF BOSNIA AND HERZEGOVINA

under the United Nations Framework Convention On Climate Change
July 2016

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Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the United Nations Framework Convention on Climate Change was adopted by Council of MInisters of Bosnia and Herzegovina on 23.05.2017.

Bosnia and Herzegovina, as a non-Annex I party to the United Nations Framework Convention on Climate Change (UNFCCC) is obligated to submit its National Communications on Climate Change (NC) every four years and its Biennial update reports on the greenhouse gases emissions in BiH (BUR) every two years. Given that the First Biennial Update Report of Bosnia and Herzegovina on greenhouse gases emissions (FBUR) was submitted in 2014 and the Second National Communication of Bosnia and Herzegovina under the United Nations Framework Convention on Climate Change (SNC) in 2012, the year for the submission of the Third National Communication (TNC) coincides with the year for submission of the Second Biennial Update Report on greenhouse gas emissions in BiH (SBUR), and therefore this document includes both reports.

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COUNTRY CONTEXT

Structure and institutional framework

Bosnia and Herzegovina is a sovereign state with a decentralized political and administrative structure. It comprises two entities: Republika Srpska (RS) and Federation of Bosnia and Herzegovina (FBiH), and Brčko District. Decision making involves the Council of Ministers, two Entities (Federation of Bosnia and Herzegovina and Republika Srpska) and Brčko District. Federation of Bosnia and Herzegovina is sub-divided into 10 Cantons. In the environmental sector in BiH, the Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (MOFTER) is responsible for coordinating activities and for international relations, but environmental issues in BiH are the responsibility of the entity governments. The corresponding authorities are the Ministry of Environment and Tourism of Federation of BiH, the Ministry of Spatial Planning, Civil Engineering and Ecology of Republika Srpska (which is the UNFCCC Focal Point), and the Department for Communal Works of Brčko District (BD). On its 66th session held at May 16th 2002, the Council of Ministers of BiH had adopted the proposals and draw a conclusion by which the proposal on organizational structure and responsible authority for coordination of international agreements (conventions) in Bosnia and Herzegovina had been adopted. By that conclusion, it had been decided that Ministry for spatial planning, civil engineering and ecology of Republika Srpska shall coordinate the activities on implementation of United Nations Framework Convention on Climate Change. The Council of Ministers of BiH is a party to a number of international environmental agreements and conventions, and it is fully committed to meeting the requirements stipulated in these agreements.

Bosnia and Herzegovina is a potential candidate for EU membership. The Stabilisation and Association Agreement (SAA) between Bosnia and Herzegovina and EU was signed in June 2008. An Interim Agreement, mainly on trade and trade-related matters under the SAA, that had been in force since July 2008. The Agreement on Stabilization and Association had been adopted at June 1st 2015 by which an Interim Agreement has been replaced. By adopting the Decision on coordination of European integration process in BiH (BiH Official gazette, no. 72/16), operational and institutional systems and coordination of institutions in BiH on implementation of activities related to the EU integration process were defined. However, progress towards EU reforms is limited.

The most important ratified international agreements in the area of environmental protection include the United Nations Framework Convention on Climate Change (UNFCCC). Bosnia and Herzegovina ratified the UNFCCC in 2000. Following the ratification, BiH has made a number of efforts to establish appropriate political, institutional and legal frameworks so as to meet the commitments of the Convention. Based on mutual agreement of both of the relevant entities, the BH Focal Point for the UNFCCC is the Ministry of Spatial Planning, Civil Engineering and Ecology of RS. The Kyoto Protocol was also ratified on 16 April 2007.

In 2010, BiH submitted its Initial National Communication under the United Nations Framework Convention on Climate Change to the UNFCCC Secretariat. In October 2013 the Second National Communication under the UNFCCC was adopted and forwarded to the Secretariat of the Convention. Information on the status of other conventions related to the environmental protection is available in the Second National Report of Bosnia and Herzegovina under the UNFCCC[1].

[1] *Report available at: http://unfccc.int/resource/docs/natc/bihnc2.pdf*

Environmental statistics

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

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

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

• According to the Law on environmental protection of RS (RS Official gazette, no. 71/12), an obligation for establishment and maintenance of Register on release and transfer of pollution substances has been delegated to the Ministry for spatial planning, civil engineering and ecology of RS. Following the obligations stipulated by the same Law, the Register on plants and pollutants that contains information on releases of pollution substances in air, water and soil and waste transfer has been established as well. According to the Law on Ammendments to the Law on environmental protection of RS (RS Official gazette, no. 79/15), Republic Hydrometeorological Service of RS is responsible for Register. In line with the Law on Air Protection (RS Official gazette, no. 124/11), Republic Hydrometeorological Service of RS is an institution authorized for GHG inventory including the: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), fluorocarbons (HCFs), perfluorocarbons (PFCs) and sulfur hecafluoride (SF_6).

• The reports on emission inventories have to be prepared in compliance with reporting requirements determined by the international agreements.

Emission inventories must be prepared for the following substances: SO_2, N_2O, CO_2, CO, NH_3, NOx, CH_4, NMVOCs, C_6H_6, and PM_{10}. The emission inventory registry is maintained by fields of activity. Emission assessments are performed in accordance with internationally approved methods and guidelines. Polluters, specialized institutions, and authorized bodies are responsible for submitting the data required for dissemination, assessment, and/or monitoring to the ministries. Although not directly involved, entity level statistical institutes and Agency for statistics of BiH also play a key role in environmental monitoring.

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. According to its geographical position on the Balkan Peninsula, BiH belongs to the Adriatic basin and the Black Sea basin.

BiH has common borders with the Republic of Croatia (931 km), the Republic of Serbia (375 km) and the Republic of Montenegro (249 km). The border on the Adriatic sea is 23,5 km long. The relief is mainly hilly to mountainous, with an average altitude of 500 meters. There are seven river basins of surface water (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: Geographical map of Bosnia and Herzegovina

Population

According to preliminary results of the census in Bosnia and Herzegovina, which was conducted in 2013, the total number of enumerated persons was 3,791,622[2]. Compared to the last 1991 census, the population decreased by 585,411 (population in 1991 was 4,377,033). Reasons for the population decrease include war conflicts, migration and declining birth rates. Preliminary results indicate that in 2013 in Republika Srpska 1,326,991[3] (35%) persons were enumerated, in the Federation of Bosnia and Herzegovina 2,371,603[4] (63%) and in Brcko District 93,028[5] (2%).

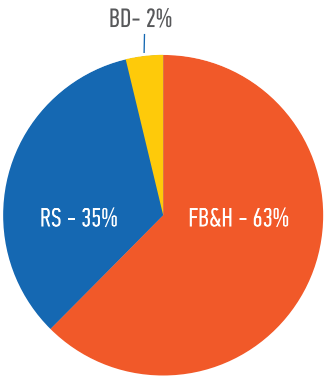


Chart 1: Schematic overview of the population in Bosnia and Herzegovina in entities and Brcko District (Preliminary results of the enumerated persons in 2013)[6]

In recent years, there is a trend of negative population growth in Bosnia and Herzegovina. In other words, the number of deaths is greater in relation to the number of live births. Negative population growth rate is particularly pronounced in 2011 and 2012 (Table 1).

Climate characteristics

Bosnia and Herzegovina has several climate types: the temperate continental climate type (northern and central parts), the sub-mountainous and mountainous type, the Adriatic and modified Adriatic climate type. Mean annual temperatures in the period 1981 – 2010, were in the range of 1.6 °C (Bjelašnica) to 15.2 °C (Mostar). Temperatures during winter are in the range of -6.0 °C to 6.2 °C and during the summer from 9.8 °C to 24.7 °C. Temperature increase on annual level is evident in the entire area and it even exceeds 1.5 °C in the northwestern part (Banja Luka).

The annual precipitation ranges from 792 mm in the northeastern part (Semberija–Bijeljina) to 1,707 mm (Herzegovina-Trebinje). During the summer reduction in rainfall is evident. In the past two decades the sum by the seasons and the distribution of rainfall are much disrupted, which along with the increase in temperatures causes problems with droughts and floods.

	Live births			Deaths			Population growth
	Total	Men	Women	Total	Men	Women	
2007.	33.835	17.534	16.301	35.044	18.154	16.890	-1.209
2008.	34.617	17.758	16.859	33.983	17.681	16.302	634
2009.	34.820	18.163	16.657	34.772	17.913	16.859	48
2010.	33.779	17.455	16.324	34.633	17.892	16.741	-854
2011.	31.875	16.485	15.390	35.552	18.358	17.164	-3.647
2012.	32.072	16.527	15.545	35.692	18.532	17.160	-3.620

Table 1: Natural movement of the population of Bosnia and Herzegovina in the period 2007 – 2012[7]

[2] *Agency for Statistics of Bosnia and Herzegovina, 2013*
[3] *The Republika Srpska Institute of Statistics, 2013*
[4] *Federal Office of Statistics of Federation of Bosnia Herzegovina, 2013*
[5] *Agency for Statistics of Bosnia and Herzegovina, 2013*
[6] *Agency for Statistics of Bosnia and Herzegovina*
[7] *Agency for Statistics of Bosnia and Herzegovina*

Duration of solar time (insolation) is on the rise. The average insolation in the period 1961–2011, in Sarajevo is 1,806, Banja Luka 1,821 and it is the longest in Mostar – 2,337 hours. During the extremely warm years the insolation value reached up to 2,630 hours in Mostar.

Extreme climate events in Bosnia and Herzegovina are becoming more frequent. In the past 12 years, six years were very to extremely dry (2003, 2007, 2008, 2011, 2012, 2013). In addition, years with large to disastrous floods are very common (2001, 2002, 2009, 2010, 2014). Extreme climate events are especially pronounced during the last seven years (in 2009 and 2010 major floods were recorded, in 2011, 2012 and 2013 there were severe droughts and waves of high/tropical temperatures, early 2012 saw the wave of extreme cold and the occurrence of windstorms in mid-2012).

April and May 2014 saw the record of rain series (over 420 mm) in the northern part of the country, which caused disastrous flooding in the catchment area of the Vrbas and Bosna rivers, as well as in the area of Semberija.

SECTOR ANALYSIS
Economy and industry

Despite comprehensive efforts, the pace of post-war recovery has been much slower than anticipated. Data of the BiH Agency for Statistics for 2012 show that GDP value was KM 25,734 million, while an average GDP per capita was KM 6,709. In 2012, the share of GDP by sector was as follows: 8.6% agriculture, 21.06% industry, 4.75% construction and 66,03% services[8].

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
Trade balance (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 in the period 2004-2012[9].

[8]Agency for Statistics of Bosnia and Herzegovina, 2013
[9]Agency for Statistics of Bosnia and Herzegovina, 2013: GDP of Bosnia and Herzegovina for 2012 – production approach, available at: http://www.bhas.ba/saopstenja/GDP_Proizvodni_sr.pdf

Indicators	2005.	2006.	2007.	2008.	2009.	2010.	2011.	2012.
Republika 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 Entities in GDP of Bosna and Herzegovina (%)[10]

BiH GDP per capita, expressed as PPS (Purchasing Power Standards) in 2012 was 28% of the EU-27 average, while consumption per capita in PPS for the same year was 36% of the EU-27 average. During the period of 2008 – 2010, BiH GDP in PPS increased from 30% to 31% of the EU-27 average. The general level of prices in BiH in 2010 was 50% of the EU-27 average. During the period of 2008 – 2010, the general level of prices in BiH increased from 49% to 50% of the EU- 27 average. Based on the average movement of the consumer price index in Bosnia and Herzegovina in 2012 compared to the average of 2011, there has been an increase in inflation by 2.1%. Price increases were recorded in all categories except for clothing and footwear, and health sector and education. Annual inflation in 2011 was 3.7%, while in 2012 it was 2.1%.

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

Energy

Total electricity generation of BiH in 2013 was 17,451 GWh, which represented a significant increase (about 35%) compared to 2012 (12,935 GWh). Electricity generation in hydropower plants was 7,236 GWh. In the thermal power plants the electricity generation was 9,846 GWh.

Total electricity consumption in 2013 in households amounted to 42,3%, industry 37,4%, and other consumers, including the building sector, transport and agriculture take the share of 20,3%.

Total generation of thermal energy in Bosnia and Herzegovina in 2013 was 5.722 TJ, of which 3.501 TJ or 61,2% was generated in the heating plants, 1.463 TJ or 25,6% in thermal power plants, and 758 TJ or 13,2% was generated in industrial energy plants. Final thermal energy consumption in 2013, was divided among households with 77%, industry and other consumers with 23%.

Transport

According to the available data gathered from the relevant authorities, the total length of the road network in Bosnia and Herzegovina is 22,609.11 km, which is comprised of 69,60 km of motorways, 3,772.88 km of trunk roads, 4,566.63 km of regional roads, and approximately 14,200 km of local roads.

[10]Agency for statistics of Bosnia and Herzegovina, 2012: GDP by production approach for 2000-2011, GDP by income approach for 2005 – 2011, GDP by expenditure approach for 2007-2011, available at: http://www.bhas.ba/tematskibilteni/BILTEN_11_bos_3.pdf & Agency for statistics of Bosnia and Herzegovina, 2013: GDP of Bosnia and Herzegovina for 2012 – production approach, available at: http://www.bhas.ba/saopstenja/GDP_Proizvodni_bos.pdf

Length (km)				
Category	**FBiH***	**RS****	**Brčko District***	**Total**
Motorway	37,60	32,00	-	69,6
Trunk road	2.005,00	1.767,88	**	3.772,88
Regional road	2.461,80	2.104,83	36,80	4.566,63
Local road	[11]	6.030,00	170,66	14.200,00
TOTAL	**4.504,40***	**9.934,71****	**207,46***	**22.609,11**

Table 4: Total length of road network in Bosnia and Herzegovina

* - data source: SNC BiH, 2012
** - data source: Ministry of transport and communication of RS

The total number of registered road motor vehicles in 2013 was 776,415. Of the total number of registered road motor vehicles in 2013, 86,7% were passenger vehicles, 8,36% were cargo vehicles, and 5% were from all other categories of vehicles. Out of the total number of registered motor vehicles, 68,195 were road motor vehicles registered for the first time in 2013 (7,62%). With respect to the type of fuel used, 56,38% of vehicles use diesel, 43,1% use petrol.

The 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 1%. More detailed indicators on the volume of transport by type are presented in the table 5.

Cargo transport	2010	2011	2012	2013	2014
Vehicles – kilometers travelled (thousands)	284.680	317.032	343.278	385.808	432.683
Tons of goods transported (thousands)	4.837	4.857	6.288	6.349	6.975
Ton/km (thousands)	**2.038.731**	**2.308.690**	**2.310.607**	**2.657.648**	**3.107.874**
Passenger transport	2010	2011	2012	2013	2014
Vehicles – kilometers travelled (thousands)	97.663	93.823	94.376	96.020	91.423
Transported passengers (thousands)	28.702	29.303	31.399	29.478	21.358
Passenger – kilometers (thousands)	**1.864.471**	**1.926.212**	**1.925.617**	**1.764.325**	**1.676.173**

Table 5: Volume of transport, by type

[11]No data are available on the length of roads in the Federation of BiH and Brcko District

The rail network of BiH consists of 1,031 km of railways, of which 426 km are in the RS (Institute for statistics of RS) and 615 in FBiH. Although the density of the railway network in BiH is comparable with that of Western European countries, the volume of transport of goods and passengers per kilometer of railways is far below the European average. The current condition of the railway infrastructure is such that normal transport is not possible without major investments, and the current volume of transport is insufficient to generate income that would be sufficient to cover expenditures.

The volume of the rail transport in Bosnia and Herzegovina can be divided into two categories: cargo transport and passenger transport (Table 6).

Cargo transport	2010.	2011.	2012.	2013.	2014.
Tons of goods transported (thousands)	12.882	14.224	13.556	13.359	13.506
Ton/km (thousands)	1.232.034	1.298.294	1.150.325	1.242.688	1.313.356
Passenger transport	**2010.**	**2011.**	**2012.**	**2013.**	**2014.**
Transported passengers (thousands)	898	821	846	628	530
Passenger–kilometers (thousands)	58.559	54.811	54.468	39.812	34.949

Table 6: Volume of rail transport in Bosnia and Herzegovina

As opposed to road transport, the volume of the railway passenger transport experienced a decrease of about 8.5% compared to 2010. The listed indicator best illustrate the existing trends, as well as the climate change mitigation potential in the transport sector in BiH.

Out of 27 officially registered airports, only four (Sarajevo, Banja Luka, Mostar and Tuzla) are registered for international traffic[12]. The annual number of passengers for 2012 is around 580,000 for Sarajevo International Airport, while Banja Luka, Mostar and Tuzla have relatively small but continuously increasing number of passengers. There is no domestic air traffic in Bosnia and Herzegovina, and all data refer to international traffic. In 2012 there were 13,980 airport operations, indicating a growth of 77,5% compared to the preceding year. The number of transported passengers is 2.9% higher compared to 2011.

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

In BiH, the Sava River is the main navigable river, and it is 333 km long. Water transport along the Sava river 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 (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.

Agriculture

The share of agriculture, hunting, and related services comprised 6.26% of GDP in 2012. Out of the total area of Bosnia and Herzegovina, approximately 2.572 million ha (50,3%) is suitable for agriculture, of which only 0.65% is irrigated. Arable land covers 1,009,000 ha, or 20.0% of the total area of BiH, whereby 478,000 ha (47%) of arable land is not cultivated at present. There is approximately 0.56 ha of agricultural land per capita, of which 0.36 ha is arable land and vegetable gardens.

[11]*BiH Ministry of Communications and Transport, 2005.*

45% of agricultural land is hilly (300 to 700 meters above sea level), of moderate quality and suitable for semi-intensive cattle breeding. Mountainous regions (above 700 meters above sea level) represent an additional 35% of farmland. However, high altitude, slopes and aridity limit the use of this land for pastures only to spring and summer months. Less than 20% of agricultural land (half of all arable land) is suitable for intensive agriculture and it is mainly located in lowland areas in the north of the country, in the river valleys. Natural water resources are abundant, with many unpolluted rivers and available groundwater. Despite the abundance of water, water supply is a limiting factor for production in many areas. About 10,000 hectares (0.1 percent of arable land) was irrigated before the war. The area that is now being irrigated is much less than the one mentioned above.

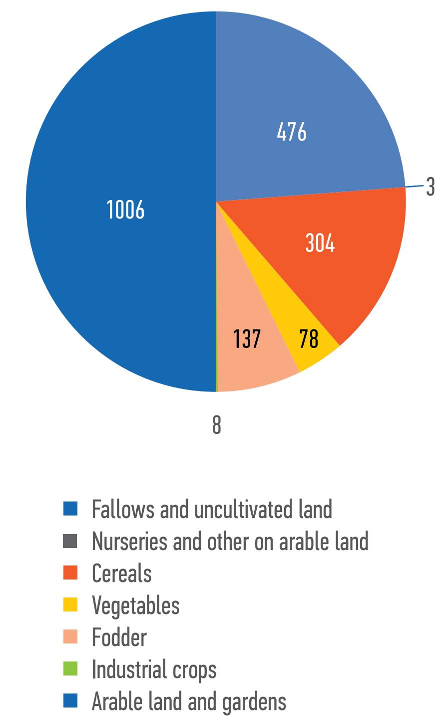


Chart 2: Arable land, by land utilization in thousands ha (2012.)

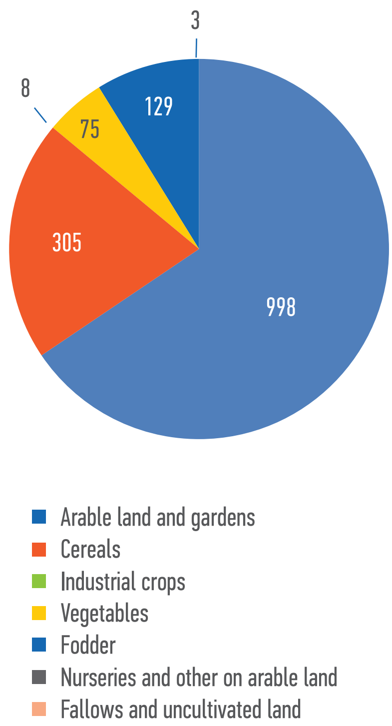


Chart 3: Arable land, by land utilization in thousands ha (2013.)

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

According to the data available from the 2012 BiH Foreign Trade Exchange Analysis, conducted by the Ministry of Foreign Trade and Economic Relations, total area covered by cereal crops was 304,000 ha, by fodder crops – 137,000 ha, by vegetable crops – 78,000 ha, and by industrial crops – 8,000 ha. Total achieved production in 2011 was as follows: 1,077,387 tons of cereals, 771,999 tons of fodder crops, 676,109 tons of vegetable crops, and 10,113 tons of industrial crops. More details on the agricultural sector can be found in the Second National Communication of Bosnia and Herzegovina under UNFCC.

Forestry

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

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

Total production of forest assortments in Bosnia and Herzegovina in the fourth quarter of 2012 increased by 3.04% compared to the same period of 2011. Production of coniferous (softwood) assortments recorded a slight increase of 11.75%, while production of broadleaf (hardwood) assortments in the same period recorded a significant decrease of 3.83%. The production increase is recorded in category of coniferous logs by 9.30 %, while production of broadleaf logs recorded a drop of 4.74%. The drop in production of 2.84% is recorded with broadleaf firewood in relation to the fourth quarter of 2011. The largest increase in production is in the coniferous cordwood of 32.40%. The biggest drop was recorded in the production of other coniferous long wood of 36.23% and other rough-cut wood of 92.42%.

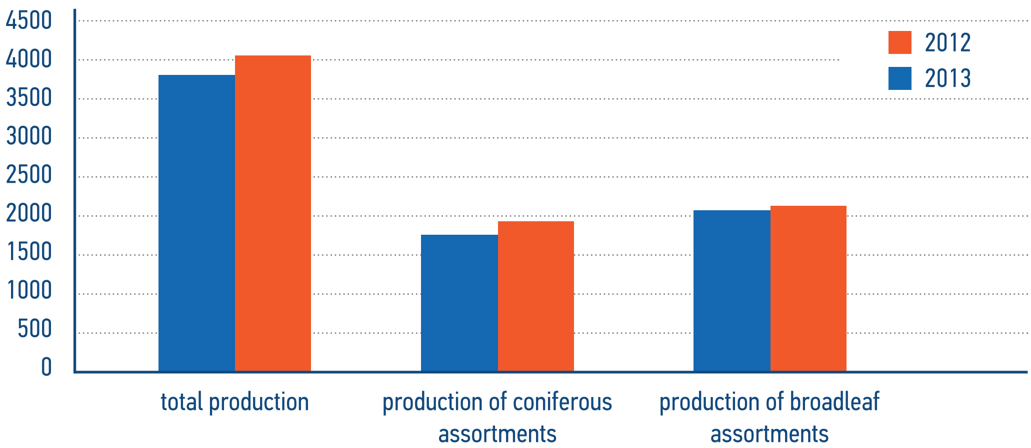


Chart 4: Production of forest assortments in 1000 m^3 in 2012 and 2013[13]

[13] *Agency for Statistics of Bosnia and Herzegovina*

Waste management

The estimated quantity of municipal waste generated in 2012 was 1,302,866 tons, i.e., 340 kg per year per capita or 0.9 kg per capita per day. In 2012, the amount of municipal waste collected by public waste collection services was 964,121 tons, which is by 6.2% less compared to 2011. The percentage of the population covered by waste collection services is on average 68%. The remaining population, which is not covered by municipal services, mainly resides in rural areas. The total quantity of waste collected is comprised of municipal mixed waste (86.5%), collected municipal waste separated at the source (7.3%), waste from gardens and parks (4.8%), and packaging waste (1.4%).

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

The PRSP Medium-Term Development Strategy envisaged the introduction of 16 sanitary solid waste disposal sites: 10 in FBiH and 6 in RS. Particularly important is the fact that treatment plants for medical and other hazardous waste still do not exist, while recycling of industrial and municipal waste continues to be limited.

Water resources management

The territory of BiH covers two main river basins: the Black Sea basin (38,719 km or 75,7% of total surface area) and the Adriatic Sea basin (12,410 km 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 protection 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 following rivers: Sava, Vrbas, Bosna and Drina. The consequences of floods are the result from exceptionally high waters in this area and if they were to occur, would be immeasurable.

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

In 2012, total water intake was 328,756,000 m^3, which is 0.4% less than in 2011. In the structure of the total water intake, 46.7% of water came from underground sources, 36.1% came from surface sources, 14.7% came from river courses, 0.8% came from reservoirs, and 1.7% came 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 total water delivered by public water supply systems. Outlets of untreated wastewater, access to drinking water and flood management remain the key issues in this sector.

Health

Bosnia and Herzegovina (BiH) is a member state of the World Health Organization (WHO), which endorsed the revised International Health Regulations [IHR (2005)] that entered into force on 15 June 2007. The organization, financing and provision of health care services are the responsibilities of the entities and Brčko District, and they are regulated by the FBiH Ministry of Health, the Ministry of Health and Social Welfare of the Republika Srpska and Department of Health and Other Services of Brčko District. At the state level, the Ministry of Civil Affairs, as the competent ministry in the Council of Ministers of Bosnia and Herzegovina, is responsible for "carrying out tasks and discharging duties which are within the competence of BiH and relate to defining basic principles, coordinating activities and harmonising plans of the Entity authorities and defining a strategy at the international level in the field of health and social welfare. The social welfare expenditures per capita are seven times lower than in Slovenia and three times lower than in Croatia[14].

[14] *Report „Strengthening health systems for BiH's EU integration, EuropeAid/120971/C/SV/*

In 2012, the leading causes of death in Bosnia and Herzegovina are still circulatory system diseases with participation of 55,27% in RS (Public Health Institute of RS, 2012) and 53.9% in FBiH (SNC BiH, 2012) while malignant diseases cause 21,28% of deaths in RS and neoplasms cause 19.7% of deaths in FBiH (SNC BiH, 2012). In other words, nearly three quarters of all deaths could be grouped into these two categories. Respiratory system diseases are ranked among the five leading causes of death in FBiH. 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 are 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 from the institutions of Bosnia and Herzegovina have not been used for development of a clear response methodology for crisis situations caused by climate change, including the preventive measures that must be implemented in order to avoid the occurrence of crisis situations, or mitigating measures for consequences caused by climate change (e.g. reduced food yield due to drought or flooding or a shortage of safe drinking water). In BiH practice, there is still no clear model of information flow between different sectors, competences frequently overlap, and it is not clear who is responsible to whom, who takes data from whom and by which methodology or how data are delivered.

Education

At the beginning of 2012/2013 school year, there were 471,543 students in Bosnia and Herzegovina[15]. Of these, 304,881 students attended 1,881 primary schools, which is for 3.7% less compared to the preceding school year; and 166,662 students attended 309 secondary schools, which is for 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. There are separate laws for each of the four levels of education mentioned above. In FBiH, education is regulated at the cantonal level. Each of the ten cantons has its own law on pre-school, primary and secondary education, and the cantons that have universities also have laws on higher education. The Brčko District, as a separate organizational unit in BiH, has its own laws covering each of the four levels of education. Therefore, there are more than thirty laws at different levels governing this area.

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

In RS, sectors of higher education and science are regulated at the entity level by the RS Ministry of Education and Culture and the RS Ministry of Science and Technology. The RS Ministry of Science and Technology within the Government of RS is in charge of issues related to science and technology in the RS, and it actively participates in distribution of information related to research funds (such as FP7) in the field of science and technology.

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

Brčko District, as a separate administrative unit also has the

[15]Agency for Statistics of Bosnia and Herzegovina, 2013

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

Programme for sustainable development by 2030 – sustainable development goals

On the Summit on Sustainable Development, which took place on 25 September 2015, the Member States of the United Nations adopted a Programme for sustainable development by 2030, which contains **17 sustainable development goals** aimed at eradicating poverty, combating inequality and injustice and addressing climate change by 2030.

The sustainable development goals, also called Global goals, build on the Millennium Development Goals (MDGs) – eight goals of fighting against poverty that the world has committed to achieve by 2015. Millennium Development Goals, adopted in 2000, include a number of issues, including the fight against poverty, hunger, disease, gender inequality and the provision of water and sanitary living conditions. In achieving the Millennium Development Goals a huge success was accomplished, which indicates the importance of having a unifying program that is based on goals and outputs. Despite the success, poverty is not completely eradicated. Global goals and broader sustainability programme go far beyond the Millennium Development Goals and address the underlying causes of poverty and the universal need of development to the benefit of all people.

Climate change mitigation (goal 13) is one of the 17 global goals of the Programme for Sustainable Development by 2030. In order to achieve the progress on several goals in parallel, this requires an integrated approach. As part of this goal, the idea is that by 2020, 100 billion USD is mobilised annually to address the needs of developing countries and mitigate disasters caused by climate change. Implementation of this goal, in the context of an integrated approach, will require significant changes in the sphere of policy and investment of the resources within the climate change segment of BiH.

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

EXECUTIVE SUMMARY

COUNTRY CONTEXT

Geographical characteristics	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 Republika Srpska (RS) and Brčko District. The Federation of Bosnia and Herzegovina is sub-divided into 10 Cantons. Decision-making involves the Council of Ministers, the two Entities and Brčko District.
Population	Total BiH population size is 3,791,622 according to preliminary results of the enumerated persons in 2013, out of which 1,326,991 (35%) in the Republika Srpska, 2,371,603 (63%) in the Federation of Bosnia and Herzegovina and 93,028 (2%) in Brčko District.
Economy	GDP 25,734 million KM, GDP per capita 6.709 KM[16] (2012)
Industry	Processing industries are prevalent in BiH, producing 78.3% of the total value of industrial product sales (2011). In 2012, 21,06% of GDP is industry.
Energy	Total electricity generation in BiH in 2013 was 17,451 GWh
Transport	BiH has 22,740.20 km of roads, of which 72.60 is highway; 3.786,00 km of trunk roads, 4.681,60 km of regional and about 14.200 km of local roads; 4 international airports; and no seaport. The Sava River is the main navigable river.
Agriculture	2. 572 million ha or 50.3% is suitable for agriculture, of which only 0.65% is irrigated; the share in the GDP structure is 6.26% (2012).
Forestry	27.000 km^2 (53% of the BiH territory) is occupied by forests and forest land: of which some 23,000 km^2 are the forests and 4,000 km^2 forest land and 13,000 km^2 of managed high forests.
Waste management	68% of the population utilises municipal waste disposal services; the average amount of municipal waste generated is 0.9 kg per capita per day (2012)

[16] 1 EUR=1,95583 KM, Central Bank of Bosnia and Herzegovina, June 2016

Water management	BiH has two main river basins: the Black Sea basin (38,719 km or 75,7% of total surface area) and the Adriatic Sea basin (12,410 km or 24,3% of total surface area) with discharge of 433 m^3/s. Water intake totals 328,756,000 m^3 (2012)
Health	Increased risk in people with cardiovascular and neurological diseases and allergic reactions. The leading cause of death is circulatory system diseases (2012)
Education	At the beginning of the school year 2012/2013 there were 471,543 students, seven public universities with 95 schools and a number of private universities with about 116,000 full-time students.
International cooperation	Ratified conventions: UNFCCC, the UN Convention of Biological Diversity, the UN Convention to Combat Desertification, the Vienna Convention for the Protection of the Ozone Layer, the Convention on Long-range Transboundary Air Pollution Potential candidate for EU membership (Stabilisation and Association Agreement signed in 2008)

Inventory of greenhouse gas emissions

The inventory of greenhouse gases in this Communication covers a period 2002 – 2009, and 2012 and 2013. It has been compiled in line with the inventory development recommendations – UNFCCC Reporting Guidelines as per Decisions 3/CP.5 and 17/CP.8, including the common reporting format (CRF) and the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, which specify reporting requirements under Articles 4 and 12 of the UNFCCC (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

This report also covers the revision of the First Biennial Update Report on Climate Change for 2010 and 2011.
Total emissions in the inventory period vary from 16,170 Gg CO_2eq in 2002 (47.5% compared to the baseline of 1990) to 28.086 Gg CO_2eq in 2011 (82% compared to the baseline of 1990). After 2011, emission is in decline and in 2013 it was 24,028 CO_2eq, i.e. 70.6% of the emission in 1990.
The most significant source of CO_2 emissions (see the Chart 5) is certainly the energy sector, which in this twelve-year period contributed with about 53% of total CO_2 emissions, followed by agriculture (14%), industrial processes (6%) and waste (5%). The share of emissions from other sectors in the total emissions during this period is about 22%.

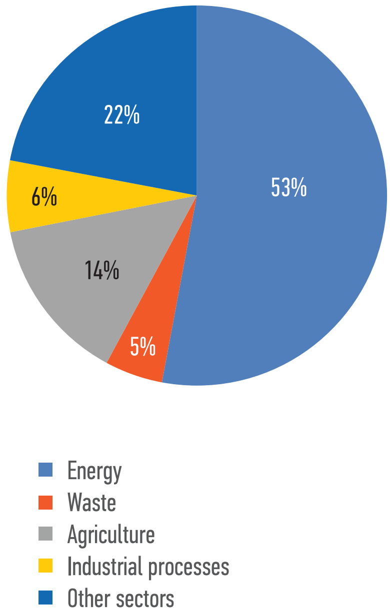


Chart 5: Average share of CO_2 emissions by sectors (%) for the period 2002-2013

Vulnerability and adaptation to climate change in BiH

Climate change and increased frequency and intensity of extreme climate events have caused increased pressure in the sectors of agriculture, water management, health, forestry and tourism, as well as in management of water resources and protected areas. There was an increase in variability and intensity of extreme weather conditions (heat waves, intensive rainfall, windstorms, days with hail, etc.). In the last five years, Bosnia and Herzegovina has been facing with several significant extreme climate and weather episodes that have caused substantial material and financial deficits, as well as casualties. The two most important events are drought during 2012 and flooding during 2014.

Observed climate change

The TNC covered the analysis of meteorological data from the period 1961–2014. The mean annual temperature maintains a continuous rise on the entire territory. Trends in annual temperatures on all analyzed stations are statistically significant, while the changes are more pronounced in the continental part. The increase in annual air temperature ranges from 0.4 to 1.0°C, while the increase in temperature during the growing season (April– September) even reaches 1,2°C. However, increases in air temperature over the last fourteen years are even more pronounced. In the analyzed period, all indices of warm temperature extremes have positive trends, while indices of cold temperature extremes have negative trends. The most significant change in this period was observed in the number of cold days (FD) and the number of warm days (SU). In all the meteorological stations the number of cold days (FD) has a negative trend. In the central mountain areas the number of cold days has decreased by 4 days per 10 years, while in the south of the country the decrease is slightly less and it ranges around 2 days per 10 years. Number of warm days (SU) has a positive trend and it is statistically significant.

In the period from 1961 to 2014 most of the territory of Bosnia and Herzegovina was characterized by a slight increase in the amount of rainfall annually. Linear trends for multi-year period from 1961 to 2014 indicate stagnation or a slight increase in the amount of rainfall on the entire territory of Bosnia and Herzegovina. Changes in the amount of rainfall are more pronounced by seasons than annually. The rainfall trend by seasons is different. In the central part it is negative during spring and summer (the most pronounced in the area of Herzegovina – up to 20%), while during autumn the increase in rainfall was observed, especially in the north-western and central parts. Although significant variability in precipitation has not been recorded, pluviometric regime has been greatly disrupted, that is, the annual distribution. Due to the increased intensity of rainfall and its greater variability, as well as due to the increased share of heavy rains in the total amount of rainfall, there is the increased the risk of flooding especially in the north-eastern part of BiH, where the most disastrous floods in history have been recorded during May 2014.

Projections of future climate change

By the end of the XXI century all three scenarios indicate a continuous increase in temperature on the territory of Bosnia and Herzegovina. According to the scenario RCP8.5 the increase in temperature in the first thirty-year period is in the range from +1.6 to + 2°C, whereas in the last thirty-year period, this range was from +5.4 to +5.6°C. The temperature increase is somewhat lower under scenarios A2 and A1B. In the first two thirty-year periods the temperature anomaly is higher based on the scenario A1B and for the period from 2011 to 2040 it is approximately +1 °C, while for the period from 2041 to 2070 the anomaly is around +2.4 °C. For the last thirty-year period based on the A2 scenario, the extent of the anomaly ranges from +3.8 to +4.2 °C. These results are consistent with the concentrations of greenhouse gases that are foreseen in some of the scenarios, given that the greatest concentrations at the end of the century are defined within the scenario RCP8.5, then A2 and finally based on the scenario A1B the concentrations of greenhouse gases by the end of this century would be the lowest compared to RCP8.5 and A2.

According to the scenario RCP8.5 and in relation to the reference period 1971–2000, a decrease in precipitation can be expected by the end of the XXI century. Only for the future period 2011–2040 most of the territory has a positive anomaly of annual precipitation, with most of the territory having an anomaly of + 5%. For future periods from 2041 to 2070 and from 2071 to 2100 negative anomaly is expected for almost the entire territory. For the period from 2041 to 2070 most of the territory has a negative anomaly of -10% while for the period from 2071 to 2100 the anomaly ranges from -10 to -20% in most of the territory. Seasons DJF and SON have qualitatively similar anomalies for all three future periods with approximately the same areas with positive and negative anomaly. Anomalies in most of the territory range from -10 to +10%. Seasons MAM and JJA are characterized by a decrease in precipitation for further time horizons, which is especially pronounced for the season JJA, for which, for the period from 2071 to 2100, about a third of the territory (southern parts) has a negative anomaly greater than -40%.

Agriculture

Agriculture is one of the sectors mostly affected by climate change in Bosnia and Herzegovina. The consequences are predominantly but not exclusively negative. Increasing droughts and floods in the past two decades have caused a significant damage to the agricultural sector. It is expected that climate change will have a positive effect on the yield and quality of winter crops due to the extended growing period. Areas of cultivation of fruit and vines will be expanded due to the disappearance of very cold winters and late spring frosts. However, spring crops will be at risk due to high temperatures and water shortages during the summer months. There will be also a decrease in the yield and the quality of pasture, feed (particularly of spring crops), depletion of pastures due to heavy rains and strong winds. The extension of the growing period due to the increase in the winter and early spring temperatures leads to greater opportunities for the development of diseases and pests. Pathogens of plant diseases, pests and weeds represent a very important segment to which the future climate change have an impact. More arid climate will require changes in agricultural technologies, such as the intensification of irrigation, which may increase the frequency of some other phytopathogenic bacteria. Treating these bacteria can increase the costs of production, which directly affects the energy efficiency and greenhouse gas emissions.

Hydrology and water resources

Having analysed a series of annual precipitation supplemented with the values for the period 2011–2014, both for the Sava River basin and the Adriatic Sea basin, it can be concluded that the mean value has not changed significantly. However, the value range (distribution) is significantly higher for both basins. In relation to the series of 1961–90, in the period 1991–2014 annual precipitation in the Sava River Basin was higher by 44 mm compared to the period 1961–90, which is somewhat lower increase in value compared to the period 1991–2010. However, the range has significantly increased (769 mm compared to 407 mm) and the minimum value is lower for 100 mm, whereas the maximum value is higher for 262 mm. Accordingly, the value of variance is significantly higher in the period 1991 – 2014.

Water resources are very vulnerable and over time the threat will be increasing. This will require further research and development of hydrologic models according to the climate scenarios.

Forest ecosystems

As a consequence of global warming, more frequent occurrence of extremes are expected through climate change, threatening the functioning of forest ecosystems. Introduction of species from drier and warmer climate regions is one of the options under consideration so as to adapt the forest ecosystems to the adverse effects of climate change. High-level genetic diversity of some species, and thus the potentials in differences in tolerance to climate change, set aside some species that have priority in terms of adaptive capacity. However, it is necessary to evaluate the response of different species and their provenances to climate extremes and identify appropriate populations or ecotypes that are better suited to the projected climate change.

Biodiversity and sensitive ecosystems

The vulnerability of ecosystems to the effects of climate change has increased because of their impaired condition, fragmentation and various anthropogenic impacts. The impact of climate change on different ecosystems is expressed through a range of effects, whereby the actions are complex and are often in synergy with other factors. Climate change, through the joint action with other factors, significantly affect the time of occurrence and duration of the individual seasons, which to a large extent has effects on the length of the growing period and the timing of certain phenophases. Climate change manifest their effects on plants and plant communities, which in the first place can be noticed through the changes of phenophases. They exert their effects in terms of all aspects of biodiversity, through changes in the distribution of populations and species, as well as in functioning of ecosystems.

Tourism

Climate change is having an increasing negative impact on tourism development. In the case of winter tourism, the negative effect on development concerns the lack of precipitation in the form of snow. Studies conducted so far indicate that climate change, accompanied by reduced amount of snowfall, reduced duration of snow cover, increased average and especially daily winter temperatures, will increasingly represent a factor of tourist traffic in winter tourist centers of Bosnia and Herzegovina. In order to reduce the negative impact of global climate change on winter tourism development, relying on winter sports, it will be necessary to ensure adequate snowmaking in all tourist centers which, with regard to the tourism infrastructure and suprastructure, seriously count on this type of tourism. However, sustainable tourism of winter tourist centers, regardless of the nature of climate change and the possibility of overcoming problems of this kind, already at this stage requires and will increasingly require alternative forms of tourist offer throughout the year. Practically, a better quality and eventful tourism product is necessary in all winter tourist centers in BiH.

Human health

The main causes of serious health impacts caused by extreme climate change are heat strokes, which lead to the increased mortality of the BiH population. The deterioration of climate conditions will lead to more frequent changes and worsening in the health status of people with cardiovascular and neurological diseases. These include diseases with cardiovascular and neurological risks, allergy reactions and other acute reactions to high daily temperatures, as well as other health problems such as diseases caused by waterborne and foodborne bacteria, diseases transmitted by mosquitos, birds, etc. It is necessary to continuously inform the public about the possible impact of climate change on human health, especially in extreme weather and climate conditions.

Estimating the potential for mitigating climate change

In the Third National Communication the section on climate change mitigation includes description and analysis of measures by individual sectors (power generation, district heating, buildings, transport, waste, agriculture and forestry) in BiH, mitigation scenarios to model the possible trajectory of greenhouse gas emissions by 2050, as well as a review of activities, projects and initiatives that will contribute to the mitigation, which are already ongoing or planned for implementation in the future period.

Specific quantitative modeling of greenhouse gas emissions trajectories over time has been accomplished using three development scenarios: S1 – Business as Usual scenario; S2 –with the partial application of mitigation measures and S3 – advanced scenario, with the more intensive application of a comprehensive set of mitigation measures. In considerations of the aforementioned emission scenarios the initial data have been used for 2013, while emission calculations were made for five-year periods from 2010 and 2050 (i.e. for 2010, 2015, 2020.....2050).

Power sector

In order to analyze potential GHG reductions by 2050 in BiH, three mitigation scenarios have been analysed for the power sector:

- **The S1 scenario as the baseline scenario** – includes phasing out the operation of existing coal-fired thermal power plants due to the end of their service life and construction of the new with the degree of efficiency of about 40%, construction of new large hydro power plants playing a role in climate change adaptation, construction of power plants using other renewable energy sources.

- **The S2 scenario** – this scenario envisages a faster phasing out of the existing thermal power plants from the operation due to the introduction of some of the mechanisms that result in reduced emission, construction of new coal-fired power plants, more intensive use of renewable energy sources.

- **The S3 scenario** – implies intensive use of potentials of RES and EE for joining of BiH in the European emission trading system for greenhouse gases (EU ETS) and creating competitive regional electricity market.

Mitigation scenarios S2 and S3 lead to a significant reduction in carbon dioxide emission from the power sector. In particular, a significant reduction in emissions is recorded under scenario S3, according to which in 2050 the emissions will drop to 1.55 million tons of CO_2.

Renewable energy sources

Mitigation scenarios of using renewable energy sources are based on estimated reserves and resources of individual forms of renewable energy sources, as well as technological, social, political and economic opportunities for their exploitation.

- **The S1 scenario** – baseline scenario implies business as usual, does not include any changes, incentives or specific additional research of the potentials and implies no change of the current position in relation to these forms of energy.
- **The S2 scenario** is characterized by the gradual introduction of new technologies, start of the initiatives for more massive use and for domestic production of the equipment, applying limited models of support and incentives.

• **The S3 scenario** assumes a high degree of climate change mitigation activities, the full implementation of legal provisions that deal with the obligation to use renewable energy sources, accession of BiH to the EU in 2025, i.e. commitment and compliance with the requirements, the use of efficiently developed incentive models and funding the use of renewable energy sources.

Given that scenarios S2 and S3 imply significant use of the renewable energy sources, the effects of CO_2 emissions are more significant than in the case of the baseline scenario (S1).

District heating

For all scenarios of district heating development an expansion of district heating systems is planned, as well as the use of renewable energy sources, but to different extents.

• **The S1 scenario** – baseline scenario – Only new buildings, with lower energy consumption will be connected to the district heating system and the dispersion of energy sources remains as foreseen by the existing strategic documents.

• **The S2 scenario** – New consumers are gradually connecting to the district heating system to a greater extent, the dispersion of energy products remains as envisaged by the strategic documents, a slight increase of efficiency in generation and distribution of thermal energy.

• **The S3 scenario** – This scenario envisages more intensive heating system, intensive introduction of renewable energy sources, construction of several smaller heating plants that will use municipal waste for energy, the intensive introduction of cogeneration in district heating systems, as well as increased efficiency in production and distribution of thermal energy.

The S2 scenario foresees the continuing rise in CO_2 emissions by 2040 from the district heating system and then their decline, while according to scenario S3, after 2020, there will be an intensive decrease of CO_2 emissions from the district heating system. Through implementation of the scenario S3, CO_2 emissions from district heating systems in 2050 would be approximately 8.32% of CO_2 emission in 2010.

Building sector

Different measures which result in reduced energy consumption and thus GHG emissions in the building sector are separately for housing and separately for the service sector, separately at the level of Entities and BD and all these cam be also observed jointly.

• **The S1 scenario** – baseline scenario – this scenario assumes continuation of current trends and does not foresee any energy efficiency measures, apart from the implementation of the legislation that has already been enacted.

• **The S2 scenario** – this scenario assumes that, in addition to the implementation of new legislation, more intense activities are undertaken in terms of reconstruction of the existing residential buildings, as well as change is the ratio of energy sources used for obtaining thermal energy.

• **The S3 scenario** –This scenario is quite similar to scenario S2, but in this scenario RES are more intensively used, as well as measures to improve energy efficiency, including the intensive implementation of the provisions of the EU Directives and regulations.
Trends in emission reductions under scenarios S2 and S3 are characterized by approximate trajectories, but with lower absolute values on the scenario S3.

Transport

Three scenarios of CO_2 emissions in the transport sector, which are being developed for the period 2010 – 2050:

• **The S1scenario /baseline scenario** –is based on the development of the sector based on the already present trends and currently applicable local legislation.

• **The S2 scenario** – implies an average reduction in the intensity of all types of vehicles, a significant decrease in the share of diesel and petrol vehicles in passenger kilometers at the expense of the increased share of electric vehicles, as well as passenger kilometers in the bus transport, reduction in the volume of road ton/k and the increase in rail ones, reduction of the average age of vehicles.

• **The S3 scenario** –is based on a significant mitigation through the implementation of EU directives in BiH by 2025, construction of more efficient road infrastructure and flow of vehicles, introduction of measures in the urban/city traffic which result in reducing emissions, and significant increase of railway transport, etc.

According to the projections of the developed scenarios, total CO_2 emissions from the transport sector in any case record a growth. Taking into account the intensity of application of mitigation measures, scenario S3 results with the mildest increase in the observed period.

Agriculture

Three analysed mitigation scenarios in the agricultural sector are based on different intensity of internal and external factors with the basic features:

• **The S1 scenario** – baseline scenario –no major changes can be expected in terms of the development of the agricultural sector and sectoral policies, because agricultural practices will remain at the current level, as well as incentive measures, and the issue of climate change is not part of sectoral policies and strategies.

• **The S2 scenario** –there are positive changes and progress in the agricultural sector and this is the most realistic scenario for BiH. Starting points are that the share of agriculture in the overall economy of BiH increased, that the trends of use of agricultural land, as well as trends in production of agricultural products are improved. Climate change make an integral part of sectoral policies, strategies and the incentive programmes.

• **The S3 scenario** –Upon joining the EU, the agricultural policy of BiH is developed in accordance with the Common agricultural policy and the available resources are used to boost the development of the sector. Awareness of climate change is highly raised.

The expected emission from the agricultural sector in 2050, according to the scenario S2 remains somewhat balanced, with no significant reduction, while when it comes to the developments according to S3 scenario, significant emission savings can be expected.

Forestry

Based on the available documents in the forestry sector in Bosnia and Herzegovina, sectoral strategies, international commitments that BiH has taken over, as well as the economic situation and expectations of BiH to become an equal member of the EU by 2025, developed scenarios have been prepared by 2050 as follows:

• **The S1 scenario** – baseline scenario – is based on the detected trend of increased intensity of deforestation in the past 3 years compared to 2010. This scenario has a negative trend of sequestration capacity, the volume of reforestation and success is the same as to date activities.

• **The S2 scenario** – is based on the application of certain stimulus measures for preserving existing forest cover. The basic measure involves increasing the sinks capacity, reforestation of bare lands and similar.

• **The S3 scenario** – 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 all obligations and directives related to the forestry sector.
The results of the scenarios formed in such way, in terms of projections of CO_2 sinks (Gg), in the forestry sector they show an increase of about 3.4% by 2050 according to the scenario S2 or less than 8% according to the scenario S3.

Waste

In the waste sector, the developed scenarios are based on the following assumptions:

• **The S1 scenario** – baseline scenario – business as usual when it comes to waste generation, collection and disposal.

• **The S2 scenario** – envisages construction of regional sanitary landfills with the systems for the collection and burning of biogas across BiH by 2025, increase in recycling and waste treatment using other methods.

• **The S3 scenario** – envisages increased level of recycling at the source and on the landfills, as well as the change of billing services based on the generated amount of waste, including the disposal of residual waste only on regional sanitary landfills.

Results of the developed scenarios show that by 2020 significant drop in emissions cannot be expected, although some measures have been taken. Measures taken, depending on the level of their application, ultimately result in drop of the emissions with the scenarios S2 and S3.

Summary results for mitigation scenarios

Summary review foresees the total mitigation potentials for each of the scenarios, not including the effects of sinks in forestry.

Scenarios 2 and 3 are characterized by moderate steady drop in emissions, which will decrease by 2050 for 14% compared to 2010, according to the scenario S2 and for 55% according to the advanced scenario S3.

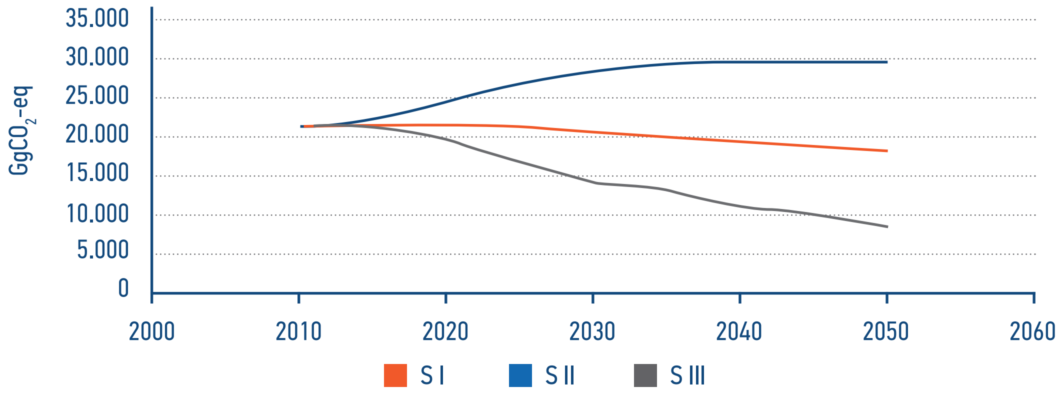


Chart 6: Total (sink in the forestry sector is not included) emissions by scenarios for the period 2010 – 2050

Other relevant activities

Technology Needs Assessment for mitigation and adaptation

Nationally Appropriate Mitigation Actions (NAMAs) – are programs of mitigation or voluntarily implemented policies of developing countries in the context of sustainable development, which are supported and enabled, in whole or in part, by technology, financial resources and capacity building activities provided by developed countries. In Bosnia and Herzegovina, a mechanism has been established for approving and sending NAMA projects under the UNFCCC registry, the purpose of which is to keep the record on the demand for international support for the implementation of NAMAs in order to facilitate obtaining financial resources, technology and capacity building support through these measures.

In addition, Climate Change Adaptation and Low-Emission Development Strategy was initiated based on the climate and mitigation scenarios developed under the SNC. The strategy has the following main two objectives: increase resilience to climate change and reach a peak and stop annual growth values of greenhouse gas emissions in 2025. The Strategy, which was adopted by the Council of Ministers of Bosnia and Herzegovina in October 2013, clearly defines the results and activities, as well as the funds necessary for their implementation, all in order to achieve sustainable development.

Considering that countries, non-Annex I parties, suffer the most from climate change effects, it is very important that Bosnia and Herzegovina as such analyzes development scenarios and accordingly define the policy of sustainable development, which will include adaptation and mitigation measures. On this occasion, within the report, drafting of the Technology Needs Assessment for mitigation and adaptation has been made, and its main highlights are provided in the relevant section.

Overview of plans and programs for systematic observing

One of the important assumptions to combat climate change is strengthening capacities; i.e., institutional and staff training, development and improving of meteorological monitoring.

In order to develop a sustainable system for the estimation of greenhouse gas emissions for BiH and their elimination in the long-term, it is recommended to revise relevant environmental and air protection laws in accordance with general requirements of the Directive (EU) no. 525/2013 on the mechanism for monitoring and reporting GHG emissions, and it is also recommended to harmonize data of statistical methodology with IPCC methodology requirements, to the extent to which the methodological requirements of the IPCC coincide with the requirements and standards of the relevant statistical methodology.

Education, training and raising awareness
Activities conducted so far in the field of education and raising awareness about climate change were quite modest. Therefore, a better education in the sphere of environmental protection and raising awareness are of particular importance because it can help in the implementation of long-term strategies and policies related to climate change.
Climate change priorities in education, training and awareness raising imply the following objectives:

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

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

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

• Conduct outreach to state officials, including representatives of ministries of education, on climate change causes and effects and their integration into curriculum and standards;

• Implement teacher training on the need to introduce climate change into the curriculum and on appropriate teaching methods;

• Nominate an expert group in education and economic sectors to introduce education on climate change in each sector;

• Organize scientific gatherings on linking informal education and private and public enterprises aiming to adjust to climate change and alleviate its impacts;

• Politicians, businessmen, and journalists should be educated about the causes and effects of climate change through projects in accordance with development strategies;

• Politicians, businessmen, and journalists should be educated on the international mechanisms for financing projects in the areas of mitigation and adaptation to climate change, as well as on project submission;

• A campaign on climate change and its impacts should be initiated with an identifying logo and slogan in the short term.

Preparation of operational programs to inform the public
Basic concept for the overall information system remains unchanged when compared to the Second National Communication and additional efforts should be invested for this concept to become active.

In order to implement adaptation and mitigation programs, it is necessary for the information to reach all levels, types, and profile of education of all citizens, economic organizations, and all employees in state bodies.

Constraints and gaps

This chapter provides an overview of limitations and obstacles related to institutional, legal, financial, technical, and human resource capacities in BiH that affect the implementation of obligations under the United Nations Framework Convention on Climate Change (UNFCCC).

Some of the suggested measures imply the implementation of various forms of research and building of a system of monitoring the climate change impact, and their implementation requires an adequate support. To that end, it is necessary to provide financial resources as one of the first steps in implementing these measures. Another important area of focus is to improve insufficiently developed research capacity to understand climate change impacts and address climate change adaptation. It is also important to define the roles of various stakeholders tackling these issues.
At the same time, it is necessary to work on promoting understanding of the importance of climate change, and a special task is to preserve the established system and capacity, as well as strengthening their values.

1. CALCULATION OF GREENHOUSE GAS EMISSIONS

1.1. Methodology

The inventory of greenhouse gas emissions in this Third National Communication (TNC) covers the years between 2002 and 2009, as well as 2012 and 2013. For the purposes of calculating emissions in this communication, the GHG Inventory compliance team used the Intergovernmental Panel on Climate Change (IPCC) methodology laid in Convention, based on the reference manual Revised IPCC 1996 Guidelines for National GHG Inventories, 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, with predominant use of the recommended IPCC default emission factors. 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 IPCC methodology and approach ensure the principle of 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.

Quality assessment 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.

Furthermore, compilation of the Inventory within the TNC also included the revision of previously submitted First Biennial Update Report (FBUR) for 2010 and 2011.

1.2. Data collection and processing system

In the framework of the Third National Communication on climate change, the Inventory was compiled for years between 2002 and 2009, and years 2012 and 2013. Data for Inventory compilation were collected on four different levels:

- Bosnia and Herzegovina
- Federation of BiH
- Republika Srpska
- Brčko District

The inventory compilers faced a number of obstacles and inconsistencies while collecting activity data. Namely, statistical data are not harmonized with methodology of inventory compilation in terms of data availability and inadequate data format. This refers to all sectors (waste, transport, industrial processes, energy industry, LULUCF, agriculture), with special accent to energy sector (a key sector from the aspect of GHG emission), but also to waste sector (linked indirectly with number of population and their distribution), to wastewaters (data on industrial and communal wastewaters are either lacking or missing completely), to agriculture (data on fertilizers consumption are almost completely missing, so expert judgments had to be made), etc.

Official statistical data had priority while compiling inventory. In that regard, for calculating fuel consumption using reference approach for energy sector was done in accordance with methodology requirements (import, export, stock changes) only for 2013 and partially for 2012, and significant changes were recorded in reference and sectoral approach due to the statistical data on coal types. Namely, statistics differ between lignite and brown coal, regardless of their lower heating value, while IPCC methodology categorizes lignite as coal with lower heating value below 17,435 TJ/kt, and sub-bituminous coal as coal with lower heating value greater than 17,435 TJ/kt.

However, data collected from the operators were categorized following the IPCC methodology. Furthermore, operators of large energy and industrial facilities delivered data as required by the questionnaires prepared separately for each sector, and activity, comprising data on fuel consumption, product quantity and needed technology parameters, and these data can be considered reliable.

For the presentation of emissions in the Reference approach, the following was done: total production of coal Banovići (sub-bituminous coal)[17] was distracted from total production of brown coal (as presented in statistics), and presented as production of sub-bituminous coal. Remaining quantity of brown coal produced was accounted to lignite, and summed up with presented lignite production. Thus, it was not possible to present export and import of coal because there were no available data on export/import for specific coal mines.

1.2.1. Energy industry

Amounts of coal used for calculation of GHG emissions are based on consumption data gathered from TPP operators. Power utility companies in both entities definitely possess data on fuel consumption in thermal power plants, and characteristics of coal to a certain extent, and these data may be considered reliable. Large scaled energy and heating plants also possess good quality data on fuel consumption. Data on coal production were collected through the database from the Ministries of Energy and entity Institutes of Statistics.

Consumption of brown coal is divided to lignite and sub-bituminous coal on the basis of their lower heating value, as required by the IPCC methodology. Accordingly, only coal from coalmine Banovići was categorized as sub-bituminous coal, and all other brown coal is accounted together with lignite.

Data on fuel consumption (except for transport sector) were collected on the level of entities, and then summed up together, following the net weight principle.

1.2.2. Transport

For the period between 2009 and 2013 calculation was performed using data on number of vehicles from IDDEEA (Agency for Identification Documents of BiH)[18];
Number of vehicles for previous years was taken from BIHAMK database (Bosnia and Herzegovina Auto-moto Club)[19] and from Federal Hydrometeorological Institute and Republic Hydrometeorological Institute, which uses the database of the RS Ministry of Transport and Communications;
Data on fuel consumption in 2013 were taken from official publication of the Agency for statistics of BiH – Balance of oil derivatives[20];

Fuel consumption for period between 2002 and 2005 was taken from Study on Energy Sector in Bosnia and Herzegovina[21];

Share of fuels used in transport sector (diesel 78,7%, gasoline 99%, LPG 53%) was taken from total balance of oil derivatives for Bosnia and Herzegovina, and these percentages were applied to data on fuel consumption from the Study on Energy Sector for both period of 2002 – 2005 and for 2013;

Data on fuel consumption for remaining years were calculating using individual index for each year (fuel consumption was divided with number of vehicles).

1.2.3. Industrial processes

Production data are obtained directly from the following industries:

- Iron and steel;
- Ferroalloy production;
- Cement production (two cement plants; Kakanj and Lukavac);
- Coke, Nitrate acid, and Koch Advanced Nitrogen (KAN) fertilizer production

Other production data were taken from statistics;
CO_2 emission calculation is based on clinker production, which is obtained from the cement producer.

[17]The GHG Inventory compliance team agreed to classify only coal from coal mine Banovići as a sub-bituminous coal, and coal from all other coal mines as lignite
[18]Web page od the Agency: http://www.iddeea.gov.ba/index.php?lang=bs
[19]Information on total number of registered and sold new vehicles in BiH in period january-december 2012, Available at: http://bihamk.ba/assets/files/YYFaLSg2Gs-registrovana-vozila-u-2012godinipdf.pdf
[20]Agency for statistics of BiH, 2015: Energy statistics, available at: http://www.bhas.ba/saopstenja/2015/END_2013G01_001_01_bos.pdf
[21]Energy Sector Study in BiH – Final Report, available at: http://www.mvteo.gov.ba/vijesti/posljednje_vijesti/default.aspx?id=117&langTag=bs-BA

EF for CO_2 equals 0,5071 t CO_2/t of clinker, applying correction factor CKD of 1,02 which is in accordance with Revised 1996 IPCC Guidelines.

EF used in iron and steel production from 2002-2008 is 0,08 t CO_2/t of iron or steel produced, due to the technology using electric arc furnace, and it is in accordance with Revised1996 IPCC Guidelines;

EF used for the later years is 1,46 t CO_2/t of iron or steel produced, due to the integrated technology using basic oxygen furnace (BOF), and it is in accordance with Revised1996 IPCC Guidelines;

For some years both EFs were applied, because the operator delivered detailed data on quantity of steel produced using both technologies.

EFs used for HNO_3 production for N_2O: until 2009 were 9 kg of N_2O per t of nitric acid produced, and from 2010 it was 2 kg of N_2O per t of nitric acid produced, due to the introduction SNCR technology, and is in accordance with IPCC 1996 Guidelines;

EF used in ferroalloy production is 4,3 t CO_2/t of ferroalloy production, which relates to production of silica metal (information provided by the operator), and is in accordance with IPCC 1996 Guidelines.

1.2.4. Waste

Due to the fact that all landfills (for the analysed period) in BiH were non sanitary municipal landfills, deeper than 5 m, default IPCC 1996 Methane Correction Factor of 0.8 is used. Data about total MSW disposed were obtained from the official documents of FBiH, RS and Agency for statistics of BiH and entity Institutes of Statistics. Those data are used as an input for the sheet 6-1A. Other sheets request input data for the (re)calculation of disposal amounts (i.e. in case the exact data on disposed waste amounts are missing), and due to the fact that official data were available, the idea was to avoid lack of correlation in numbers and double calculation.

1.3. Engagement of experts for development of greenhouse gas inventory

For the preparation of the Inventory within the Third National Communication, UNDP Bosnia and Herzegovina hired experts in a public tender, with a required experience in previous National Communications.

They are mainly employees of Hydro meteorological Institute of Federation of BiH, and Hydro meteorological Institute of Republika Srpska, Statistical office of Republika Srpska, Power utility companies, Agriculture faculties, as well as freelance experts.

Inventory compliance and reporting system with regards to GHG in Bosnia and Herzegovina has not been established yet. There is neither formal framework nor agreement that defines the establishment of a system of GHG Inventory at the level of BiH, nor formalized role of institutions in these activities. Although in Republika Srpska the Law on Air protection (RS Official gazette, no.124/11) provides that the jurisdiction to conduct a greenhouse gas inventory lies with the republic administrative organization in charge of hydrometeorology, i.e. Hydro meteorological Institute of Republika Srpska, appropriate bylaws that govern the manner of keeping an inventory, its adoption, etc. have not been passed.There is no such jurisdiction prescribed at the level of FBiH, or Brčko District level and procedures for the BiH inventory are not legally prescribed as well.

Summing up everything said above, key shortages identified in the field of GHG Inventory are the following:

- Incompatibility between the existing data and those required under the IPCC methodology;
- Missing data;
- Lack of legislative requirements on the type and scope of data to be collected;
- Insufficient knowledge with regards to the treaty obligations;
- Lack of institutional responsibilities due to non-existence of legal competencies and procedures for developing of greenhouse gas inventory for BiH.

In terms of Article 12 of the UNFCCC, the responsibility for reporting rests with the Ministry of Spatial Planning, Civil Engineering and Ecology of Republika Srpska in its capacity as the Focal Point for BiH. Major difficulties in Bosnia and

Herzegovina with regards to reporting are the following:

- Lack of permanent funding for reporting – it is not foreseen by institutional budgets;
- Lack of relevant implementing regulations for data collection requirements;
- Lack of activity data needed for reporting to IPCC and fulfilling commitments under the UNFCCC – even though it is slightly getting better;
- Lack of administrative capacity for the high-quality subordinate legislation on activity data collection; and
- Lack of expert assistance to allow implementation of commitments under UNFCCC.

1.4. Results of emission estimations for period between 2002 – 2009 and 2012 and 2013

This section provides an overview of results of the GHG emission calculation for Bosnia and Herzegovina. The results have been given first as total (aggregated) emissions of all greenhouse gases by sector and then as emissions of specific greenhouse gases, also by sectors. Given that certain greenhouse gases differ in terms of their radiating characteristics, their contribution to the greenhouse effect varies. In order to allow the aggregation and total overview of emissions, it is necessary to multiply emission of each gas by its Global Warming Potential (GWP). GWP is a measure of how much a specific gas contributes to the greenhouse effect in relation to the impact of CO_2. In this case, the emission of greenhouse gases is expressed in Gg CO_2eq (mass of equivalent CO_2). Table 7 shows the global warming potentials for individual gases for a period of 100 years.

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

Table 7: Global warming potentials for individual gases for a period of 100 years

Carbon dioxide (CO_2) is one of the most important greenhouse gases, especially where the consequences of human activities are concerned. Carbon dioxide is estimated to be responsible for around 50% of global warming[22]. Almost everywhere in the world, including Bosnia and Herzegovina, the most common anthropogenic sources of CO_2 are the combustion of fossil fuels (for power production, industry, transport, heating, etc.), industrial activities (steel and cement production), and land use change and forestry activities (in BiH, due to an annual biomass increase, there is a negative emission, or sink, in this sector).

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

Table 8 below presents the overview of emissions by sector for the period covered by this Report, i.e. 2002 – 2009, 2012 and 2013.

[22] *Source: IPCC*

GHG source category /Year	2002	2003	2004	2005
Total emissions (Gg CO_2e) – without sinks	16.170,12	16.436,75	17.451,83	16.645,07
Total emissions (Gg CO_2e) – with sinks	11.450,76	11.448,75	10.144,89	9.230,82
1. Energy	12.211,98	12.430,34	13.114,89	11.921,82
A. Fuel combustion (sectoral approach)	11.643,20	11.831,36	12.472,60	11.272,90
1. Energy Industries	8.319,73	8.555,57	8.663,45	7.316,17
2. Manufacturing industries and construction	738,30	680,55	975,68	979,85
3. Transport	1.954,54	2.046,18	2.245,13	2.222,35
4. Other sectors	630,63	549,07	588,34	571,02
5. Other (please specify)	NO	NO	NO	NO
B. Fugitive emissions from fuels	568,78	598,98	642,30	648,92
1. Solid fuels	568,39	595,43	614,14	612,99
2. Oil and natural gas	0,42	3,55	28,16	35,93
2. Industrial processes	527,57	537,96	634,25	748,25
A. Mineral products	364,95	355,90	442,46	469,22
B. Chemical industry	NO	NO	0,47	59,39
C. Metal production	162,62	182,06	191,31	219,63
D. Other production	NO	NO	NO	NO
E. Production of halocarbons and sulphur hexafluoride	NO	NO	NO	NO
F. Consumption of halocarbons and sulphur hexafluoride	0	0	0	0
3. Solvent and other product use	NE	NE	NE	NE
4. Agriculture	2.628,51	2.610,53	2.791,12	3.035,80
A. Enteric fermentation	738,01	795,69	835,02	848,01

	2006	2007	2008	2009	2010	2011	2012	2013
	18.721,67	18.788,49	20.379,40	23.783,52	25.723,00	28.086,27	21.816,43	24.027,84
	11.629,42	11.144,30	12.982,74	15.784,06	20.037,00	22.183,27	14.270,09	17.886,84
	13.824,23	**13.918,55**	**14.910,70**	**18.023,96**	**19.986,38**	**21.876,94**	**15.923,95**	**18.258,27**
	13.147,13	13.176,99	14.173,06	17.286,51	19.275,78	21.114,48	15.266,62	17.517,74
	10.044,75	10.019,05	10.917,91	13.818,59	15.220,72	16.737,31	10.805,02	12.449,53
	762,55	693,72	624,99	627,58	580,41	753,27	735,05	858,26
	2.339,83	2.372,17	2.497,32	2.529,91	2.579,46	2.666,19	2.753,18	2.896,33
	0,00	92,06	132,83	310,32	895,19	957,71	973,37	1.313,63
	NO	NO	NO	NO	NO	NO	NO	NO
	677,10	741,56	737,64	737,45	710,59	762,47	657,33	740,53
	646,61	720,90	720,83	730,21	710,59	762,47	644,80	735,31
	30,49	20,66	16,82	7,24	NE	NE	12,54	5,22
	992,98	**1.078,16**	**1.509,19**	**1.720,95**	**1.906,96**	**2.277,17**	**2.178,75**	**2.039,71**
	562,45	608,15	651,84	573,12	583,00	664,00	599,42	605,58
	130,98	150,90	229,12	153,49	114,96	292,17	217,42	42,38
	299,55	319,11	628,24	994,34	1.209,46	1.320,56	1.361,92	1.391,76
	NO	NO	NO	NO	NO	NO	NO	NO
	NO	NO	NO	NO	NO	NO	NO	NO
	0	0	0	0	0	0	0	0
	NE	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
	2.972,94	**2.680,09**	**2.755,06**	**2.758,54**	**2.879,93**	**2.915,47**	**2.465,84**	**2.555,40**
	930,97	867,18	852,85	854,47	841,02	822,23	807,51	813,88

	B. Manure management	293,68	313,32	329,89	341,23	
	C. Rice cultivation	NO	NO	NO	NO	
	D. Agricultural soils	1.596,81	1.501,52	1.626,22	1.846,56	
	E. Prescribed burning of savannahs	NO	NO	NO	NO	
	F. Field burning of agricultural residues	NE	NE	NE	NE	
5. Land-use change and forestry [1]		**-4.719,00**	**-4.988,00**	**-7.306,94**	**-7.414,25**	
	A. Changes in forest and other woody biomass stocks	-4.719,00	-4.988,00	-7.306,94	-7.414,25	
	B. Forest and grassland conversion	NE	NE	NE	NE	
	C. Abandonment of managed lands	NE	NE	NE	NE	
	D. CO_2 emissions and removals from soil	NE	NE	NE	NE	
6. Waste		**1.174,46**	**857,91**	**911,57**	**939,20**	
	A. Solid waste disposal on land	464	513,30	567,64	599,69	
	B. Waste-water handling	248	344,61	343,93	339,51	
	C. Waste incineration	NO	NO	NO	NO	
Memo items						
	International bunkers	NO	NO	NO	NO	
	Aviation	NO	NO	NO	NO	
	Marine	NO	NO	NO	NO	
	CO_2 emissions from biomass	NE	NE	NE	NE	

Table 8: CO_2eq emissions for period 2002–2009, 2012 and 2013

	374,04	341,43	331,42	337,81	344,19	332,59	323,07	330,77
	NO	NO	NO	NO	NO	NO	NO	NO
	1.667,94	1.471,48	1.570,78	1.566,26	1.694,71	1.760,64	1.335,25	1.410,75
	NO	NO	NO	NO	NO	NO	NO	NO
	NE	NE	NE	NE	NE	NE	NE	NE
	-7.092,25	**-7.644,19**	**-7.396,66**	**-7.999,47**	**-5.686,00**	**-5.903,00**	**-7.546,34**	**-6.141,00**
	-7.092,25	-7.644,19	-7.396,66	-7.999,47	-5.686,00	-5.903,00	-7.546,34	-6.141,00
	NE	NE	NE	NE	NE	NE	NE	NE
	NE	NE	NE	NE	NE	NE	NE	NE
	NE	NE	NE	NE	NE	NE	NE	NE
	931,52	**1.111,68**	**1.204,45**	**1.279,54**	**974,32**	**1.017,70**	**1.247,89**	**1.174,46**
	597,47	759,69	872,41	953,52	798,00	840,00	918,81	847,66
	334,06	352,00	332,04	326,01	168,49	198,70	329,08	326,79
	NO	NO	NO	NO	NO	NO	NO	NO
	NO	NO	NO	NO	NO	NO	NO	NO
	NO	NO	NO	NO	NO	NO	NO	NO
	NO	NO	NO	NO	NO	NO	NO	NO
	NE	NE	NE	NE	NE	NE	NE	NE

Greenhouse gas inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol and greenhouse gas precursors

Greenhouse gas source and sink categories	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NOx (Gg)	CO (Gg)	NMVOCs (Gg)	SOx (Gg)
Total emissions and removals for BiH	**19.417**	**-6.141**	**132**	**6**	**72**	**140**	**23**	**412**
1. Energy	**17.420**	**0**	**37**	**0**	**71**	**118**	**22**	**409**
A. Fuel combustion (sectoral approach)	17.420		1	0	71	118	21	408
1. Energy Industries	12.394		0	0	37	3	1	378
2. Manufacturing industries and construction	854		0	0	3	1	0	10
3. Transport	2.881		0	0	30	101	19	0
4. Other sectors	1.291		1	0	2	14	1	19
5. Other (please specify)	0		0	0	0	0	0	0
B. Fugitive emissions from fuels	0		35		0	0	1	2
1. Solid fuels			35		0	0	0	0
2. Oil and natural gas			0		0	0	1	2
2. Industrial processes	1.997	0	0	0	1	22	1	3
A. Mineral products	606				0	0	0	0
B. Chemical industry	0		0	0	1	0	0	0
C. Metal production	1.392		0	0	0	21	0	2
D. Other production	0		0	0	0	0	1	1
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)	0		0	0	0	0	0	0
3. Solvent and other product use	0			0			0	
4. Agriculture			44	5	0	0	0	0
A. Enteric fermentation			39					
B. Manure management			5	1			0	
C. Rice cultivation			0				0	
D. Agricultural soils				5			0	

E. Prescribed burning of savannahs			0	0	0	0	0	
F. Field burning of agricultural residues			0	0	0	0	0	
G. Other (please specify)			0	0	0	0	0	
5. Land-use change and forestry 1	0	-6.141	0	0	0	0	0	0
A. Changes in forest and other woody biomass stocks	0	-6.141						
B. Forest and grassland conversion	0	0	0	0	0	0		
C. Abandonment of managed lands		0						
D. CO_2 emissions and removals from soil	0	0						
E. Other (please specify)	0	0	0	0	0	0		
6. Waste			51	0	0	0	0	0
A. Solid waste disposal on land			40		0		0	
B. Waste-water handling			11	0	0	0	0	
C. Waste incineration					0	0	0	0
D. Other (please specify)			0	0	0	0	0	0
7. Other (please specify)	0	0	0	0	0	0	0	0
Memo items								
International bunkers	0		0	0	0	0	0	0
Aviation	0		0	0	0	0	0	0
Marine	0		0	0	0	0	0	0
CO_2 emissions from biomass	0							

Table 9: Emissions by sectors in 2013 on gas-by-gas basis

Greenhouse gas inventory of anthropogenic emissions of HFCs, PFCs and SF_6								
Greenhouse gas source and sink categories	HFCs[a,b] (Gg)				PFCs[a,b] (Gg)			SF_6[a] (Gg)
Insert PFC	HFC-23	HFC-134	R134a		CF_4	C_2F_6		
Total emissions and removals	0	0	0,00011		0	0		0
1. Energy								
A. Fuel combustion (sectoral approach)								
1. Energy Industries								
2. Manufacturing industries and construction								
3. Transport								
4. Other sectors								
5. Other (please specify)								
B. Fugitive emissions from fuels								
1. Solid fuels								
2. Oil and natural gas								
2. Industrial processes	**0**	**0**	**0,00011**		**0**	**0**		**0**
A. Mineral products								
B. Chemical industry								
C. Metal production								
D. Other production								
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride			**0,0001064**					
G. Other (please specify)								
3. Solvent and other product use								
4. Agriculture								
A. Enteric fermentation								
B. Manure management								
C. Rice cultivation								

D. Agricultural soils								
E. Prescribed burning of savannahs								
F. Field burning of agricultural residues								
G. Other (please specify)								
5. Land-use change and forestry								
A. Changes in forest and other woody biomass stocks								
B. Forest and grassland conversion								
C. Abandonment of managed lands								
D. CO_2 emissions and removals from soil								
E. Other (please specify)								
6. Waste								
A. Solid waste disposal on land								
B. Waste-water handling								
C. Waste incineration								
D. Other (please specify)								
7. Other (please specify)								
Memo items								
International bunkers								
Aviation								
Marine								
CO_2 emissions from biomass								

Table 10: Potential HFC emissions in 2012[23]

[23] *Please note that data on HFC consumption in 2013 were not available, and therefore consumption for 2012 is presented*

1.4.1. Emission of carbon dioxide (CO_2) by sectors

1.4.1.1. Total emissions

Chart 7 shows total emissions for the period 1990-2013.

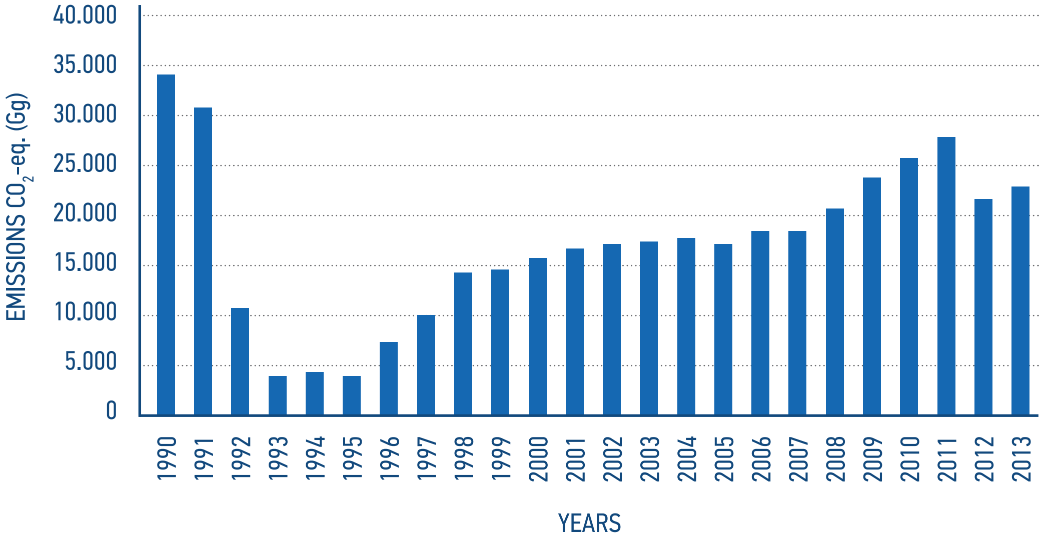


Chart 7: Total emissions (Gg CO_2eq.) for the period 1990 – 2013

As it may be depicted from the Chart 7, emission quantity from the base year 1990 hasn`t been reached yet. It is clear that emission levels started to rise in the post-war period, due to increased industrial activities, and in general have the trend of increasing. Changes in emission values for the period 2002 – 2013 are explained by the changing pattern of coal consumption in thermal power plants, having in mind that it is the sector with greatest contribution to total emissions.

1.4.1.2. Share of emissions by sectors

Chart 8 shows a share in CO_2 eq. emissions of each sector in total emissions.

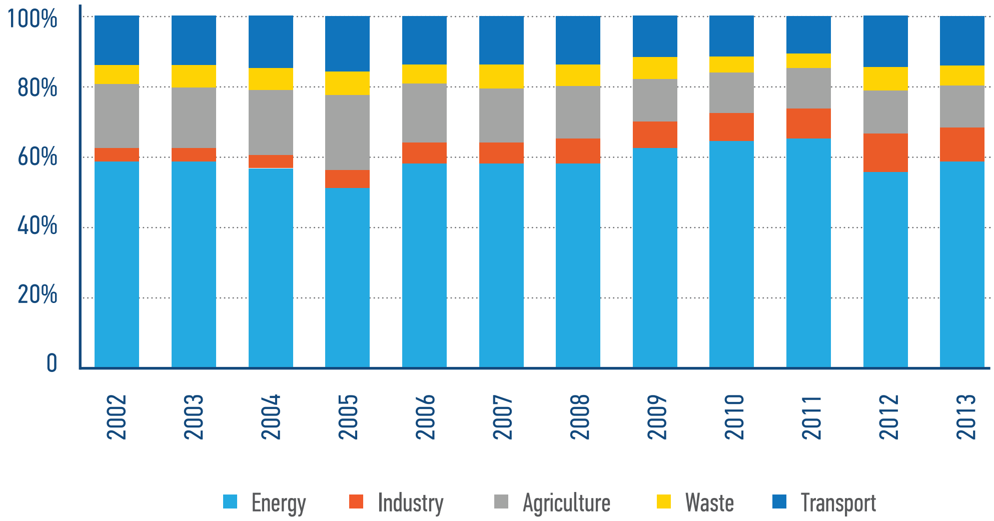


Chart 8: Share of each sector in total emissions of CO_2eq. (%)

As it may be seen from the Chart 8 energy sector is the greatest contributor to CO_2 emissions, with share between 51 and 60%, followed by agriculture sector (11 – 16%), transport (9 – 13%), industrial sector (3 – 10%), and waste (4 – 6%).

1.4.1.3. Energy production

The main source of CO_2 emissions is certainly the energy production sector, which contributes around 70% in 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. Fugitive emissions occur during production, transport, processing, storage and distribution of fossil fuels. The energy sector is the main source of anthropogenic emission of greenhouse gases.

Emissions over time are presented in Chart 9 below. Emission calculations have been based on fossil fuel consumption data obtained by operators of thermal power plants, heating plants, and relevant official energy studies, which allowed a calculation to be performed within the prescribed IPCC methodology, for sectoral approach.

In reference approach calculation which considers only the total balance of fuel, without sub-sectoral analysis, it was difficult to be precise having in mind different classification of coal types used for sectoral and reference approach. As already explained earlier in the text the sectoral approach calculation was done in accordance with IPCC guidelines, clearly dividing lignite and sub-bituminous coal.

Two the most carbon-intensive energy sub-sectors are energy conversion (thermal power plants, heating plants, transport) and industrial fuel combustion. Most of the CO_2 emissions in energy conversion are from fuel combustion in thermal power plants, and the changing pattern in coal consumption affects the changes in total emissions. Furthermore, changing of fuel in industry facilities (mainly coal and natural gas) contributes to these changing emission values.

Share of energy industry in total emissions vary from 61 to 70% through years. Taking into consideration all of these facts, the data are considered logical and comprehensible. As it may be also depicted from the Chart 9, emission quantities from 1990 have not been reached yet. The highest emission from energy industries was in 2011 and it amounted 72 % of emission in the base year 1990.

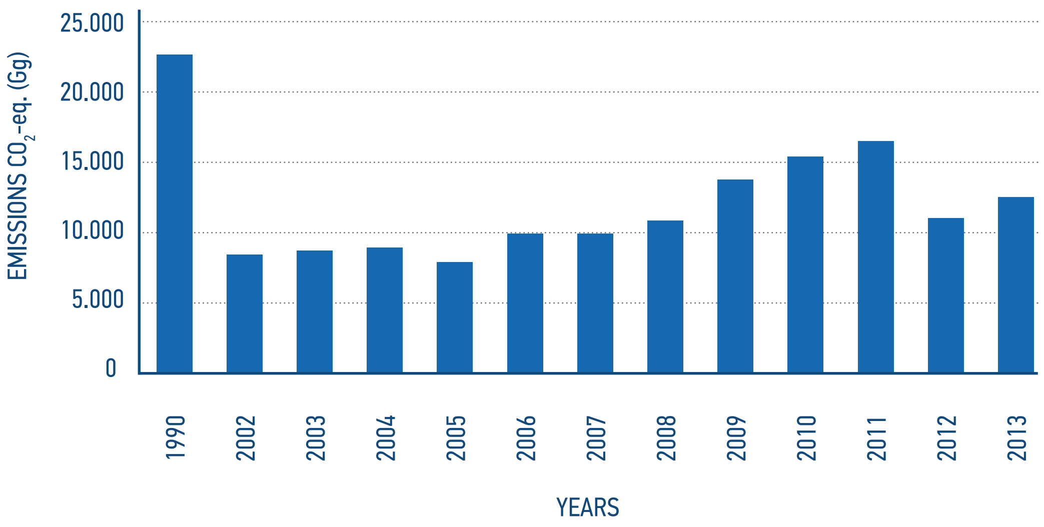


Chart 9: CO_2eq. emissions from energy industry for the period 2002 – 2013 and in 1990

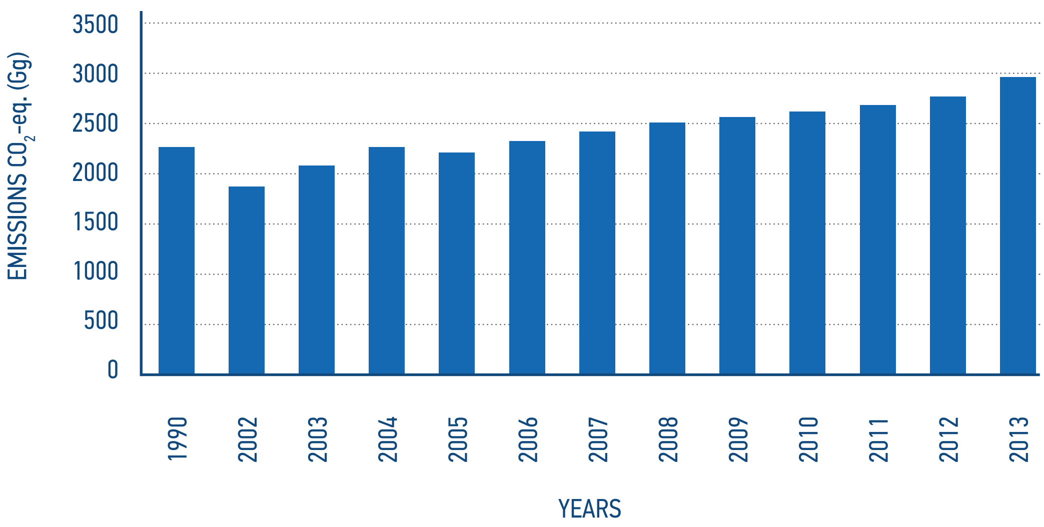


Chart 10: CO_2eq. emissions from transport for the period 2002 – 2013 and in 1990

As it may be seen from the Chart 10, emissions from transport are increasing steadily by years. The share of emissions from transport in energy sector emissions rose from almost 10% in 1990 to 30% in 2005 and it dropped again in 2013 to 23%. These fluctuations may be explained by the changes in energy production (coal consumption) patterns.

1.4.1.4. Fugitive emissions from fuel

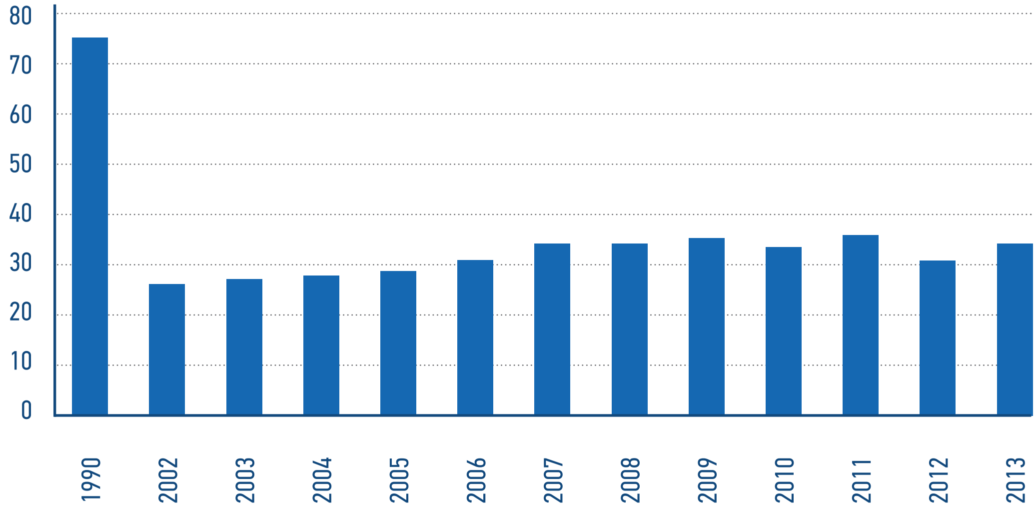


Chart 11: Fugitive emissions from solid fuel – coalmines (Gg CH_4)

Fugitive emissions from solid fuel are mostly generated from coalmines, primarily from underground exploitation. The huge difference between 1990 emissions and emissions in period 2002 – 2013 is explained by decreased exploitation from underground coalmines.

1.4.1.5. Industrial processes

Greenhouse gases may also occur as a by-product of various industrial processes outside of the energy sector in which an input substance is chemically transformed into a final product. The industrial processes known as significant contributors to CO_2 emissions are the production of cement, lime, ammonia, iron and steel, ferroalloys, and aluminium, as well as the use of lime and dehydrated soda lime in various industrial processes. The recommended IPCC methodology was used for calculation of emissions from industrial processes[24]. Emissions of CO_2 from industrial processes over period between 2002 and 2013 and in 1990 are presented in Chart 12.

[24]*Source: Revised IPCC Guidelines for National Greenhouse Gas Inventories from 1996*

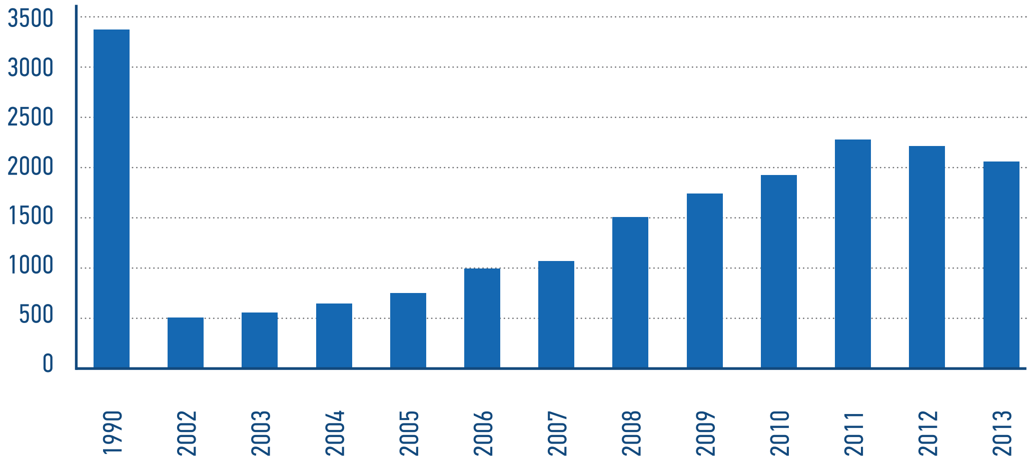


Chart 12: CO_2eq. emissions from industrial processes for the period 2002 – 2013 and in 1990

As it may be seen from the Chart 12, emissions from industrial processes have an increasing trend through years, due to developing and increasing industrial activities. However, minor changes occurred in production in certain industries, which caused some inconsistencies in trend, but this can be logically explained by decreased production capacities, which are not following the development curves. Even though activities and consequently emissions have an increasing trend, emissions from 1990 have not been reached yet.

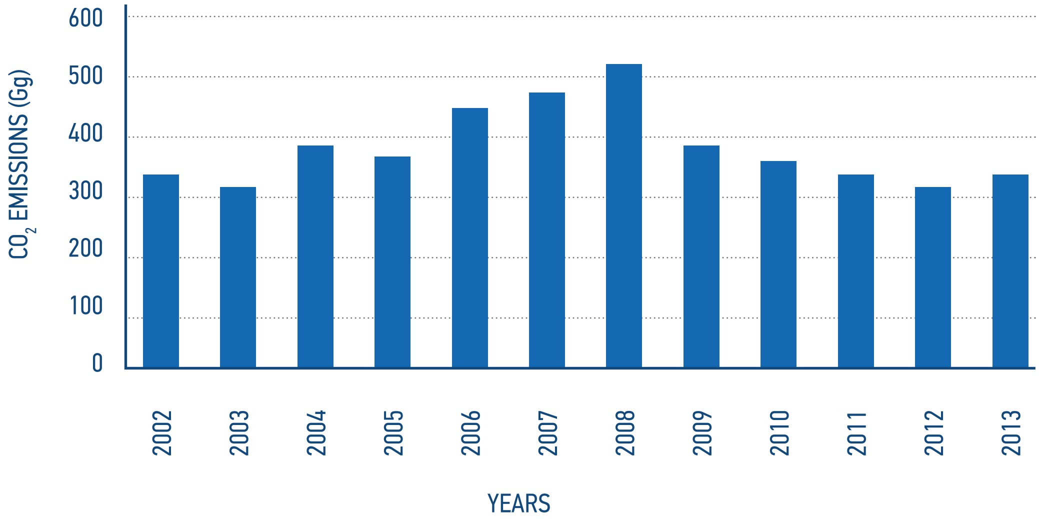


Chart 13: CO_2 eq. emissions from cement production in the period 2002–2013

As it may be depicted from the Chart 13, CO_2 emissions from cement production vary through years, due to changing production of cement. The highest emissions were recorded in 2008, when cement production in the cement plant Kakanj raised to 770.000 tons, which was the highest production in the history of that factory.

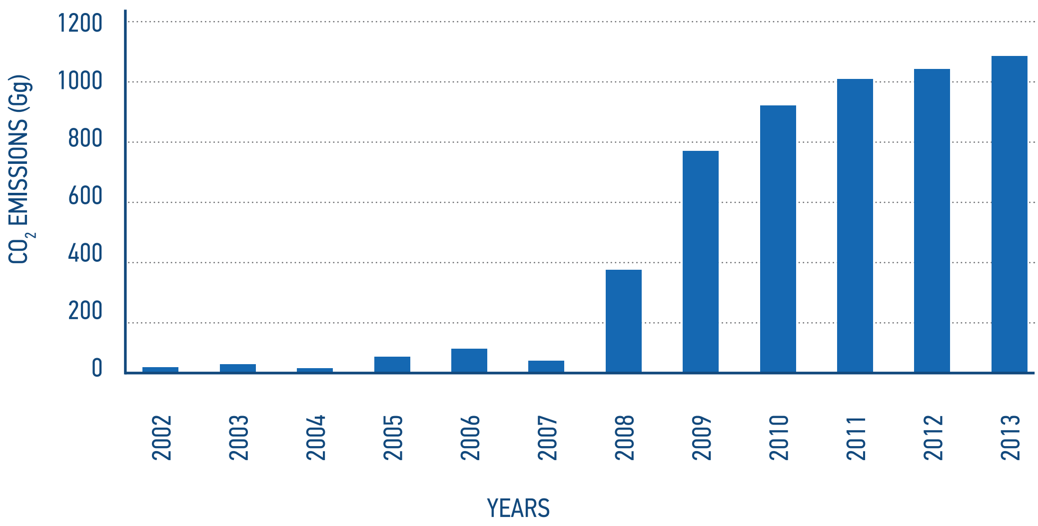


Chart 14: CO_2 emissions from iron and steel production in the period 2002–2013

It is obvious that CO_2 emissions from iron and steel production started to grow rapidly in 2008 (see Chart 14) due to the startup of integrated steel production in blast oxygen furnace (BOF), compared to the previous electric arc furnace (EAF) production, and non-existence of integrated production until 2008. Higher emissions are the result of both increased production and of different emission factors (0,08 for EAF vs.1,46 for BOF) applied.

1.4.1.6. Solvent and other products use

Solvent and other products use have not been estimated due to the lack of activity data.

1.4.1.7. Sinks - LULUCF (Land Use, Land Use Change and Forestry)

When absorption of greenhouse gases occurs (e.g. absorption of CO_2 due to an increase in forest wood biomass), we talk about greenhouse gas sinks, and the amounts are shown with a negative value.

Total emissions and sinks in the forestry sector and land use change for Bosnia and Herzegovina were calculated for the period between 2002 and 2009 and for 2012 and 2013. According to the data collected, the results of the calculation indicate that forests in BiH represent a significant CO_2 sink.

According to the data available for the baseline year, forests in BiH cover an area of approximately 2.28 million hectares[25] Deciduous trees (which have a high capacity to absorb carbon) account for 68,8% of all trees, with beech dominating (39%) and sessile-flowered oak accounting for 18,9%.

Coniferous trees total 31,2% of all trees, with a significant proportion of fir (12,8%), spruce (8,6%), black pine (7,2%) and Scots pine (2,5%) trees and only a minute proportion of other coniferous trees (0,1%). Based on these indicators and the annual increment of 10.5 million hectares (GTZ, 2001), an annual increment factor was determined in tons of dry matter per hectare (2.375). Noble broadleaves and wild fruit trees have been also included in the calculations.

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

Using the IPCC values of carbon proportion in dry matter, the

[25] *Source: FAO, 2005*

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 7,423.53 Gg CO_2, and for the year 2013 is 6,141 Gg CO_2. Detailed calculations of sinks were performed in accordance with the 1996 IPCC Guidelines, and the enclosed IPCC CRF tables are used for calculations per years, and are presented in Chart 15.

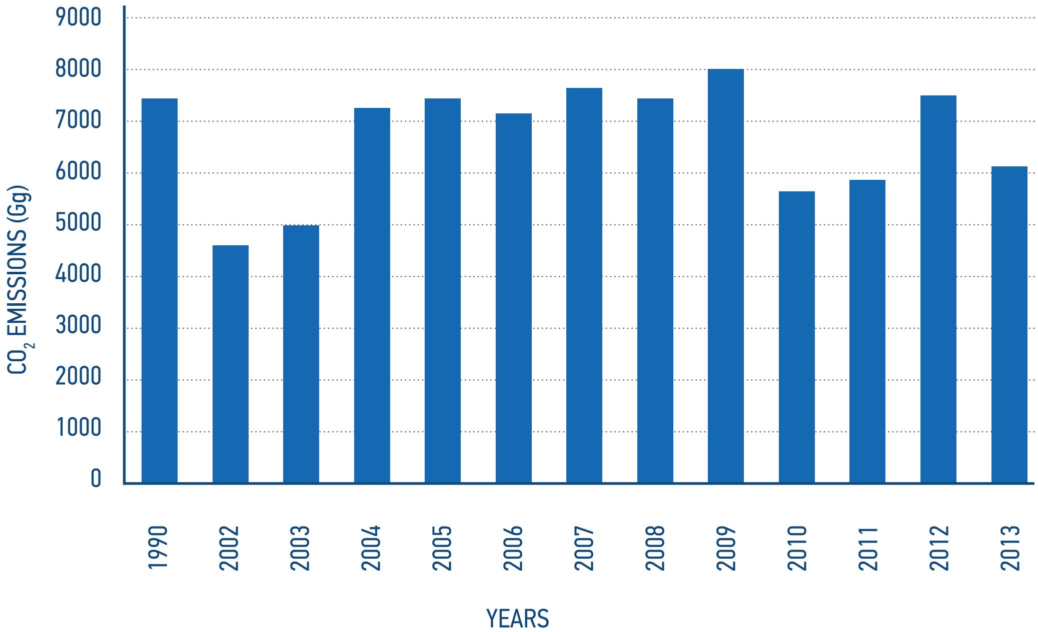


Chart 15: Sinks for the period 2002 – 2013 and in 1990

1.4.2. Emission of methane (CH_4) by sectors

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, bulls, sheep, horses, swine and poultry). Methane emissions from waste disposal sites occur as a by-product of anaerobic decomposition of waste material with help of methanogenic bacteria. The amount of methane released firing 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.

The main sources of methane in Bosnia and Herzegovina are agriculture (enteric fermentation and manure management), fugitive emissions from coalmines, and waste disposal. IPCC emission factors were used for the calculation of all the above mentioned sectors.

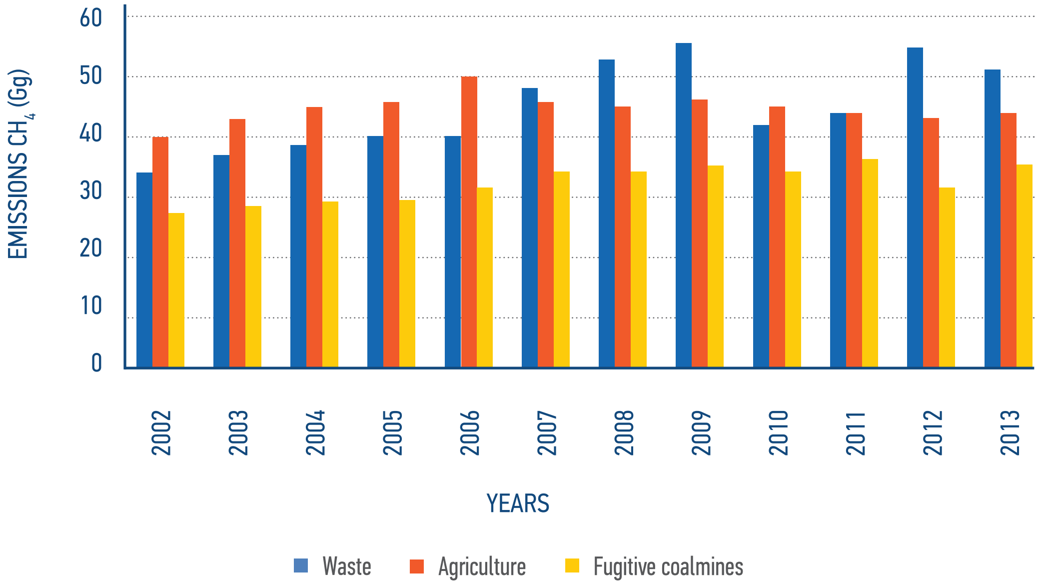


Chart 16: Emissions of methane in the period 2002 – 2013 by sectors
As it may be depicted from the Chart 16, CH4 emissions are slightly changing by years in all sectors.

1.4.3. Emission of nitrous oxide (N_2O)

The principal source of N_2O emissions in Bosnia and Herzegovina is the agriculture sector. Many agriculture activities add nitrogen to soils, thus increasing the available nitrogen for nitrification and de-nitrification, which has an impact on the amount of N_2O emissions. The methodology used here identifies three N_2O emission sources: direct emissions from agricultural soils, emissions from domestic livestock, and indirect emissions caused by agricultural activities. Of these three sources, the largest amount of emissions comes from agricultural soils through soil cultivation and crop farming. This includes the application of synthetic fertilizers, nitrogen from animal manure, legume and soy farming (nitrogen fixation), and nitrogen from crop residues and peat-bog cultivation.

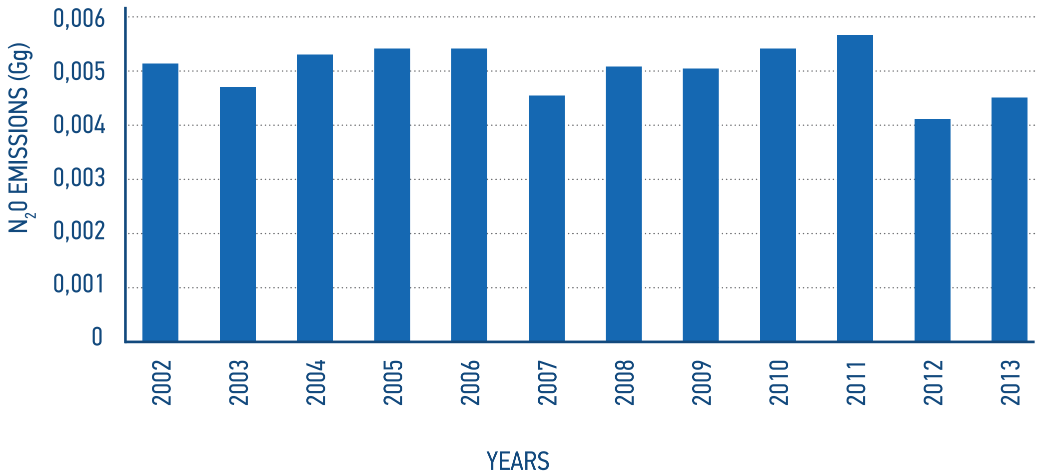


Chart 17: Emissions of N_2O from agriculture soils in the period 2002 – 2013

As it may be seen from the Chart 17, emissions of N_2O from agriculture soils (as the main source of N_2O emissions) slightly changes through years, varying from 4 to 6 Gg. Total N_2O emissions from this category were 4.31 Gg in 2012, and 4.55 Gg in 2013.

1.4.4. Emission of indirect greenhouse gases

Photo-chemically active gases, such as carbon monoxide (CO), nitrogen oxides (NOx) and non-methane volatile organic compounds (NMVOC) 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.

Total emissions of indirect greenhouse gases for period 2002 – 2013 are presented in Charts below.

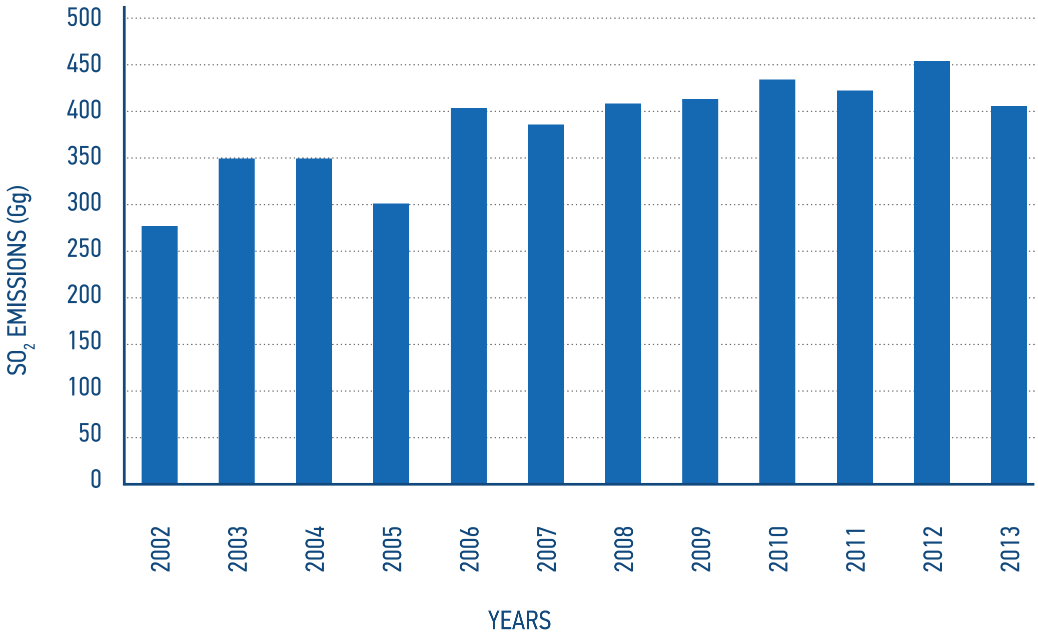


Chart 18: Total SO_2 emissions in the period 2002 – 2013

Emissions of SO_2 are dominant from power production sector. Changes in emissions through years are explained by the changing sulphur content in coal, and changing coal consumption.

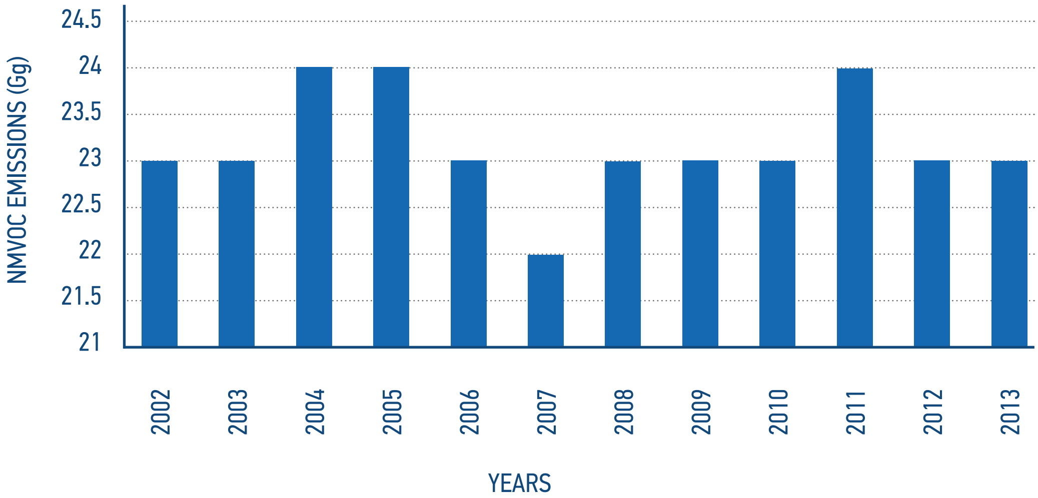


Chart 19: Emissions of NMVOC in the period 2002 --2013

Emissions of NMVOC are mainly generated in transport sector, and only negligible amount in industrial processes due to food and beverage production.

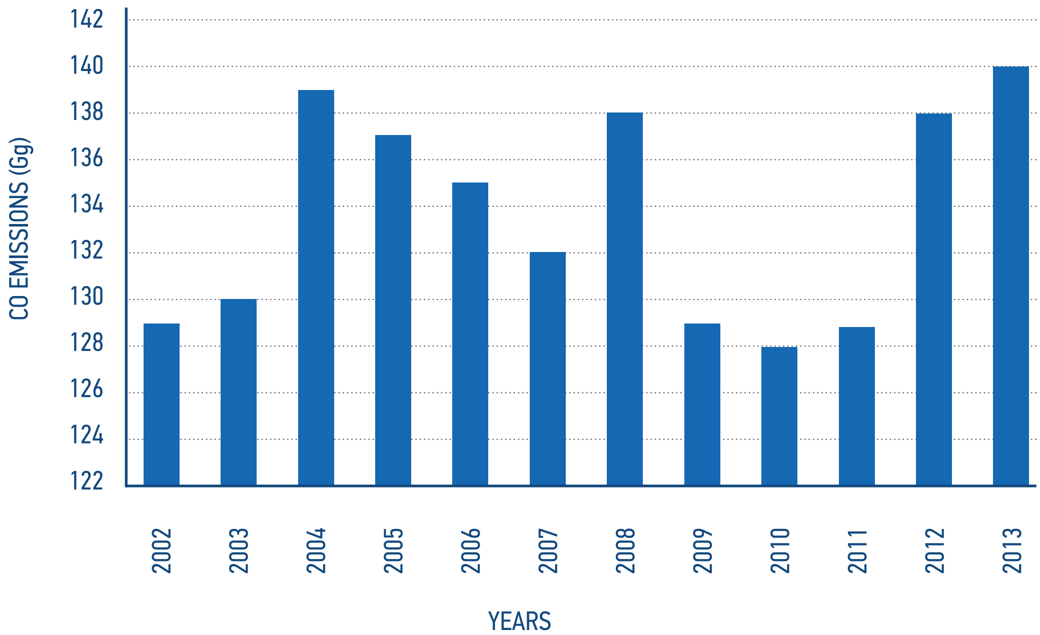


Chart 20: Emissions of CO in the period 2002 – 2013

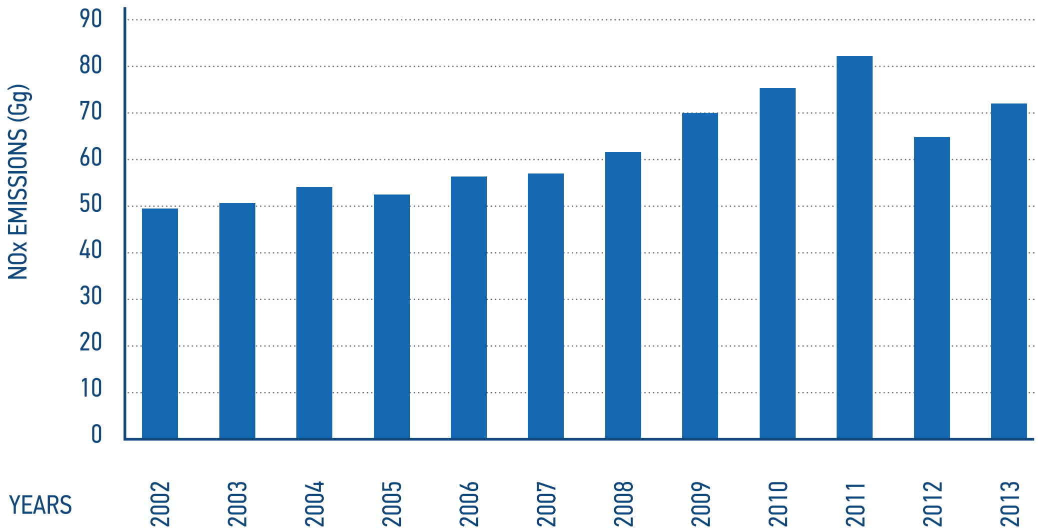


Chart 21: Emissions of NOx in the period 2002 –2013

1.4.5. Emission of F-gases

For calculation of potential bulk halocarbon emission, only data on import of HFC R134a were available for 2010, 2011, and 2012. There are no data on production, export or destroying of F-gases.

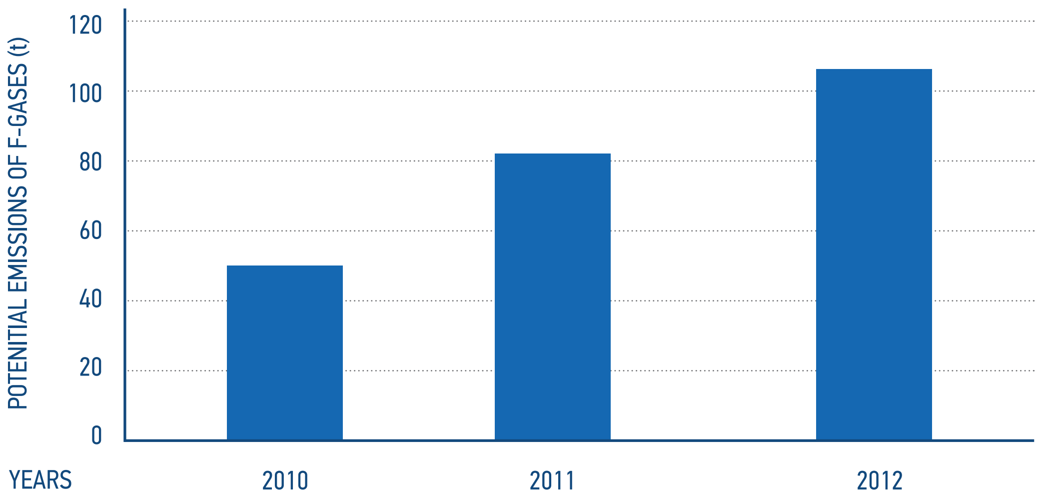


Chart 22: F-gases emissions in 2010, 2011 and 2012

1.5. Key emission sources

The key source emission analyses weren`t performed for each year inventory, but only for the first two (2002, 2003) and last two years (2012, 2013). Emissions in other years have similar values in percentage for selected emission sources. This analysis was performed excluding LULUCF sector.

However, detailed analyses for each year are presented in cumulative excel tables 7A. Key sources (in accordance with Good Practice Guidance 2000-GPG2000) in 2002, 2003, 2012, and 2013 are presented in Table 11 below.

Key category 2002	Gas	CO_2e (Gg)	Level assessment (%)	Cumulative total (%)
1A1 Energy Industries	CO_2	8320	51	**51**
1A3b Road Transportation	CO_2	1955	12	**63**
4D Agricultural Soils	N_2O	1597	10	**73**
1A2 Manufacturing Industries and Construction	CO_2	738	5	**78**
4A Enteric Fermentation	CH_4	738	5	**83**
1B1a Coal Mining (fugitive emissions)	CH_4	569	4	**87**
6A Solid Waste Disposal on Land	CH_4	464	3	**90**
1A4b Residential sector	CO_2	631	4	**94**
2C1 Iron and Steel Production	CO_2	163	1	**95**

Table 11: Key emission sources in 2002

Key category 2003	Gas	CO_2e (Gg)	Level assessment (%)	Cumulative total (%)
1A1 Energy Industries	CO_2	8.556	52	**52**
1A3b Road Transportation	CO_2	2.046	12	**64**
4D Agricultural Soils	N_2O	1.501	9	**73**
4A Enteric Fermentation	CH_4	796	5	**78**
1A2 Manufacturing Industries and Construction	CO_2	681	4	**82**
1B1a Coal Mining (fugitive emissions)	CH_4	595	4	**86**
6A Solid Waste Disposal on Land	CH_4	513	3	**89**
1A4b Residential	CO_2	549	3	**92**
2A1 Cement production	CO_2	356	2	**94**
2C1 Iron and Steel Production	CO_2	182	1	**95**

Table 12: Key emission sources in 2003

Key category 2003	Gas	CO_2e (Gg)	Level assessment (%)	Cumulative total (%)
1A1 Energy Industries	CO_2	10.805	50	**50**
1A3b Road Transportation	CO_2	2.753	13	**63**
4D Agricultural Soils	N_2O	1.335	6	**69**
2C1 Iron and Steel Production	CO_2	1.362	6	**75**
4A Enteric Fermentation	CH_4	808	4	**79**
6A Solid Waste Disposal on Land	CH_4	919	4	**83**
1A2 Manufacturing Industries and Construction	CO_2	735	3	**86**
1B1a Coal Mining (fugitive emissions)	CH_4	645	3	**89**
1A4b Residential	CO_2	973	4	**93**
2A1 Cement production	CO_2	599	3	**96**

Table 13: Key emission sources in 2012

Key category 2013	Gas	CO_2e (Gg)	Level assessment (%)	Cumulative total (%)
1A1 Energy Industries	CO_2	12.450	52	**52**
1A3b Road Transportation	CO_2	2.896	12	**64**
4D Agricultural Soils	N_2O	1.411	6	**70**
1A2 Manufacturing Industries and Construction	CO_2	858	4	**74**
4A Enteric Fermentation	CH_4	814	3	**77**
1B1a Coal Mining (fugitive emissions)	CH_4	735	3	**80**
6A Solid Waste Disposal on Land	CH_4	848	4	**84**
1A4b Residential	CO_2	1.314	5	**89**
2C1 Iron and Steel Production	CO_2	1.392	6	**95**

Table 14: Key emission sources in 2013

Key emission sources were presented by CRF categories and in the tables above. The total amount of emissions from key sources covered approximately 95% of emissions.
A major share of these emissions comes from public electricity and heat production (1.A.1.a), followed by transport (1.A.3.b) agriculture, manufacturing industries and construction, etc.

1.6. Key category analysis

In addition to the key source analysis performed in line with GPG2000, key category analysis is presented below following IPCC GPG LULUCF 2003 in order to include removals as well. The analysis includes both level assessment and trend assessment.

1.6.1. Level assessment

IPCC Source categories code	IPCC Source categories	Direct Greenhouse Gases	Current Year Estimate non-LULUCF	Current Year Estimate LULUCF	Current Year Estimate Absolute Value	Level Assessment without LULUCF	Cumulative Total	Level Assessment with LULUCF	Cumulative Total
SUM			**16170**	**-4.719**	**20889**	**1**		**1**	
1.AA.1	Energy industries	CO_2	8320	0	8.320	0,515	0,515	0,398	0,398
5.A	Changes in forest and other woody biomass stocks	CO_2	0	-4.719	4.719	0	0,515	0,226	0,624
1.AA.3	Fuel combustion - Transport	CO_2	1955	0	1955	0,121	0,635	0,094	0,718
4.D	Agriculture soils	N_2O	1597	0	1597	0,099	0,734	0,076	0,794
1.AA.2	Manufacturing industries and construction	CO_2	738	0	738	0,046	0,780	0,035	0,830
4.A	Enteric fermentation	CH_4	738	0	738	0,046	0,825	0,035	0,865
1.B.1	Fugitive emission from fuels	CH_4	568	0	568	0,035	0,861	0,027	0,892
6.A	Solid waste disposal on land	CH_4	464	0	464	0,029	0,889	0,022	0,914
1.AA.4b	Fuel combustion - Residential	CO_2	365	0	365	0,023	0,912	0,017	0,932
2.A.1	Cement production	CO_2	344	0	344	0,021	0,933	0,016	0,948
6.B	Waste-water handling	CH_4	248	0	248	0,015	0,948	0,012	0,960
1.AA.4c	Fuel combustion - Agriculture	CO_2	202	0	202	0,012	0,961	0,010	0,970
4.B	Manure management	N_2O	200	0	200	0,012	0,973	0,010	0,979
2.C.3	Aluminium production	CO_2	153	0	153	0,009	0,983	0,007	0,987
4.B	Manure management	CH_4	94	0	94	0,006	0,989	0,004	0,991
1.AA.4a	Fuel combustion - Commercial/Institutional	CO_2	67	0	67	0,004	0,993	0,003	0,994
2.A.2	Lime production	CO_2	22	0	22	0,001	0,994	0,001	0,995
2.C.1	Iron and steel production	CO_2	9	0	9	0,001	0,995	0,000	1,000

Table 15: Key category level assessment – Year 2002

IPCC Source categories code	IPCC Source categories	Direct Greenhouse Gases	Current Year Estimate non-LULUCF	Current Year Estimate LULUCF	Current Year Estimate Absolute Value	Level Assessment without LULUCF	Cumulative Total	Level Assessment with LULUCF	Cumulative Total
SUM			**16437**	**-4.988**	**21425**	**1**		**1**	
1.AA.1	Energy industries	CO_2	8556	0	8.556	0,521	0,521	0,399	0,399
5.A	Changes in forest and other woody biomass stocks	CO_2	0	-4.988	4.988	0	0,521	0,233	0,632
1.AA.3.b	Fuel combustion - Road Transportation	CO_2	2023	0	2023	0,123	0,644	0,094	0,727
4.D	Agriculture soils	N_2O	1502	0	1502	0,091	0,735	0,070	0,797
4.A	Enteric fermentation	CH_4	796	0	796	0,048	0,783	0,037	0,834
1.AA.2	Manufacturing industries and construction	CO_2	681	0	681	0,041	0,825	0,032	0,866
1.B.1	Fugitive emission from coal mining	CH_4	595	0	595	0,036	0,861	0,028	0,893
6.A	Solid waste disposal on land	CH_4	513	0	513	0,031	0,892	0,024	0,917
6.B	Waste-water handling	CH_4	345	0	345	0,021	0,913	0,016	0,933
2.A.1a	Cement production	CO_2	325	0	325	0,020	0,933	0,015	0,949
1.AA.4b	Fuel combustion - Residential	CO_2	288	0	288	0,018	0,950	0,013	0,962
4.B	Manure management	N_2O	212		212	0,013	0,963	0,010	0,9719
1.AA.4c	Fuel combustion - Agriculture/ Forestry/Fishing	CO_2	206		206	0,013	0,976	0,010	0,982
2.C.3	Aluminium production	CO_2	169	0	169	0,010	0,986	0,008	0,989
4.B	Manure management	CH_4	101	0	101	0,006	0,992	0,005	0,994
1.AA.4a	Fuel combustion - Commercial/Institutional	CO_2	53	0	53	0,003	0,996	0,002	0,997
2.A.1b	Lime production	CO_2	30	0	30	0,002	0,997	0,001	0,998
1.AA.3.a	Fuel combustion - Civil aviation	CO_2	23	0	23	0,001	0,999	0,001	0,999
2.C.1	Iron and steel production	CO_2	13	0	13	0,001	1,000	0,0006	1,000

Table 16: Key category level assessment – Year 2003

IPCC Source categories code	IPCC Source categories	Direct Greenhouse Gases	Current Year Estimate non-LULUCF	Current Year Estimate LULUCF	Current Year Estimate Absolute Value	Level Assessment without LULUCF	Cumulative Total	Level Assessment with LULUCF	Cumulative Total
SUM			**21816**	**-7.546**	**29363**	**1**		**1**	
1.AA.1	Energy industries	CO_2	10805	0	10.805	0,495	0,495	0,368	0,368
5.A	Changes in forest and other woody biomass stocks	CO_2	0	-7.546	7.546	0	0,495	0,257	0,625
1.AA.3.b	Fuel combustion - Road Transportation	CO_2	2742	0	2742	0,126	0,621	0,093	0,718
4.D	Agriculture soils	N_2O	1335	0	1335	0,061	0,682	0,045	0,764
2.C.1	Iron and steel production	CO_2	1054	0	1054	0,048	0,730	0,036	0,800
6.A	Solid waste disposal on land	CH_4	919	0	919	0,042	0,773	0,031	0,831
4.A	Enteric fermentation	CH_4	808	0	808	0,037	0,810	0,028	0,859
1.AA.2	Manufacturing industries and construction	CO_2	735	0	735	0,034	0,843	0,025	0,884
1.B.1.a	Fugitive emission from solid fuels - coal mining	CH_4	645	0	645	0,030	0,873	0,022	0,906
1.AA.4b	Fuel combustion - Residential	CO_2	509	0	509	0,023	0,896	0,017	0,923
1.AA.3.a	Fuel combustion - Commercial/Institutional	CO_2	447	0	447	0,020	0,917	0,015	0,938
6.B	Waste-water handling	CH_4	329	0	329	0,015	0,932	0,011	0,949
2.A.1	Cement production	CO_2	315	0	315	0,014	0,946	0,011	0,960
2.A.2	Lime production	CO_2	285	0	285	0,013	0,959	0,010	0,970
2.C.3	Aluminium production	CO_2	239	0	239	0,011	0,970	0,008	0,978
4.B	Manure management	N_2O	221	0	221	0,010	0,980	0,008	0,985
2.B	Chemical Industry	N_2O	217	0	217	0,010	0,990	0,007	0,993
4.B	Manure management	CH_4	103	0	103	0,005	0,995	0,004	0,996
2.C.2	Ferroalloys production	CO_2	68	0	68	0,003	0,998	0,002	0,999
1.AA.3.c	Fuel combustion - Agriculture/ Forestry/Fishing	CO_2	17	0	17	0,0008	0,999	0,0006	0,999
1.AA.3.a	Fuel combustion - Civil aviation	CO_2	12	0	12	0,001	0,999	0,0004	1,000
1.B.2.b	Fugitive emission from oil and natural gas - natural gas	CH_4	12	0	12	0,0006	1,000	0,0004	1,000

Table 17: Key category level assessment – Year 2012

IPCC Source catego-ries code	IPCC Source categories	Direct Greenhouse Gases	Current Year Estimate non-LULUCF	Current Year Estimate LULUCF	Current Year Estimate Absolute Value	Level Assessment without LULUCF	Cumulative Total	Level Assessment with LULUCF	Cumulative Total
SUM			**24028**	**-6.141**	**30169**	**1**		**1**	
1.AA.1	Energy industries	CO_2	12450	0	12.450	0,518	0,518	0,413	0,413
5.A	Changes in forest and other woody biomass stocks	CO_2	0	-6.141	6.141	0	0,518	0,204	0,616
1.AA.3.b	Fuel combustion - Road transportation	CO_2	2885	0	2885	0,120	0,638	0,096	0,712
4.D	Agriculture soils	N_2O	1411	0	1411	0,059	0,697	0,047	0,759
2.C.1	Iron and steel production	CO_2	1085	0	1085	0,045	0,742	0,036	0,795
1.AA.4.b	Fuel combustion - Residential	CO_2	613	0	613	0,026	0,768	0,020	0,815
1.AA.2	Manufacturing industries and construction	CO_2	858	0	858	0,036	0,803	0,028	0,843
6.A	Solid waste disposal on land	CH_4	848	0	848	0,035	0,839	0,028	0,871
4.A	Enteric fermentation	CH_4	814	0	814	0,034	0,872	0,027	0,898
1.B.1	Fugitive emission from solid fuels - coal mining	CH_4	735	0	735	0,031	0,903	0,024	0,923
1.AA.4.a	Fuel combustion - Commercial/Institutional	CO_2	670	0	670	0,028	0,931	0,022	0,945
2.A.1.a	Cement production	CO_2	331	0	331	0,014	0,945	0,011	0,956
6.B	Waste-water handling	CH_4	327	0	327	0,014	0,958	0,011	0,967
2.A.1.b	Lime production	CO_2	275	0	275	0,011	0,970	0,009	0,976
2.C.2	Aluminium production	CO_2	236	0	236	0,010	0,980	0,008	0,984
4.B	Manure management	N_2O	227		227	0,009	0,989	0,008	0,991
2.C.3	Manure management	CH_4	103	0	103	0,004	0,993	0,003	0,995
1.AA.4.c	Ferroalloys production	CO_2	71	0	71	0,003	0,996	0,002	0,997
4.B	Chemical Industry	N_2O	42	0	42	0,002	0,998	0,001	0,998
1.AA.3.a	Fuel combustion - Agriculture/ Forestry/Fishing	CO_2	30	0	30	0,001	0,999	0,001	0,999
2.B	Fuel combustion - Civil aviation	CO_2	11	0	11	0,0005	1,000	0,0004	1,000

Table 18: Key category level assessment – Year 2013

1.6.2. Trend assessment

IPCC Source categories code	IPCC Source categories	Direct Greenhouse Gases	Base Year Estimate	Current Year Estimate	Trend Assessment	% Contribution to Assessment	Cumulative Total
SUM			**26.620**	**11451**	**0,264**	**1**	
1.AA.1	Energy industries	CO_2	16.510	8.320	0,046	0,173	0,173
5.A	Changes in forest and other woody biomass stocks	CO_2	-7.424	-4.719	0,057	0,217	0,390
1.AA.3	Fuel combustion - Transport	CO_2	2,358	1,955	0,035	0,134	0,523
4.D	Agriculture soils	N_2O	2,378	1,597	0,022	0,082	0,605
1.AA.2	Manufacturing industries and construction	CO_2	535	738	0,019	0,072	0,677
4.A	Enteric fermentation	CH_4	1,548	738	0,003	0,010	0,687
1.B.1	Fugitive emission from fuels	CH_4	1,597	568	0,004	0,017	0,704
6.A	Solid waste disposal on land	CH_4	992	464	0,001	0,005	0,709
1.AA.4b	Fuel combustion - Other sectors	CO_2	3,889	634	0,039	0,148	0,857
2.A.1	Mineral production	CO_2	737	366	0,002	0,007	0,864
6.B	Waste-water handling	CH_4	0	248	0,000	0,000	0,864
2.C.3	Metal production	CO_2	2,603	162	0,036	0,136	1,000
4.B	Manure management	CH_4	682	294	0,000	0,000	1,000

Table 19: Trend Assessment – Year 2002

IPCC Source categories code	IPCC Source categories	Direct Greenhouse Gases	Base Year Estimate	Current Year Estimate	Trend Assessment	% Contribution to Assessment	Cumulative Total
SUM			**26620**	**11449**	**0,287**	**1**	
1.AA.1	Energy industries	CO_2	16.510	8,556	0,055	0,190	0,190
5.A	Changes in forest and other woody biomass stocks	CO_2	-7.424	-4,988	0,067	0,235	0,425
1.AA.3	Fuel combustion - Transport	CO_2	2,358	2,046	0,039	0,135	0,560
4.D	Agriculture soils	N_2O	2,378	1,502	0,018	0,063	0,623
4.A	Enteric fermentation	CH_4	1,548	796	0,005	0,017	0,699
1.AA.2	Manufacturing industries and construction	CO_2	535	681	0,017	0,059	0,682
1.B.1	Fugitive emission from fuels	CH_4	1,597	595	0,003	0,012	0,711
6.A	Solid waste disposal on land	CH_4	992	513	0,003	0,011	0,722
1.AA.4b	Fuel combustion - Other sectors	CO_2	3,889	547	0,042	0,147	0,870
2.A.1	Mineral production	CO_2	737	355	0,001	0,005	0,875
6.B	Waste-water handling	CH_4	0	345	0,000	0,000	0,875
2.C.3	Metal production	CO_2	2.603	182	0,035	0,123	0,997
4.B	Manure management	CH_4	682	313	0,001	0,003	1,000

Table 20: Trend assessment – Year 2003

IPCC Source categories code	IPCC Source categories	Direct Greenhouse Gases	Base Year Estimate	Current Year Estimate	Trend Assessment	% Contribution to Assessment	Cumulative Total
SUM			**26,620**	**14,270**	**0,358**	**1**	
1.AA.1	Energy industries	CO_2	16,510	10,805	0,073	0,205	0,205
5.A	Changes in forest and other woody biomass stocks	CO_2	-7.424	-7.546	0,134	0,375	0,580
1.AA.3	Fuel combustion - Transport	CO_2	2,358	2,754	0,056	0,156	0,736
4.D	Agriculture soils	N_2O	2,378	1,335	0,002	0,006	0,743
1.AA.2	Manufacturing industries and construction	CO_2	535	735	0,017	0,047	0,790
4.A	Enteric fermentation	CH_4	1,548	808	0,001	0,002	0,792
1.B.1	Fugitive emission from fuels	CH_4	1,597	657	0,007	0,021	0,813
6.A	Solid waste disposal on land	CH_4	992	919	0,015	0,041	0,854
1.AA.4b	Fuel combustion - Other sectors	CO_2	3,889	973	0,042	0,117	0,970
2.A.1	Mineral production	CO_2	737	600	0,008	0,022	0,992
6.B	Waste-water handling	CH_4	0	329	0,000	0,000	0,992
2.C.3	Metal production	CO_2	2,603	1,361	0,001	0,004	0,996
4.B	Manure management	CH_4	682	324	0,002	0,004	1,000

Table 21: Trend Assessment – Year 2012

IPCC Source categories code	IPCC Source categories	Direct Greenhouse Gases	Base Year Estimate	Current Year Estimate	Trend Assessment	% Contribution to Assessment	Cumulative Total
SUM			**26,620**	**17,887**	**0,269**	**1**	
1.AA.1	Energy industries	CO_2	16,510	12,450	0,051	0,190	0,190
5.A	Changes in forest and other woody biomass stocks	CO_2	-7,424	-6,141	0,043	0,161	0,351
1.AA.3	Fuel combustion - Transport	CO_2	2,358	2,896	0,049	0,184	0,534
4.D	Agriculture soils	N_2O	2,378	1,411	0,007	0,026	0,561
1.AA.2	Manufacturing industries and construction	CO_2	535	858	0,019	0,070	0,630
4.A	Enteric fermentation	CH_4	1,548	814	0,009	0,032	0,662
1.B.1	Fugitive emission from fuels	CH_4	1,597	735	0,013	0,047	0,709
6.A	Solid waste disposal on land	CH_4	992	848	0,007	0,025	0,735
1.AA.4b	Fuel combustion - Other sectors	CO_2	3,889	1,313	0,049	0,182	0,917
2.A.1	Mineral production	CO_2	737	606	0,004	0,016	0,932
6.B	Waste-water handling	CH_4	0	327	0,000	0,000	0,932
2.C.3	Metal production	CO_2	2,603	1,392	0,013	0,050	0,982
4.B	Manure management	CH_4	682	330	0,005	0,018	1,000

Table 22: Trend Assessment – Year 2013

1.6.3. Key category analysis summary

Quantitative Method Used for Key Category Analysis:		Tier 1		
IPCC Source/Sink Category	**Direct Greenhouse Gas**	**Key Category Flag**	**Criteria for Identification**	**Comments**
Energy industries	CO_2	YES	Level/Trend	
Changes in forest and other woody biomass stocks	CO_2	YES	Level/Trend	
Fuel combustion – Transport	CO_2	YES	Level/Trend	
Agriculture soils	N_2O	YES	Level/Trend	
Manufacturing industries and construction	CO_2	YES	Level/Trend	
Enteric fermentation	CH_4	YES	Level/Trend	
Fugitive emission from fuels	CH_4	YES	Level/Trend	
Solid waste disposal on land	CH_4	YES	Level/Trend	
Fuel combustion – Residential	CO_2	YES	Level/Trend	
Cement production	CO_2	YES	Level/Trend	Trend assessment included mineral production in total, because there were no data on solely cement production for the base year 1990
Waste-water handling	CH_4	YES	Level/Trend	

Table 23: Key category analysis summary – Year 2002

Quantitative Method Used for Key Category Analysis:		Tier 1		
IPCC Source/Sink Category	Direct Greenhouse Gas	Key Category Flag	Criteria for Identification	Comments
Energy industries	CO_2	YES	Level/Trend	
Changes in forest and other woody biomass stocks	CO_2	YES	Level/Trend	
Fuel combustion – Road Transportation	CO_2	YES	Level/Trend	
Agriculture soils	N_2O	YES	Level/Trend	
Enteric fermentation	CH_4	YES	Level/Trend	
Manufacturing industries and construction	CO_2	YES	Level/Trend	
Fugitive emission from coal mining	CH_4	YES	Level/Trend	
Solid waste disposal on land	CH_4	YES	Level/Trend	
Waste-water handling	CH_4	YES	Level/Trend	
Cement production	CO_2	YES	Level/Trend	Trend assessment included mineral production in total, because there were no data on solely cement production for the base year 1990
Fuel combustion – Residential	CO_2	YES		

Table 24: Key category analysis summary – Year 2003

Quantitative Method Used for Key Category Analysis:		Tier 1		
IPCC Source/Sink Category	Direct Greenhouse Gas	Key Category Flag	Criteria for Identification	Comments
Energy industries	CO_2	YES	Level/Trend	
Changes in forest and other woody biomass stocks	CO_2	YES	Level/Trend	
Fuel combustion – Road Transportation	CO_2	YES	Level/Trend	
Agriculture soils	N_2O	YES	Level/Trend	
Iron and steel production	CO_2	YES	Level/Trend	
Solid waste disposal on land	CH_4	YES	Level/Trend	
Enteric fermentation	CH_4	YES	Level/Trend	
Manufacturing industries and construction	CO_2	YES	Level/Trend	
Fugitive emission from solid fuels – coal mining	CH_4	YES	Level/Trend	
Fuel combustion – Residential	CO_2	YES	Level/Trend	
Fuel combustion – Commercial/ Institutional	CO_2	YES	Level/Trend	
Waste-water handling	CH_4	YES	Level/Trend	
Cement production	CO_2	YES	Level/Trend	Trend assessment included mineral production in total, because there were no data on solely cement production for the base year 1990

Table 25: Key category analysis summary – Year 2012

Quantitative Method Used for Key Category Analysis:		Tier 1		
IPCC Source/Sink Category	**Direct Greenhouse Gas**	**Key Category Flag**	**Criteria for Identification**	**Comments**
Energy industries	CO_2	YES	Level/Trend	
Changes in forest and other woody biomass stocks	CO_2	YES	Level/Trend	
Fuel combustion – Road Transportation	CO_2	YES	Level/Trend	
Agriculture soils	N_2O	YES	Level/Trend	
Iron and steel production	CO_2	YES	Level/Trend	
Fuel combustion – Residential	CO_2	YES	Level/Trend	
Manufacturing industries and construction	CO_2	YES	Level/Trend	
Solid waste disposal on land	CH_4	YES	Level/Trend	
Enteric fermentation	CH_4	YES	Level/Trend	
Fugitive emission from solid fuels – coal mining	CH_4	YES	Level/Trend	
Fuel combustion – Commercial/ Institutional	CO_2	YES	Level/Trend	
Cement production	CO_2	YES	Level/Trend	Trend assessment included mineral production in total, because there were no data on solely cement production for the base year 1990

Table 26: Key category analysis summary – Year 2013

1.7. Uncertainty estimate of calculations

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

There are many reasons why actual emissions and sinks may differ from the value calculated in the inventory. Some sources of uncertainty may generate well-defined, easily characterised estimates of the range of potential error, as opposed to other sources of uncertainty, which may be much more difficult to define. Total estimated uncertainty of emissions from individual sources is a combination of the individual uncertainties of two elements of emission calculations:

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

1.7.1. Uncertainty in calculation of CO_2 emissions

CO_2 emissions from fuel combustion depend on the quantity of fuel consumed (energy balance), its calorific value (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 Institutes of Statistics of Federation of BiH and Republika Srpska 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 used only for years 2012 and 2013, since they started to be published by statistical agency in 2012. However, emission by reference and sectoral approach differs in more than 3.000 Gg, because of coal classification, as explained earlier in the text. Considering all given circumstances, the estimated total uncertainty for the energy sector data is from 7-10%, depending on fuel (see Table 27).

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 un-oxidised 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 recommendations from 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), because the records for natural gas consumption were of sufficient quality.

Source category / GHG	Uncertainty of activity data (%)	Uncertainty of emission factors (%)	Total uncertainty (%)
Fuel combustion – coal, CO_2	±8	±6	**±10**
Fuel combustion – liquid fuels, CO_2	±12	±5	**±13**
Fuel combustion – natural gas, CO_2	±5	±5	**±7**

Table 27: Estimated uncertainty in the calculation of CO_2 emissions for period 2002 - 2013

1.7.2. 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. Verification identifies flaws in calculations that indicate which parts of the inventory need to be improved, which indirectly leads to the improvement of the inventory`s quality.

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

- Activity data were taken from from various sources, with the additional data checks and additional analysis;
- Emission factors were used in accordance with 1996 IPCC Guidelines.

Verification through Reference approach could not be done, because of different coal classification used in statistics and in IPCC methodology (used for sectoral approach). Reference approach did not include import and export of coals, because of impossibility to obtain correct data for certain coal types, as already explained above in the text. However, comparison of emission presented by Reference approach prepared by GHG inventory team was compared to IEA[26] emission estimation, and it is presented in the Table 28 below.

	2012 BiH	2012 IEA	2013 BiH	2013 IEA
Reference Approach	**19,36**	**21,65**	**19,02**	**21,50**

Table 28: Comparison of calculations (Reference approach) – Gg CO_2

The difference between calculations for year 2012 is 11%, and the difference for the year 2013 is 13%.

The Inventory team is also in the process of preparation of the Inventory using COLLECTER software, which will in another way verify these calculations, and vice versa.

1.8. Recommendations for future improvement

1.8.1. General

In order to develop a sustainable system for the estimation of greenhouse gas emissions and their elimination in the long-term, it is recommended to revise relevant environmental and air protection laws in accordance with general requirements of the Directive (EU) no. 525/2013 on a mechanism for monitoring and reporting GHG emissions in order to stipulate preparation and enforcement of secondary legislation which shall primarily establish mandatory data flow system between competent authorities with clear responsibilities and timing. Secondly, it is recommended to establish clear connection between QA/QC Program, QA/QC Plan (which has yet to be developed) and capacity building and training needs for GHG inventory team in order to focus on those parts of GHG inventory, IT applications and databases and methodological issues which are critical. Finally, it is recommended to develop alternative calculation methods (see IPCC GPG, section 7) based on expert judgment, drivers and/or cluster analysis in cases when emission sources or sinks have occurred but activity data could not be obtained. Suggestion is also to harmonize data of statistical methodology with IPCC methodology requirements to the extent to which the methodological requirements of the IPCC coincide with the requirements and standards of the relevant statistical methodology.

1.8.2. General recommendations

- Strengthening capacity of institutions in charge of developing greenhouse gas inventory;
- Delineation of institutional responsibility for the systematic compilation of the National GHG Inventory;
- Capacity building in the statistical offices both on state and entity level in collection of data needed for GHG Inventor compilation;
- Institutional budgeting for activity data collection, emission data calculation, compilation of the Inventory, training of personnel, QA/QC procedures; and
- Authorizing relevant institutions at all levels to be responsible for GHG Inventory compilation (data providers, data collectors and inventory compilers).

[26] *Web page of the International Energy Agency, indicators for Bosnia and Herzegovina for 2012: http://www.iea.org/statistics/statisticssearch/report/?country=BOSNIAHERZ&product=Indicators&year=2012*

1.8.3. Specific recommendations

- Statistical data published officially, along with background documents in statistical offices should be in line with requirements of the IPCC methodology, preferably 2006 Guidelines;
- The reporting system must be in line with the most recently developed IPCC Guidelines (i.e. moving from the 1996 IPCC Guidelines to 2006 IPCC Guidelines);
- The system should be multifunctional, making it possible to report under different conventions with a single centralized data collection, and it is therefore necessary to establish a comprehensive Register of polluters and pollutants (e.g. Collecter database, PRTR, etc.);
- Inventory compilers must have access to all data necessary for the emission calculation and inventory compilation;
- Data on mineral fertilizers` consumption have to be easily available;
- Data for calculation of local emission factors for different coal types have to be available, i.e. detailed coal analyses have to be submitted by operators to the inventory compilers;
- PRTR has to be established and operational;
- Forestry inventory has to be established;
- Several landfills have to have data on waste composition, in order to extrapolate it on the state level, which would enable calculation of reliable degradable organic content (DOC), to move forward from using the default one;
- More detailed analyses should be undertaken of waste water discharge system all over the country;
- Inventory compilers should try to move to more complex (Tier 2) methods to calculate emissions, especially for key categories;
- Development of local emission factors for specific energy sources, especially for coal.
- In case of FBiH, Federal Hydrometeorological Service should be designated as the institutions responsible for GHG inventory of the FBiH
- Strenghten the capacities of both hydrometeorological services, by increasing the number of employees and their professional capacities.

1.8.4. Training needs

Inventory compilers, statistical offices staff, and other relevant stakeholders (industry/operators, institutions managing registers, reference centres performing verification and validation of emission data, etc.) have to undergo a series of capacity building trainings in order to be able to compile and verify inventory data. Issues to be covered by these trainings include, but are not limited to the following:

- Development of the 2006 IPCC Guidelines and reference to earlier IPCC Guidelines;
- Guidance on good practice elements
  - Approaches do data collection;
  - Uncertainty analysis;
  - Methodological choice and key category analysis;
  - Time series consistency;
  - QA/QC and documentation;

- Estimation of emissions following the UNFCCC and UNECE/LRTAP guidebooks and in accordance with the relevant reporting guidelines;
- Training on monitoring, verification, and reporting (MVR) system;
- Organize regular workshops/trainings/seminars to inform and train the users about updates of methodology, tools, software, procedures, etc.;
- Industry/operators have to receive training on PRTR reporting.

2. CHAPTER SENSITIVITY AND CLIMATE CHANGE ADAPTATION IN BiH

The previous two national communications of Bosnia and Herzegovina under the UNFCCC have determined a strong climate change impact in the most sensitive sectors but they have also defined possibilities of adaptation. Climate change and increased frequency and intensity of extreme climate events have caused increased pressure in the sectors of agriculture, water management, health, forestry and tourism, as well as in management of water resources and protected areas. There was an increase in variability in weather conditions, recorded in all seasons, with the rapid changes occurring during short periods (five to ten days) from the extremely cold to warm weather, or from the period of extremely large amounts of precipitation to extreme drought periods. In the last two decades, Bosnia and Herzegovina has been facing with several significant extreme climate and weather episodes that have caused substantial material and financial deficits, as well as casualties. The two most important events are drought during 2012 and flooding during 2014.

According to the Global Adaptation Index (GAIN Index[27]) for 2014, Bosnia and Herzegovina ranks 84th in the world and it is the penultimate in Europe, according to the vulnerability and preparedness to response to climate change.According to the Global Risk Index (GRI[28]), during 2014, BiH ranked third in the world in terms of vulnerability, when it was hit by intense and prolonged rainfall, which caused the most disastrous flooding ever since records began 120 years ago (https://germanwatch.org/en/download/13503.pdf).

The Chapter Sensitivity and adaptation consists of three parts. The first part (3.1) treats the observed climate change in Bosnia and Herzegovina, based on meteorological data measured on meteorological stations. The second part (3.2) presents the expected climate change under climate scenarios RCP8.5, A2 and A1. Analysis of the impact by the most vulnerable sectors and possibilities of adaptation is included in the third section (3.3).

2.1. Observed climate change

For the analysis of climate change and variability of air temperatures and precipitation in Bosnia and Herzegovina available data sets from meteorological stations have been used, with a homogeneous series of observations and which represent the relevant mesoclimate regions in the geographic territory of BiH. This report analyzes the linear trends in annual and seasonal values of air temperatures and precipitation for the period 1961-2014.

2.1.1. Changes in air temperature

Analysis of meteorological data from the period 1961 – 2014 show that the mean annual temperature maintains a continuous rise. In the analysis of multi-year series of data (1961 – 2014) by years, a positive linear trend was observed in mean annual temperature, which is especially pronounced in the past 30 years, since 1982. As for the aforementioned series, trends in annual temperatures on all analyzed stations are statistically significant, while the changes are more pronounced in the continental part. The increase in annual air temperature ranges from 0.4 to 1.0°C, while the increase in temperature during the growing season (April –September) even reaches 1,0°C. However, increases in air temperature over the last fourteen years are even more pronounced. It must be emphasized that the increase in temperature, in addition to increases in GHG emissions, is caused by a more pronounced effect of the urban heat island.

[27]Web page of GAIN Index: http://index.gain.org/
[28]Kreft et al, 2016: Global Climaet Risk Index 2016 - Who Suffers Most From Extreme Weather Events? weather-related Loss Events in 2014 and 1995 to 2014, Available at: https://germanwatch.org/en/download/13503.pdf

	Doboj	Banja Luka	Bijeljina	Sokolac	Trebinje	Mostar	Bjelašnica	Tuzla	Sarajevo	Zenica
max 2001-2014	12,73	13,07	13,10	8,82	15,52	16,17	2,46	12,03	11,70	12,58
min 2001-2014	10,40	10,71	11,13	6,55	13,90	14,58	0,63	9,65	9,14	10,25
mean 2001-2014	11,77	12,12	12,39	7,75	14,95	15,67	1,78	11,15	10,62	11,45
max 1961-2014	12,73	13,07	13,10	8,82	15,52	16,21	2,46	12,03	11,70	12,58
min 1961-2014	9,60	9,72	9,88	5,03	13,00	13,63	0,47	8,24	8,68	9,31
mean 1961-2014	11,02	11,12	11,44	6,88	14,33	14,97	1,41	10,32	9,95	10,57
max 1981-2010	12,45	12,82	13,10	8,39	15,52	16,21	2,28	11,98	11,27	11,87
min 1981-2010	10,07	10,18	9,95	5,34	13,38	14,08	0,47	8,24	8,92	9,51
mean 1981-2010	11,15	11,41	11,65	7,10	14,37	15,17	1,51	10,37	10,06	10,73
max 1961-1990	11,45	11,66	12,30	7,51	15,15	15,59	2,14	10,83	10,42	11,10
min 1961-1990	9,60	9,72	9,88	5,03	13,00	13,63	0,48	9,06	8,68	9,31
mean 1961-1990	10,63	10,58	10,93	6,38	14,03	14,58	1,23	10,02	9,55	10,15

Table 29: Changes in air temperature in Bosnia and Herzegovina, period 1961 – 2014

In all analyzed meteorological stations the biggest difference between the reference period from 1961 to1990 and the other two analyzed periods from 1981 to 2010 and from 2000 to 2014 is mainly pronounced in the summer period of the year (JJA). Differences between the reference period from 1961 to 1990 and the period from 1981to 2010 range from 1.9 in Sarajevo to 0.8°C in Tuzla. The differences between the reference period from 1961 to 1990 and the period from 2000 to 2014 are significantly higher than in the period from 1981 to 2010, and they range from 2.7 in Sarajevo to 1.5°C on Bjelašnica. Positive deviations are evident for the spring and fall seasons, as well as for the growing period in all meteorological stations. Annually, the differences between the aforementioned periods are positive –in all meteorological stations there is an evident increase in temperatures. The increase in mean annual temperatures ranged from +0.02 on Bjelašnica and in Sarajevo to +0.03 in Livno, mainly due to the increase in the maximum temperatures with the trend of +0.07 in Livno to +0.03 on Bjelašnica.

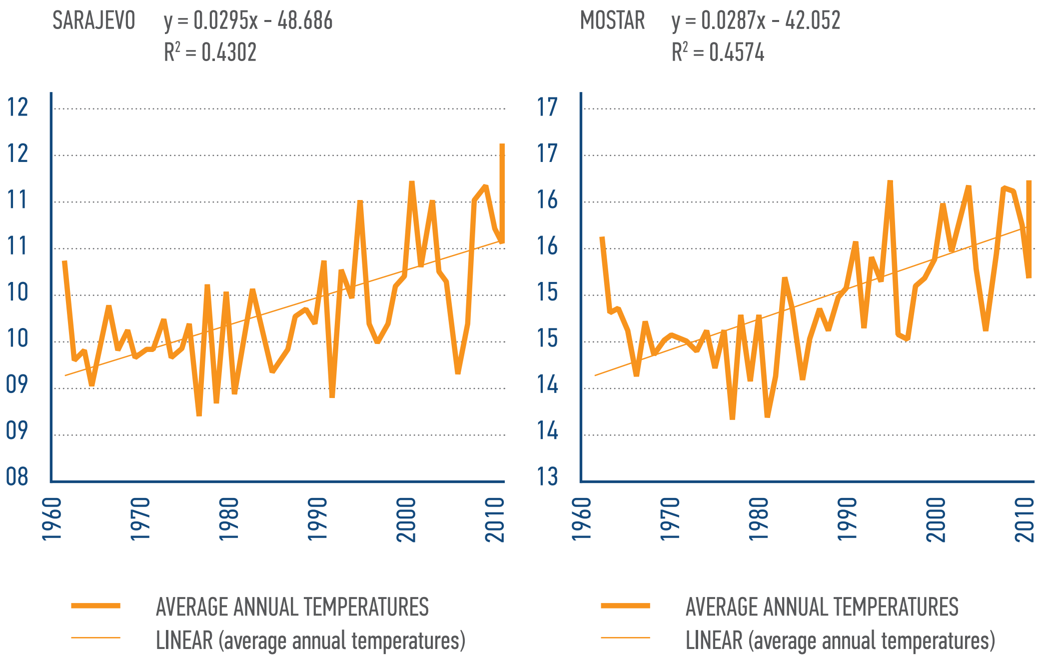


Chart 23: Trends of air temperature changes in Bosnia and Herzegovina

In the analyzed period, all indices of warm temperature extremes have positive trends, while indices of cold temperature extremes have negative trends. The most significant change in this period was observed in the number of cold days (FD) and the number of warm days (SU). In all the meteorological stations the number of cold days (FD) has a negative trend. In the central mountain areas the number of cold days has decreased by 4 days per 10 years, while in the south of the country the decrease is slightly less and it ranges around 2 days per 10 years. Number of warm days (SU) has a positive trend and it is statistically significant. The increase in the number of warm days ranges from 7 days in Livno to 3 days in Mostar and Banja Luka per 10 years. Number of cold nights (Tn10%) and cold days (Tx10%) has a negative trend, but not significant one and at all stations it is in decline by 1 to 2 days per 10 years. Number of warm nights (Tn90%) and warm days (Tn90%) have a statistically significant positive trend and they rise from 3 to 5 days per 10 years. The analysis of the index of temperature extremes confirms the increasing frequency of extreme maximum temperatures, whereas the frequency of extreme minimum temperatures is lower. This certainly contributes to the aforementioned positive trend of mean air temperatures both annually and seasonally.

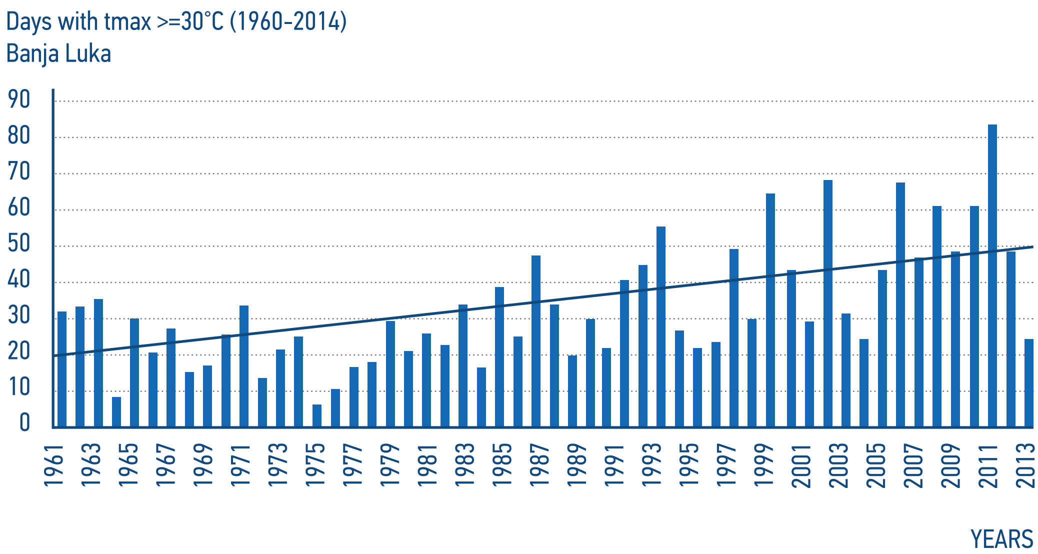


Chart 24:. Changes in number of tropical days in Banja Luka

2.1.2. Variability in precipitation

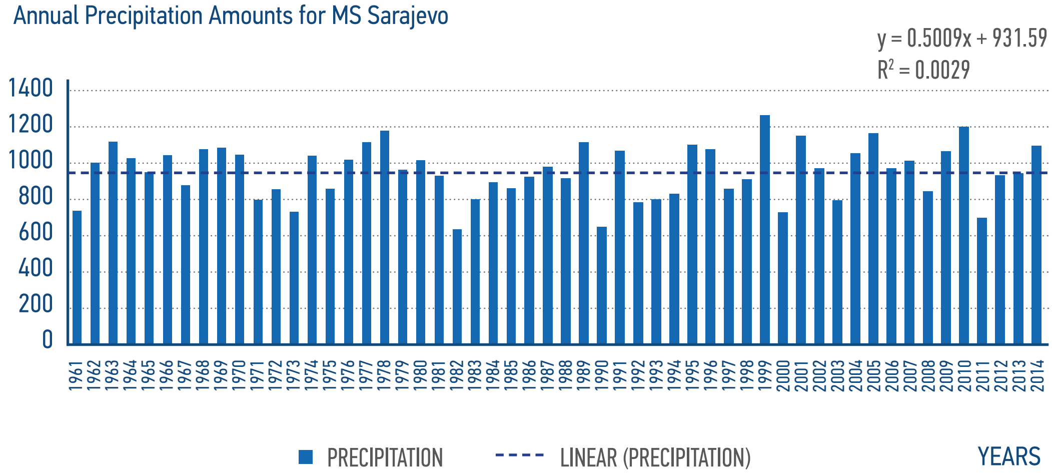
In recent years there has been a pronounced impact of climate change on rainfall regime with the consequences on water resources. The consequences of these changes are reflected in the distribution of rainfall during the year. For the analysis of rainfall, monthly and annual amounts were used, different quintiles of daily rainfall, number of rainy days for a multi-year series from 1961-2014. In the period from 1961 to 2014 most of the territory of Bosnia and Herzegovina was characterized by a slight increase in the amount of rainfall annually. Linear trends for multi-year period from 1961 to 2014 indicate stagnation or a slight increase in the amount of rainfall on the entire territory of Bosnia and Herzegovina. Changes in the amount of rainfall are more pronounced by seasons than annually. The rainfall trend by seasons is different. In the central part it is negative during spring and summer (the most pronounced in the area of Herzegovina – up to 20%), while during autumn the increase in rainfall was observed, especially in the north-western and central parts. Although significant variability in precipitation has not been recorded, pluviometric regime has been greatly disrupted, that is, the annual distribution. Due to the increased intensity of rainfall and its greater variability, as well as due to the increased share of heavy rains in the total amount of rainfall, there is the increased the risk of flooding especially in the north-eastern part of BiH, where the most disastrous floods in history have been recorded during May 2014.

	Banja Luka	Bjelašnica	Bijeljina	Doboj	Zenica	Mostar	Sarajevo	Sokolac	Tuzla	Trebinje
max 2001-2014	1.561	1,996	1,090	1,494	1,201	2,491	1,187	1,274	1,353	2,734
min 2001-2014	589	972	466	496	519	873	692	622	566	1,054
mean 2001-2014	1,054	1,397	781	1,009	848	1,527	984	946	963	1,776
max 1961-2014	1,561	1,996	1,090	1,494	1,201	2,491	1,249	1,274	1,353	2,741
min 1961-2014	589	693	466	497	519	841	625	562	566	1,054
mean 1961-2014	1,042	1,204	760	922	810	1,499	945	850	906	1731
max 1981-2010	1,396	1,996	1,090	1,427	1,051	2,491	1,249	1,274	1,325	2,741
min 1981-2010	702	952	481	627	543	841	625	562	569	1.101
mean 1981-2010	1,039	1,314	792	934	811	1,401	937	859	911	1,678
max 1961-1990	1,281	1,518	892	1,154	1,010	1,987	1,170	1,048	1,233	2.398
min 1961-1990	685	693	492	657	543	841	625	562	600	1,311
mean 1961-1990	1,029	1,114	738	871	782	1,522	932	802	894	1,751

Table 30: Variability in precipitation in Bosnia and Herzegovina, period 1961 – 2014

Pronounced change in the annual rainfall patterns with increase of temperature is one of the key factors which cause more frequent and more intense occurrence of droughts and floods in Bosnia and Herzegovina. An increase in the number of days with convective precipitation has been observed, i.e. with more intense rainfall per seasons and partially also on an annual basis.

Annual Precipitation Amounts for MS Sarajevo



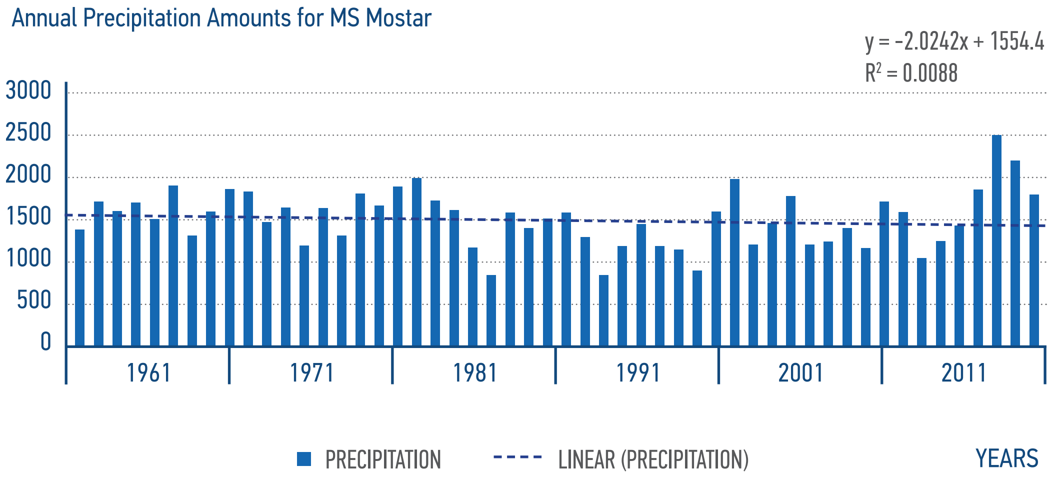


Chart 25: Changes in annual precipitation amounts in Sarajevo and Mostar, 1961–2014.

The period from 1961 to 2014 saw an increase in the annual number of very wet days and extremely wet days. The biggest trend of very wet days (R95p) was recorded at 3.973 at Bjelašnica to 0.521 in Mostar. The negative trend of very wet days (R95p) was also recorded in Sarajevo at -0.102. When it comes to extremely wet days (R99p) throughout Bosnia and Herzegovina a positive trend was recorded ranging from 2.886 at Bjelašnica to 0.236 in Sanski Most. The pronounced trend was also recorded for indicators of maximum 1-day and 5-day precipitation (RX1d and RX5d). At Bjelašnica, the maximum 1-day precipitation (Rx1d) has a positive trend of 0.611, while in the other regions it ranges from 0.226 in Mostar to 0.116 in Sarajevo. The negative trend for maximum 1-day precipitation (Rx1d) was recorded only in Sanski Most.

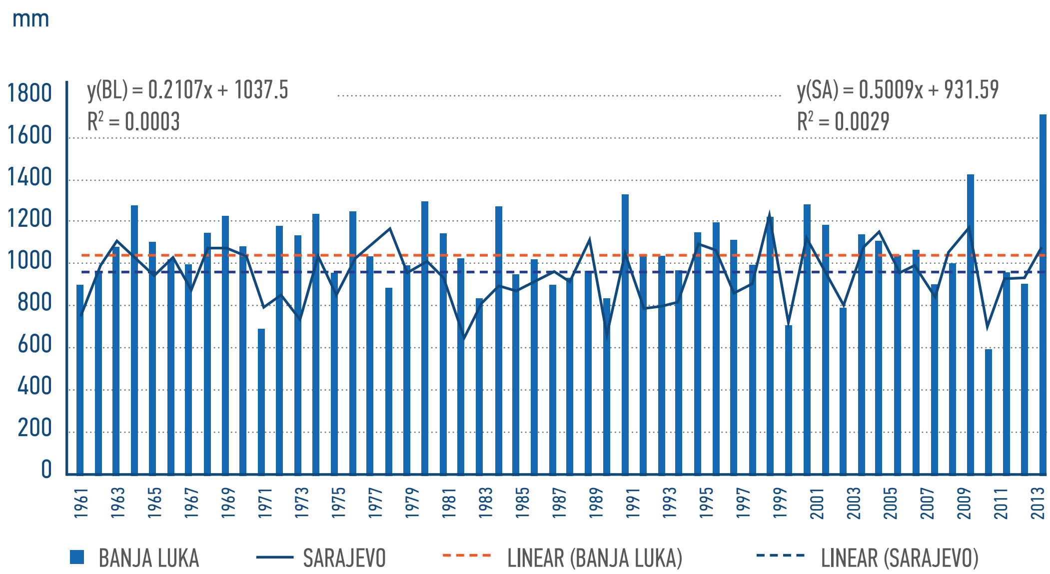


Chart 26: Variability in annual precipitation in Banja Luka and Sarajevo, 1961–2014

2.2. Climate models-expected climate change

On the territory of Bosnia and Herzegovina significant climate change can be expected in the future, especially in the case of climate scenarios that do not foresee implementation of appropriate mitigation measures. By the end of this century, based on IPCC scenarios, the possible change in the mean annual temperature, compared to the period from 1961 to 1990, ranges from 2.4 to 4°C, depending on the selected scenario and the part of the territory. Changes in mean annual accumulated precipitation varies in the range from 0 to -30%, in relation to the same reference period, whereby the greater part of the territory is characterized by negative anomaly (Cupac et al, 2013). The imposed conclusion is that if the global greenhouse gas emissions retain the observed trend of the last few decades, in mid-term the climate of Bosnia and Herzegovina could become warmer and more arid compared to the climate conditions of the mid-twentieth century. In addition to changes in the multi-annual mean values of temperature and precipitation, future changes will also cause the changes in extreme values of climate variables. Several reports and studies indicate possible adverse changes in the intensity and frequency of extreme precipitation (EEA, 2012; SREX, 2012; IPCC, 2013) in possible future changed climate conditions. This report will analyze changes in extreme daily precipitation through the analysis of changes of the relevant climate indices for three possible scenarios of future climate.

2.2.1 Regional climate model and climate scenario

Regional climate models (RCM) are the most commonly used tools for regionalization of the results (dynamical downscaling) of global climate models (General Circulation Model –GCM) and the assessment of regional climate change in the future, depending on different scenarios of possible increase in the concentration of Greenhouse gases (Giorgi et al, 2001). Method of regionalization ensures obtaining the relevant information about future climate at the appropriate spatial and temporal scales that are necessary for the implementation of impact and vulnerability studies, especially when these are focused on regional and sub-regional domains (Jacob et al, 2007). Results of regionalization of three climate scenarios for the territory of Bosnia and Herzegovina have been used in producing this Report (TNC), and these have been carried out with two different regional models, nonhydrostatic regional NMMB model and related hydrostatic regional model EBU-POM.

Regional model NMMB is a nonhydrostatic atmospheric model that in addition to its operational use for weather forecast in the national Weather Service of USA (Janjic 2003; 2005; Janjic and Gall, 2012) is also used in many research institutions in Europe and America (Peres et al, 2011, Djurdjevic and Krzic, 2013). The fact that the NMMB model is nonhydrostatic allows for its use in integrations with extremely high horizontal resolutions below 10 km (proportions typical of convective processes). Integrations of such high horizontal resolutions ensure better simulation of the relevant atmospheric nonhydrostatic processes, which are extremely important in the development of convective systems that are the most common cause of extreme precipitation accumulation in short periods of time, especially during the warmer part of the year (Djurdjevic and Krzic, 2013). Integrations of NMMB model have been made within the project ORIENTGATE (http://www.orientgateproject.org, Djurdjevic et al, 2014).
Regional climate model EBU-POM is fully linked atmospheric and oceanic model (Djurdjevic and Rajkovic, 2008; Djurdjevic and Rajkovic, 2010). The atmospheric component of the model is Eta model

and oceanic component is the Princeton Ocean Model (POM). The results of this model made the basis for the impact and vulnerability analysis of socio-economic sectors to climate change (Cupać et al, 2013) in the Second National Communication of BiH under the UNFCCC.

With the NMMB Model the regionalization of climate scenario RCP8.5 was made (Moss et al., 2008), as defined in the fifth report of the Intergovernmental Panel on Climate Change (IPCC – AR5), while the EBU-POM model was used for regionalization of the scenarios A1B and A2 (Nakicenovic and Swart, 2000), as defined in the fourth report of the Intergovernmental Panel on Climate Change (IPCC – AR4). Horizontal resolution of the NMMB model was 8 km, and the resolution of EBU-POM model was 25 km. The selected reference period was the period from 1970 to 2000, while the future climate integrations covered the period from 2011 to 2100. For the boundary conditions in the integration of RCP8.5 scenario, the results of global climate model CMCC-CM were used (Scoccimarro et al. 2011), while for the boundary conditions for the scenarios A1B and A2 the results of the global climate model ECHAM5 were used (Roeckner et al, 2003).

According to the selected scenarios concentration values of CO_2 at the end of the twenty-first century for A1B scenario range around 690 ppm, and for A2 scenario around 850 ppm and in relation to the concentration of greenhouse gases, A1B was characterized as “medium” and A2 as “high” scenario. According to the scenario RCP8.5, at the end of the twenty-first century, the concentration of CO_2 would be somewhat higher than 900 ppm, therefore this scenario could be characterized as pessimistic compared to the scenario A2.

Concentrations CO_2 according to SRES and RCP scenarios

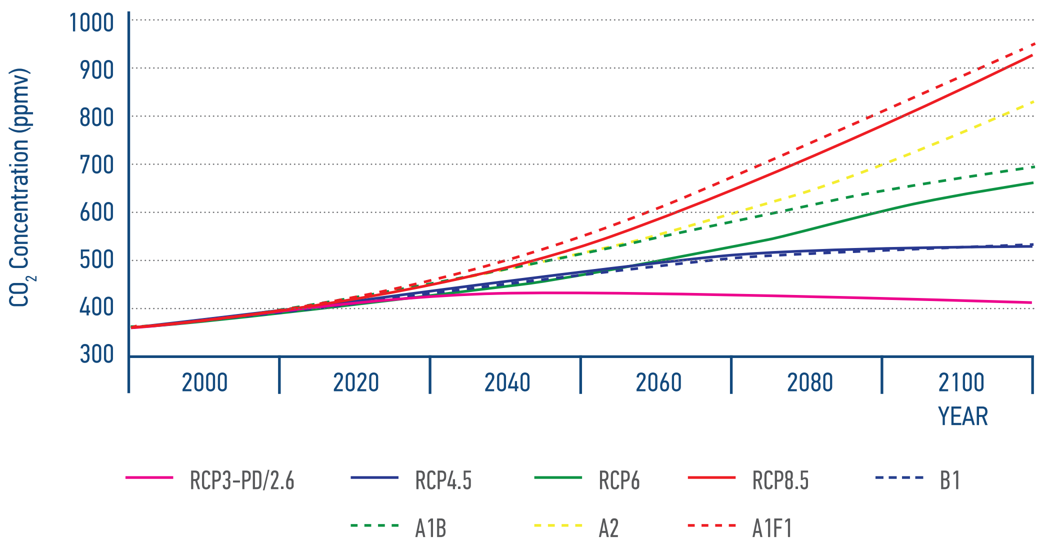


Chart 27: Model of change of CO_2 concentrations according to SRES scenario by the end of XXI century[28].

[28]*Web page of Climate Change in Australia – Projections for Australia's NRM Regions, available at: https://www.climatechangeinaustralia.gov.au/en/climate-projections/climate-futures-tool/experiments/*

2.2.2 Expected temperature changes based on climate scenarios

Figure 2 shows the increase in mean annual temperatures for the three-time horizons, 2011–2040, 2041–2070 and 2071–2100 and for the three observed scenarios RCP8.5, A2 and A1B. By the end of the XXI century all three scenarios indicate a continuous increase in temperature on the territory of Bosnia and Herzegovina. According to the scenario RCP8.5 the increase in temperature in the first thirty-year period is in the range from +1.6 to + 2°C, whereas in the last thirty-year period, this range was from +5.4 to +5.6°C. The temperature increase is somewhat lower under scenarios A2 and A1B. In the first two thirty-year periods the temperature anomaly is higher based on the scenario A1B and for the period from 2011 to 2040 it is approximately +1 °C, while for the period from 2041 to 2070 the anomaly is around +2.4 °C. For the last thirty-year period based on the A2 scenario, the extent of the anomaly ranges from +3.8 to +4.2 °C. These results are consistent with the concentrations of greenhouse gases that are foreseen in some of the scenarios, given that the greatest concentrations at the end of the century are defined within the scenario RCP8.5, then A2 and finally based on the scenario A1B the concentrations of greenhouse gases by the end of this century would be the lowest compared to RCP8.5 and A2.

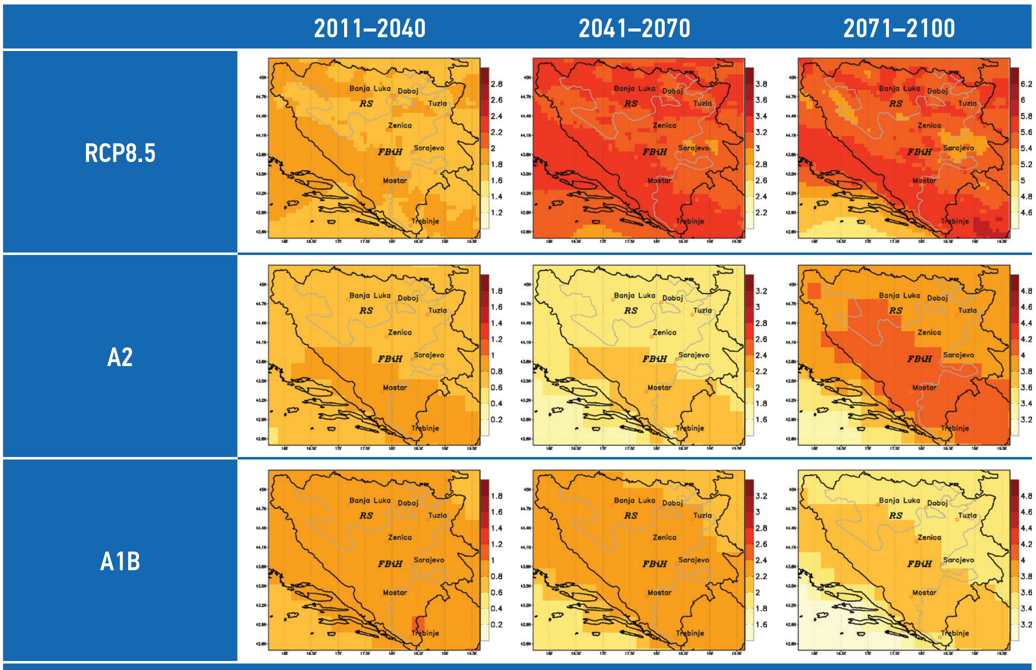


Figure 2. Changes in annual temperatures for the scenarios RCP8.5, A2 and A1B, for future periods 2011 – 2040, 2041 – 2070 and 2071 –2100 in relation to the reference period 1971 – 2000.

For the period 2011–2040, changes in seasonal mean temperatures for the seasons DJF and SON are around 2.2°C while the change for the seasons MAM and JJA is in the range from 1.2 to 1.6 (Scenario RCP8.5). For the remaining two periods from 2041 to 2070 and from 2071 to 2100, the difference between the change in temperature for the seasons DJF and SON, and JJA is smaller, so that for the period from 2071 to 2100 the changes are in the range from 5.2 to 6 °C. Change for the season MAM for the period from 2071 to 2100 is smaller than compared to the other seasons and it ranges from 4.6 to 5 °C.

2.2.3 Changes in summer days index (TX>25°C) according to scenario RCP8.5

Figure 3 shows the changes in the index of summer days (days with maximum temperatures above 25 °C) expressed in days/per year, annually and for the season JJA compared to the period from 1971 to 2000. For the period from 2011 to 2040 the annual index change is 5 days, on the parts of the territory with the higher altitude, then around 10 days in the northern regions, and over 15 days in the south of the country. For the season JJA these changes range from 3-12 days. For the period from 2041 to 2070 the changes range from 15 to 40 days with a similar geographic distribution. The northern parts of the territory have a change of about 30 days, while in the south of the territory the changes are even more than 40 days. JJA season has changes in the range from 10 to 30 days. For the last period, from 2071 to 2100 the changes are in the range from 40 to 90 days annually, and during this period the difference between the northern and southern parts is less pronounced. For the season JJA the change is about 30 days for most of the territory, while on the south it is higher for up to 40 days.

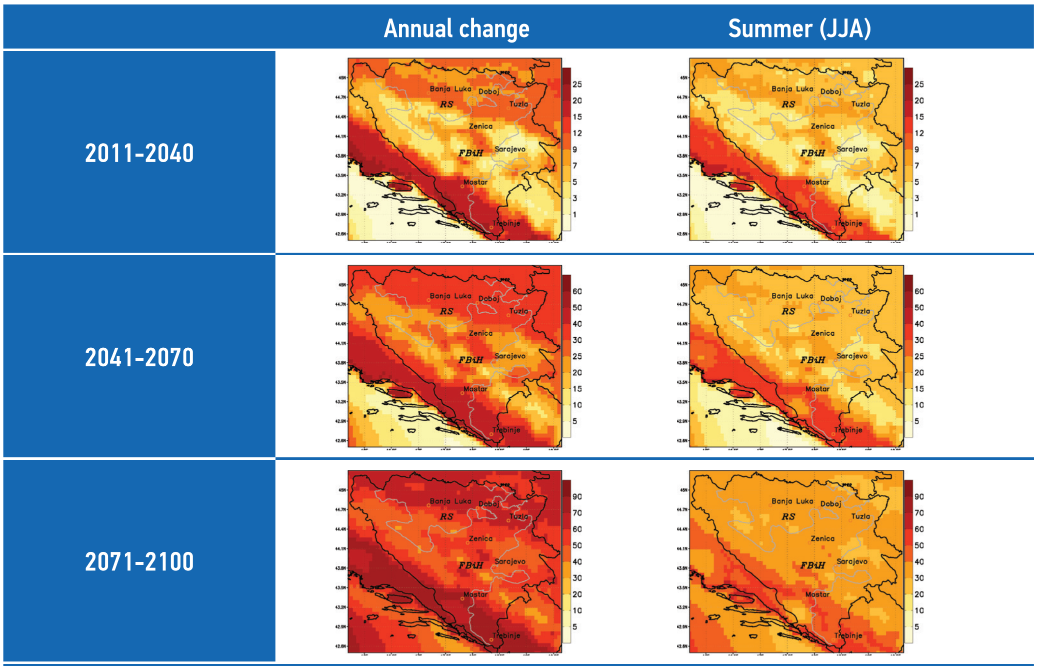


Figure 3: Change of index TX25 annually and for the summer season (JJA), in days/per year, for periods 2011 – 2040, 2041 – 2070 and 2071 – 2100 in relation to the period 1971 –2000, based on the future climate scenario RCP8.5.

2.2.4 Expected precipitation changes based on climate scenarios

Figure 4 shows the change in mean annual and mean seasonal accumulated precipitation, expressed in %, on the territory of in Bosnia and Herzegovina for three future time horizons, 2011–2040, 2041–2070 and 2071–2100, according to the scenario RCP8.5 in relation to the reference period 1971–2000. Only for the future period 2011-2040 most of the territory has a positive anomaly of annual precipitation, with most of the territory having an anomaly of + 5%. For future periods from 2041 to 2070 and from 2071 to 2100 negative anomaly is expected for almost the entire territory.

For the period from 2041 to 2070 most of the territory has a negative anomaly of -10% while for the period from 2071 to 2100 the anomaly ranges from -10 to -20% in most of the territory. Seasons DJF and SON have qualitatively similar anomalies for all three future periods with approximately the same areas with positive and negative anomaly. Anomalies in most of the territory range from -10 to +10%. Seasons MAM and JJA are characterized by a decrease in precipitation for further time horizons, which is especially pronounced for the season JJA, for which, for the period from 2071 to 2100, about a third of the territory (southern parts) has a negative anomaly greater than -40%.

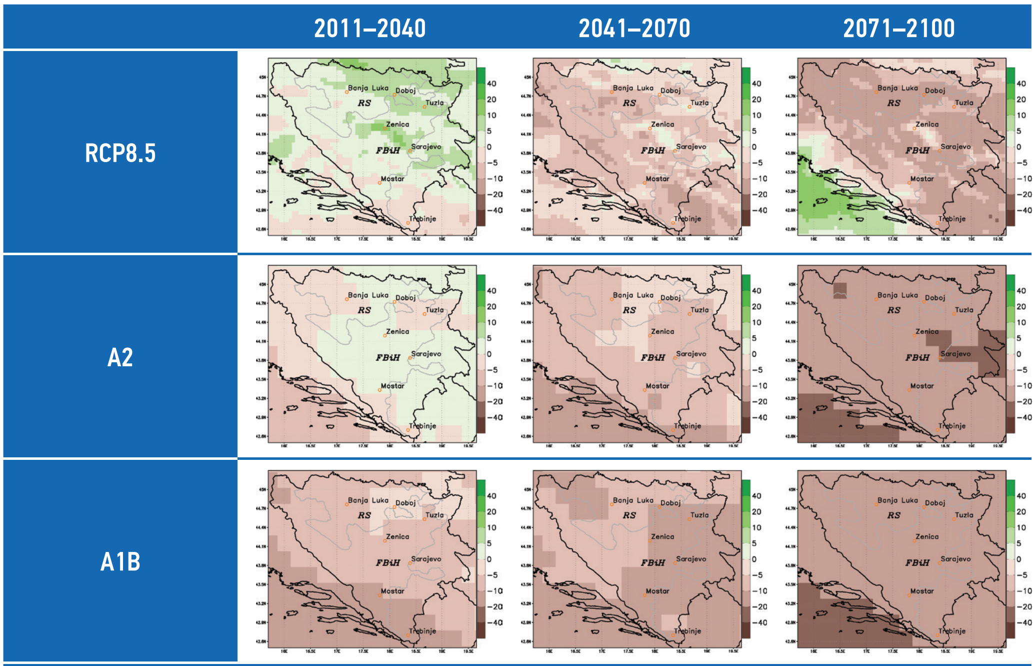


Figure 4: Change in annual precipitation for the scenarios RCP8.5, A2 and A1B, for future periods 2011–2040, 2041 –2070 and 2071 –2100 in relation to the reference period 1971 – 2000.

According to the scenario A2 (Figure 4, figures in the center) for the future period from 2011 to 2040 most of the territory has a positive anomaly of annual precipitation, whereby most of the territory has an anomaly of +5%. For future periods from 2041 to 2070 and from 2071 to 2100 negative anomaly is expected for almost the entire territory. For the period from 2041 to 2070 most of the territory has a negative anomaly of -10% while for the period from 2071 to 2100 the anomaly ranges from -10 to -20% in most of the territory. Seasons DJF, SON and MAM have qualitatively similar anomalies for the future period from 2011 to 2040 with positive precipitation anomaly on greater part of the territory of Bosnia and Herzegovina. Season JJA has a negative anomaly for all time horizons, which is especially pronounced for the period from 2071 to 2100 with about half the territory that has a negative anomaly greater than -40%. Unlike RCP8.5 scenario for the period from 2071 to 2100, all seasons on almost the entire territory have a negative anomaly of precipitation in relation to the reference period.

As opposed to the previous two analyzed scenarios, according to the scenario A1B (Figure 4, three figures below), the first considered thirty-year period from 2011 to 2040 has a negative anomaly of mean annual precipitation compared to the reference period from 1970 to 2000. In the case of the previous two scenarios, the mean annual precipitation anomaly has been positive in this period on majority of the territory of Bosnia and Herzegovina. Similar to the previously considered scenarios and based on this scenario the largest deficits are for the season JJA, which is especially pronounced in the periods from 2041 to 2070 and from 2071 to 2100, when the anomaly is greater than -20% for the entire territory.

Presented results for the three analyzed climate scenarios show that extreme precipitation would intensify under warmer climate conditions on the territory of Bosnia and Herzegovina, as a result of continuous increase of greenhouse gases concentrations. Even in case that annual anomalies are negative in relation to the reference climate period, changes of indices of extreme precipitation indicate that there might be an increase in the daily accumulations in the days with precipitation greater than 20 mm or greater than the 95th percentile. In some cases even the increase of the total precipitation during the day with extreme precipitation can result in a positive anomaly on the significant part of the territory, with a change of up to several dozen percentages for some seasons compared to the reference period. This situation is consistent with the fact that warmer air can carry a greater amount of water vapor, which, under favorable synoptic situations, primarily through convective processes, can be a source of abundant precipitation. Moreover, a significant increase in specific humidity in the atmospheric near-surface layer has been already observed at the global level (Osborne and Lindsey, 2012), which follows the increase in global mean temperature, hence in support of this fact.

2.3. Sensitivity analysis and possibilities of adaptation by sector

2.3.1. Impact of climate change on agriculture

Agriculture is one of the sectors mostly affected by climate change in Bosnia and Herzegovina. The consequences are predominantly but not exclusively negative. It can be stated that climate change will have a positive effect on the yield and quality of winter crops due to the extended growing period. Areas of cultivation of fruit and vines will be expanded due to the disappearance of very cold winters and late spring frosts. However, spring crops will be at risk due to high temperatures and water shortages during the summer months. There will be also a decrease in the yield and the quality of pasture, feed (particularly of spring crops), depletion of pastures due to heavy rains and strong winds. In addition, accelerated processes of land erosion can be expected mainly through increased land erodibility, changes in land use, increased intensity of rainfall and prolonged dry periods (Custovic et al, 2015).

The extension of the growing period due to the increase in the winter and early spring temperatures leads to greater opportunities for the development of diseases and pests. Pathogens of plant diseases, pests and weeds represent a very important segment to which the future climate change have an impact. Warmer and drier climate affects the diminishing in the spread of phytopathogenic fungi. However, more arid climate will require changes in agricultural technologies, such as the intensification of irrigation, which may increase the frequency of some other phytopathogenic bacteria. Treating these bacteria can increase the costs of production, which directly affects the energy efficiency and greenhouse gas emissions.

Besides, as it was mentioned in the Second National Communication, mild winters can contribute to spreading of harmful insects (e.g. more intense spreading of Capondis tenebrionsis, from the southern regions to the northern ones), and even the emergence of new species, which also requires prevention measures and thus increase the production costs. A warmer climate could lead to spreading of invasive thermophilic weeds such as Amorpha fructicosa (indigo), Ambrosia artemisiifolia (ragweed), Helianthus tuberosus (Jerusalem artichoke) and similar.

Weeds and pests are likely to expand to the north. This will cause new problems for farmers because they do not expect them in these areas. Plants weakened due to drought will be easier “target” for the pathogens of plant diseases and insects. All this will lead to an increased use of pesticides, which can have a negative impact on human health and the environment.

Adverse effect can be expected from the point of view of enlargement of spatial distribution and intensity of existing pests, diseases and weeds and all this due to the increased temperatures and humidity. Weeds grow faster than the cultivated plants and consume larger quantities of water, which in conditions of drought intensifies scarcity of water in the soil.

2.3.1.1. Impact on livestock production

Possible effects of climate change on food production are not limited solely to plant production. Climate change, which include temperature increase, as well as change of spatial (geographic) and temporal pattern of precipitation, lead to the increased spreading of various diseases, but also the emergence and spreading of new exotic animal diseases. During the last decade significant changes in the occurrence and distribution of some vector-borne diseases were observed, including: Lyme disease, leishmaniosis, trypanosomiasis, dengue fever and similar.

Spreading of diseases is also facilitated by mass migration of animals in search of new habitats. In this way, foot and mouth disease and ovine rinderpest/peste des petits ruminants (IUCN, 2010) are being spread. On the other hand, areas with abundant rainfall are conducive to spreading of Anthrax.

Direct effects of climate change on animals are also reflected through thermal (heat) stress, which leaves negative consequences both in terms of animal production and in terms of the quality of animal products. Overall, the increase in temperature, as well as air humidity increase reduces the food consumption and milk production in cows (1.5 – 2 liters/cow/day, and in some cases even 50%). The problems are more pronounced in animals, which are always out in the open. Because of the poor quality of fodder, the final weight of animals is less, and the quality of meat is poorer.

2.3.1.2. Vulnerability and selection of species and varieties

In order to avoid drought, crops and plantations that reach early technological maturity can be used. Examples of such crops can be found in all types of crop production (early potatoes, lettuce, scallion, early fruit, etc.). Some local (indigenous) or old varieties and populations of plants have specific forms of adaptation to local conditions of production, including adaptation to the diseases and climate variation, including the emergence of high temperatures and drought. Such varieties often are not being sold but they are held “on farm” and used for exchange of seeds among farmers. For example, there are the old and indigenous varieties of onions, legumes (string bean, peas, broad beans), cabbage plants, cucurbits (pumpkins, melons and watermelons) and fruit vegetables (peppers, tomatoes). In general, growing a variety resistant to drought does not mean one will get a high yield as in the case of growing some other non-resistant variety in the conditions of intensive agriculture (irrigation). However, drought resistant varieties are better for the conditions without irrigation than many popular varieties, because they give stable yield in variations of external conditions, particularly during the meteorological and land drought. In principle, it is expected that the in cases of majority of winter crops climate change will have a positive effect on yield, and in the cases of spring crops the summer droughts will prevail and lead to a significant decrease in yield. For this reason, decrease of the share of spring and increase of the share of winter crops is imposed as an adaptation measure.

In areas where there is a summer deficit or shortage of water for normal development of agricultural crops, and there are no opportunities for irrigation, the selection of crops should be adapted to the natural distribution of rainfall, i.e. the dynamics of land and water balance. It is the so-called rainfed agriculture or crops to climate and soil suitability.

One should distinguish between winter and spring grains. In this respect, the most characteristic winter grain is winter wheat, which is the most widespread. Winter grains on average give higher yields than the spring ones, which also makes the economic importance greater. In addition to greater yields, there is also more stable increase in yields from winter compared to the spring crops. In this regard, winter grains are frost resistant, but they also have the need for vernalization i.e. dormancy. In terms of this issue the increased temperatures shorten the time of vernalization, which should be compensated by the selection of new varieties.

The varieties of grains that have a short growing period often have greater drought resistance because they bring the yield before the start of the warmest part of the summer (July-August). For example, early varieties of wheat may ripen 15 to 30 days before the late ones. Early hybrids of maize are those belonging to FAO maturity groups from 100 to 400. In the domestic production almost all surfaces are occupied by domestic high-yielding varieties or varieties that are traditionally sown. Maize is one of the most important agricultural crops, especially in livestock production be it the production of silage or grain.

Changes in agro-climatic conditions will result in greater impact on maize in comparison to wheat. The reasons for this are numerous, but one of the key is the maize's need for water and the projected reduction of water during the growing period. In addition, preliminary studies indicate the possibility of moving the calendar of spring sowing in terms of its earlier start.

Forecasts for the potential yield of rainfed maize for 2025 and 2050, which was developed by the International Institute for Applied Systems Analysis (IIASA) for the World Bank show that over time the most important regions for maize growing, in the north of BiH, could experience the drop in yields of 10 – 25% (World Bank, 2010).

In other scenarios, such as for example, analysis of change in Selianinov's hydrothermal coefficient (HTC) and annual crop yields, according to the climate scenarios A1B and A2, the decline in annual yield of up to 50% at the end of this century is expected in BiH.

Production in fruit growing, by its nature is dependent on environmental conditions, and thus of all the changes that occur in nature (production in the open air). Due to the climate change that are already taking place, and according to A1B 2011–2040, which indicates that the climate continues to change in terms of decrease in the total precipitation and increase in average annual temperatures, it is necessary to think in terms of adaptation, that is, customization to future changes. This means it is necessary to plan a new distribution pattern of production in orchards and vineyards, due to the changes in climate, especially in the increased temperature and length of sunlight. In this sense, transfer of production of some fruit crops and vines from the Mediterranean to continental areas is expected.

Since these are the perennial crops, adaptation in fruit growing is much more demanding and expensive than in farming or gardening. Adaptation means reselection of orchard and vineyard crops for the given climate areas and their further adaptation. For example, peach (lat. *Prunus persica*), or apricot (lat. *Prunus armeniaca*) are not adapted to the continental mountainous conditions due to the occurrence of frosts, which can lead to freezing of aerial parts of the tree. In addition, certain fruit crops such as apple (lat. *Malus domestica)*, are not adapted to the Mediterranean climate, due to the high temperatures that exceed 35°C, causing the sunburns on the fruits and leaves. According to the future scenario A1B a shift in production of peaches and apricots to the continental parts of BiH is expected, while the production of apples will move to higher altitudes. Similar scenarios can be also planned for other fruit crops. High temperatures lead to excessive transpiration or water loss from the plant, but also sunburns to the leaves. As a technical solution to mitigate these negative effects shading netting is used, making the shade and preventing sunburns, as well as the excessive transpiration of plants.

The spatial representation of the grape is determined by environmental conditions, but also by the biological adaptability of some varieties and substrates to the environmental conditions that are constantly changing. In our case the most widely used are vine varieties which, in terms of color, are divided into vines of white, red and black varieties. But we should not neglect table varieties the cultivation of which also starts to occupy an important position, and the use is getting wider. For the success of grape growing and wine-producing by regions and by vineyards it is very important to identify the most suitable vine or table grape varieties to grow, but also the grape rootstock. Assortment which is grown in BiH has a wide range of adaptability and is suitable for growing in a changing climate. Vines, in order to be accepted, must undergo a procedure of adaptability and evaluation by the manufacturer. According to climate scenarios, this adaptability will be even more manifested in terms of spreading of vineyards to the region towards the continent and higher altitudes, but also in terms of change in the assortment, whereby breeding of red vine and table varieties will come to the fore, which require greater heat.

2.3.1.3. Adaptation opportunities

There is an obvious need for planning and implementation of appropriate measures of adaptation to climate change. In the first place developing of the appropriate irrigation systems should be a preferred option, as well as the development and introduction of varieties resistant to dry climate conditions, if the level of production from the previous period is to be maintained. However, an adequate assessment of climate change and their impact on the agricultural sector requires significant improvements in the processes of monitoring, analysis and data modeling.

In addition, it is necessary to strengthen systematic research on climate change and agriculture, as well as capacity building in terms of early warning for extreme events, such as: drought, floods and hail. Moreover, it is necessary to raise the awareness of the public on the harmful consequences of climate change, and the possibilities of adequate adaptation. An efficient adaptation to changed climate conditions requires use of modern solutions that match the specific, local conditions. Farmers will need to acquire new knowledge and to follow new scientific and technological solutions, in order to adapt their production to changed environmental conditions. In this process, the important role is played by universities, institutes, professional services and education system in general.

Continuous training and capacity building are necessary for farmers. Professional advisory services should play a key role in promoting agricultural practices and sharing of knowledge and skills in terms of adaptation measures. To this end, it is necessary to strengthen the capacities of the professional advisory services.

Irrigation will certainly be one of the key mechanisms for adaptation. However, flood protection and drainage of excess waters from the plot, and in general regulation of water and air regime is a matter of priority for further development of the agricultural sector. The construction and completion of complex hydromelioration systems, as well as watershed-based approach to spatial planning is set as a key strategic issue. To start with, the existing systems could be properly maintained.

In order to accomplish the aforementioned objectives, it takes a strong institutional, policy and legislative framework for risk management and adaptation to climate change, as well as sustainable financial mechanisms for their implementation. These conclusions are in accordance with generally accepted view on climate change and the need for adaptation of the production to the resulting changes, however the changes and adaptations will be much more successful if followed-up and adapted to lower regional and production area, rather than globally. According to many opinions, the future of agriculture belongs to genetics and irrigation.

2.3.2. Climate change impact to water resources

2.3.2.1. Hydrogeological characteristics

The territory of Bosnia and Herzegovina is characterized by complex geological and hydrogeological environment, which causes existence of a large number of phenomena and aquifers of different types, genesis and value in use. All of these are exceptional natural treasure. Hydrogeological characteristics directly condition the runoff from basins of Bosnia and Herzegovina. This area mainly belongs to the geotectonic unit of Dinarides, and based on the physical-geographical, geological and hydrogeological conditions to the hydrogeological inner region (part which is very distinct morphologically, with heterogeneous litostratigraphic composition and complex structural pattern), and to the Pannonian region (lowland terrains south of the Sava River) and karst region.

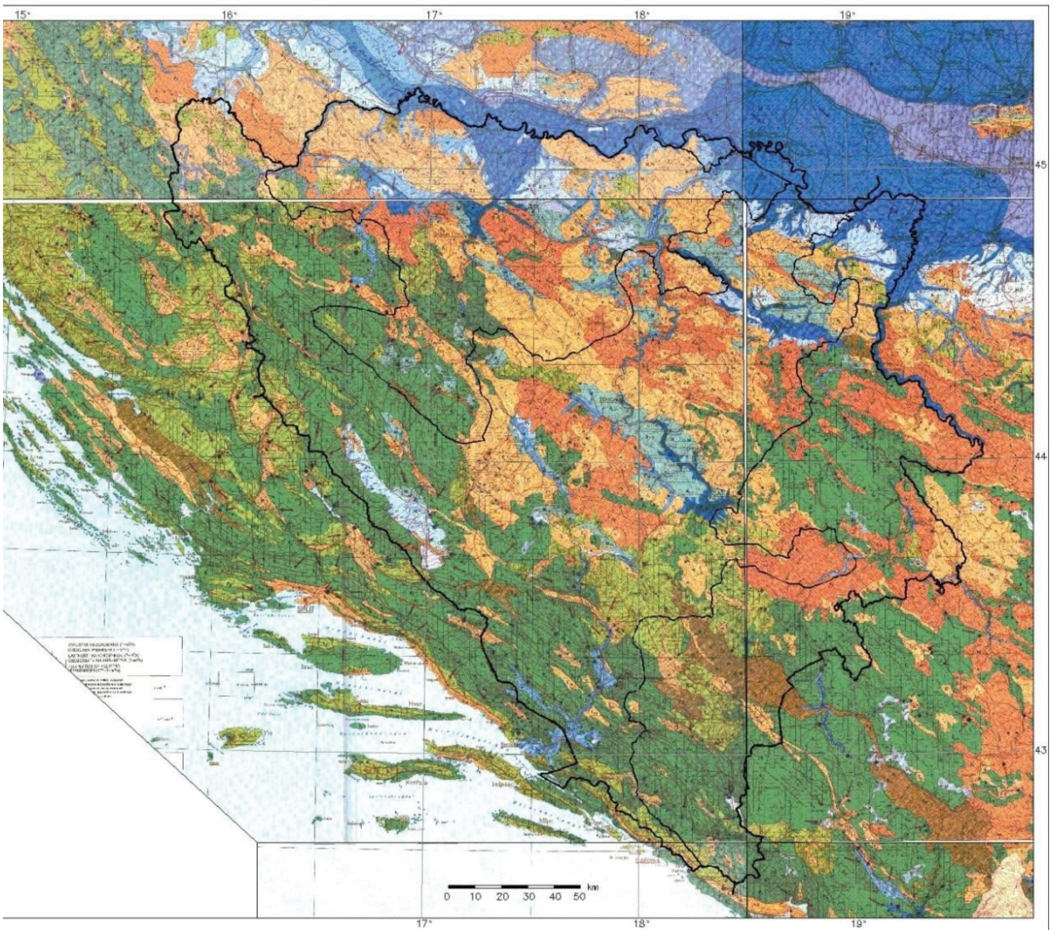


Figure 5: Schematic hydrogeological map of BiH

2.3.2.2. Hydrogeology of inner region

In orographic terms the inner region covers mountain mass of Dinarides system. Heterogeneous lithological composition of this region affected the great level of stratification. The highest mountain ranges of this region are on the move Višegrad-Rudo-Sarajevo-Ključ. Towards the Pannonian plain the mountain ranges cross the zones of medium and low mountains and hills. Mountain ranges are separated by numerous valleys.

Due to the significant amounts of precipitation and impermeable lining within the inner region, larger number of watercourses have been formed. The density of river network is uneven, but it is certainly higher than in other regions. In this region, the most important aquifers are alluvial sediments, Neogene sediments and karst aquifers. The inner region is particularly interesting for its numerous thermal mineral waters. As for the alluvial aquifers in the inner region those significant ones are alluvial deposits of rivers Una, Vrbas, Bosna and Drina, with a thickness of up to 10 m, rarely up to 15 m, and in the plains (Prijedor, Sarajevo and others) up to 60 m. They are consisted of mainly coarse, very permeable gravels. Filtration coefficient of such environment is more than $5x10^{-1}$ m/sec, and the coefficient of the effective porosity ranges from 0.1 to 0.25.

Bluish clays are of small thickness. Groundwater is closely hydraulically linked with surface flows. In the case of Vrbas and Bosna rivers, the current river beds are in places cut into the tight slope.

Highly permeable alluvial gravel of Prijedorsko polje in places lie over karstified dolomitic limestone together forming a unique aquifer. Coefficient of water permeability ranges from $2.7x10^{-2}$ to $6.5x10^{-3}$ m^2/sec.
The inner region also covers a large number of isolated limestone mass, where the large amounts of groundwater are accumulated.

Area Manjača-Stričići is characterized by intensely developed and deep karst. Groundwater circulates towards erosion base of rivers Sana and Vrbas.

In the area of Vlašić groundwater are accumulated in the central part. Emptying takes place along the contact of limestone with Werfenian and Palaeozoic impermeable formations.

Romanija and other surrounding mountains in their calcareous sediments of the Triassic age contain significant accumulation of groundwater. In a significant part of the area, diabase-chert formation, ultramafic rocks or Neogene sediments cover limestone aquifers. In these areas there are significant accumulations of thermal or plain artesian waters.

2.3.2.3. Hydrogeology of karst region

Karst hydrogeological region in Bosnia and Herzegovina includes its western and south-western parts of the surrounding mountains. They form a long and uninterrupted mountain belt, which stretches along the coast of the Adriatic Sea in the direction S3 – JI.

Hydrography of this region is a typical karst. The important rivers of the region are Piva, Tara, Neretva and parts of rivers Sana, Vrbas, Bosna and Drina. There are also great karst underground rivers Trebišnjica, Zalomka and Mušnica.

2.3.2.4. Hydrogeology of Pannonian region

Pannonian region in Bosnia and Herzegovina encompasses the courts of alluvial plains of the right bank of the Sava River from the mouth of Una River to the mouth of Drina River. Rivers, lakes, ponds, swamps, to a greater or lesser extent regulate the regime of aquifers.

Within the Pannonian region there are three groups of aquifers with free groundwater.

• Aquifers in quaternary alluvial-lake, alluvial sediments where groundwater is predominantly free-surface.

• Aquifers in upper Pontic Levantine and Pleistocene sandy and sandy gravel layers, which, due to horizontal and vertical facial changes are mutually connected, but also with the aquifers in Quaternary sediments. Groundwaters in this group of aquifers are under pressure.

• Aquifers in the Triassic and Tortonian and Sarmatian coarse clastic and porous sediments are completely isolated from the previous two groups of aquifers with a thick series of watertight sediments so they contain significant reserves of thermal-mineral waters

On the right bank of the Sava River, in the lower reaches of the Una River, from Novi Grad to Kozarska Dubica, alluvial formations have a thickness of 40 m. Roof seam clay sediments are 0.5 to 10 m thick. The coefficients of filtration in these aquifers range from $5x10^{-2}$ to 5 cm/sec, and the transmissibility is from $5x10^{-3}$ – $5x10^{-2}$ m^2/sec. Much of the accumulation is formed beneath the riverbed of Una and Sana, and the roof seam insulators partly condition subartesian character of aquifers.

Alluvial sands and gravel of Lijevče Polje have a thickness of 15–30 m and they represent water abundant environment of free and sub-artesian character. Coefficients of filtration amount around $7x10^{-2}$ m/sec, and with a transmissibility of $4\text{-}6x10^{-3}$ m^2/sec. Specific outflow of drilled wells range from 30-120 l/sec/m.

Area Brod-Šamac-Brčko, and alluvial sediments of Ukrina, Bosna and Sava rivers represent very water abundant environment. In the alluvium of Ukrina, sand and gravel have the thickness of 10 – 70 m, and the roof seam clay blanket from 2–6 m. Aquifer is free and sub-artesian type with a coefficient of filtration of $6x10^{-2}$ to $3x10^{-1}$ m/sec and transmissibility of $5x10^{-3}$ to $4x10^{-2}$ m^2/sec. Bosna River, on the move from Modriča to Šamac deposited the gravel and sand with a thickness of 20 – 75 m on the Pliocene watertight sediments. Aquifer is predominantly free with the coefficient of filtration of $1x10^{-2}$ to $5x10^{-1}$ m/sec and with the transmissibility of $5x10^{-3}$ to $2x10^{-1}$ m^2/sec.

In the alluvial plain of Semberija, sand and gravel with layers of clay have the thickness of 30 to 60 m, the slope is made of the negoenic clays. Surface parts of the ground are silty-clay sediments with the thickness of usually up to 10 m. In Semberija, the aquifer thickness increases towards Drina.
In the western part the coefficients of filtration amount $5x10^{-3}$ m/sec and they increase towards the east, where they reach the values of $1x10^{-1}$ m/sec. Specific outflow of drilled wells range from 50 – 120 l/sec/m.

2.3.2.5. Water resources

The Second National Communication presents an overview of the typical indicators of water resources of Bosnia and Herzegovina. The spatial and temporal unevenness of availability of water resources will be again pointed out herein.

Multi-annual average precipitation in BiH is about 1,250 mm/year, which – given that the surface area of BiH is 51,209 km^2 – amounts to total quantity of precipitation of approximately 64 billion of m^3 during a year, or 2,000 m^3/s. Compared with neighbouring countries, in BiH, during a year, the precipitation is on average higher by around 350 mm[30]. However, the common perceptions of water resources significantly change when the spatial distribution is analysed. At about 74% of the territory of Bosnia and Herzegovina, outflow[31] of one km^2 of Sava River Basin does not even reach 50% of the outflow of the Adriatic Sea basin (Figure 6).

[30]Average annual precipitation in Serbia is 896 mm. Source: web RHMZ RS;
[31]Average surface runoff

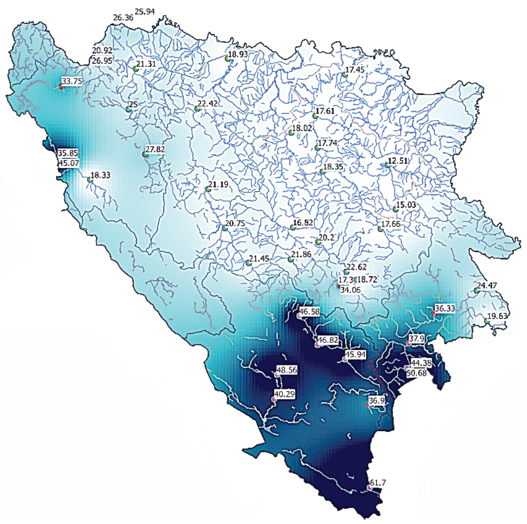
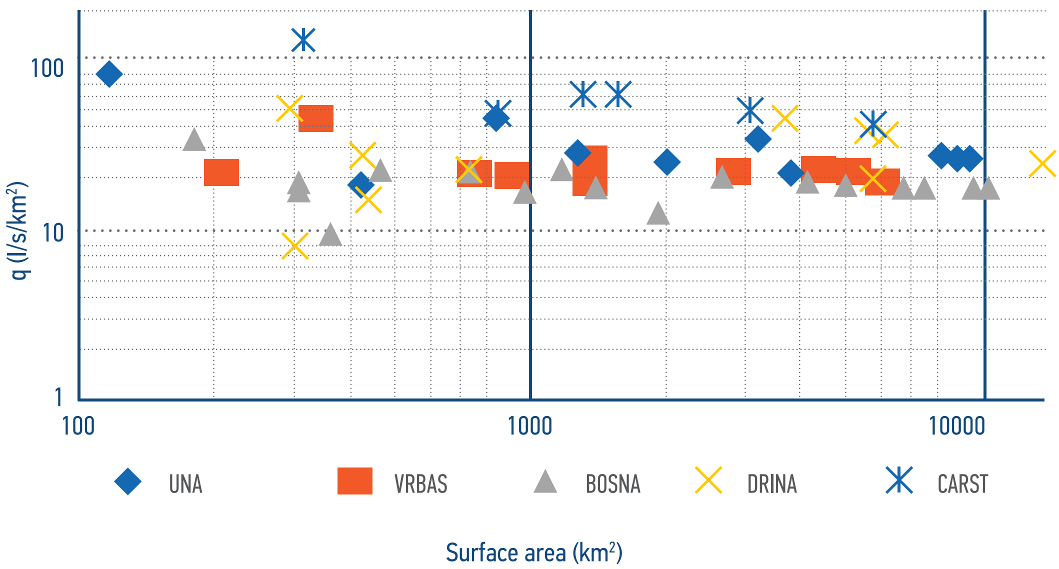


Figure 6: Average surface runoff (outflow) in BiH (expressed in l/s/km²), according to the discharges registered in the profiles of surface watercourses (Source of data for creation of the map: Framework Water Management Plan of BiH, 1994)

The highest values of the average surface runoff are in the Neretva river basin with Trebišnjica, then Vrbas River Basin, Una, Drina, Bosna river basin, Korana and Glina and at the end in the basins of water streams that flow into the river Sava (Ukrina, Tolisa and other water streams, the so-called "immediate" basin of Sava River). Basins poor in water (Bosna, immediate basin of Sava river, upper course of Vrbas river), have even poorer parts of the basin, such as Spreča River Basin, parts of the immediate basin of Sava River, the immediate basin of Bosna[32] river, and especially its middle and lower course, the basins of Rivers Miljacka and Lašva, then Vrbanja basin, etc.



[32] *The reference is made to smaller water streams, tributaries to Bosna River.*

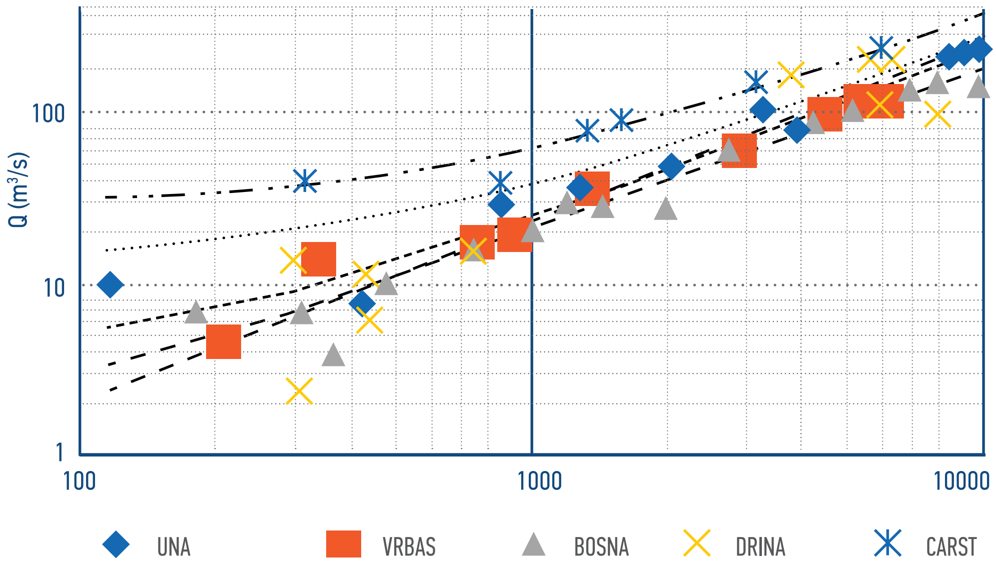


Chart 28: Relations between specific (q) and average flows (Q) based on the surface areas

The strength of connection between specific average flows and surface area has not proven to be sufficiently reliable, in part due to the lack of precision in determining the size of basin areas, especially in areas of highly developed karst. Somewhat better relationship has been determined between the average flow and basin area (Chart 28). BiH is not among the countries in which water as a resource is a limiting factor of development, on the contrary, water resources are among the most important natural resource in BiH. Consequently, there is a need to monitor and observe changes due to the impact of climate change.

In relation to the Second National Communication, series of precipitation and discharge were supplemented conclusive with the end of 2014 and the analysis have been conducted the results of which are comparable to the results of analysis from the previous Communication. Analysis of precipitation in BiH was made for two main basin areas, the Sava River Basin (Danube) and the Adriatic Sea basin. The available annual data series have been used: for the Sava Basin data on precipitation from meteorological stations in Bihać, Sanski Most, Sarajevo, Zenica and Tuzla, and for the Adriatic Sea basin the data were used from the station in Mostar. Calculation of basic statistical parameters of the aforementioned series is presented in Table 31.

Statistical parameter[33]	Annual precipitation in Sava River Basin (mm)[34]				Annual precipitation in Adriatic sea basin (mm)			
	1948-2014	1961-1990	1991-2010	1991-2014	1948-2014	1961-1990	1991-2010	1991-2014
Mean value	1,009.3	990.4	1,040.9	1,034.3	1,481.6	1,523.8	1,456.5	1,469.1
Median	1,004.8	989.3	1,033.3	1020.1	1502.4	1,584	1,412.4	1,412.4
Stand.dev.	137.77	104.38	144.08	172.62	324.26	282.71	371.1	398.4
Variance	18,979.8	10,896.2	20,759.1	29,795.2	10,514.5	79.927,2	137,749.8	158,692.1
Kurtosis	1.2304	-0.2116	0.0197	0.5623	0.4953	0.4511	1,8350	0.5427
Skewness	0.3610	-0.5703	0.1961	0.1349	0.2119	-0.7549	1,1432	0.8045
Range – scope	768.94	406.56	582.66	768.94	1,650.2	1,146.7	1.594	1,618.2
Minimum	653.86	754	768.46	653.86	840.5	841	897	872.5
Maximum	1,422.8	1161	1,351.12	1,422.8	2,490.7	1,987	2,491	2,491

Table 31: Statistical parameters of the series of annual precipitation in BiH, for the periods 1948 –2014, 1961 –1990, 1991–2010 and 1991–2014.

Having analysed a series of annual precipitation supplemented with the values for the period 2011-2014, both for the Sava River basin and the Adriatic Sea basin, it can be concluded that the mean value (obtained as the arithmetic mean) has not changed significantly. However, the value range (distribution) is significantly higher for both basins, as well as variability, indicating that the arithmetic mean is less reliable. In relation to the series of 1961-90, in the period 1991-2014 annual precipitation in the Sava River Basin was higher by 44 mm compared to the period 1961–90, which is somewhat lower increase in value compared to the period 1991-2010. However, the range has significantly increased (769 mm compared to 407 mm) and the minimum value is lower for 100 mm, whereas the maximum value is higher for 262 mm. Accordingly, the value of variance is significantly higher in the period 1991-2014.

In the Adriatic Sea basin, in the period 1991-2014, the greater is the range (for as much as 471 mm), the maximum annual precipitation (for 504 mm) and minimum (for 33 mm), however, mean value has only increased for 12 mm, but it is still lower by 55 mm compared to the period 1961-90. The value of variance and standard deviation continued to grow. The expressed frequency in favor of below-average values of precipitation in the period 1991-2010 decreased from 1,1432 to 0.8045 in the period from 1991-2014, which means that the distribution can be considered as moderately asymmetric[35].

For the same sequences (periods 1948-2014, 1961–1990 and 1991-2014), a trend analysis was made, Charts 29 and 30. It can be seen that for the sequences 1961-90 there is a distinctive negative trend of annual precipitation both in the Sava River basin and in the Adriatic Sea basin, and in the period 1991–2014 the trend is positive. Looking at the sequence 1948-2014, trends have far less inclination, but they have a positive sign both in the Sava River basin and in the Adriatic Sea basin.

[33]Variance, flatness and skewness are dimensionless statistical parameters
[34]The series of average values of precipitation from MS Bihać, Sanski Most, Sarajevo, Zenica and Tuzla have been statistically analysed
[35]Skewness is a measure of asymmetry. If the skewness is between -1 and -0.5 or between 0.5 and 1, the distribution is moderately asymmetric.

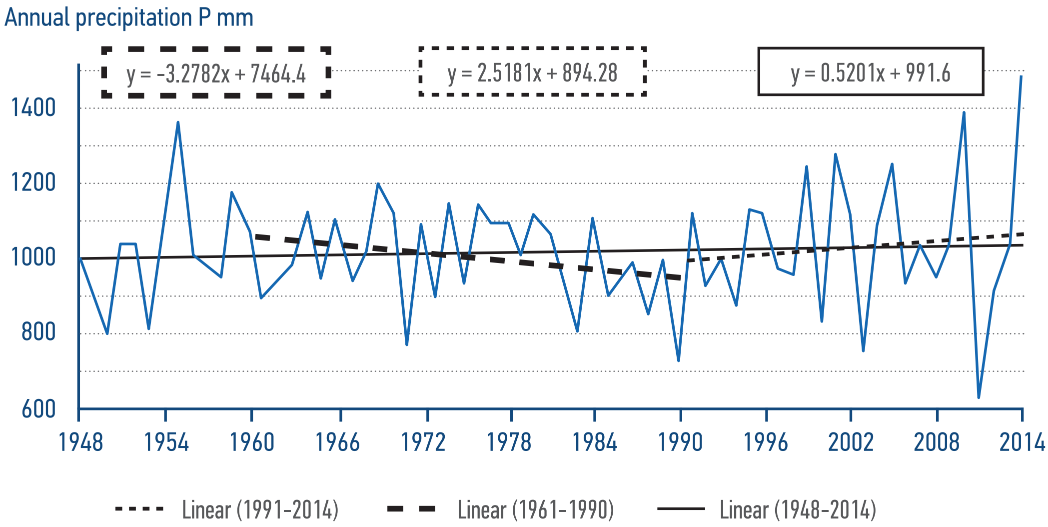


Chart 29: Annual precipitation in the Danube basin in BiH (average from MS Bihać, Sanski Most, Sarajevo, Zenica and Tuzla), with linear trends

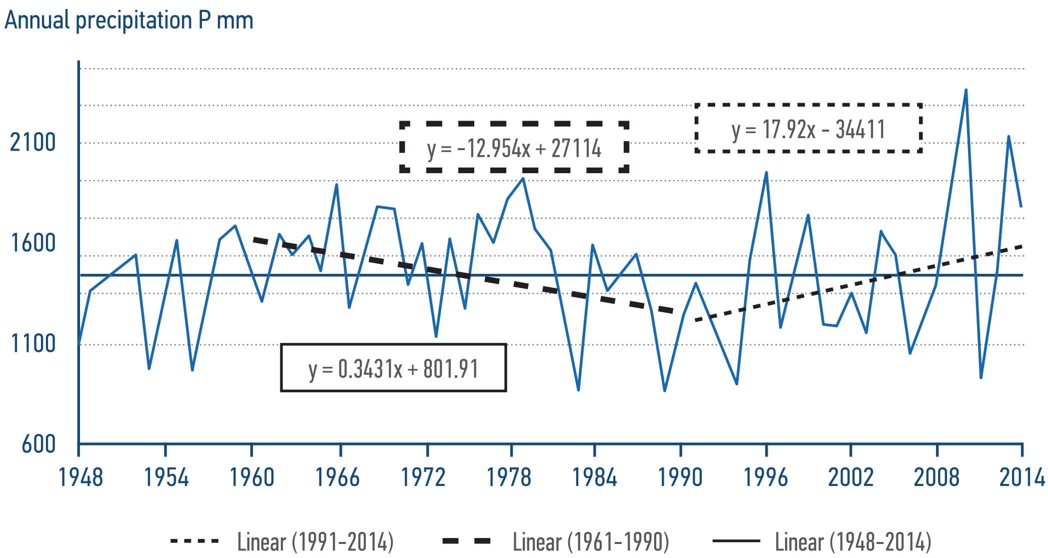


Chart 30: Annual precipitation in the Adriatic Sea basin in BiH (MS Mostar), with linear trends for different periods of processing

2.3.2.6. Flows

The flow trends have been analysed for the rivers in the Sava basin: Bosna in Maglaj, Lašva in Merdani and Sana in Sanski Most. The available, interrupted flow sequences of Neretva in Žitomislići are presented below in Charts 31 and 32.

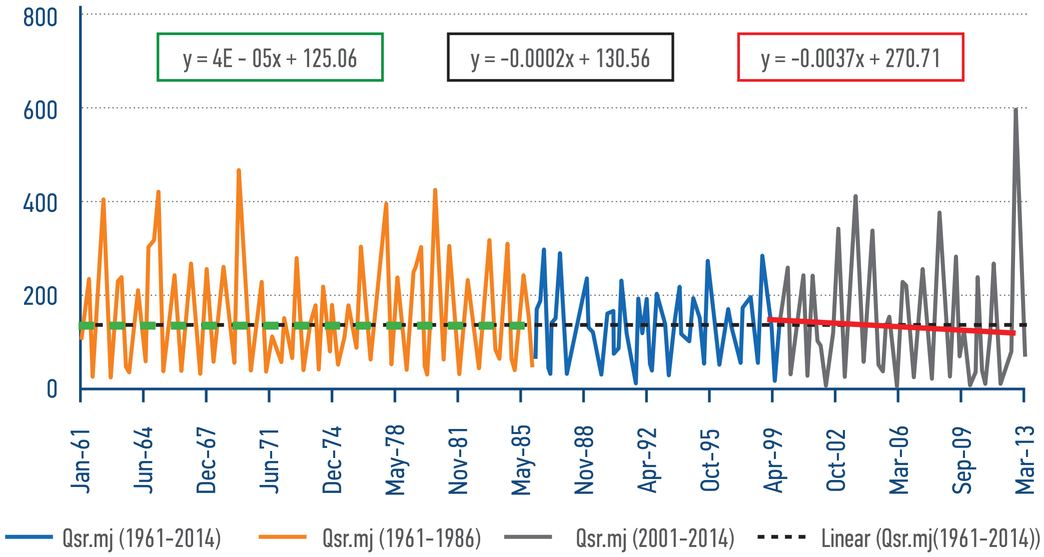


Chart 31: Bosna River, HS Maglaj: Average annual flows with the trends, for various periods.
(Interruption in the observations from 1987-2000 was completed using the hydrological HBV model for the Bosna River basin. The data on precipitation were used from MS in Tuzla, Zenica and Doboj)

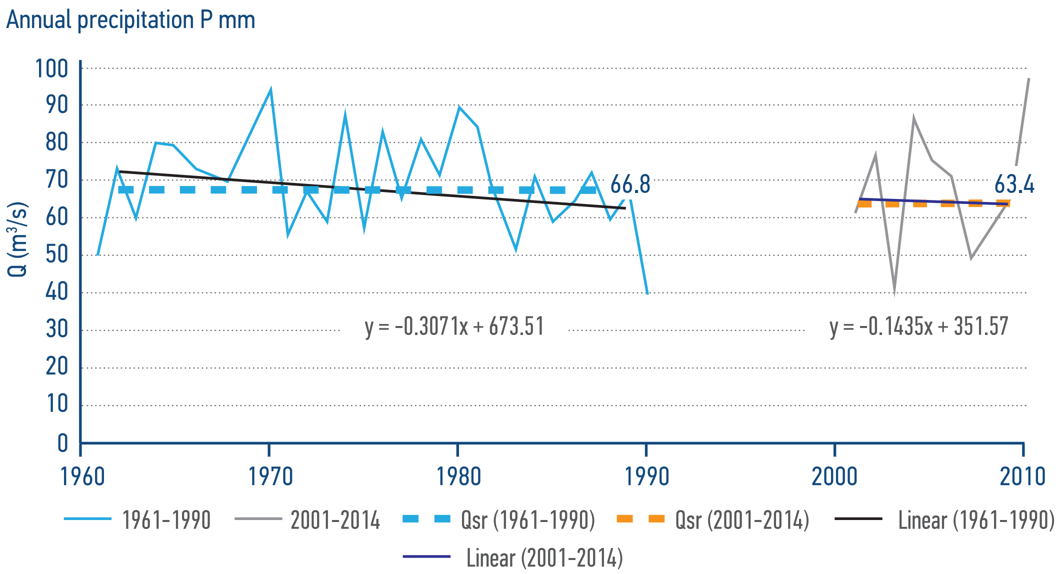


Chart 32: Sava River, HS Sanski Most: Average annual flows with the trends, average flows for different periods of processing

The analysis of intra-annual distribution of sequences of medium, maximum and minimum monthly flows at the station Maglaj on the Bosna River is presented below, for the periods 1961 – 1990 and 2001 – 2014.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Station	Bosna - Maglaj												QSR
$Q^{SR}_{1961-1990}$	131	162	188	210	171	109	73	52	56	78	105	145	123
$Q^{SR}_{2001-2014}$	145	132	218	219	170	118	69.0	51.4	68.8	75.6	99.5	141	126
ΔQ^{SR}	14.0	-30.0	30.0	9.0	-1.00	9.00	-4.00	-0.60	12.8	-2.4	-5.5	-4.0	3.00
Station													QMAX
$Q^{max\ monthly}_{2001-2013}$	380	473	523	475	440	217	204	160	121	294	341	512	1050
$Q^{max\ mj}_{1961-1990}$	482	369	542	539	373	358	354	166	205	354	370	397	1226
$Q^{max\ monthly}_{2014}$ [35]	184	124	237	924	3579	270	192	879	737	180	121	329	3579
Station													QMIN
$Q^{min}_{1961-1990}$	69.7	75.4	95.6	134.0	95.1	61.0	37.2	30.0	31.8	33.5	44.0	63.2	23.6
$Q^{min}_{2001-2014}$	82.4	85.1	107.0	115.0	78.9	51.6	36.7	31.2	29.1	34.2	41.2	53.4	23.8
ΔQ^{min}	12.7	9.70	11.4	-19.0	-16.2	-9.40	-0.50	1.20	-2.70	0.70	-2.80	-9.78	0.12

Table 32: Medium, maximum and minimum monthly flows of the Bosna River in Maglaj, for the periods 1961 – 1990 and 2001–2014, and the difference between the average values by periods

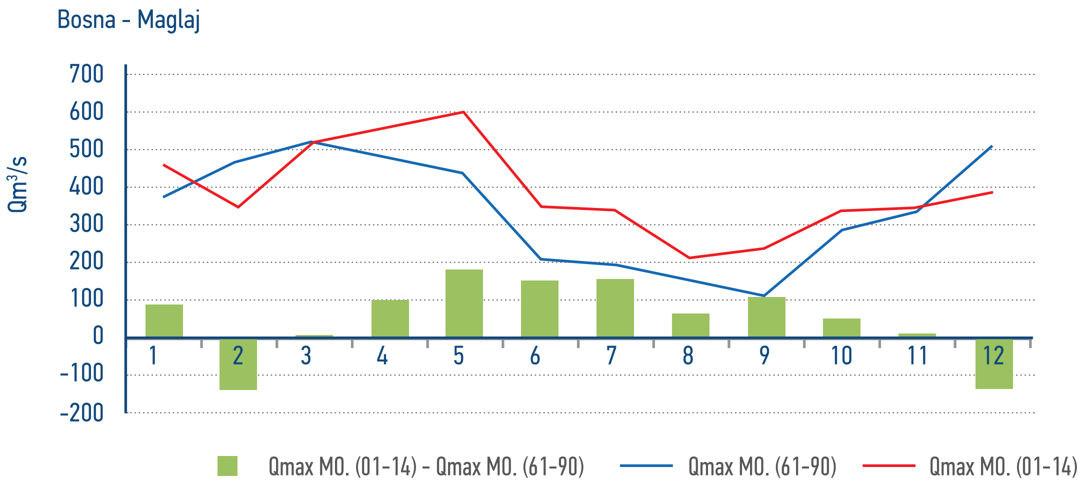


Chart 33: Difference of maximum monthly flows (ΔQ^{max}) of Bosna River in Maglaj for different periods of processing.

Analysis of the flow of Bosna River in Maglaj shows no significant changes in the values of mean monthly flows. Trend analysis of monthly precipitation in the period 1961 – 2014 (obtained as the average value of monthly precipitation on MS Sarajevo, MS Zenica and MS Tuzla), as well as the mean monthly flows of the Bosna River in Maglaj for the same period, does not indicate a significant trend change.

From the statistical analysis of monthly maximum and monthly minimum flows of the Bosna River in Maglaj in two periods, 1961 – 90 and 2001–2014, an increase in the standard deviation, variance, kurtosis, skewness and scope can be observed; all these are statistical parameters which indicate greater severity of extreme events – maximum and minimum flows, Table 33.

[35] *Maximum registered flows of Bosna river in Maglaj in 2014, by months*

Statistical parameter[37]	Bosna – Maglaj			
	Maximum monthly flows (m^3/s)		Minimum monthly flows (m^3/s)	
	1961 – 1990	2001–2014	1961–1990	2001–2014
Mean value	345.07	395.18	64.19	59.20
Median	262.43	265.82	55.46	46.54
Stand.dev.	322.60	432.93	41.01	50.56
Variance	104,075.67	187,429.40	1,682.23	2,556.48
Kurtosis	5.77	18.70	1.20	17.50
Skewness	2.05	3.41	1.22	3.35
Range - scope	2,150.25	3,554.85	204.61	410.98
Minimum	26.7	24.14	11.77	15.16
Maximum	2,177	3,579	216.38	426.14

Table 33: Statistical parameters of sequences of maximum monthly flows of the Bosna River in Maglaj, for different periods

In general, out of the current analysis it can be concluded that no significant changes in the value of the quantity of waters can be observed at the level of average values. This should be taken with a grain of salt, given the data availability. For Sava River basin, although the length of the post-war sequences is in increase (conclusive with 2014, the length of the sequence is 14 years), these are the sequences that are relatively short for analyzing trends. Statistical parameters show the frequency of extreme values. For the Adriatic Sea basin, situation for the estimate is worse, because there is not a single sequence suitable for the analysis. Analyses of the maximum and minimum monthly flows show changes in the characteristics of the sequences from the period 1961–90 and 2001–2014, through increased deviation from the mean value, and the increase in the difference between the minimum and maximum values within the analyzed sequence.

2.3.2.7. Climate change impact and recurrence intervals

In practice, for the purpose of sizing various structures, benchmark values of high waters are being determined by defining the maximum flows and shape of hydrograph of a large flood wave that corresponds to a probability of occurrence or the return period. The data on maximum annual flows are being analysed and the analysis of such data are based on the practical application of the theory of mathematical statistics and the theory of probability of occurrence. In general, the results of processing depend on the input values of the flow sequence, therefore the analysis of the probability of flooding at the gauging station Maglaj is presented below, for different periods. According to the diagram from the period 1961–1990 (Chart 34), floods of May 2014 have more than thousand-year return period, and according to the diagram, which covers the period 1961–2014 (Chart 35), the probability of flooding from 2014 has a return period slightly more than hundred years. Change in the frequency of extreme hydrological phenomena is reflected in the criteria for sizing of the hydraulic structures: for example,

[37] *Variance, kurtosis and skewness are dimensionless statistical parameters*

levees are sized to the emergence of 100-year high water, cascades of dams are sized for high water that might occur once in 1,000 years, and as for embankment dams even stricter criterion is applied (10,000 years).

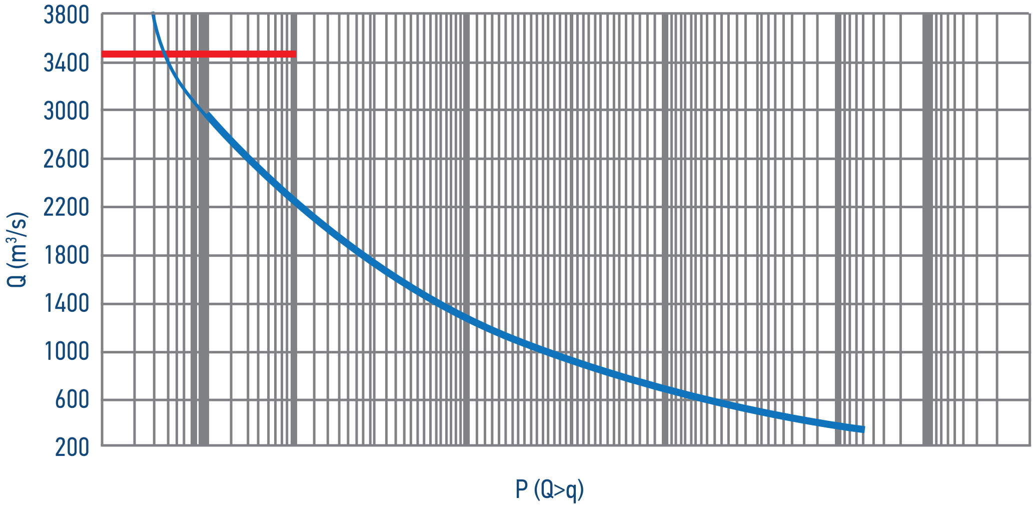


Chart 34: Probability of occurrence of maximum annual flows of the Bosna River at the gauging station Maglaj, (1961 – 1990). Red color –maximum flows in May 2014

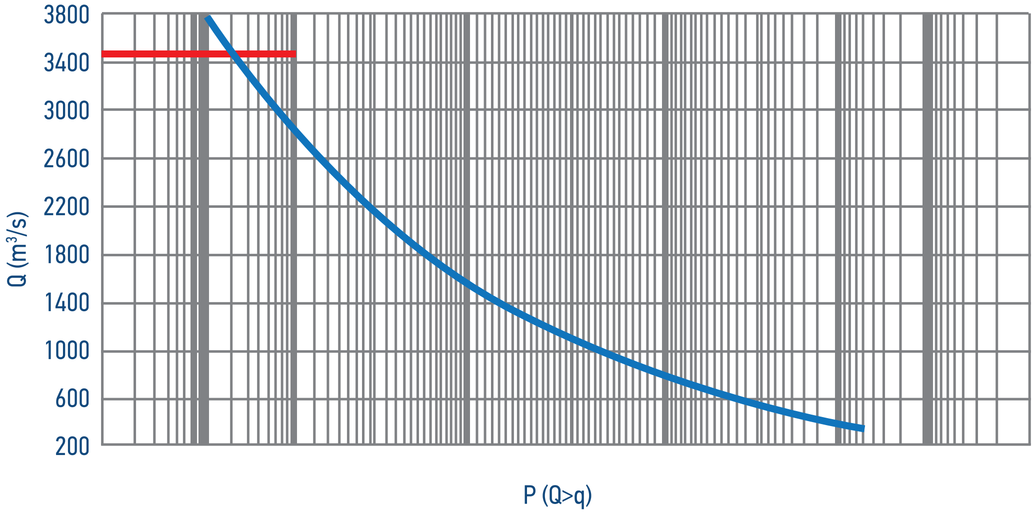


Chart 35: Probability of occurrence of maximum annual flows of the Bosna River at the gauging station Maglaj, processing period 1961 – 2014. Red colour is used to mark maximum flow of May 2014.

2.3.3. Climate change impact on forest ecosystems

Bosnia and Herzegovina falls under the group of European countries that are rich in forest resources in terms of their distribution and biodiversity. The fact that according to the latest survey over 60% of the territory of BiH is covered with forests indicates their importance in ensuring multiple benefits, and thus in the context of climate change (unpublished results of the II National Forest Inventory, 2012). The richness of diversity is reflected in the large number of plant and animal species in the region (around 4,500 higher plants, 600 taxa of mosses and around 80 ferns, around 250 species of forest trees and shrubs - Brujić 2011), which puts BiH high on the list of the most interesting countries in Europe. This remarkable diversity ensures for the forest ecosystems a better starting position for adaptation to climate change, but at the same time there is a risk of loss of rare and unique species.

BiH has an extremely high level of diversity of habitats, i.e. the geological diversity. A contributing factor is very specific orography, geological structure, hydrology and "eco-climate". Centuries of coexistence and a broad range of interactivity between biological and geological diversity, adding the anthropogenic impact, are best reflected in the extremely high diversity of landscapes throughout Bosnia and Herzegovina.

In terms of composition of the species in the forests of BiH, it is dominated by: beech forests with about 31% of the share, followed by sessile oak forests with the share of 14% and Pedunculate oak with 2%, thermophilic oak forests with 17%, willow, poplar and alder forests with 1%, followed by coniferous forests, mixed coniferous and broadleaves forests with 23%, while pine forests make around 7%. The other are mostly planted indigenous (4%) or non-native species (1%). Despite the fact that most of the forests are "commercial" in nature, the role played by forests for conservation of biodiversity in BiH is enormous.

In terms of the ownership structure, according to the latest data from the Second National Forest Inventory in BiH, out of the total area of forests and forest land, 70% of the area is owned by the state, which is managed by the Public companies, while 30% is privately owned.

Although lacking significant participation in GDP, the forestry and wood industry is an important economic and, above all, natural resource of Bosnia and Herzegovina. The share of the forest sector in total employment is greater than its share in GDP (in RS 6.5% and in FBiH 4.6% in 2008). Although the share of forestry in GDP in BiH in 2010 amounted to only 0.83%, this economic activity is of strategic importance because of its export orientation and job creation. State forests are managed by public companies at the entity level, which are controlled by the relevant ministries and entity parliaments. The legal and institutional framework covering forestry is structured through two entities.

As a consequence of global warming, more frequent occurrence of extremes are expected through climate change, threatening the functioning of forest ecosystems. Introduction of species from drier and warmer climate regions is one of the options under consideration so as to adapt the forest ecosystems to the adverse effects of climate change. High-level genetic diversity of some species, and thus the potentials in differences in tolerance to climate change, set aside some species that have priority in terms of adaptive capacity. However, it is necessary to evaluate the response of different species and their provenances to climate extremes and identify appropriate populations or ecotypes that are better suited to the projected climate change.

In Bosnia and Herzegovina there are no permanent measuring stations that are used for monitoring and tracking changes and reactions of the most important forest ecosystems to climate change. In the institutional framework there is an evident lack of integration of problems and issues of climate change in the policies and strategies on forestry, as well as lack of coordination among managers and beneficiaries of forest resources.

Based on the assumed climate change models, a comparison was conducted with known, general data on climate parameters for particular forest communities (Bertović, 1975). Currently, average temperatures in different forest ecosystems in BiH range from beech forests in the Dinaride range (with average annual temperatures of 7.2 to 7.7°C) to the stands of downy oak and hornbeam (with average annual temperatures of 12.7 to 13.5°C). In addition, Table 34 provides an overview of average annual temperatures at individual locations from the lowest to the highest within 4 ecological-vegetation areas.

Area	Mean annual air temperature[°C]		Mean annual precipitation [mm]		
	min	max	min	max	IV-IX
Pre-Pannonian area	9,6 (Tešanj)	10,9 (Modriča)	831 (Gradiška)	1.139 (Sanski Most)	457-613
Transitional Illyrian-Moesian region	4,8 (Vrelo Prače)	11,2 (Brčko)	719 (Višegrad)	1.147 (Čajniče)	373-579
Areas of internal Dinarides	1,3 (Bjelašnica)	10,7 (Bihać)	804 (Sokolac)	1.787 (Vaganj)	416-711
Mediterranean	6,0 (Čemerno)	15,0 (Čapljina)	1112 (Prozor)	1.951 (Ljubinje)	364-658

Table 34: Average annual temperatures and precipitation amounts at the measuring stations with the lowest and highest values within the four ecological-vegetation areas (Stefanović, et al, 1983).

	2011 – 2040		2041–2070		2071–2100	
	temp	precip.	temp	precip.	temp	precip.
RCP8.5	+1.6 do +2 °C	+5%	+3 to 3.2 °C	-10 %	+5.2 to 5.8 °C	-10 to -20 %
A2	0.8 do 1°C	+5 %.	1.8 to 2.4°C	-10 %	3.8 to 4.2°C	-10 to -20 %
A1B	0.8 do 1 °C	From -5 to -10%	2 to 2.4 °C	From -5 to -10%	3.4 to 3.8 °C	From -5 to -10%

Projected scenarios

This range shows that the RCP8.5 scenario for the end of this century with the forecasted increase of average temperatures from 5.2 to 5.8°C would be close to the currently existing average temperatures for extremely different forest communities and it exceeds differences in extreme values within certain ecological and vegetation areas. The assumed changes in forest ecosystems indicate that drastic changes would occur even in the mildest scenario A1B. The majority of forests characteristic of the mountainous (Dinarides) regions would evolve into forests of mountainous beech. In the A1B scenario at the end of this century, dominance is expected from the thermophilic forests of the sessile oak with hornbeam, the downy oak and the Holm oak. Model A2 leads to the total devastation of forest ecosystems and the formation of sub-Mediterranean and Mediterranean forest communities. Generally speaking, the proposed scenario would have unforeseeable (unthinkable) consequences for forest ecosystems in BiH. It is hard even to imagine the consequences the RCP8.5 scenario would have on forest ecosystems, which realistically calls into question even the possibility of occurrence of events foreseen under this scenario.

The possibility exists that climate change will affect forests in BiH in a manner that could potentially transform entire forest systems over time, shifting their distribution and composition. This carries a burden of socio-economic and environmental consequences. The climate change that has occurred will not have the same impact on all forest ecosystems throughout Bosnia and Herzegovina. In support of this argument goes the fact that survival of the forest community is not linked only (or exclusively) to the average annual temperature in the area where the community appears, which means that the increase of average annual temperature will not be the only factor affecting the change. In addition to average annual temperatures, other important elements include distribution and intensity of precipitation, which should be analyzed together and in interaction with the increase in average temperatures, as well as with a series of other factors that appear in immeasurable periods and with immeasurable intensity. Taking into account the developed scenarios it can be concluded that changes in precipitation (+5 to -10%) would not have had such drastic impact as in the case with the predicted changes in average annual temperatures.

The fact that has already been proven on the basis of research in the world is that each region for which the changes are predicted should be analyzed individually. This means that it could be expected that regions in which changes are not predicted would not see the changes in structure of forest ecosystems. Not all communities will react in the same way (some are located on higher altitude, deeper pedological profile, greater number of species and individuals, some are less sensitive, i.e. formed by more tolerant varieties, etc.), meaning that each community's reaction should be analyzed separately. Varieties located in the centre of their natural habitat will be more tolerant to climate change, while those near the edges (marginal populations) will be very vulnerable. Also, succession of varieties (their evolution) and a change of communities' structure are linked to the natural regeneration of forests and are defined by the age of the trees. In some varieties (such as oaks) this is more than 100 years, and in some varieties it is unrealistic to expect changes of the existing vegetation for the period shorter than one century (except in events of natural disasters). Finally, a series of other factors that affect the changes of forest ecosystems (changes in soil structure, changes in genetic resources and diversity, adaptability of species, etc.) must be taken into account in all changes and shifting of forest communities.

In addition to the aforementioned threats, another significant threat to forest ecosystems is caused by increase in occurrence of forest fires. Increased risks of forest fires caused by increases in temperature and changes in patterns of precipitation are expected in some parts of BiH, which implies the need for expansion of fire protection capacities. All these aspects (weather, vermin, pathogens, fires) may, in a long term, cause lower productivity and poorer health status of forests in BiH.

In summary, available data and research indicate that climate change represents a threat for all four macro-regions in BiH (ecological-vegetation areas). The Dinarides Region will be under particular threat, as a very important and rich centre of endemic species in Balkans. Threats imposed to this rich flora and fauna by a wide range of different human activities are numerous. One of many significant consequences of global warming for ecosystems will certainly be a shifting of water supplies and distribution of agricultural pests and diseases. Penetration of allochthonous species will continue, and those more aggressive types can extrude the autochthonous species from their natural habitats. It is currently not possible to make a precise prognosis of successful adaptation to a life in new habitats created by climate change.

Significant changes are expected in lineages that inhabit mountainous regions of Bosnia and

Herzegovina, in northwest migrations of wood species in the direction of the Dinarides, with possible local depletion of flora. It is feasible to expect reduction in number of herbaceous species of a narrow ecological valence in highest mountainous regions that will not be able to adapt their habitats fast enough. Also, it can be assumed that the most affected regions will be the high mountains in Bosnia and Herzegovina at approximately 1,500 m altitude, which corresponds to the border of sub-alpine belt.

2.3.3.1. Adaptation opportunities

In terms of climate change and the consequences for forestry in Bosnia and Herzegovina, it is possible to implement a wide range of practices, such as improvement in silviculture practices, as well as sustainable management practices, promotion of genetically superior planting material, enlargement of the system for the management of protected areas, substitution of fossil fuels with bio-energy, more efficient protection of forests against fire, diseases and pests, more efficient processing and use of forest products and monitoring of area and growing status of forests, particularly under afforestation practices of bare lands.
Human resource development and strengthening organizations in governmental institutions for research, which are focused on assessment of impact/vulnerability of climate change in terms of the forest sector could lead to the inclusion of these aspects in policy making. It is necessary to assess in detail the ecological, social and economic impacts of climate change on forest ecosystems. This could indirectly contribute to progress on issues such as the establishment of mixed stands, use of indigenous species, selection of more tolerant genotypes, support to natural forest dynamics and encouragement and promotion of biodiversity. This could lead to raising awareness, distribution of information, cooperation among sectors and greater involvement of the forestry sector in adaptation and mitigation aspects of climate change.
Negative consequences of extreme climate change in forests and forest ecosystems are more difficult to identify. Their detection requires long-term research and monitoring activities. That is the only way to determine and identify the cumulative effects of temperature and precipitation. Equally important are forest locations, such as geographic and climate zones.

As the most important factor in the field of forestry in terms of the ability to mitigate the effects of climate change is certainly the increase of forest area. This activity is implemented in two ways:
- direct increase of the surface on bare grounds and clearways (the areas on which in the past 50 years there were no forests – afforestation)
- afforestation of shrubbery, abandoned land, degraded forests and similar (the areas on which in the past 50 years there used to be forest vegetation – reforestation).

Reforestation practices are important in order to decrease erosion processes and regulate the water regime, apart from the storage of CO_2. This practice should take into account which varieties should be used, which are indigenous for that area and how the planted varieties will be affected by future climate regimes, thus selecting the ones that are most suitable. The establishment of forests with varieties and ecotypes more tolerant to higher temperatures and changed regime in precipitation and return of vegetation in degraded and barren areas should imply a planned approach with new or increased funding mechanisms. Promoting carbon sequestration through forestry practices should be increased, especially in areas where there is an extremely low level of carbon in the soil, and where there is the potential for afforestation.

Frequent forest fires reduce productivity in the forestry sector and wood processing industry, which directly affects the socio-economic situation. High temperatures increase the vulnerability of forests to forest fires, droughts and floods. Bosnia and Herzegovina must implement measures that will reduce vulnerability to climate change. Adequate legislation based on EU practice should be adopted together with the programme of long-term forestry development harmonized with the Ministerial Conference on the Protection of Forests in Europe (MCPFE). This requires better forest inventories and databases, management, monitoring and sustainable financing of the revitalization of forests and forest ecosystems, afforestation, cultivation and protection.

The establishment of intensive plantations with the selected clones (fast-growing species) can significantly contribute to the adoption of the CO_2 in the forestry sector in BiH. Production of biomass from 20-40m^3/ha per year is possible with carefully selected clones on the suitable surfaces. This would at the same time intensify activities to increase biomass and the possibility of using it as a substitute for fossil fuels.

During 2014 significant direct damages were identified (accurate assessment has not been performed) during the several months of precipitation as a consequence of landslides. Many valuable facilities were completely destroyed within these micro-sites. One of the best measure of protection is establishing forests in these areas, which would be implemented through the system of anti-erosion reforestation (combination of selected species and the systems of technical and technological solutions).

Protected areas comprise an extremely small size of the territory of BiH and they are one of the smallest in the regional data assessments. Therefore, it is necessary to urgently consider the measure of enlarging these areas, with a significant review of the climate impact factors that will identify new areas for consideration. This calls for an assessment of capacities of forestry experts to manage these areas and increase the integral concept of forest management with monitoring measures.

2.3.4. Climate change impact on biodiversity

The vulnerability of ecosystems to the effects of climate change has increased because of their impaired condition, fragmentation and various anthropogenic impacts. Through the national reports of BiH on climate change and biodiversity protection it was pointed out that climate change is one of the factors of compromising biodiversity.

The impact of climate change on different ecosystems is expressed through a range of effects, whereby the actions are complex and are often in synergy with other factors. Climate change, through the joint action with other factors, significantly affect the time of occurrence and duration of the individual seasons, which to a large extent has effects on the length of the growing period and the timing of certain phenophases. Climate change manifest their effects on plants and plant communities, which in the first place can be noticed through the changes of phenophases. They exert their effects in terms of all aspects of biodiversity, through changes in the distribution of populations and species, as well as in functioning of ecosystems.

In the Initial and Second National Communication of Bosnia and Herzegovina under the UNFCCC, sensitive areas have been identified, which are exposed to strong pressure of changing climate.

In addition, the strategy and action plan for the protection of biological and landscape diversity (2014) present the landscapes highly sensitive to climate change with the dominant ecosystems: high mountain landscapes, mountain landscapes, relict-refugial landscapes. Apart from those mentioned, the ecosystems situated in karst landscapes are also very vulnerable to climate change, and at the same time they are also strongly affected by other anthropogenic pressures. Among these, the wetlands of karst fields are particularly sensitive.

A special feature of karst areas are endemic species that can be found in a very limited area of distribution, which, in addition to the contribution of other factors, is one of the main reasons for their vulnerability (Dekić et al., 2013). It is expected that climate change will significantly affect biodiversity in a way that 15-37% of terrestrial species will eventually become extinct as a result of climate change in the next 50 years (Thomas et al., 2004) and the same trend will be reflected in cases of freshwater species (Xenopoulos, 2005).

As a result of climate change, in interaction with other factors that affect disruption of biodiversity a shift in vegetation zones is expected, as well as changes in the functioning of ecosystems, fragmentation of habitats and extinction of some species. Strategy and Action Plan for the Protection of Biological and Landscape Diversity (2014), stated the data that during 2013 intensive drying of individual trees of spruce, fir, white and black pine, juniper was observed, and the cause was considered to be climate change and other anthropogenic impacts.

Aquatic ecosystems are very sensitive to global climate change. Increased temperatures and extended growing season of vegetation can lead to increased production of macrophytes, the elimination of many fish species and invading species that tolerate low oxygen content in the water.

It is believed that the species will migrate to higher altitudes and latitudes, depending on their thermal preferences. In parallel, through the effects on ecosystems different effects are exert on populations of plants and animals in these ecosystems, with changes in physiological processes at the level of the organism. Changes in the speed of physiological processes are primarily related to poikilotherms, which do not have the ability to regulate body temperature.

Temperature is one of the most important environmental factors that affect all living beings, and the impact of which is especially pronounced in poikilotherms. It affects a variety of physiological processes in the body by changing the speed of their action.

The effects of increasing water temperatures can affect individuals by altering their physiological functions and the ability to maintain internal homeostasis in the face of a variable external environment (Roessig et al, 2004).

The factors that cause stress condition in fish are naturally associated with changes in physical, chemical and biological factors of the aquatic environment which affects the increased susceptibility of fish to diseases (Kubilay, Ulukoy, 2002). Climate change also lead to the following changes in abiotic factors: increase in water temperature, increase in the concentration of CO_2 in the water, decrease of the concentration of O_2 in water, acidification of watercourses.

Response of the freshwater ecosystems to the changes must allow for the interaction between climate change and many stressors that already now affect the rivers, lakes and swamps. These include watercourses management, eutrophication, acidification, toxic substances, hydro-morphological changes, habitat changes and invasive species.

In colder areas the following changes are expected: increased production due to the extension of the growing season of plants, increased release of nutrients from the soil, decrease in the population of stenothermal species and alterations of trophic relationships. In moderate and warm regions increase of eutrophication problem is expected. In the lakes there are usually algal blooms, long periods of summer stratification with the reduction of oxygen in the hypolimnion and the release of phosphorus from the sediment.

The potential consequences of climate change also include shifting of the spawning period and egg hatching earlier during the year. For example, European perch (Perca fluviatilis) would be likely to spawn even a month before the spring, whereby the juveniles will have the extended growing season. It is very likely that the high temperatures of incubation will cause emergence of larvae of small dimensions with smaller yolk-sac and the increased rate of metabolism.

This further implies that small larvae are susceptible to predators, they have higher rate of metabolism and their time to adapt to the feeding in the environment is reduced. Higher winter survival rates lead to greater demand for prey, therefore most scientists agree that the body size of fish will significantly shrink.

Zander (*Sander lucioperca*) is eurythermal specie widely spread in Europe, whose reproductive success and growth rate depend on the water temperature. Current distribution areal is likely to move to the north. Abundance increase will cause changes in the competitive relationships of residents of northerly habitat because it is questionable whether the productivity of watercourses will be able to provide enough food for newly arrived representatives of the family Percidae (Wrona et al, 2010).

Synergistic effects of climate change with other factors is also impacting the endemic ichthyofauna. Some of the endemic fish species are exclusively linked with the karst areas, and this category also includes minnow. The term minnow covers several fish species of the karst area waters, which are characterized by a specific way of life because they spend a part of their life cycle in the underground lakes of karst caves, and when in certain hydrological stages water pours in the flood zones, minnow appears in the surface water. In our waters in Eastern Herzegovina the presence of the following species of minnow has been identified: Telestes metohiensis (Steindachner, 1901), Telestes dabar (Bogutskaya, Zupančič, Bogut, Naseka, 2012) and Delminichthys ghetaldii (Steindachner, 1882).

Figure 7: minnow-Telestes metohiensis

Figure 8: minnow-Delminichthys ghetaldii

These species are on the Red List of Threatened Species of Republika Srpska, and according to IUCN Telestes metohiensis and Delminichthys ghetaldii are in the category of vulnerable (VU). In addition to the aforementioned, other endemic fish species can be also found in our waters.

2.3.5. Climate change impact on tourism

Climate change is having an increasing negative impact on tourism development. In the case of winter tourism, the negative effect on development concerns the lack of precipitation in the form of snow. This phenomenon was registered back during the late eighties in the Alps. It was accompanied by problems related to a decreased income from winter tourism, increased investment activities, increase of employment in tourism and so on (Elsasser & Messerli, 2001).

Studies conducted so far indicate that climate change, accompanied by reduced amount of snowfall, reduced duration of snow cover, increased average and especially daily winter temperatures, will increasingly represent a factor of tourist traffic in winter tourist centers of Republika Srpska and Bosnia and Herzegovina. In order to reduce or possibly completely eliminate the negative impact of global climate change on winter tourism development, relying on winter sports, it will be necessary to ensure adequate snowmaking in all tourist centers which, with regard to the tourism infrastructure and suprastructure, seriously count on this type of tourism. However, sustainable tourism of winter tourist centers of the RS and BiH, regardless of the nature of climate change and the possibility of overcoming problems of this kind, already at this stage requires and will increasingly require alternative forms of tourist offer throughout the year. Practically, a better quality and eventful tourism product is necessary in all winter tourist centers in BiH.

2.3.5.1. Some indicators of tourism development

The number of arrivals and overnight stays of domestic and foreign tourists in Republika Srpska, generated in the period from 2003 to 2013 has significantly grown. Tourist arrivals increased from 152,441 in 2003 to 253,653 in 2013 (Institute for statistics of RS). In the observed period, which is of particular importance, the arrival of foreign tourists has doubled. Overall, the number of arrivals in all tourist places has been on the rise, especially in the category of other tourist places. Practically, it is about the increasing number of tourist arrivals in the urban centers and in differently categorized accommodation facilities outside of urban areas. Similar situation to the trend of arrivals is in the number of overnight stays. The total number of overnight stays increased from 391,995 in 2003 to 629,663 in 2013 (Institute for statistics of RS). In the same period, the number of overnight stays of foreign tourists increased from 121,107 to 273,936, and in the case of domestic tourists from 270,888 to 355,727 (Institute for statistics of RS).

Tourist arrivals and overnight stays vary by type of tourist resort (spa centers, mountain resorts, other tourist resorts and other places). The highest number of tourist arrivals in tourist places was achieved in the summer months, in May and June, while the least arrivals were recorded in January and February. In fact, in 2013, mountains were visited by a total of 41,902 tourists, or 16.51% of the total number of tourists in Republika Srpska (Institute for statistics of RS). In terms of the number of overnight stays 121.412 overnight stays were recorded in mountain regions, or 19.28% of the total number of overnight stays in Republika Srpska (Institute for statistics of RS). Increased share of tourists in the summer period is generated through spa tourism (health and congress), as well as in transit tourism and tourism of other tourist places. Analogous to the number of arrivals, the maximum number of overnight stays was generated in August for most of the years under review, while the minimum number of overnight stays was generated in the winter months, November, December, January and February.

Year	Arrivals			Overnight stays		
	Total	Domestic	Foreign	Total	Domestic	Foreign
2009	333	122	211	684	231	453
2010	407	142	265	819	262	557
2011	436	146	290	870	270	600
2012	496	164	332	998	320	678
2013	577	166	411	1135	309	826

Table 35: Arrivals and overnight stays in the Federation of BiH for the period 2009–2013 (in thousands)
Source: Federal Institute for Statistics (2014): Statistical Yearbook of the Federation of BiH, Sarajevo

Federation of Bosnia and Herzegovina, in the observed period, records a steady growth of tourist traffic, and the number of arrivals and overnight stays. In the structure of arrivals there is a predominance of foreign tourists.

In the observed period, 2009–2013, the average stay of tourists in the tourist places of the Federation of BiH shows almost no change. The longest stay of tourists was recorded in Neum, which suggests that it is a place with the most important tourist function in Federation of Bosnia and Herzegovina.

In the structure of arrivals and overnight stays of tourists in the Federation of BiH, according to the type of tourist resort, Sarajevo dominates. More than half of the total number of arrivals and overnight stays is linked to this city.

2.3.5.1.1. Correlation between climate elements and number of overnight stays in the case of Jahorina

The number of arrivals, the number of overnight stays and average stay of tourists in winter resorts, as the analysis showed, are directly dependent on the quantities of snow and the length of its duration. In other words, winter tourism is correlated with the number of ski days.

Season 2008/2009	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Σ
Number of skiing days		13	31	28	31	8	111
Total skiers		9.411	36.373	32.943	14.878	309	93.914
Average number of skiers per day		724	1.173	1.177	480	39	846
Achieved daily max.			2.616				
Revenues in KM (VAT)	-	-	-	-	-	-	2.030.726

Season 2009/2010	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Σ
Number of skiing days		4	26	28	29		87
Total skiers		474	27.108	38.112	17.781		83.475
Average number of skiers per day		119	1.043	1.361	613		959
Achieved daily max.				3.551			
Revenues in KM (VAT)	-	-	-	-	-	-	1.920.067

Season 2010/2011	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Σ
Number of skiing days		6	31	28	29		94
Total skiers		1.071	19.577	33.248	18.203		72.099
Average number of skiers per day		179	632	1187	628		767
Achieved daily max.				3327			
Revenues in KM (VAT)	-	-	-	-	-	-	1.490.051

Season 2011/2012	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Σ
Number of skiing days		12	31	29	31	13	116
Total skiers		6.964	49.271	41.562	24.684	429	122.910
Average number of skiers per day		580	1.589	1.433	796	33	1.060
Achieved daily max.				**3.343**			
Revenues in KM (VAT)	-	-	-	-	-	-	**2.404.068**

Season 2012/2013	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Σ
Number of skiing days		23	31	28	31	13	126
Total skiers		15.418	55.854	51.390	27.020	698	150.380
Average number of skiers per day							1.193
Achieved daily max.					**3.697**		
Revenues in KM (VAT)	-	-	-	-	-	-	**3.204.029**

Season 2013/2014	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Σ
Number of skiing days		23	19	9	15		66
Total skiers		3.791	6.409	2.889	7.581		20.670
Average number of skiers per day							313
Achieved daily max.			986				
Revenues in KM (VAT)	-	-	-	-	-	-	**568.429**

Table 36: No. of ski days, the total number of skiers and max. no. of skiers in one day in a tourist complex Jahorina, in the winter season for the period 2008/09 – 2013/14
Source: Lazarević, V., Đogo, M., Brčkalović, G., Maletić, M., Ćosović, N. (2014) Analysis of the OC Jahorina as at 31 March 2014 with a proposal of measures for overcoming the crisis. Pale: AD OC Jahorina

From the table above we can notice that the largest number of skiing days was recorded in 2012/2013 season (126), and the lowest in the season 2013/2014, in which the season lasted only 66 days. Presented indicators are correlated with the generated tourist traffic. In fact, revenues generated during the tourist season 2013 – 2014, compared to 2012/2013, due to the aforementioned reasons, are even six-fold lower.

Practice has shown that climate change (increase in average and extreme temperatures), alteration of the regime and spatial distribution of precipitation (decrease in precipitation in the form of snow, decreasing precipitation in mountain resorts below 1,800 meters above sea level), have a negative impact on tourism development, especially winter tourism. For these reasons, in order to support the sustainability of this type of tourism, it will be necessary to equip technically the well-established winter mountain tourist centers in Bosnia and Herzegovina so that the lack of snowfall is compensated by artificial snowmaking, unless this has been already achieved. On the other hand, for the purpose of the sustainability of tourism in the mountain tourist centers, regardless of whether it is winter or summer tourism, it will be necessary to enrich their tourist offer with new events. This calls for the alternative programmes in tourist offer and a range of incentives for their attainment, as well as very significant investments in programmes to improve infrastructure and suprastructure.

2.3.6. Climate change impact on health

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

The interaction between climate change and human health has an impact on the overall socio-economic situation and the standard of the population of Bosnia and Herzegovina, especially those with lower incomes. Although there are no precise indicators of the impact of climate change on human health, it can be assumed that any investments in adaptation to climate change in the economic, but above all in human terms are justified and cost-effective. It is necessary to focus more resources in the prevention of heat stroke, training and raising awareness of the population, as well as monitoring accompanied by scientific research. At a later stage it is necessary to make detailed cost-benefit analysis for this area, because it is beyond doubt that human lives are the most valuable. If the mortality from certain diseases in extreme climates is reduced only by 10%, investment in adaptation measures will pay off.

The impact of climate change on human health is not sufficiently explored. There are studies that show that there is the increased number of cardiovascular diseases during climate extremes. In the TNC it was established that there is an increased number of strokes per type of bleeding in the population of the municipality Laktaši in the months of July and August. Probably it is a population that is engaged in agricultural work and they are exposed to the direct effects of sun. On the basis of this result recommendations for this population can be obtained. However, to our knowledge, there are no studies that would analyze the connection of other diseases with climate extremes. The results of this study indicate relatively small sample and in future studies the period of research could be extended to greater number of years under review.

In future studies the connection between climate extremes and myocardial infarction, chronic obstructive pulmonary disease, patients with arrhythmias and patients with respiratory diseases should be examined. In addition, the attention should be paid to and a research should be conducted in terms of overall mortality during climate extremes and a distinction should be made in terms of which disease has the highest increase in mortality in our country. This research should be implemented also in future on the population of other cities and municipalities in Bosnia and Herzegovina.

As a result of this research we would get the conclusions that would enable us better recommendations for the adaptation of the population to climate extremes. These adaptation measures would be targeted and directed towards certain populations (e.g. people with chronic obstructive pulmonary disease or people engaged in activities in the open air), and then such recommendations would be translated into passing of the legislation that would regulate this area in terms of working hours and work commitments in the days of climate extremes.

In the analysis of data for Banja Luka and Laktaši by individual days and comparing the number of strokes with humidex values and degrees of comfort there was no statistically significant association identified between stroke and days with elevated humidex and degree of comfort. Looking at the data by month there are statistically significantly more strokes per type of bleeding in the months of July and August, but only for the municipality of Laktaši. This could be explained that this population works in the field and as such exposed to stronger influence of weather conditions. However, the absolute figures are low and new studies are needed in order to confirm or reject this conclusion. Despite the growing records and evidence, further research is required in terms of the adverse impacts of climate change on human health. It is certain that long-term adverse effects on human health resulting from climate change can be modified and reduced by the adaptation measures.

Researches in the region indicate that climate change will lead to changes in the distribution and increase the frequency of vector-borne infectious diseases (malaria, dengue fever, West Nile virus, etc.), as well as the spread of infectious diseases transmitted through water[37].

Based on the seasonal monitoring of the West Nile virus during the summer season in 2013, in Serbia there were 302 cases of infection with this virus. Presence of this virus can also be expected in the territory of Bosnia and Herzegovina.

Greater synergies are required among the institutions dealing with early warning system (Hydrometeorological Institutes) and public health (Public Health Institutes and medical facilities) during extreme weather events that are becoming more and more frequent (extreme temperatures, floods, air pollution, etc.).

One of the key issues is the lack of data and the lack of investigation by the respective branches of medicine where a significant impact of climate change is expected (cardiology, pulmonology, etc.). It is necessary to keep the public informed about the possible impact of climate change on human health, especially in extreme weather and climate conditions.

[37] *Assessment of vulnerability to climate change – Serbia, 2012, available at: http://d2ouvy59p0dg6k.cloudfront.net/downloads/cva_srbija_srpski.pdf*

3. ESTIMATING THE POTENTIAL FOR MITIGATING CLIMATE CHANGE IMPACT

The achievement of planned objectives and tasks in the field of climate change mitigation, contained in the Third National Communication of Bosnia and Herzegovina in accordance with the United Nations Framework Convention on Climate Change, is based on the results of the latest scientific research pertaining to the emission scenarios, potentials for climate change mitigation and mitigation measures that have been achieved at the international level and the level of Bosnia and Herzegovina.

The main documents containing and interpreting climate change impact mitigation measures, which to some extent served as a background to this document are the Initial and Second National Communication of BiH in accordance with the United Nations Framework Convention on Climate Change, as well as the first Biennial Report of Bosnia and Herzegovina on Greenhouse Gas Emissions in accordance with the United Nations Framework Convention on Climate Change.

In the TNC, the chapter dedicated to climate change mitigation contains a description and analysis of measures by individual sectors in BiH, mitigation scenarios for modeling possible pathways of greenhouse gas emissions by 2050 and a summary of activities, projects and initiatives that will contribute to mitigation, which are already underway or planned for implementation in the forthcoming period.

Specific modeling of quantitative evaluation of time-series GHG emissions considered three development scenarios: S1 – a baseline scenario ("business as usual"); Scenario S2 – assumed partial implementation of mitigation measures, and S3 – the advanced scenario (assumed implementation of a comprehensive set of mitigation measures). In considerations of the aforementioned emission scenarios, for 2013 the initial data were taken, while emission calculations were made by five-year periods from 2010–2050 (i.e. for 2010, 2015, 2020 ... 2050). Activities are further supported by organized data collection and more intensive involvement of the relevant state and entity ministries, Brčko District, as well as major public agencies in the overall operation.

An important novelty in relation to the SNC of BiH is the use of software for long-term energy planning, i.e. LEAP software (Long Range Energy Alternatives Planning System). Through the use this software the courses of development are modeled according to the aforementioned scenarios for the most influential sectors, i.e. energy sector, district heating, building and transport. Other sectors are modeled by tools already developed through SNC.

3.1. Electric power sector

3.1.1. The situation in the electric power sector of Bosnia and Herzegovina

Bosnia and Herzegovina (BiH) is an exporter of electricity. Total electricity generation in 2013 was approximately 17,451 GWh, while final consumption was approximately 10,933 GWh. Net export of electricity amounted to 3,695 GWh (Agency for Statistics of BiH, 2014). At the same time, electricity consumption per capita is relatively low (compared to European countries). Electricity consumption per capita in 2000 was 1,915 kWh, and in 2013 it reached 2,840 kWh, which exceeds the world average. Electricity consumption has increased in the period 2002 –2013 from 9,150 GWh to 10,933 GWh. However, consumption in 2013 was lower than consumption in 2011, when it was at 11,880 GWh.

In 2013, 9,846 GWh or 56.5% of electricity was generated in power plants using domestic coal and that have fairly high specific emissions of carbon dioxide (1.3 tCO_2/MWh). The rest of the electricity is generated mainly in large scale hydropower plants, with a minor contribution of small hydropower plants. The emission factor of carbon dioxide network is about 720 kg/MWh. A conservative estimate of the potential of renewable energy sources for climate change mitigation by 2025 amounts to 0.88 Mt for biomass, 0.11 Mt for water energy and 0.15 for wind.

According to the entity's strategic documents, domestic coal will remain the main source of electricity generation and the generating capacity could be increased more than two-fold. There are significant reserves of coal and it is the sector that employs a large number of people. However, the competitiveness of the existing and new coal-fired thermal power plants in BiH on the open market is very questionable. Therefore, in parallel with the construction of new and closure of existing units in thermal power plants, it is necessary to intensify capacity building using renewable energy sources. Given the potentials of BiH, the reference is primarily made to the hydropower plants, biomass power plants, and wind power and solar power plants.

After seven years from the completion of Energy sector Study in BiH and three years from the completion of the SCN it can be concluded that the forecasted growth of electricity consumption is not being met. However, due to the demand for electricity in neighboring countries, the movement in electricity generation in BiH is not conditioned by the movement in terms of domestic needs. All organizations dealing with electrical energy mainly continue with "business as usual", using the existing capacities with a slight increase in the share of RES from small plants. Under such circumstances, the carbon dioxide emission highly depends on hydrological conditions and dynamics of the maintenance of individual plants, which determines the ratio of hydro and thermal power plants in the total generation.

According to the Energy Community Treaty, by 2020 BiH has to achieve the share of renewable energy sources in total energy consumption by 40% (from the current 34%). This will contribute to reduction of greenhouse gases also in the electrical energy sector. Both entities have enacted laws on renewable energy sources and high efficiency cogeneration (in FBiH – Law on the use of renewable energy sources and efficient cogeneration, in RS – Law on renewable energy sources and efficient cogeneration) in 2013, which encourage electricity generation from RES. On the basis of the laws, the Entities have adopted Action Plans for renewable energy sources by 2020. These Action Plans define capacities of some renewable energy sources that will be encouraged by 2020 through the guaranteed purchase prices. It should be noted that the aforementioned laws and Action Plans came as a response to the commitments of BiH under the Energy Community Treaty. Given that the EU has already defined objectives pertaining to renewable energy sources, even beyond 2020, adoption of Action Plans in BiH in the field of renewable energy is expected also for the period beyond 2020, which will be along the lines of the defined objectives of the EU by 2030 and 2050. The goal is that in 2050 all the quantities of electricity are produced from renewable energy sources.

BiH has liberalized electricity market since January 2015. In the short term, market liberalization will not have a significant impact on reducing carbon dioxide emissions. The impact can be expected after 2020. Because of the slow progress towards the EU it is not realistic to expect that BiH will become a member of the EU ETS before 2020. In addition, the impact of the EU ETS on emissions of EU countries is almost negligible, because the current price of emission permits is very low, several times lower than the price that was expected in the third phase of EU ETS. Increase of emission permits was expected after reaching a global agreement on reducing greenhouse gas emissions, in December 2015, but due to missing of quantified emission reduction target, so far the price has not increased After entering the EU, ETS competitiveness of the coal-fired thermal power plants will drop significantly, and the funds collected from fees for emission permits will be used for the promotion of RES. Such situation will benefit the exploitation of the technical potential of RES in BiH which is given in Table 37.

RES	Technical potential MW	Annual generation GWh
Hydro energy	1.000	4.000
Wind energy	1.200	3.000
Solar energy	450	495
Biomass	800	3.200
TOTAL	**3.450**	**10.695**

Table 37: Potentials of RES in BiH for electrical energy generation (UNDP, 2013)

3.1.2. Overview of scenario of greenhouse gas emissions from the power sector in Bosnia and Herzegovina by 2050

With the aim of analyzing the movement of potential greenhouse gas emission reductions in BiH by 2050 (following EU Energy roadmap 2050), in the power sector three scenarios are analysed:

1. Scenario 1 (S1, “business as usual” – baseline scenario) – includes phasing out the operation of existing coal-fired thermal power plants (efficiency degree about 30%) due to the end of their lifetime. Out of 1,765 MW in the existing coal-fired thermal power plants, in 2030, 900 MW will remain in operation and by the end of the observed period, out of existing thermal power plants, 300 MW will remain in operation. In parallel with the termination of the operation of the existing blocks, construction of the new ones is foreseen with the new degree of efficiency of about 40%. The total capacity of new thermal power plants in 2030 will amount to 1,000 MW and by 2040 this amount will be 1,200 MW. In 2050, the capacity of new power plants will also be reduced because some of them will be shut down due to the end of their service life and the unprofitable return on investments in their revitalization. Although, in this scenario, electricity generation from coal-fired thermal power plants is growing, carbon dioxide emissions are not growing because most of the electricity will be generated from new, more efficient power plants.

Total production is on the rise from the initial 17,451 GWh in 2013 to 23,368 GWh, i.e. by about 34%. At the same time, carbon dioxide emission is dropping from the initial 10.67 million of tons in 2013 to 6.50 million of tons in 2050, i.e. by about 39%.

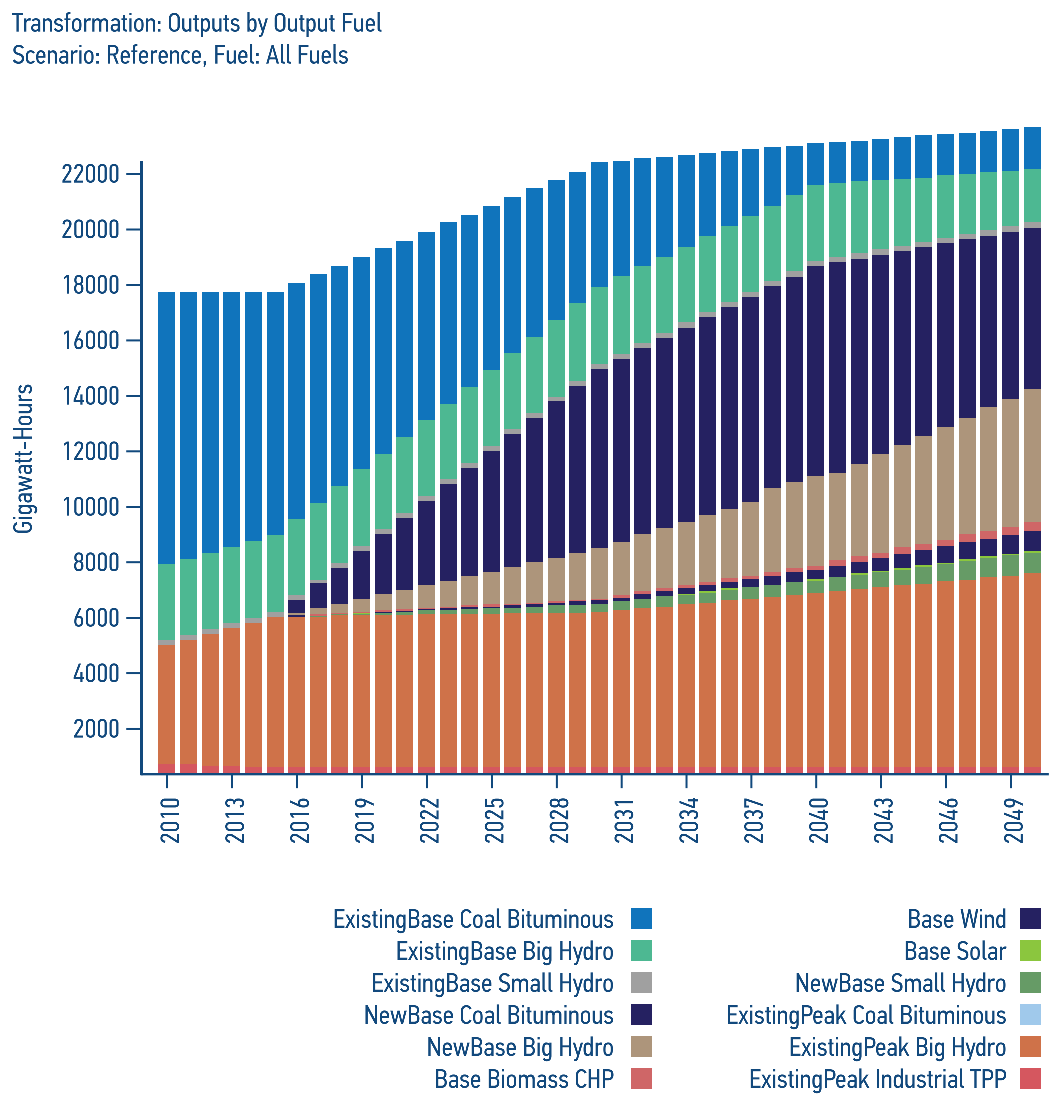


Chart 36: Electricity generation in BiH according to the reference scenario

In addition to the partial replacement of the existing thermal power plants with the new ones, more efficient, decrease of carbon dioxide emissions was also caused by the construction of new large hydropower plants that also play a role in the adaptation to climate change. By 2030, construction of 300 MW is envisaged in the new large hydropower plants, and 800 MW by 2050.

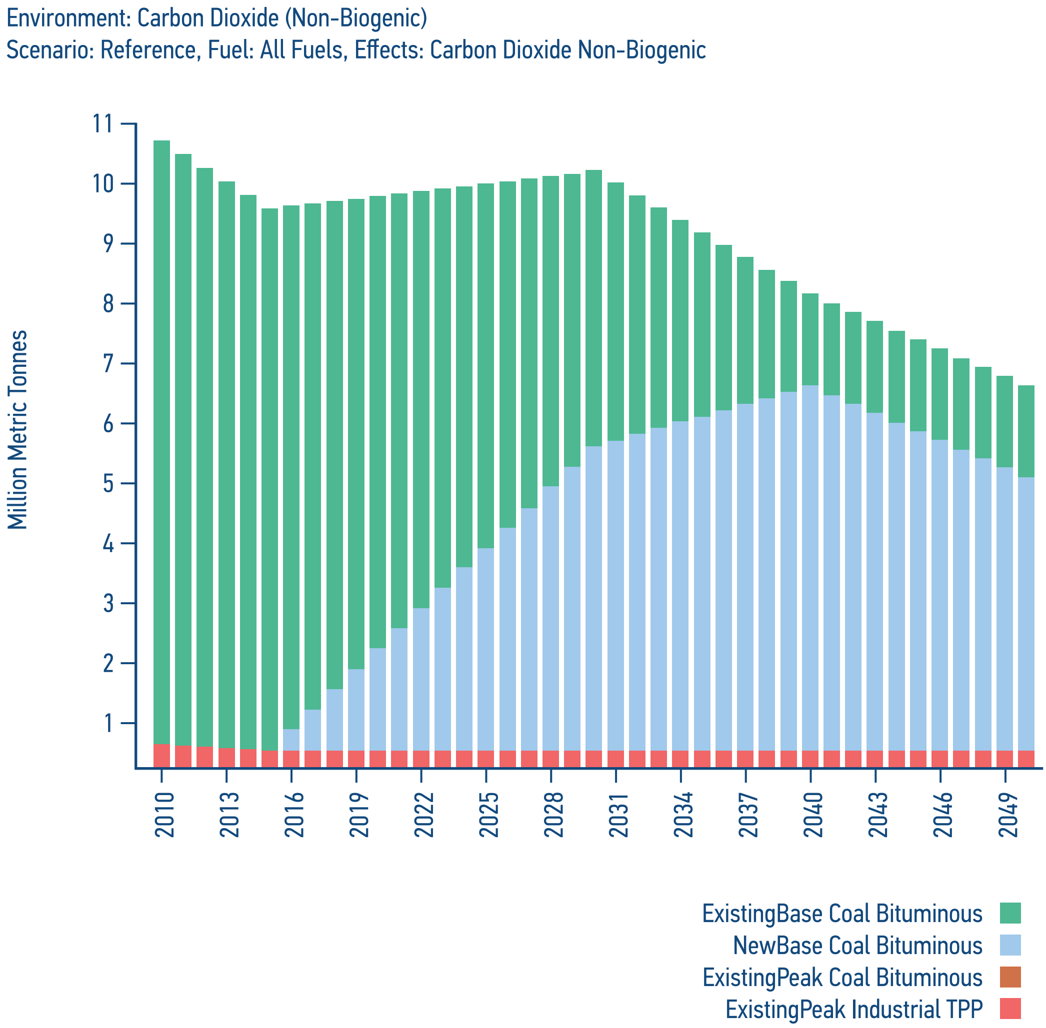


Chart 37: Carbon dioxide emissions from the power sector in BiH according to the reference scenario

Due to the learning curves, construction of power plants using other renewable energy sources is also expected. By 2050, a total of 40 MW is foreseen for biomass cogeneration plants, 300 in wind turbines, 40 MW in solar power plants and 250 MW in small hydropower plants.

2. Scenario 2 (S2, "moderate mitigation scenario") – this scenario envisages a faster phasing out of the existing thermal power plants from the operation due to the introduction of some of the mechanisms (open market, eliminating subsidies for electricity from fossil fuels, etc.) that result in reduced emission. In such circumstances, owners of the existing thermal power plants will be more focused on faster construction of new coal-fired power plants that will be substituted with the new ones and, moreover, to the more intensive construction of power plants using renewable energy sources.

Transformation: Outputs by Output Fuel
Scenario: Light Mitigation, Fuel: All Fuels

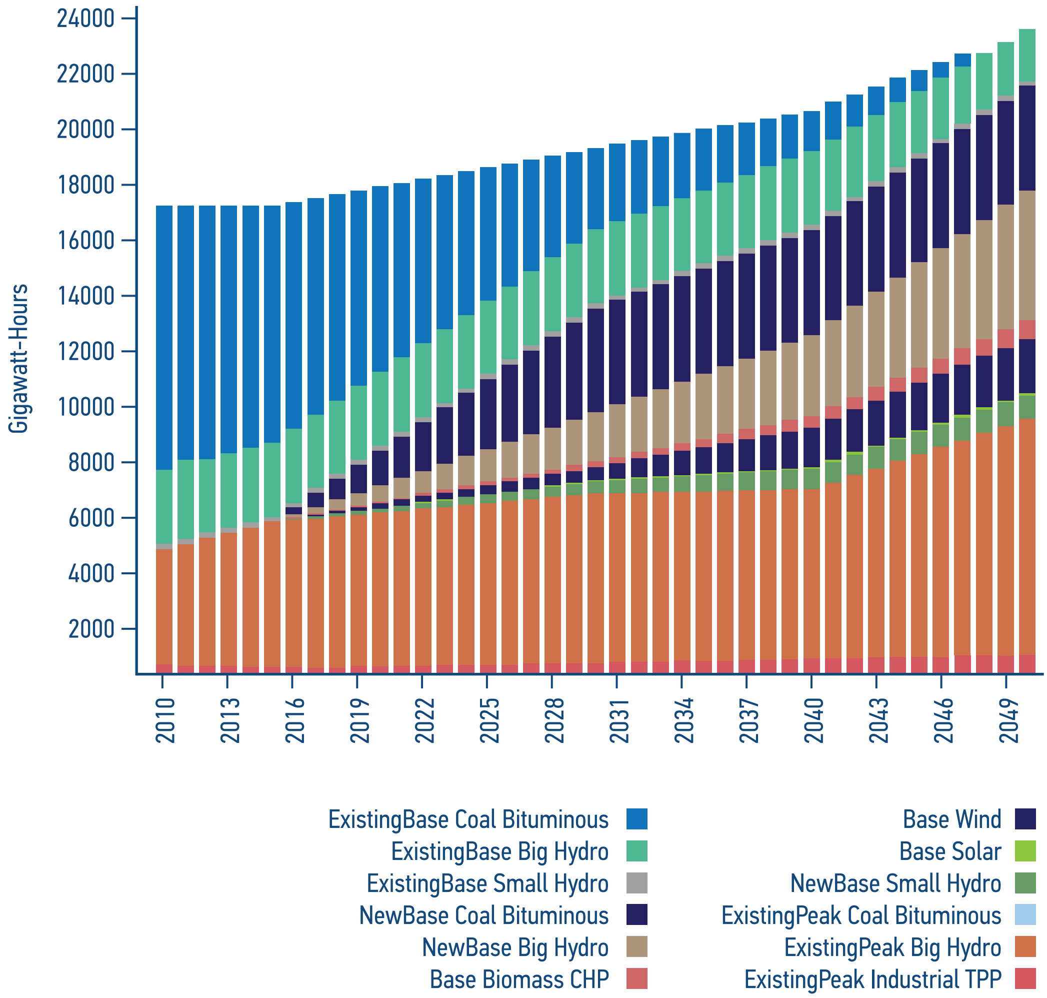


Chart 38: Electricity generation in BiH according to scenario S2 – moderate mitigation scenario

By 2030, about two-thirds of the existing thermal coal-fired power plants will be shut down and total of 600 MW will remain in operation. By 2040 this capacity would be reduced to 300 MW, and in 2050 to zero. In the new coal-fired power plants about 600 MW will be built by 2030 and they will operate with that capacity until the end of the observed period.

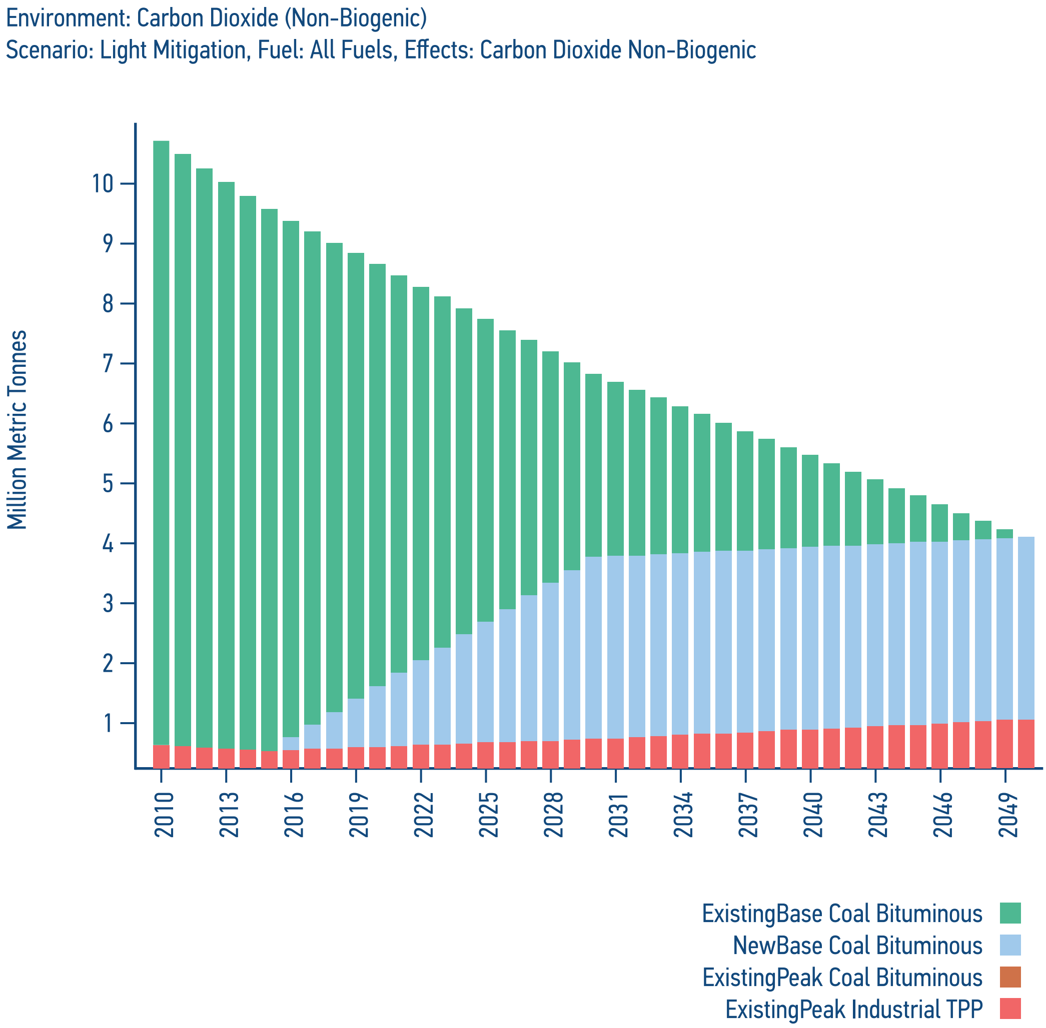


Chart 39: Carbon dioxide emission from the power sector in BiH according to scenario S2 – moderate mitigation scenario

Total electricity generation grows from initial 17,451 GWh in 2013 to 23,995 GWh, i.e. by about 37.5%. At the same time, carbon dioxide emission decreases from initial 10.67 million tons in 2013 to 3.93 million tons in 2050, i.e. by about 63%.

This scenario is characterized by intensive use of renewable energy sources compared to the reference scenario. Already by 2030 it is envisaged to have the total of 30 MW in biomass cogeneration plants, 200 in wind turbines, 20 MW in solar power plants and 150 MW in small hydropower plants, and by 2050 the capacities will be increased to 100, 800, 60 and 300 MW, respectively. Due to the increasing decentralization of electricity generation, an increase in generation is foreseen in the industrial cogeneration plants.

3. Scenario 3 (S3, "advanced mitigation scenario") – implies intensive use of potentials of RES and EE for joining of BiH in the European emission trading system for greenhouse gases (EU ETS) and creating competitive regional electricity market. Entry of BiH into the EU ETS also includes payment of emission permits for greenhouse gases for the power sector, which significantly reduces the competitiveness of fossil-fuel power plants, particularly coal-fired. Therefore, a gradual phasing out of the operations of the existing power plants is foreseen already by 2030, but also construction of new power plants with a total capacity of 600 MW. Foreseen active capacity of power plants at the end of the observed period amounts to 300 MW. S3 is characterized by the most intensive use of renewable energy sources compared to the S1 and S2. Already by 2030 it is envisaged to have the total of 60 MW in operation in the biomass cogeneration plants, 200 in wind turbines, 40 MW in solar power plants and 150 MW in small hydropower plants, and by 2050 their capacities will increase to 200, 1200, 160 and 600 MW, respectively. Since the industrial power plants mainly use fossil fuels, the plan is to reduce their production.

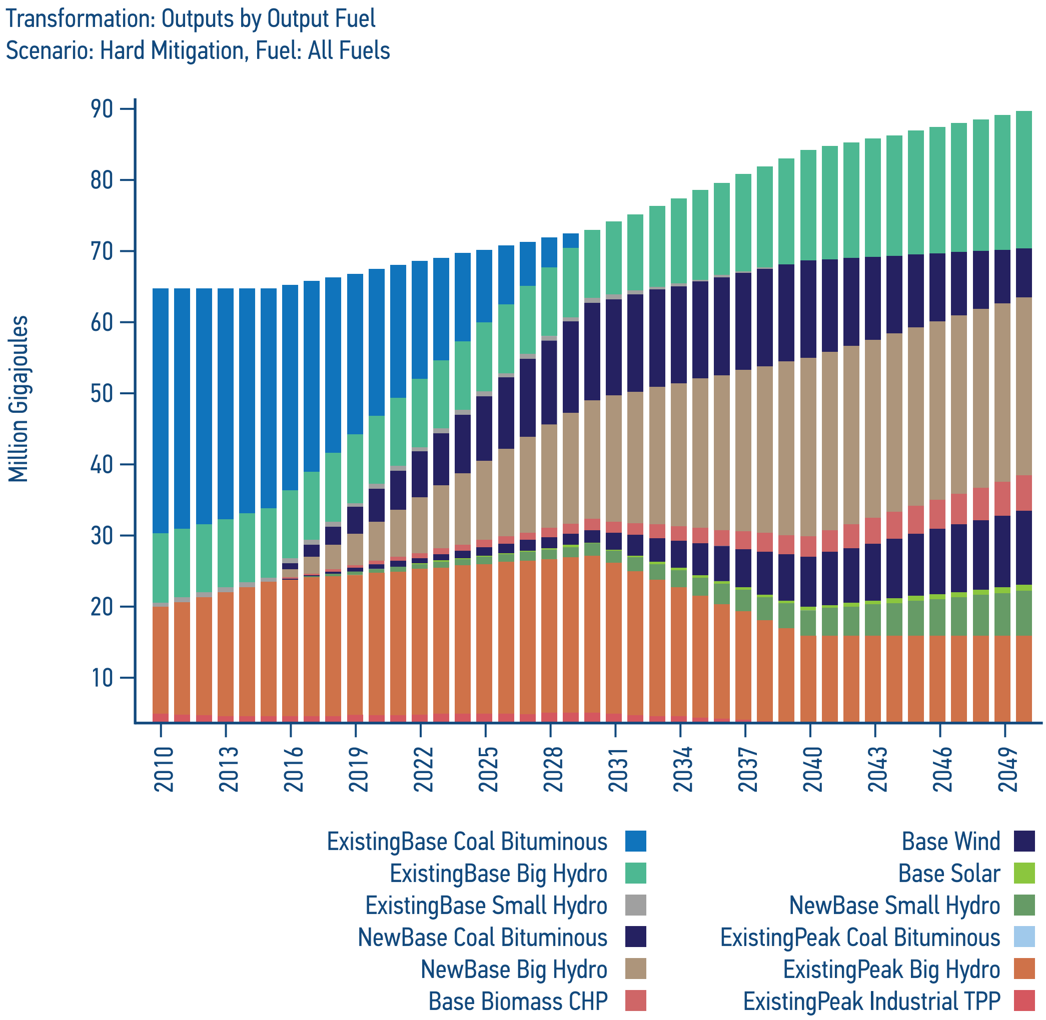


Chart 40: Electricity generation in BiH according to the scenario S3 – advanced mitigation scenario

The total electricity generation grows from initial 17,451 GWh in 2013 to 24,590 GWh, i.e. for about 41%.

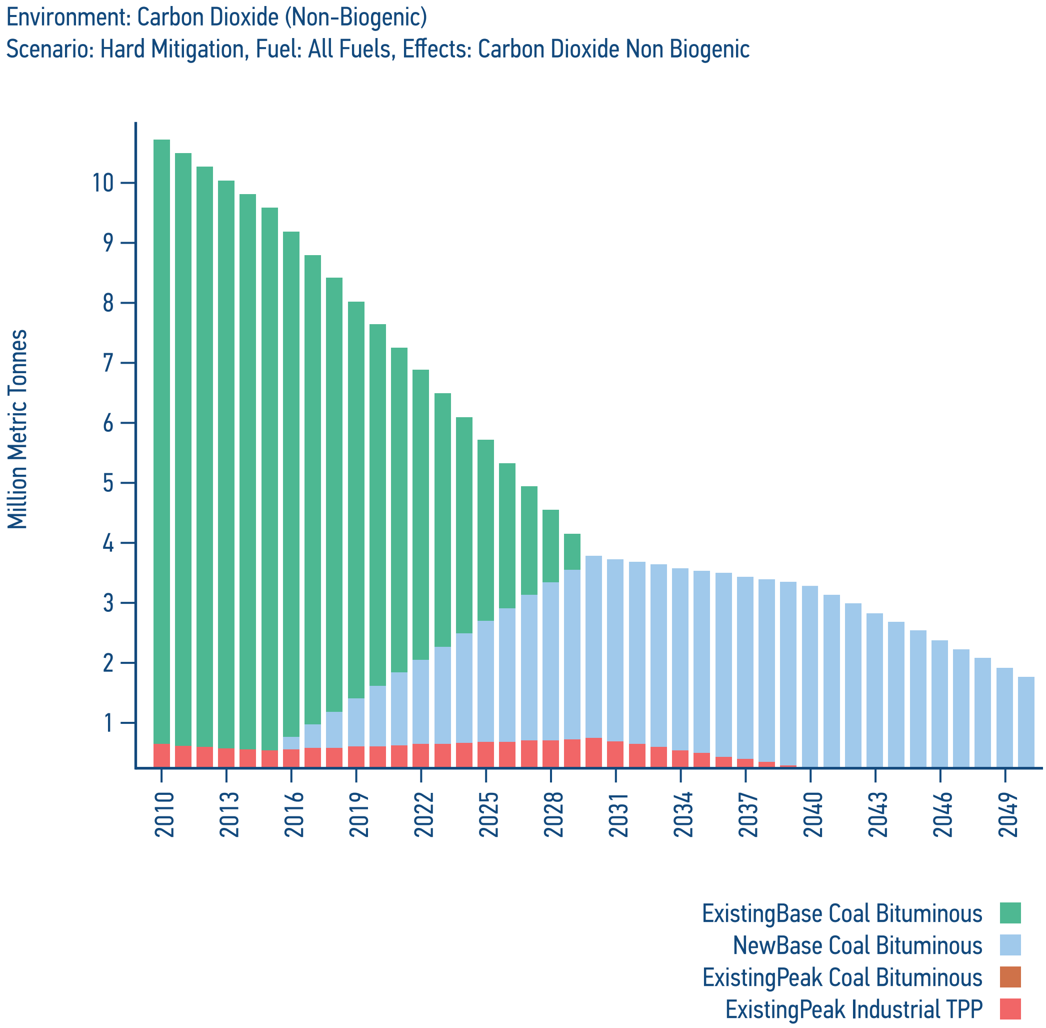


Chart 41: Carbon dioxide emission from the power sector in BiH according to the scenario S3 – advanced mitigation scenario

Based on all the scenarios, increase of electricity generation is foreseen. This increase is the largest in the S3, and the least in S1. Therefore, with the most intensive use of renewable energy sources it is possible to achieve the highest generation growth. New thermal power plants, in all scenarios, are modeled as cogeneration plants. Revenue from the sale of heat will be one of the important measures to strengthen the competitiveness of power plants on the electricity market.

Chart 42 provides a comparative overview of the carbon dioxide emissions for all three scenarios. In the period from 2010 to 2015 emission decreases due to the decrease in electricity generation from thermal power plants, which is taken from the report of the Agency for Statistics. After the drop, the S1 emissions grow in the period by 2030, when the closure of the existing coal-fired thermal power plants is expected, as well as the gradual entry into operation of new, more efficient thermal power plants. After 2030, also under S1, emissions decrease will be in operation only in the new thermal power plants. Emission in 2050 is by about 40% lower than emission in 2010, although the utilization of renewable energy sources potentials is relatively low.

According to S2, reduction of carbon dioxide emissions from the power sector is about 63%. The goal for developing countries, by 2050, is to reduce emissions by 50%. Similar as in the case of S3, it can be concluded that the S2 is on the path to achieve the goal of reducing emissions in developing countries.

Under S3, the carbon dioxide emissions decrease from initial 10.67 million tons in 2010 to 1.55 million tons in 2050, i.e. by about 85%. S3 results in a somewhat higher percentage reduction of carbon dioxide compared to the one defined as a target for developed countries by 2050 (80%)[38]. However, one should consider that this is only related to the power sector. Bearing in mind that the greatest contribution in reducing emissions is actually expected from the power sector, in order to achieve this target for overall emissions it is necessary to achieve emission reductions in the power sector over 80%. Therefore, S3 is on path to achieve the goal for developed countries.

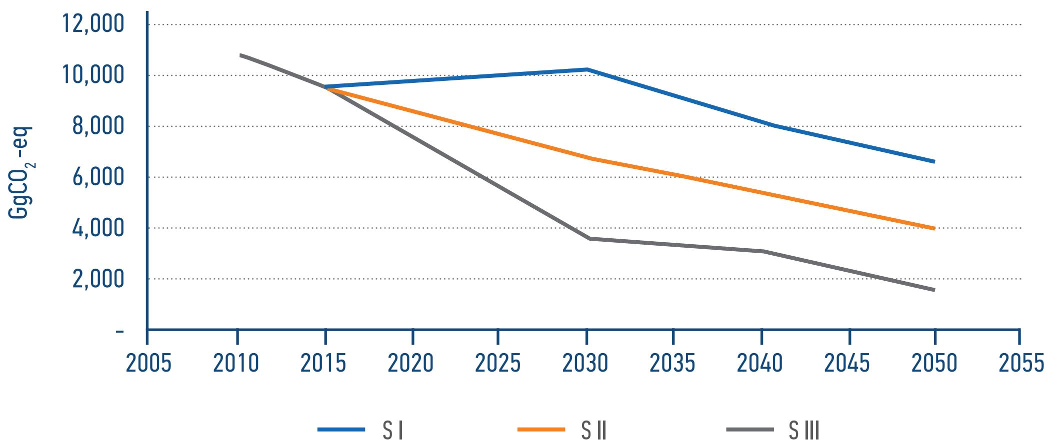


Chart 42: CO_2 emissions from the power sector in BiH according to the scenarios

The problem of intermittency that occurs as a result of the large share of energy from intermittent renewable energy sources will be dealt with through large, reversible and pump hydropower plants (on high voltage network), biomass cogeneration power plants and by electricity accumulation (on low voltage network).

[38]In order to stop climate change on the increase in global temperature of 2 °C, developed countries should reduce their greenhouse gas emissions by 80% and developing countries by 50% in relation to the defined base year.

3.2. Renewable energy sources

Chapter that deals with the renewable energy sources sector analyses those forms and the amount of energy generated from the potentials of solar and geothermal energy only for the purpose of obtaining thermal energy and the biogas for obtaining both heat and electricity. This part does not deal with either the analysis of the use of biomass in cogeneration systems or the production of thermal energy in the district heating systems or the use of other forms of renewable energy sources that are used solely for the purpose of electricity generation (wind, water).

3.2.1. Overview of the situation in the renewable energy sector

Pursuant to the recent enactment of legislation, primarily the Law on renewable energy sources and efficient cogeneration (RS Official Gazette, no. 39/13), the Law on the use of renewable energy sources and efficient cogeneration (FBiH Official Gazette, no. 70/13), as well as regulations governing energy efficiency, containing provisions and obligations for more intensive guidance in terms of the use of renewable energy sources, especially in the case of new facilities where it is technically and economically justified, it is expected that the intensity of the implementation of RES projects in the forthcoming period will experience its expansion. Still, the incentives model is lacking for the full implementation and realization, therefore implementation of such projects on the field will be postponed.

3.2.1.1. Biogas

Based on the available data on livestock for 2010 and 2011, potential biogas production was calculated at 800,000 to 850,000 m^3/day. So far there is only one biogas facility designed and constructed in BiH, in the city of Banja Luka (Srbac). The other biogas facility is in the stage of completion and experimental testing in Donji Žabari near Brčko. The installed generating capacity of the aforementioned first facility is 35 kW in electricity, and 70 kW of thermal energy. For the time being in households there is the individual use on several farms. However, these plants are too small, with a small power and impact on savings or almost meaningless when it comes to describing the degree of savings.

3.2.1.2. 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 based on the already undertaken initiatives and unfortunately based on the poor statistics on the implemented projects in those cities. Estimates are that in BiH there are about 7,000 m^2 of the installed collectors, and that the annual rate of increase is about 28%. A great interest and increase in applying of solar collectors is noticeable in all sectors. A number of projects have been initiated, the activity is particularly significant in the public sector (such as solar roofs in schools, hospitals, etc.) covering electricity generation and thermal energy. It is estimated that the construction and use of solar collectors will proportionately increase in households through incentives and co-funding, as well as in public buildings.

3.2.1.3. Geothermal energy

Geothermal resources in BiH take the triple form of hydrothermal systems, geo-pressurized zones and hot dry rocks. These areas cover mainly central and northern parts of BiH. Out of the three mentioned forms, hydrothermal systems are the most interesting, because their exploitation is the most developed and the cheapest when compared to two other types. Total heating strength and geothermal energy of BiH were calculated by adding up the potentials of RS and FBiH. The total potential of installed capacity of geothermal sources on 42 sites amounts to 9.25 MWt for space heating, or 90.2 MWt for heating and recreational and balneological purposes (bathing). When using all of the stated resources with the utilization factor of 0.5, it is possible to produce 145.75 TJ in one year for space heating, that is 1,421.75 TJ of energy for both heating space and bathing. Researches have shown that a large part of the RS has a perspective in terms of the presence of geothermal waters, mostly in the area of Posavina, Semberija, Banja Luka valley and Lijevče polje. The energy potential is estimated at 1,260 TJ. The largest potential for the use of this energy source is in aquaculture, agribusiness, and for heating of the settlements. According to the conducted researches, it was established that about 25% of BiH is considered to be potential geothermal resource.

Practically there are no significant projects by the level of installed capacities. Heat pump systems are used on small and medium-sized facilities, with still a small share but with the trend suggesting modest expansion.

A step forward was made by initiation of implementation of the concession policies. Concessions are intensely implemented in Banja Luka, Sarajevo, Bijeljina and Doboj, as well as the plans related to the implementation of making deep boreholes for the purpose of city heating system.

3.2.2. Overview of mitigation scenarios in the sector of RES

Mitigation scenarios of using renewable energy sources are based on estimated reserves and resources of individual forms of renewable energy sources, as well as technological, social, political and economic opportunities for their exploitation.

• The S1 – baseline scenario does not consider any mitigation measures and business as usual, which means that increase in the use of energy from renewable energy sources is not expected, as the prices of energy from these sources are still uncompetitive compared to technologies that use conventional energy sources. This scenario does not include any changes, incentives or specific additional research of the potentials and implies no change of the current position in relation to these forms of energy. A significant feature of this scenario is relatively low level of interest and activities of state and entity institutions in this energy sub-sector.

• The S2 scenario is characterized by the gradual introduction of new technologies (orientation towards RES and their greater use), start of the initiatives for more massive use and for domestic production of the equipment (e.g. solar energy), and accordingly assumes more intense and active analyzing of the cost-effectiveness, sustainability, and increasing energy efficiency, applying limited models of support and incentives.

• The S3 scenario assumes a high degree of climate change mitigation activities which are being implemented at different levels of government, the full implementation of legal provisions that deal with the obligation to use renewable energy sources in new buildings with the size exceeding 500 m^2 where this is technically and economically justified, accession of BiH to the EU in 2025, i.e. commitment and compliance with the requirements in terms of reductions of GHG emissions, the use of efficiently developed incentive models and funding the use of renewable energy sources, significant use of biogas (twice the installed capacity by five-year periods by 2040) from agriculture (livestock) in cogeneration plants for which the efficient siting is assumed and intensive use of solar energy with planned coverage of about 200,000 m^2 by 2025, and proportionally by 2040, as well as significant representation of the use of geothermal resources by using heat pumps in the household and SME sector.

Chart 43 gives a comparison of movements in savings in carbon dioxide emissions as a result of the use of RES in BiH for three previously described scenarios.

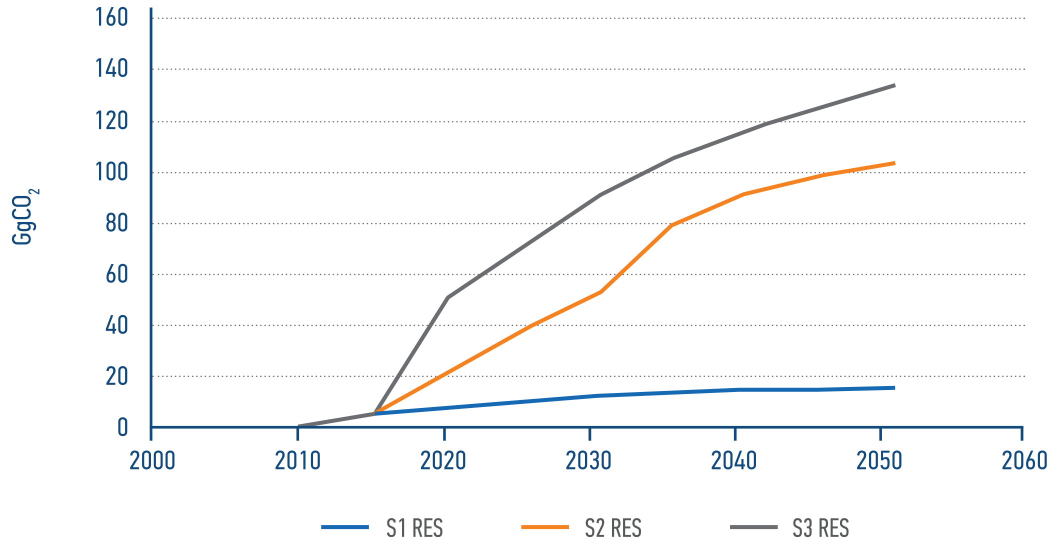


Chart 43: Values for total savings of CO_2 emissions by using renewable energy sources, by scenarios

Results of different scenarios of application and use of renewable energy sources for the needs of production of heat and electricity through biogas can be seen on the chart. Scenario 1 shows rather mild upward trend of the effects on CO_2 emissions, which is the result of quite limited and modest use of renewable energy sources in the observed period – 2010 – 2050. Compared to the emissions generated in the most efficient emission sectors (electricity sector, heating, etc.), the obtained values of savings can be considered almost negligible. Given that scenarios 2 and 3 imply significant use of the renewable energy sources, the effects of CO_2 emissions are more significant than in the case of the baseline scenario (S1). Although the growth rates of the installed capacity of the individual sources of renewable energy for scenarios 2 and 3 are linear in nature, projected CO_2 effects recorded a certain deviation from this linearity. The reason is the recognition of the parallel development of relevant scenarios in the sectors of district heating, building and electricity, where emission factors have a decreasing trend in the observed period.

3.3. District heating

3.3.1. The situation in the district heating sector

According to the available data, there are currently 26 major 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 around 12% of households in BiH. In the past 7 years a number of smaller district heating companies have started to work (in Gračanica, Livno, Zenica, Srebrenik, Bugojno, etc.) but the newly installed capacities are relatively small compared to the existing one, it can be considered that percentage of household coverage by district heating system has not significantly changed since then.

District heating companies in Republika Srpska mainly have their own plants for the production of thermal energy. For fuel they mainly use heavy fuel oil (Banja Luka, Brod, etc.) and coal (Doboj, etc.), and lately there is an increase in use of biomass (plant in Pale, Sokolac, Gradiška, two boilers in Banja Luka, and for the heating season 2015/16 it is planned to release into operation the power plant in Prijedor). In Zvornik, natural gas is used as the energy source; for heating of the city Ugljevik the heat obtained from the thermal power plant RTE Ugljevik is used. According to the data from 2010 (SESRS, 2010), installed capacity of the heating plants in Republika Srpska is 483.5 MW, district heating covered around 40,000 flats with a total area of 2.3 million m^2, as well as 460,000 m^2 of office space.

In Federation of BiH, some district heating companies do not have their own plants for the production of thermal energy but they provide for it using the local thermal power plants (mostly thermal power plants – Tuzla, Lukavac, Kakanj). Currently, the most modern district heating system is the one in the city of Sarajevo in which natural gas is used as the energy source. This has enabled the development of a flexible heating system, consisting of a series of individual networks and the use of small, efficient boiler rooms.

Other facilities that are not connected to the district heating network, such as medical centers (hospitals and clinics), some state institutions (courts, police), catering and other similar institutions generally have their own plants for the production of thermal energy, which as the energy source use heavy fuel oil, heating oil, coal, biomass or gas, where available.

Generally, in most district heating companies, particularly in Republika Srpska, heating plants and accompanying equipment are more than 30 years old. These systems operate with low efficiency and the losses of heat in some cases reach the value of up to 60%. In the last 25 years major reconstructions were carried out only in the district heating system of the city of Sarajevo. District heating companies in Banja Luka, Prijedor and Gradiška conducted the reconstruction and modernization of systems for the production of thermal energy, while very little investments have been made in the heating distribution systems. In most other systems only the most necessary reconstruction were made in order to ensure the minimum functioning of the district heating system. Lately, there is an increase of private suppliers of thermal energy in the form of ESCO companies (Gračanica, Livno, Gradiška, etc.).

One of the major obstacles to more intensive heating systems is insufficiently legally regulated area of district heating.

The biggest obstacle to the modernization of the district heating system in BiH and intensive implementation of the measures proposed in the strategic documents (ESSBiH Module 9, 2008, Strategic Plan and Program for Energy Sector Development in FBiH, 2009, SESRS, 2010, LEDS, 2013, FBUR 2014) in the district heating sector, is the difficult economic situation that causes difficulties in operations of all district heating companies. On the other hand, it is exactly the difficult financial situation that prompted some district heating companies in searching for new solutions, i.e. providing lower cost thermal energy by substituting the energy source that they use. Hence, during 2013/14, the plant in Gradiška started to use biomass instead of heavy fuel oil and during 2015/16 the same is expected in the case of the heating plant in Prijedor.

In most district heating systems prices of thermal energy from the district heating systems are determined in consultation with the local authorities and are not based on actual costs of production and supply of thermal energy, therefore these companies operate with subsidies by local authorities. In such circumstances it is not possible to have significant allocation of funds for the modernization of district heating systems and only emergency intervention measures are being carried out, such as replacing worn-out distribution network, mainly on the most critical points of the network where frequent breakdowns occur during the heating season. All other investments in district heating systems are mainly completely suspended. Collection/billing for thermal energy supplied to consumers in many cases is still carried out on the basis of the surface of the heated area, rather than on the basis of consumption. This is contrary to the Consumer Protection Act of 2006, which obligates thermal energy providers to charge consumers for the supplied thermal energy based on consumption and not based on the surface of heated space. The application of this Law has been totally reduced and it comes down to individual cases. In the application of the aforementioned Law the major progress has been made in the Sarajevo Canton.

Law on the production, distribution and supply of thermal energy has not been adopted yet at the level of Entities, although the adoption of this Law was foreseen in a number of strategic documents (ESSBiH Module 9, 2008, Strategic Plan and Program for Energy Sector Development in FBiH, 2009, SESRS, 2010, LEDS, 2013). The Law should define the conditions for the production, distribution and supply of thermal energy, the rights and obligations of both producers and consumers of thermal energy.

In 2013, three very important laws on energy efficiency and renewable energy sources entered into force in Republika Srpska that should significantly affect further development of district heating. It is the Law on Spatial Planning and Construction (RS Official Gazette 40/13), which should implement in the legislation of Republika Srpska requirements of the Directive 2010/31/EC – Directive on the energy performance of buildings, then the Law on energy efficiency (RS Official Gazette 59/13) which should implement in the legislation of Republika Srpska requirements of the Directive 2006/32/EC – Directive on energy end-use efficiency and energy services and 2010/30/EC – Directive on the indication by labeling of energy-related products, and the Law on renewable energy sources and efficient cogeneration (RS Official Gazette 39/13) which should implement in the legislation of Republika Srpska requirements of the Directives 2009/28/EC – on the promotion of the use of energy from renewable sources and 2004/08/EC– Directive on the promotion of cogeneration. The adoption of the relevant by-laws on thermal insulation of buildings is expected during 2015.

In Federation of BiH, since 2010, new regulations came into force on thermal insulation of buildings so the energy consumption in new buildings, which are connected to the district heating system, is considerably lower compared to the average consumption determined by the BiH Energy Sector Study, Module 1B, of 2008. In 2013, the Federation of BiH adopted the Law on the use of renewable energy sources and efficient cogeneration which ensured implementation in the legislation of Federation of BiH provisions of the Directives 2009/28/EC – on the promotion of the use of energy from renewable sources and 2004/08/EC– Directive on the promotion of cogeneration. Currently, the Law on energy efficiency is in the draft stage, which should implement the provisions of the Directives 2006/32/EC – Directive on energy end-use efficiency and energy services, 2010/30/EC – Directive on the indication by labeling of energy-related products 2010/31/EC Directive on the energy performance of buildings (together with the Law on spatial planning and land use at the level of Federation of BiH). All these laws should also have a significant impact on the future development of district heating systems.

3.3.2. Overview of scenarios of greenhouse gas emissions from district heating sector by 2050

For all scenarios of district heating development an expansion of district heating systems is planned, as well as the use of renewable energy sources, but to different extents.

The Scenario S1 – baseline scenario – Only new buildings, with lower energy consumption will be connected to the district heating system and the dispersion of energy sources remains as foreseen by the existing strategic documents (ESSBiH Module 9, 2008, SESRS, 2010). The percentage of district heating share will not be changed compared to the current one, and the same goes for the efficiency of the production and distribution of thermal energy.
The Scenario S2 – New consumers are gradually connecting to the district heating system to a greater extent so that in 2050, in terms of percentages, the number of households covered by the district heating system will be about twice as high than the existing one. Due to application of the existing legislation, energy consumption is in decline, therefore in 2050 it will amount slightly below 50% of the consumption in 2010. The dispersion of energy products remains as envisaged by the strategic documents (ESSBiH Module 9, 2008, SESRS, 2010). This scenario also envisages a slight increase of efficiency in generation and distribution of thermal energy.
The Scenario S3 – This scenario envisages

more intensive heating system so that in 2050 the number of households covered by the district heating system, in terms of percentages, will be about three times as high as the existing one. Specific consumption of the thermal energy is decreasing in line with the implementation of the existing legislation, but in the course of the next period it is envisaged to have even more stringent legislation, which would result that in 2050 the average specific consumption of the thermal energy amounts to approximately 25% of the specific consumption of thermal energy in 2010. Renewable energy sources are intensively being introduced in higher percentages in the district heating systems, particularly biomass and geothermal energy. This scenario envisages the construction of several smaller heating plants that will use municipal waste for energy, then the intensive introduction of cogeneration in district heating systems, as well as increased efficiency in production and distribution of thermal energy.

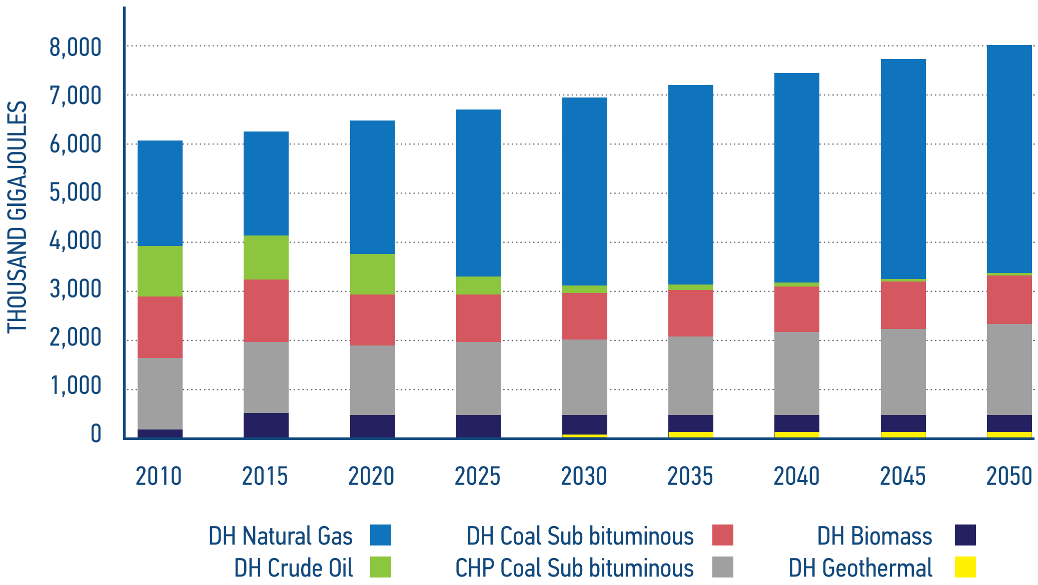
Energy consumption by all three scenarios is shown in Table 38.

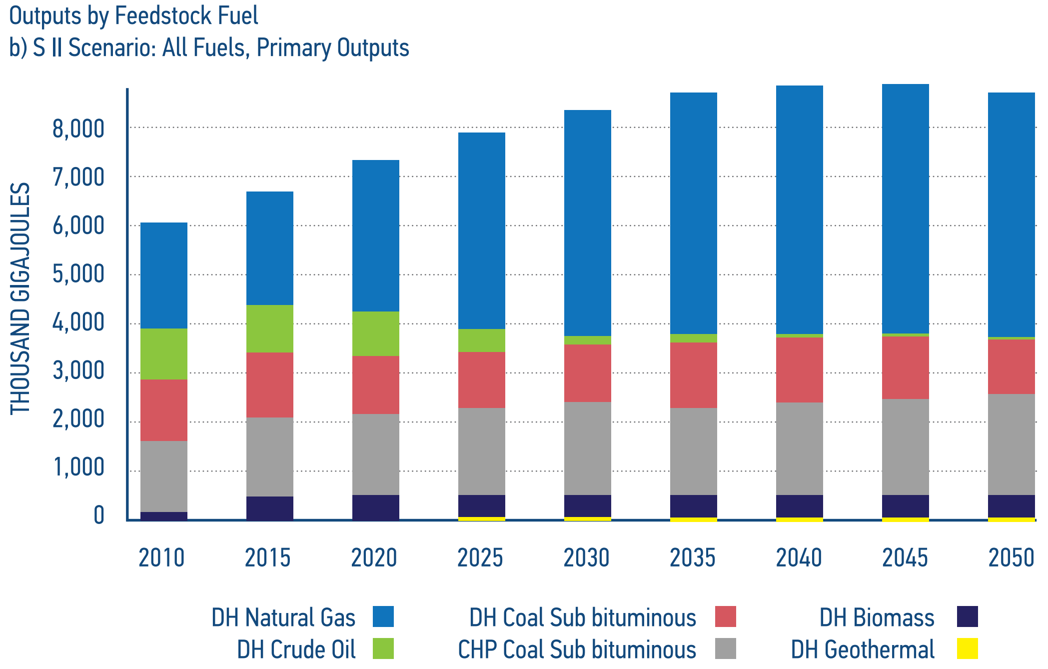
Thermal energy production by scenario (PJ)	2010	2015	2020	2025	2030	2035	2040	2045	2050
S1	**6.001**	**6.205**	**6.419**	**6.642**	**6.877**	**7.124**	**7.385**	**7.660**	**7.952**
S2	**6.001**	**6.205**	**7.253**	**7.810**	**8.267**	**8.604**	**8.798**	**8.821**	**8.644**
S3	**6.001**	**6.205**	**7.565**	**8.186**	**8.521**	**8.526**	**8.147**	**7.329**	**6.005**

Table 38: Estimate of thermal energy production through transformation in the district heating sector under different scenarios by 2050, PJ

The structure of energy sources by individual scenarios of development of district heating sector by 2050, in PJ, is shown in Chart 44.

Outputs by Feedstock Fuel
a) S I Scenario: All Fuels, Primary Outputs





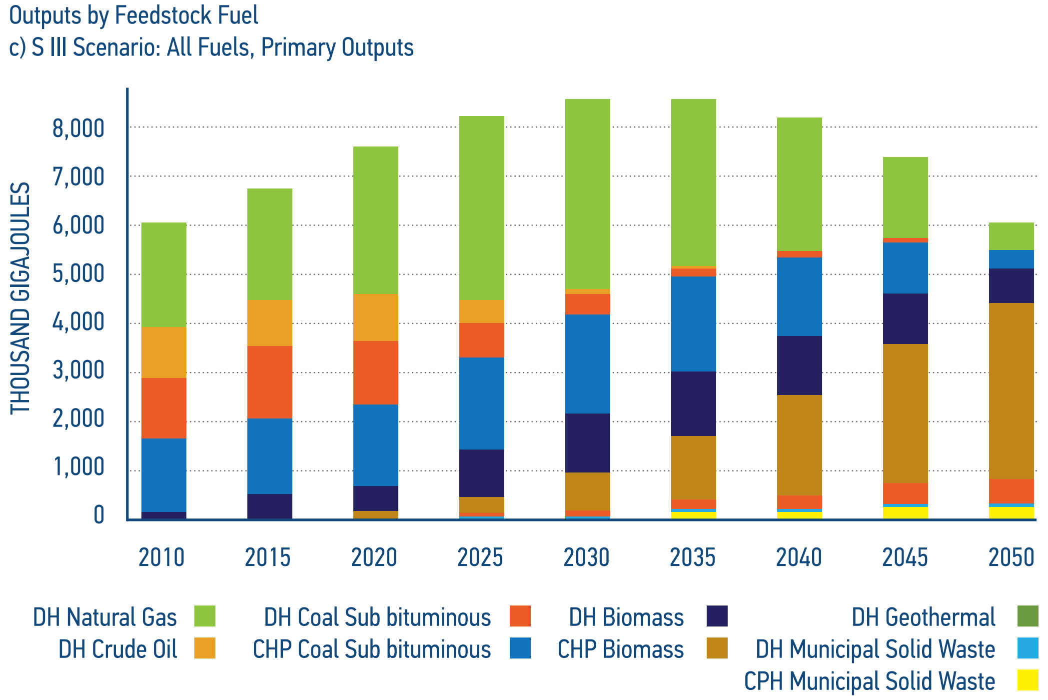


Chart 44: Forecasted structure of energy generation in the district heating sector for the three scenarios of development by 2050, a) Scenario S1, b) Scenario S2, c) Scenario S3

Assessment of emissions in the district heating sector by scenarios, by 2050, is shown in the next chart, without taking into account the emission from the plants for combined production of electricity and thermal energy.

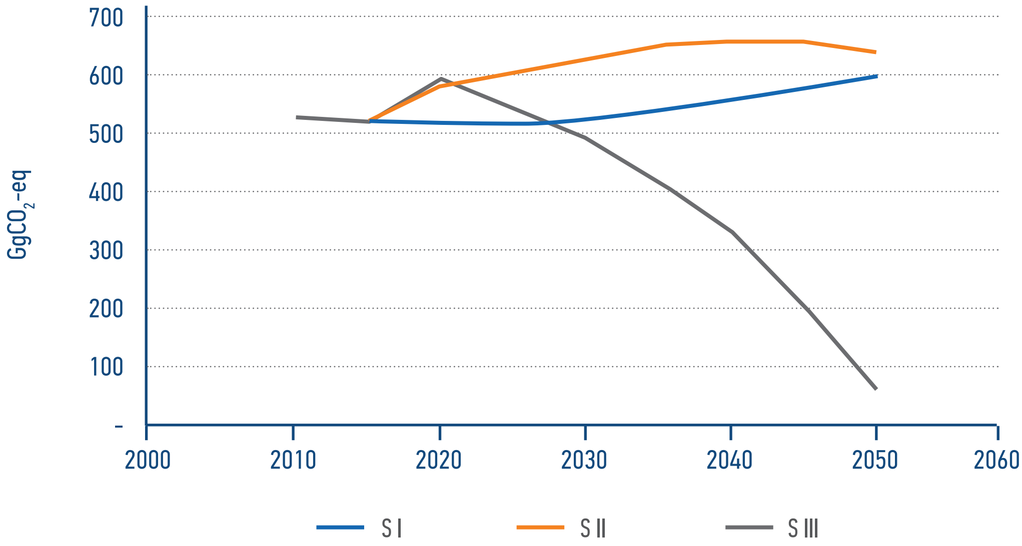


Chart 45: Assessment of CO_2 emission in the district heating sector based on different scenarios

As can be seen in Chart 45, according to the scenario S1, in the next period in the first place there is a reduction in CO_2 emissions (due to the transition of some of the district heating systems to biomass, such as in the cases of Gradiška and Prijedor), and then again there is a rise (after 2035), as a result of connecting new consumers to the district heating system, which still use fossil fuels to a great extent. The Scenario S2 envisages continuing rise in CO_2 emissions by 2040 from district heating systems, and then follows its decline, although the scenario S2 assumes a reduction of specific consumption of the energy. Such trend is the result of intensive connecting of new consumers to the district heating system, as well as gradual transition of a smaller number of district heating systems (as planned in the existing strategic documents) to the renewable energy sources.

According to the scenario S3, in the first place there is an increase (by 2020), and then follows the intensive reduction of CO_2 emissions from district heating systems, whereby new consumers continuously connect to a greater extent. Reduction of CO_2 emission after 2020 is a consequence of intensive transition of district heating systems to renewable energy sources, as well as continued reduction in specific consumption of the energy by 2050. Through implementation of the scenario S3, CO_2 emissions from district heating systems in 2050 would be approximately 8.32% of CO_2 emission in 2010.

3.4. Buildings

3.4.1. Overview of the current situation in the field of building construction

Preliminary results of the census of 2013 indicate that the number of dwellings in Bosnia and Herzegovina is 1,617,308 while the number of households is significantly lower and amounts to 1,163,387. The big difference between these figures indicates that a significant number of dwellings is not permanently inhabited, but their number cannot be determined without the results of the census. Lacking of these data and the accurate data on the heated surfaces of apartments point to the problem of reliability of data on the average energy consumption in residential buildings. However, current statistics on energy consumption by energy products can be considered as relatively accurate, and data on emissions from this sector can be considered largely reliable.

Only upon processing and publication of complete data from Census of 2013 it will be possible to calculate accurately the average consumption expressed per unit of heated area, which would pave the way to more detailed analysis of all the measures in the building sector.

A much bigger problem is the lack of data on buildings dedicated to services, which were not subject to census, hence the data from the Energy Sector Study BiH have been used as the base. When it comes to the sector of residential buildings, until the publication of the complete results of the census, data from 2007 will be used as those that are relevant and which the Agency for Statistics of BiH obtained on the basis of the survey, as well as data from the Energy Sector Study BiH and FBUR. According to the survey of the Agency for Statistics, the average size of the apartment is 73 m^2. Out of the total number of dwellings about 71% is in family houses, while almost 30% of apartments is in buildings for multifamily housing.

Buildings are very old, large number of them was built before the adoption of the regulations on thermal protection of buildings, they are poorly maintained, especially in the war and post-war years, and they represent a large potential for reducing power consumption and thus GHG emissions. In addition, a large number of new family houses, built after the war, has not been fully completed, and these facilities are a great resource for energy saving. Final completion of these buildings may have environmental benefits in terms of reducing GHG emissions, but also the social and economic benefits. New buildings are being constructed in a more quality way with better energy performance, though the regulations are not yet in place that would be fully compliant with the EU regulations in the area of the maximum allowed energy consumption in buildings. Data from Energy Sector Study of BiH can still be regarded as relevant – that the average energy consumption for heating per unit of residential buildings areas is 200 kWh/m^2 because the share of new buildings is still relatively small compared to the total housing stock.

In Bosnia and Herzegovina, in parallel to the increase in the number of apartments there is a noticeable decrease in the number of inhabitants, thus reducing the average number of residents in the household. It is evident that there is a significant increase in the number of residents in urban and a decrease in rural areas, as well as a decrease in the number of household members.

Services buildings are also old and poorly maintained, just as the residential ones, with obsolete and outdated technologies for heating and cooling. Older buildings are characterized by extremely high energy consumption, which is by far the largest in the hospital buildings. The new buildings are built in a more energy efficient manner, particularly commercial buildings, because investors pay much more attention to energy efficiency of buildings and possibilities of energy savings over the period of use of a building.

Progress in implementation of key documents for the reduction of GHG emissions caused by energy consumption in buildings is almost unnoticeable. In previous years, a number of strategic documents have been drafted and adopted, but there is no systematic way when it comes to their implementation. The new Law on Spatial

Planning and Construction in Republika Srpska (RS Official Gazette no. 40/13) envisages the adoption of by-laws which define the maximum energy consumption in buildings and process of their certification within nine months from the adoption of the Law and such deadline has expired long time ago (February 2014). New by-laws were published in April 2015, and their compulsory application started with January 2016. The adoption of the legislation in FBiH did not give the expected results because it was not implemented from the entity to the cantonal levels. Currently, the activities are ongoing to amend the by-laws in order to reduce the maximum energy consumption in buildings, and even better coordination with the cantons can be expected.

Environmental Protection Fund of the Federation of Bosnia and Herzegovina is more actively involved in the implementation of energy efficiency improvement and currently the implementation of the five-year project (2013–2018) *Capacity building and decrease of energy costs within the public sector buildings in FBiH through increasing energy efficiency, energy management and reduction of emission to air* is ongoing in cooperation with UNDP. In Republika Srpska the Fund did not begin with the financing of projects of this type because of lack of funds, that is, due to legally unregulated systematic way of fundraising for financing projects in the field of energy efficiency.

One of the key documents, NEEAP for Bosnia and Herzegovina by 2018, although accepted by the Energy Community Secretariat, has not yet been approved by the Entities and its implementation has not started yet. In addition, most of the measures provided for under SNC and LEDs are not under implementation.

The activities on improvement of the energy efficiency of the existing stock of public buildings in Bosnia and Herzegovina are mainly carried out thanks to the activities and the financial support of international organizations operating in BiH (UNDP, USAID, GIZ, the World Bank, etc.). For public purpose buildings such as schools, hospitals, municipal administrations, etc., in the first place the energy audits are done and then the projects and activities on improving their energy efficiency by implementing measures defined by the audit. Unfortunately, the number of buildings covered by these projects is small compared to the total number of public buildings. When it comes to the energy management in public buildings a progress has been made also thanks to the project funded by UNDP in BiH, which is related to the implementation of EMIS (EMIS – Energy Management Information System).

In Bosnia and Herzegovina twelve cities are signatories to the Covenant of Mayors and they have the adopted Sustainable Energy Action Plans (SEAP), which created preconditions to achieve the targets 20-20-20 through their implementation.
Owners of commercial buildings individually, in case of implementation of the measures of current maintenance, also improve the energy efficiency of their business buildings, but these are individual and still seldom cases.

In the area of residential buildings there are no major projects, which would focus on improving their energy efficiency, except in the area of the Sarajevo Canton.

The research project *Typology of residential buildings in Bosnia and Herzegovina*, which is implemented with the financial support of GIZ, as a result will have defined types of residential buildings, their structure based on energy consumption, as well as proposals of typical measures to reduce energy consumption in them. Project outputs, along with legislative changes in the field of building maintenance, will create conditions for more intensive activities to improve the energy efficiency of residential buildings, envisaged by all the strategic documents, and thus the implementation of projects that will result in reducing GHG emissions caused by irrational energy consumption.

3.4.1.1. Overview of scenarios of greenhouse gas emissions from the building sector by 2050

Scenarios for the building sector are developed using software LEAP and the methodology for creating scenarios is somewhat different in relation to the methodology applied when creating the SNC. The difference compared to the SNC is that now the building sector considers all the energy that is consumed in buildings, not just the heat. All the measures provided for in SNC are still valid, but the big problem is that they are implemented slowly or not implemented at all.

The baseline scenario marked as reference one is the BAU scenario (Business As Usual) which does not envisage any measures and based on which the current development trend of the sector is continued.

Different measures which result in reduced energy consumption and thus GHG emissions in the building sector are given in the two scenarios, separately for housing, separately for the service sector and separately at the level of the Entities, and all these can be observed also jointly.

In this way, by using LEAP, it is possible to assess the individual effect of each of the measures provided for in the individual scenario on reducing energy consumption and GHG emissions, as well as the cumulative effect of all the measures in the observed scenario.

All measures envisaged by the scenarios are already envisaged in the entity strategies, NEEAP (which is in the process of acceptance), as well as other sectoral strategies and action plans, with a note that all these experience significant delay in implementation. Given that the new regulations have not yet become effective, and their application will result in a significant reduction in energy consumption for heating in new buildings, it is envisaged that these measures in the scenarios begin in 2016.

3.4.2. Residential buildings

Residential buildings are the largest consumers of energy in the buildings sector, and therefore their importance is the greatest. The reference scenario envisages the construction of new buildings, while the individual scenarios foresee different measures that will result in reduction of GHG emissions. The reference scenario envisages an increase of the heated surface in the annual amount of 1%, and this includes increasing of the surface area of newly built apartments, as well as increasing of the heated surface along with increasing standards of the population.

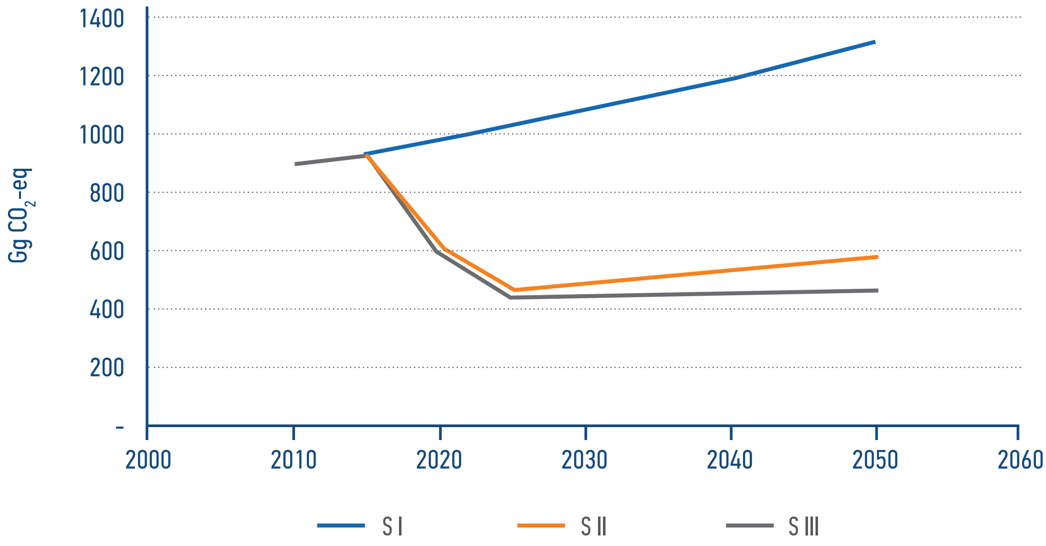
The most important measure is the application of regulations that limit energy consumption in new as well as in the existing buildings, and which quickly delivers concrete results in reducing energy consumption, without major investments. Reconstruction of envelopes of the existing buildings requires better regulation of the field governing maintenance of buildings, so as to create conditions for more extensive works on the stock of collective buildings. Use of new technologies using solar and geothermal energy is now sporadic, but it will be more intense if co-financing is ensured by the state, because these technologies are still inaccessible for most of the citizens due to their prices. The scenarios assume measures that provide the most effective results in the areas in which the energy consumption and hence GHG emissions is the largest, i.e. decreasing the energy required for heating of the space and use of renewable energy sources.

The S1 scenario – baseline scenario – This scenario assumes continuation of current trends and does not foresee any energy efficiency measures, apart from the implementation of the legislation that has already been enacted and the application of which prescribes lower energy consumption in buildings in the heating sector. The new legislation, which was adopted, but also the future one that will be issued in accordance with the European directives will result in reduction of energy consumption in buildings that will be constructed and by 2050 it will result in an average reduction of energy consumption in residential buildings to 140 kWh/m^2.

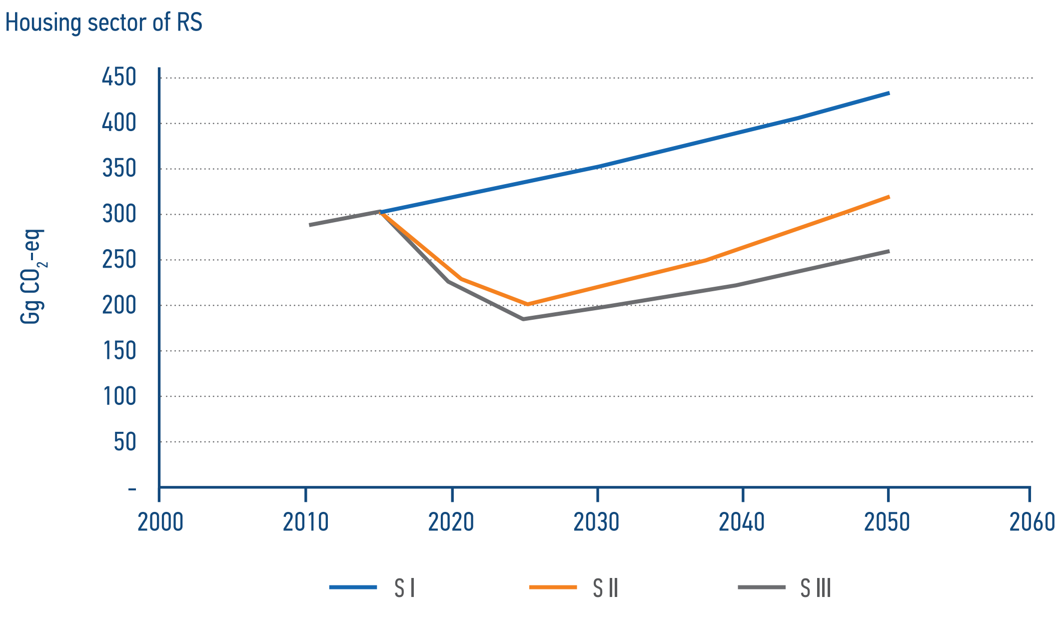
The S2 scenario – this scenario assumes that, in addition to the implementation of new legislation, more intense activities are undertaken in terms of reconstruction of the existing residential buildings in order to reduce energy consumption for heating. All these activities, along with application of the legislation, should reduce average consumption of the heating energy to around 90-95 kWh/^{2}. The increase of the share of the apartments heated through district heating is envisaged (in FBiH 18% and in RS 14%), as well as the change in the structure of energy sources in accordance with the adopted strategies at the level of Entities. Termination of use of coal and heating oil in the housing sector is planned for 2025. Increased consumption of hot water is foreseen, as well as greater use of renewable energy sources for its heating, primarily using solar collectors.

The S3 scenario – this scenario assumes intensified implementation of energy efficiency measures in the residential housing sector, especially through the reconstruction of the existing buildings, as well as the application of the legislation, which should lead to a significant reduction in the average energy consumed for heating at 50-70 kWh/m^2 by 2050. The share of apartments heated through district heating intensively increases and it is expected that by 2050 it will amount to 25% in FBiH and 20% in RS. A change in the structure of energy sources is also foreseen in accordance with the adopted strategies at the level of Entities. Termination of use of coal and heating oil in the housing sector is planned for 2025. Consumption of hot water will grow more intensively (current hot water consumption per capita is relatively small compared to other European countries), and the greater use of renewable energy sources for its heating is foreseen, primarily by using solar collectors (solar energy) and heat pumps (geothermal energy).

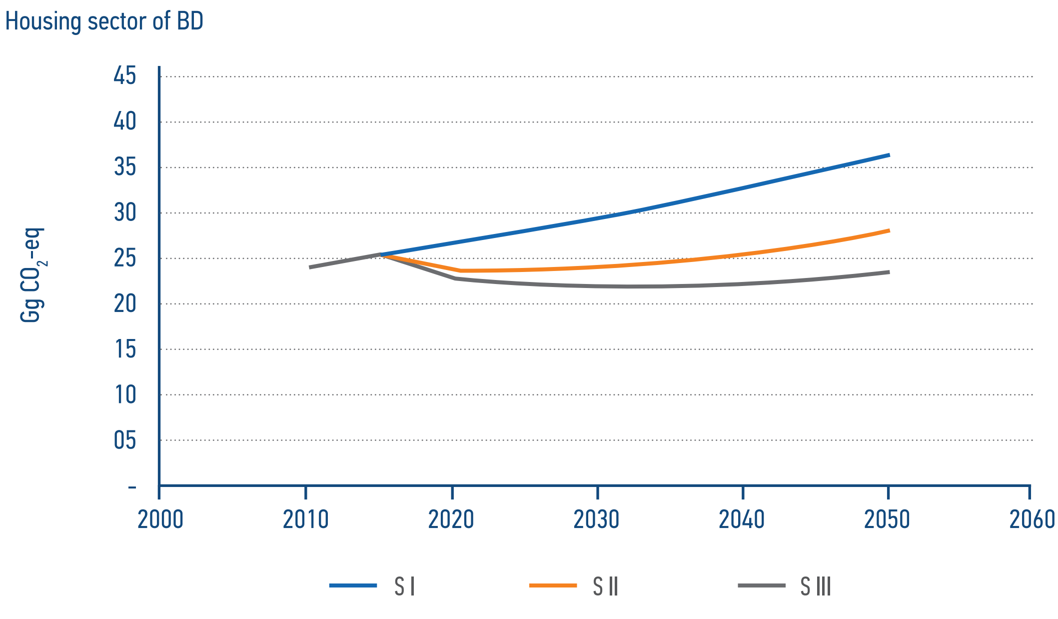
Housing sector of FBiH



a)



b)



c)

Chart 46: Assessment of emission trends in the housing sector for the observed scenarios for the FBiH (a), RS (b) and BD (c)

3.4.3. Services buildings (commercial and public buildings)

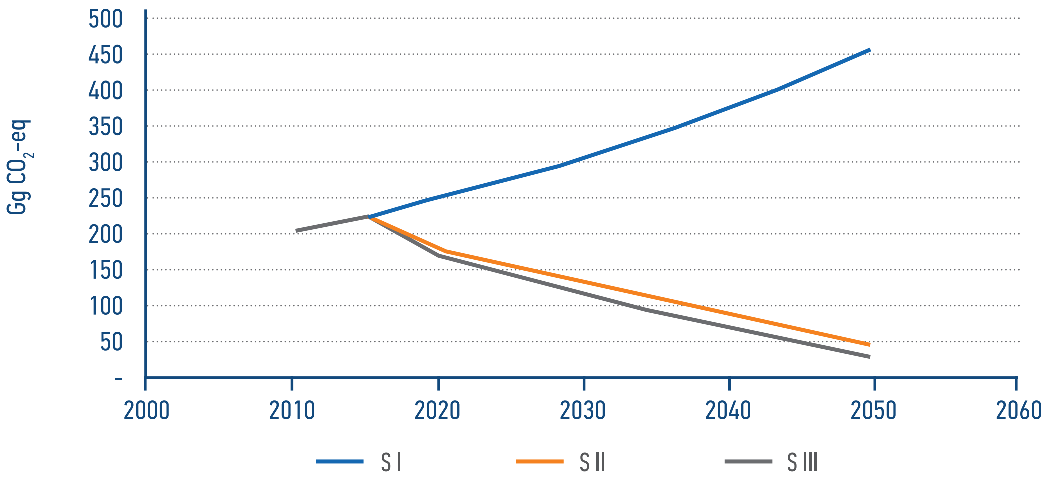
This building sector will develop much faster in comparison to the housing sector, and the application of regulations that limit energy consumption in new buildings is of great importance, although this sector has a small share in the total energy consumption in the building sector, but also in all the other sectors. This sector has a large share of the energy consumed for the non-thermal purposes, and the use of new technologies–appliances, equipment and lighting is of great importance. In this sub-sector, three scenarios have been analyzed:

The S1 scenario – baseline scenario – this scenario foresees continuation of current trends, without any significant changes in consumption structure. It is expected that the heated area will be growing faster than in the housing sector given the expected trend in the construction of commercial buildings of 2% per year.

The S2 scenario – This scenario assumes the reduction of energy consumption, especially in the heating energy sector. Improvement in the energy efficiency of the existing buildings and construction of new ones in accordance with the new regulations and new technologies will gradually result in the reduction of energy consumption by 2050. This scenario assumes change in the share of energy sources used to generate heat, with more significant share of natural gas as an energy source, as well as termination of using coal and heating oil as energy sources. The use of renewable energy sources is foreseen, i.e. the use of geothermal energy for heating purposes. It is expected that the percentage of cooled surfaces will increase, and thus the demands for cooling energy.

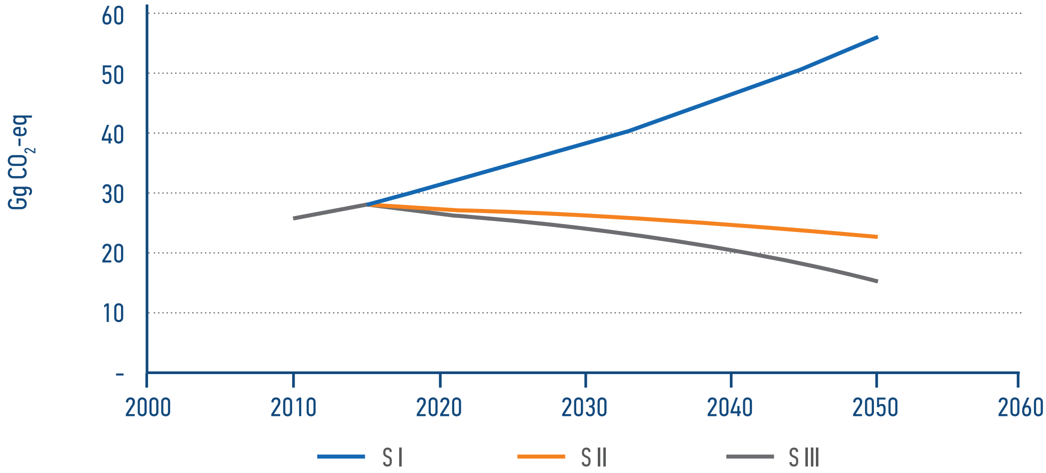
The S3 scenario – This scenario is quite similar to the scenario S2 and the only difference is that the renewable energy sources are more intensively used, especially geothermal energy, as well as measures to improve the energy efficiency of the existing buildings, which will result in reducing the necessary thermal energy. The needs for cooling will grow and the percentage of cooled surfaces will more intensively increase in comparison to the previous scenario. This scenario assumes change in the share of energy products used to generate heat, with more significant share of natural gas as an energy source, as well as termination of use of coal and heating oil as energy sources. It is anticipated that by the end of the observed period the efficiency of all systems in the buildings that are consumers of energy will improve significantly.

Commercial sector of FBiH



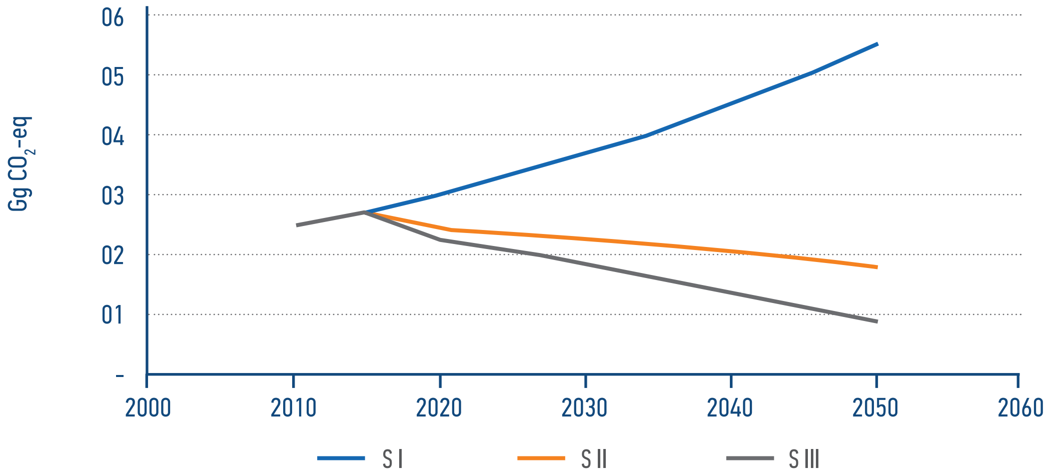
a)

Commercial sector of RS



b)

Commercial sector of BD



c)

Chart 47: Assessment of emission trends in the commercial sector for the observed scenarios for the FBiH (a), RS (b) and BD (c)

3.4.4. Total building sector (summary of commercial and public buildings)

Summary view of the results of CO_2 emissions for Bosnia and Herzegovina, observing both sub-sectors (residential and commercial) is shown in the following chart.

Building sector of BiH

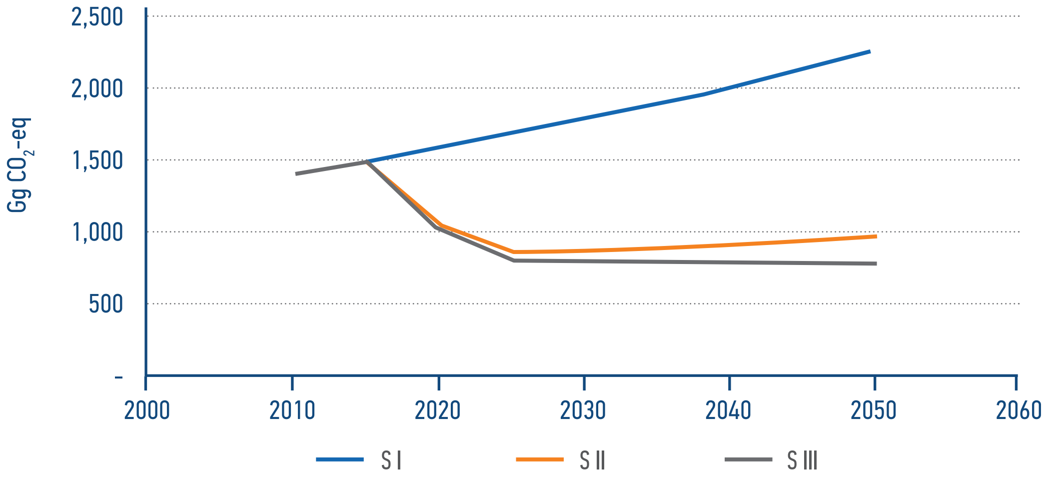


Chart 48: Estimate of overall emission movements in the building sector of BiH for the observed scenarios

The reference scenario does not envisage reduction of CO_2 emissions, but an increase due to increased construction of new buildings, particularly more intensive in the service sector, which would result in increased emissions by 60% by 2050, compared to 2010.

Reducing CO_2 emissions is envisaged by scenarios S2 and S3, according to the applied measures, however the scenario S3 provides for more intensive use of renewable energy sources. With the development based on the assumptions of the scenario S2, emissions in 2025 would have decreased by 40% compared to the emissions in 2010, and then they would gradually and moderately grow by 2050. Such movement would result in emissions in 2050, which would be for 32% less than the emissions from 2010. The scenario S3 would have similar trend to that of the scenario S2 with somewhat less emissions, which would ultimately result in emissions in 2050 which would be 45% lower than emissions in 2010. The reduction occurs as a result of changing energy sources, primarily after termination of use of coal and heating oil as energy source, greater use of gas and in particular renewable energy sources, both for hot water and for the heating and cooling systems. Greater centralization of heating system of buildings with the use of biomass and other renewable energy sources as energy products will also lead to the reduction of CO_2 emissions.

3.5. Transport

3.5.1. Overview of the situation in the transport sector

According to data collected from relevant institutions, the total length of the road traffic network in Bosnia and Herzegovina is 22.871,96 km, of which 83,50 km is highway, 30,71 km roads for motor vehicles only, 3.843,20 km of main roads, 4.714,55 km of regional roads, and 14,200 km of local roads[39].

In 2014, a total of 921,643 road vehicles were registered, which is by 2.93% more than in 2013 (895,425 vehicles), or 26,218 vehicles more. Out of the total number of registered road vehicles in 2014, 86.95% were passenger motor vehicles, 8.27% cargo vehicles and 4.78% all other categories of vehicles. Broken down by type of power generation, 63% of passenger motor vehicles used diesel and 33% petrol, and 4% used other energy sources[40]. In 2014, for the first time there were 78,213 registered road motor vehicles, which is 4.6% more than in the previous year.

The volume of road transport in BiH for 2014 is represented by two indicators: freight transport and passenger transport. According to freight transport indicator there was an increase in comparison to the previous years, i.e. around 12% in relation to 2013, while the indicator of passenger transport records a continuing decline in the last three years. More detailed figures on the volume of transport broken down by individual structure are presented in the table below.

Transport of goods	2010	2011	2012	2013	2014
Vehicle-kilometers travelled (thousands)	284.680	317.032	343.278	385.808	432.683
Tons of goods transported (thousands)	4.837	4.857	6.288	6.349	6.975
Ton/km (thousands)	2.038.731	2.308.690	2.310.607	2.657.648	3.107.874
Passenger transport	**2010**	**2011**	**2012**	**2013**	**2014**
Vehicle-kilometers travelled (thousands)	97.663	93.823	94.376	96.020	91.423
Transported passengers (thousands)	28.702	29.303	31.399	29.478	21.358
Passenger-kilometers (thousands)	1.864.471	1.926.212	1.925.617	1.764.325	1.676.173

Table 39: The volume of transport based on individual structure 2010–2014

[39] *Information on the road network status in Bosnia and Herzegovina in 2013, BIHAMK, 2013*
[40] *Release: Transport, year IV, no. 1, BHAS, 2014*

The rail network of BiH consists of 1,031 km of railways, of which 426[41] km are in the RS and 615 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 income that would be sufficient to cover expenditures.

As opposed to road transport, the volume of the railway passenger transport experienced a decrease compared to the previous years. The volume of the rail transport in Bosnia and Herzegovina can be divided into two categories: cargo transport and passenger transport

Cargo transport	2010	2011	2012	2013	2014
Tons of goods transported (thousands)	12.882	14.224	13.556	13.359	13.506
Ton/km (thousands)	1.232.034	1.298.294	1.150.325	1.242.688	1.313.356
Passenger transport	**2010**	**2011**	**2012**	**2013**	**2014**
Transported passengers (thousands)	898	821	846	628	530
Passenger-kilometers (thousands)	58.559	54.811	54.468	39.812	34.949

Table 40: Volume of rail transport in Bosnia and Herzegovina 2010 – 2014

Out of 27 officially registered airports in Bosnia and Herzegovina, only four (Sarajevo, Banja Luka, Mostar and Tuzla) are registered for international traffic[42]. The annual number of passengers is continuously increasing and for 2014 it is around 709,901 for Sarajevo airport, 151,285 for Tuzla airport, while Banja Luka and Mostar Airport also recorded an increase in the number of passengers. There is no domestic air traffic in Bosnia and Herzegovina, and all data refer to international traffic. In 2014, the number of airport operations amounted to 17,329, which shows a growth of 17,7% compared to the previous year. The number of transported passengers is 18.8% compared to 2013.

Air traffic indicators	2013	2014
Number of airport operations	14.723	17.329
Number of transported passengers	804.885	956.870
Transported cargo (t)	1.937	2.251
Transported mail (t)	399	397

Table 41: Volume of air traffic in Bosnia and Herzegovina 2013–2014

[41] *Republic Institute of Statistics*
[42] *Ministry of Communications and Transport of BiH, 2005*

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

In BiH, the Sava River is the main navigable river, and its length is 333 km. Water transport along the Sava River 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, lack of 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.

Given that in the transport sector, road transport sub-sector in BiH accounts for over 90% in greenhouse gas emissions, in this chapter we focused only on this sub-sector. The road network in BiH is among the less developed in Europe, which is clearly visible from the data on the density of the road network of 45 km/100 km^2, or 5.7 km/1000 inhabitants, which is 2.5 to 4 times less than in Western European countries. In the Federation of BiH density of main roads is 7.77 km per 100 km^2 and in Republika Srpska it is 7.11 km per 100 km^2. In the past 2014, a total of 921,643[43] motor vehicles were registered in Bosnia and Herzegovina, and based on the available data we can conclude that on 1,000 kilometers of roads there are 40,295 motor vehicles.

Currently there are no major programmes or projects in Bosnia and Herzegovina focused on reducing emissions in the transport sector. Still, the legislation at the level of the state and Entities in BiH governing transport (e.g. Law on traffic safety in BiH and other laws) and environmental protection (Law on Air Protection and associated implementing regulations) define the framework for import, purchase, registration of motor vehicles, approval, quality of fuel, compulsory annual inspection of motor vehicles, and they define obligation of the competent authorities of not allowing the owner of the motor vehicle to register vehicles that exceed certain emission limit values. In addition, in FBiH, vehicle owners are required to pay a special fee when registering their vehicles, or during technical verification, depending on the type of engine, fuel, engine capacity and age of the vehicle. In Republika Srpska there are attempts to introduce the same mechanism in early 2016. These activities, directly or indirectly, influence the reduction of CO_2 emissions in the transport sector. It is expected that further and somewhat more intensive application of EU directives in the area of reductions of emissions, more efficient motor vehicles and fuel quality in the transport sector in BiH will contribute to reducing emissions. Activities of regular maintenance and construction of new transport infrastructure by the competent authorities also contribute to reduction of emissions.

3.5.2. Overview of scenarios of greenhouse gas emissions from the transport sector by 2050

Three scenarios of CO_2 emissions in the transport sector, which are being developed for the period 2010 – 2050:

• **The S1 scenario – baseline scenario –** is based on the development of the sector based on the already present trends. It assumes retained share of road and rail transport by 2050. Increase in the number of road vehicles is expected by an average annual rate of about 5.8% with the average age of the vehicle fleet from 12 to 15 years, without the implementation of measures of approval and with a decrease in the share of diesel vehicles in passenger kilometers by 3% by 2050, petrol vehicles 5% and introduction of electric cars and their share in passenger kilometers by 10% in 2050. It is also assumed that by 2050 share of passenger kilometers of passenger vehicles will

[43] *Agency for Statistics, BiH*

decline by 10% while at the same time the share of buses will rise by 10%. The present scenario assumes that the energy intensity of passenger vehicles per year will see a decline of 0.2% and greenhouse gases emission produced by motor vehicles will proportionally grow with the increase in consumption of fossil fuels energy. In relation to the age of the vehicle fleet in BiH, it is calculated that the average CO_2 emission from road vehicles is around 185 g of CO_2/km (at an average consumption of 6,5 l/100 km for diesel and about 7,0 l/100 km for petrol vehicles for the period from 1998 to 2008). Reduction in the volume of ton/k is assumed in the area of freight transport and the increase in rail ones for about 4% by 2050. This scenario is also based on the currently applicable local legislation and trends in other sub-sectors of transport in BiH.

• **The S2 scenario –** this scenario is based on the introduction of additional technical measures for road vehicles to improve the efficiency of motors and decrease fuel consumption. This scenario implies an average reduction in the intensity of all types of vehicles by 0.5%, a significant decrease in the share of diesel and petrol vehicles in passenger kilometers at the expense of the increased share of electric vehicles by 25% by 2050, as well as a decrease in the share of passenger vehicles per passenger kilometer and increase of bus transport for approximately 13% by 2050. Another assumption is increase in the share of electric and the decrease in diesel locomotives by 10% by 2050. Improvement of the quality of fuel is assumed, as well as improvement of the road infrastructure. Reduction in the volume of ton/k is assumed in the area of freight transport and the increase in rail ones for about 12% by 2050. An important element of this scenario is the reduction of the average age of road vehicles to12 years by 2025. The main objective of this scenario is to reduce the emission coefficient from 185g of CO_2/km in the base year to 150 g of CO_2/km in 2025, with a further reduction to 130g of CO_2/km by 2040. In addition, the introduction, implementation and enforcement of EU directives in the field of transport by 2025 are also assumed.

• **The S3 scenario –**is based on a significant mitigation, that is, significant reduction in emissions in the transport sector through the implementation of EU directives in BiH by 2025 (better fuel quality, more efficient motor vehicles, better tires, exclusion of vehicles without catalytic converter from the traffic, introduction of new regulations on the importation of road vehicles, introduction of the EURO 6 standard, compliance with the EU Regulation 443/2009 on the limitation of emissions of CO_2 from new passenger cars to 95g CO_2/km by 2021), construction of more efficient road infrastructure and flow of vehicles, introduction of measures in the urban/city traffic which result in reducing emissions, as well as the impact of the ETS directive in air traffic and significant increase of railway transport (50% by 2025 and stabilization by 2040). Typical assumptions of this scenario include reducing energy intensity per passenger kilometer for all types of vehicles by 1% per year, reducing the share of road passenger kilometers and increasing the share of rail passenger kilometers by 15% by 2050, share of electric vehicles by 35%, resulting in a significant reduction of diesel and petrol vehicles in road traffic, as well as a decrease of 14% in the share of passenger cars in passenger kilometers, as well as significant increase in bus passenger kilometers. Reduction in the volume of ton/k is assumed in the area of freight transport and the increase in rail ones by 17%.

Based on the aforementioned factors and assumptions within each scenario, an overview of projections of total CO_2 emissions from the transport sector in Bosnia and Herzegovina for the period 2010 – 2050 is provided below.

Scenario	2010	2015	2020	2025	2030	2035	2040	2045	2050
S1 [GgCO_2eq]	3,371	3,669	3,994	4,347	4,730	5,147	5,600	6,093	6,627
S2 [GgCO_2eq]	3,371	3,669	3,807	4,048	4,306	4,581	4,876	5,191	5,528
S3 [GgCO_2eq]	3,371	3,669	3,569	3,676	3,789	3,907	4,032	4,163	4,301

Table 42: Overview of total CO_2 emissions in the transport sector in BiH for the period 2010 – 2050

According to the projection of the total CO_2 emissions from the transport sector of the scenario 1 (S1/BAU), an increase in CO_2 emissions is foreseen by 2050 in the amount of 6,627 GgCO_2, with an average growth in emission by about 1.5% annually in the period 2010 – 2050. It may be concluded that the relevant scenario follows the historical trend of increase in CO_2 emissions in the transport sector, typical for the previous decade and that it results in an increase in CO_2 emissions of almost 100% compared to 2010.

The scenario S2 also results in continued growth in CO_2 emissions in the period 2010–2050, however compared to S1/BAU it records a milder trend of increase of total CO_2 emissions by 32% in the observed period. An increase in the total CO_2 emission is assumed by 2050 in the amount of 5,528 GgCO_2, with an average growth of emission by about 0.6% annually in the period 2010 – 2050. The scenario S2 results in increase of CO_2 emissions by 64% compared to 2010.

According to the projection of scenario S3, effects of mitigation measures for CO_2 emissions are gradually becoming achieved resulting in the reduction of total CO_2 emissions of this sector in the amount of 4,301 GgCO_2 in 2050. Average annual growth in the entire observed period is about 0.3%. Scenario S3 results in an increase of CO_2 emission by 27% compared to 2010.

3.6. Agriculture

3.6.1. Overview of the situation in the agricultural sector

According to the level of generating gross domestic product (GDP), agriculture is an important economic activity in BiH. GDP of agriculture, forestry and fishing amounted to 1,83 billion KM, which is 6.97% of GDP in 2013 (BHAS). Agriculture, forestry and fishing grew by 14.24%, compared to 2012, when the share of this sector in GDP of BiH amounted to 6.24%.

According to data from the Workforce Survey (BHAS, 2013), the number of individuals employed in the agriculture sector was approximately 155,000 (61,9% of men and 38,1% of women), which is more than 18.8% of the total number of employed individuals in BiH. The average number of employees compared to 2012, decreased by 12,000. Although data on agricultural population and age structure are not available, existing analyzes and studies point to an increase in rural population aging.

Agricultural land in Bosnia and Herzegovina in 2013 takes up approximately 2,169,790 hectares, or approximately 42.4% of the total land area (BHAS). In the structure of agricultural land, the largest area occupied by arable land and vegetable gardens (46.7%), pastures (27.2%) and meadows (21%).

Official data on irrigated areas in BiH do not exist, but this is a very symbolic percentage which amounted only 0.4% before 1992. The share of agricultural land per capita, on average, is 0.57 hectares, and for arable land and vegetable gardens it is 0.26 hectares[44]. There is an evident trend of continuous reduction of total agricultural areas, especially arable land. According to Ljuša et al. (2015), agricultural lands decreased by 11,323 ha in the period 2000-2012, whereby decreasing trend clearly indicates the conversion of agricultural to artificial surfaces (8,658.45 ha), land abandonment and the transition to the forest area (2,329.47 ha), and water areas (318.70 ha).

Estimates suggest that in BiH there are about 515,000 farms, with an assumption that 50% of farms are less than 2 hectares in size, while more than 80% of farms are up to 5 ha. In addition, 4% of total farms, according to estimates, have an area larger than 10 hectares. Despite the fact that the farms in BiH are small (in average 3.3 ha) they are at the same time fragmented, on average divided into 7-9 smaller parcels, which causes low productivity and modest overall efficiency. The farms are mostly mixed.

The situation in the agricultural sector is best illustrated by the fact that of the total area of arable land and vegetable gardens, in 2013, 47.9% was not cultivated. 51.8% of arable land and vegetable gardens were sown. In the structure of total sown area, grains account for 58%, industrial crops 2%, vegetables 15% and fodder crops with 25% (BHAS). Average yields are still very modest and far below the European average, which is a consequence of the lack of a clear specialization in plant production, but also very frequent adverse weather conditions which have led not only to a drastic decline in yields, but also to problems in the production of fodder, which further impacted livestock production, supply to markets, prices and ultimately export of products. It is estimated that the drought and high temperatures during the summer of 2012 cost about USD 1 billion in lost agricultural production, as well as that they have destroyed almost 70% of vegetables and maize in the inner parts of BiH (Climate Change Adaptation and Low-Emission Development Strategy for Bosnia and Herzegovina, 2013). Areas under organic farming in BiH amount to 681 ha. The main crops are wheat (246 ha), industrial plants, apples, plums, raspberries, vegetable crops, and the wild herbs are collected on about 356,000 ha (GIZ, 2012).
Due to high grassland share of total agricultural area, cattle breeding is one of the most important branches of BiH agriculture, but an extensive manner of cattle breeding still prevails. A small part of the production is organized on modern, well-equipped farms. Observed by numbers (2013), the highest number is that of the poultry (24.7 mil.), sheep (1.02 mil.), pigs (0.53 mil.) and cattle (0.44 million) (BHAS).

Although agriculture is one of the most important branches of the BiH economy, as is often stated in key documents, this sector has not been receiving sufficient attention. The agricultural sector is marked by small farms, production for own use and improper functioning of the local market. Poor production performance is caused by shortcomings of high mechanization level and lack of modern agricultural systems, technologies and knowledge. The farms are mostly mixed and given the still underdeveloped manner of their administration and management, they represent a potential problem due to the amount of produced and inadequately managed manure. However, this sector is already applying certain measures of farms management, which can potentially reduce emissions of harmful gases below the current level. Legislation related to the application of measures of good agricultural practice does not exist in our conditions, however, through implementation of individual projects such measures are being promoted and farmers are being trained. This issue should also be largely regulated by the EU Water Directive, which is soon to be adopted.

The reasons for the constant changes in the sown areas, assortment of cultures, below average yield, as well as the great stagnation of the sector in general lie in the agricultural policies applicable in the country. Total allocated budget incentives for implementation of programmes and measures in the sector of agriculture and rural development in 2013 amounted to 144.83 million KM, which in

[44]Calculation based on the preliminary results of the Population and Housing Census in BiH 2013.

comparison to 2012 is less by 21.2 million KM. The agricultural policy model, which is primarily reflected in the distribution of the incentives, shows the characteristics of obsolete support solutions (BiH MOFTER, 2013).

This is supported by the fact that in 2013, 47.9% of arable land has not been cultivated. It is expected that the areas of uncultivated arable land and vegetable gardens will grow, and partly these surfaces will be affected by the processes of succession and degradation, particularly in marginalized areas and fragmented plots. Without a strong turnaround in the policies, clearly defined goals for putting agricultural areas under protection and into function, any significant changes in the sector can be hardly expected.

In the observed period, at the state level, there was no activity on the preparation or adoption of strategic documents, apart from preparatory activities on drawing up the Rural Development Strategy. Implementation of the BiH Strategic Plan for Harmonization of Agriculture, Food and Rural Development has not started.

However, it can be established that a progress has been made in the awareness of the entity ministries in charge of agriculture when it comes to climate change, their occurrence and their effects on the agricultural sector, given that the new entity agricultural strategies contain specific measures of mitigation/adaptation to climate change. Still, it remains to be seen how the new agricultural strategies will be actually implemented and whether the annual action plans will keep up with the planned investments.

Since 2013, activities are carried out at the state level related to the development of regulations under the EU Council Regulation no. 834/2007, as well as implementation of standards which regulate the field of organic production in BiH. In FBiH there is a parallel process of taking on the regulations and drafting the rules, while in Republika Srpska the Law on organic food was adopted in 2013, which already incorporates the aforementioned regulations. Other adopted laws and regulations at all administrative levels make no explicit reference to climate change or mitigation/adaptation to the climate change, therefore they can be considered as regulations having an indirect impact on mitigation/adaptation measures.

When it comes to the policies of EU accession, in the Report on progress in the field of agriculture for the past year it was stated that there has been little progress in alignment with European standards in the field of agriculture and rural development[45], where, inter alia, it is stated that climate change do not make part of sectoral policies and strategies and that there is no comprehensive strategy for climate change, and that substantial efforts are needed on dissemination of information, harmonization and implementation of the acquis, as well as strengthening administrative capacities.

3.6.2. Overview of the scenarios of greenhouse gas emissions from agriculture sector by 2050

Potentials for mitigation of climate change effects in the agricultural production in BiH can be observed from two perspectives: as sinks potentials and as a source of greenhouse gas emissions. Potentials for the sink of greenhouse gases are defined by spatial scope and manner of use of agricultural land. The existing sink capacity of land and manners of use in BiH for the main greenhouse gases amounts to approximately 1,305.3 Mt CO_2 Mt CO_2eq.

Another aspect of research of climate change mitigation potentials refers to the annual GHG emissions from the agricultural production sector. According to the data from BiH post-war period, there is a continued trend of decreasing arable land, whilst use of the existing arable land employ inadequate and energy-inefficient machines and other accompanying technological equipment. The trend of inadequate disposal and utilization

[45] *Bosnia and Herzegovina Progress Report 2013, EC, 2013.*

of manure and the use of bad types of mineral fertilizers is also evident. A similar situation exists in the subsector of livestock breeding where the existing trends indicate a decrease in production due to the poor quality and insufficient amount of fodder, which is being compensated for by increasing the number of animals.

For the scenario analysis we referred to two groups of factors that influence the development of the agricultural sector, external and internal factors. The external factors, in addition to climate change, primarily include: general trends on global, EU and regional level, entry into EU and trade liberalization. Out of the internal factors the most important ones include: the lack of a common vision for the development of agriculture and rural areas, the lack of and/or non-harmonized legal framework in the country, lack of appropriate policies, measures and investments that are directly linked to climate change and fight against drought, non-harmonized programmes and incentive measures for agricultural production, trends and levels of production, use of technical and technological innovations, demand for domestic products.

Further below we analyze three scenarios for mitigation in the agricultural sector, with the main starting points for each scenario as described.

• **S1 – baseline scenario –** Starting point of the S1 scenario, from the standpoint of greenhouse gas emissions in agriculture, is the least favorable. In this scenario, no major changes can be expected in terms of the development of the agricultural sector and sectoral policies. In addition, the share of agriculture in the overall economy remains at the same or similar level. Under these circumstances, the industrial sector is not developing significantly and therefore pressure on agriculture will be significantly increased in terms of ensuring the living conditions of the population. In such circumstances, the focus will be on increasing yield per unit area by introducing large amounts of mineral fertilizers and manure, and in some cases natural meadows and pastures will be ploughed for the production of fodder for livestock. Organic agriculture is not developing dynamically and it has a symbolic importance in the overall agricultural production. Generally, increased growth of livestock production is foreseen. The emphasis is on the concept of concentrated farm production with a large number of units. Similarly, increased use of land for non-agricultural purposes is expected, particularly from the point of view of permanent losses in construction of infrastructure, settlements, exploitation of raw materials and similar. The technologies used in agriculture and technical and technological measures will not follow world trends in this area. Measures of conservation and land development will be lacking, soil moisture conservation measures and reduced processing will be applied at a low level. Degraded land areas will be scarcely re-cultivated. Agricultural practices will remain at the current level and Nitrates Directive will not be applied. Conventional agriculture standards will be partially applied. Furthermore, what should also be added is non-harmonized development of agriculture, rural area, incentive programmes and legislation in the country. Incentive measures remain at the current or lower level, and the issue of climate change is not part of sectoral policies and strategies and there is no strategy to combat drought.

• **S2 –** Starting point of S2 scenario is that there are positive changes and progress in the agricultural sector and this is the most realistic scenario for BiH. Starting points are that the share of agriculture in the overall economy of BiH increased, that the trends of use of agricultural land, as well as trends in production of agricultural products are improved, with an increase in average yields that still remain modest. Protected areas in all categories of protection are increasing and organic farming takes a significant share in the overall agricultural production. Advanced technical and technological measures are used. A modest number of farmers apply Code of Good Practice. The Nitrates Directive is partially applied. The number of livestock is slightly on the rise, productivity has increased. Degraded land area are becoming slightly smaller. There is a harmonized process of development of agriculture, rural area and villages in general. The concept of farm production is partially developed in accordance with the condition of the environment and available resources. Programmes of measures and incentives are partially harmonized, funds slightly increased and targeted towards officially registered farmers, inter alia, in order to protect the environment and apply the best agricultural practices. Rural Development Strategy takes into account the principles of landscape design of rural areas in the concept of the construction of infrastructure, agricultural development and other secondary activities. Climate change make an integral part of sectoral policies, strategies and the incentive programmes. Climate Change Adaptation and Low Emission Development Strategy becomes the backbone of the activities, while the awareness of climate change increased, and the strategy to combat drought is being implemented.

- **S3 –** Starting point of S3 scenario is the fact that BiH is a full member of the EU. Upon joining the EU, the agricultural policy of BiH is developed in accordance with the common agricultural policy and the available resources are used to boost the development of the sector, which makes the development of the agricultural and environment sector sustainable. Degraded land areas are successively being renewed through the rehabilitation and remedial measures. The farms are modernized, high technical and technological measures and standards are used, as well as codes of good agricultural practice. Awareness of climate change is highly raised. Monitoring of the environmental conditions and changes in the area is very developed, and thus the transparent reporting to both domestic and international public.

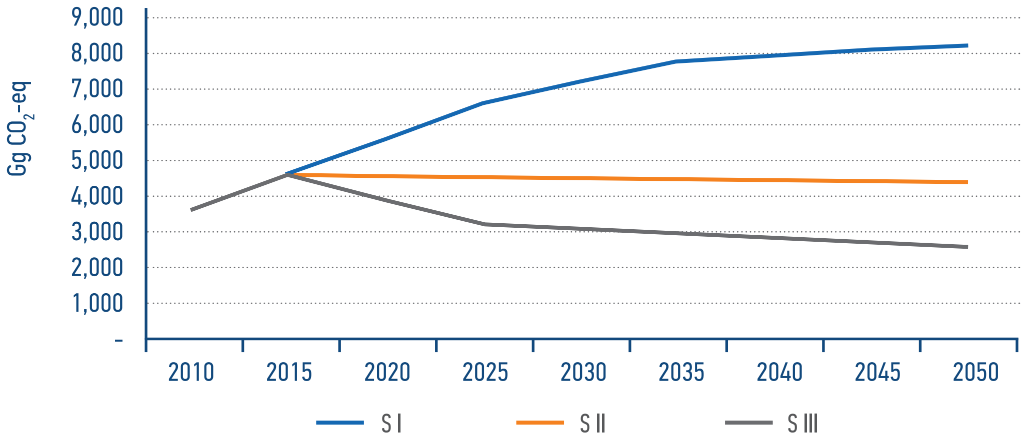


Chart 49: Total emissions of CO_2eq from the agricultural sector in BiH according to the scenarios

According to the presented figures, the total greenhouse gas emissions in the sector of agricultural production based on the S1 scenario will rise by 2050, when it will amount to 8,170 GgCO_2eq (126% more than the value of the emission in the base year, which is 3,609 GgCO_2eq).

Based on the scenario S2, the total annual emission of greenhouse gases will be reduced and in 2050, compared to 2015, it will amount to 4,359 GgCO_2eq, which is a total decrease of 5%.

The expected emission from the agricultural sector in 2050, according to the scenario S3 is at 2,562 GgCO_2eq, which compared to 2025 represents a total decrease by about 30%, and in the period from 2025 to 2050 it is a decrease of 20%. However, with regard to this scenario after 2025 only a slight decrease can be expected, because the largest part of the problem will be regulated right before and after accession to the EU.

The presented data suggest that the potentials to prevent the causes of climate change in the agricultural sector in BiH, with a strict application of the latest developments in all aspects of production, are very large. However, in order to obtain more precise scenario indicators, this requires precise data. Currently we have no data at disposal on the actual number of farms involved in agriculture, the number of farmers, livestock etc., all of which significantly affects the final results of the analysis and scenarios.

3.7. Forestry

3.7.1. Overview of the situation in the sector of forests and forestry

Bosnia and Herzegovina (hereinafter: BiH) belongs to a group of European countries that are extremely rich in forest resources in terms of their distribution and biodiversity. The fact that according to the latest survey over 60% of BiH territory is covered with forests indicates their importance in providing multiple benefits, and hence as a sector to mitigate climate change.

The war and the economic recovery in the post-war period, based mainly on the use of natural resources, had some negative impacts on forest resources in BiH. At the same time significant population migrations due to the war, but also due to urbanization, results in a spontaneous change of use of land from the agricultural to forest, which directly affects the area under forests in BiH.

Source: UNDP in BiH,
2014: Possibilities of using biomass from forestry and wood industry in Bosnia and Herzegovina

Vegetation form	Forests with regular management systems (commercial)	Forests with low commercial value	Protected areas	Special purpose forests	Inaccessible areas	Total
	hectares					
1. high forests	1.329.500	46.300	5.200	8.800	262.600	1.652.400
2. coppice forests	843.200	158.700	1.600	2.400	246.300	1.252.200
1+2	2.172.700	205.000	6.800	11.200	508.900	2.904.600
3. brushwood	52.700	41.100	0	100	36.700	130.600
4. bare ground	55.700	88.400	800	3.400	38.900	187.200
3+4	108.400	129.500	800	3.500	75.600	317.800
5. other forest areas	3.300	3.100	-	100	2.600	9.100
FAO forests (1+2+3+5)	2.228.700	241.600	6.800	11.400	548.200	3.035.700
forests and forest land	2.284.400	337.600	7.600	14.800	587.100	3.231.500

Table 43: Forest area in BiH

In terms of the ownership structure, according to the latest data from the Second National Forest Inventory in BiH, out of the total area of forests and forest land, 70% of the area is owned by the state, which is managed by the Public companies, while 30% is privately owned.

Bosnia and Herzegovina is dominated by pure beech forests at more than 30% of the surface, then the oak forests in the broader context with about 30%, and mixed coniferous and deciduous forests with a bit more than 23% of the area.

Type of forest	FBiH	RS-BiH	District Brčko	BiH	
	(ha)	(ha)	(ha)	(ha)	%
Beech forests	453.000	544.000	2.200	999.200	30.92
Coniferous forests and mixed coniferous and deciduous forests in the habitat of beech and fir forests (with spruce)	443.100	319.700		762.800	23.61
Pine forests	146.000	70.400	400	216.800	6.71
Pedunculate oak forest	25.800	41.100	4.000	70.900	2.19
Sessile oak forests	185.900	269.300	3.500	458.700	14.19
Thermophilic oak forests	334.400	205.000	400	539.800	16.70
Willow, poplar and alder forests	14.200	24.600	2.000	40.800	1.26
Pioneer forest communities	23.300	30.500	400	54.200	1.68
Forest plants of foreign tree species	11.700	21.100	100	32.900	1.02
Secondary beech forests	55.300	100		55.400	1.71
TOTAL (ha)	**1.692.700**	**1.525.800**	**13.000**	**3.231.500**	**100.00**

Table 44: Structure of forest area and forest land according to type of forest (trees)

For the continuity of the natural development of forest fund the existing traditional management system is particularly significant, which is based on natural regeneration and it is implemented in BiH through the centuries and it has contributed to the creation of significant diversity of forest cover and its intensive renewal, as well as the application of currently increasingly recognized "Close-to-Nature Forest Management". As a result, today in Bosnia and Herzegovina there are 93% natural and only 7% of planted forests. There are almost no plantations with selected fast-growing clones and intensive crop management measures.

For the purpose of proper forest management, forest certification is of particular importance and it has been implemented in Bosnia and Herzegovina during the last decade. More specifically, three public companies for forest management have undergone the inspection by the international control for obtaining the certificate of the Council for forest management (Forest Stewardship Council–FSC), while a few others are getting prepared for the same procedure. According to the data, currently around 50% of state forests in BiH is certified based on FSC standards.

The total growth of large growing stock (branches and stumps and underground parts not covered) in all forests in BiH is slightly more than 14 million m^3, which could be characterized as significantly higher growth rate in relation to the logging volume.
At the same time logging volume in BiH was on the rise in the past 4 years. Thus, in 2011 compared

to 2010, out of the total gross volume of wood, more than 397.394 m^3 was logged, while in 2012 compared to 2011 13.633m^3 more was logged (total of 411.027m^3) and in 2013 this quantity got back to slightly over 5 million cubic meters. Accordingly, it can be concluded that the volume of logging in the past three years in BiH increased in average by 5.74% compared to 2010.

In Bosnia and Herzegovina, in 2010, 2,372 ha were forested, in 2011 2,611 ha, in 2012 1,925 ha were forested, while in 2013 a total of 1,740 ha were forested, indicating a trend of decreasing volume of reforestation. Apart from the fact that in 2011 there was an increase of reforestation volume by 9.15%, due to a significant decrease in the volume of reforestation in 2012 and 2013 in average during these years, compared to 2010, 16.79% was forested. The problem of reforestation in Bosnia and Herzegovina is reflected in the manner of recording and presenting forested areas. Namely, the records of forested area (inspection) are made one year after planting seedlings. At this point most of the forested area is recorded as "successfully forested". At the same time, due to lack of funding and lack of attention to the forested areas (left to the competitive vegetation), in most cases after 5-10 years later these surfaces become completely weedy, and the success of reforestation is undermined. Therefore these data on increase of the forest area in BiH through reforestation activities, should be taken with a grain of salt.

On the basis of adequate statistical data it is estimated that about 3,000 ha of forest gets destroyed in fires in BiH. Danger of fire increased significantly over the past few decades due to rise in average and extreme temperatures, especially in the mountainous parts of BiH.

Among the strategic documents in forestry, Forestry Development Strategy of Republika Srpska 2012 – 2020 can be set aside, which in some segments indicates the importance of climate change. Thus, in the context of multi-functionality of forests, one out of ten planned criteria is the role of forests in mitigating climate change and their importance in storage of SO_2. Among 11 defined strategic objectives, the strategic objective Ecosystem-based forest management, environmental protection, conservation of nature and biodiversity through defined measures is largely devoted to climate change. In 2013, the Program for Conservation of Forest Genetic Resources of Republika Srpska 2013 – 2025 was adopted. This Programme, which was adopted by the Government of Republika Srpska defines the importance of climate change in terms of conservation of genetic resources (biodiversity) in forest ecosystems, where the partial measures also include Evaluation (scenario making) of the impact of climate change on forest genetic resources, as well as clearer (more specific) definition of the importance of preserving genetic resources in terms of adaptation of forest ecosystems to projected climate change. In order to develop the forestry programme of the Federation of Bosnia and Herzegovina, the Study on Forest and Climate Change was produced in 2011. This document, inter alia, provides an overview of the relevant international conventions, agreements, programmes, resolutions and declarations, then the Plan of Climate Change Adaptation of Bosnia and Herzegovina under INC through the Plan of mitigation of climate change and Assessment of the potential for the development of reforestation, as well as the proposal of the strategy and plan for a possible tackling of future/anticipated EU commitments.

However, it should be noted that in the previous period (during the development of the First and Second National Communication) there were no significant changes in the forestry sector in terms of recognizing the existence of climate change, directly through the change management system, greater scope of reforestation, more intensive measures for protection from fire, diseases and pests, measures to preserve the diversity, genetic diversity, etc. It can be concluded that the sector strategy in this area is very slow and that developments in forestry do not give importance to climate change in terms of the significance of the existing forests in BiH. The capacities and strategic documents are lacking that would recognise forests in BiH as a huge potential in mitigating the effects of climate change. This is the only way to establish and define the cumulative effects of temperature increases and changes in the precipitation regime.

3.7.2. Overview of scenarios of sinks of greenhouse gases in the forestry sector by 2050

Essentially, few basic measures could be identified that can be applied so that the existing mitigation potential of forest complex in BiH is raised to a higher level. The essence of all these measures is mainly related to improving forest management systems through a range of different activities, as well as through the reduction of recent negative trend in the forest cover change. In this regard the following mitigation measures could be highlighted as the most important ones:

- Maintaining the existing increment and increasing the future increment of carbon density per hectare (tC/ha) based on the applied method of silviculture. At the same time through improvement in the management system an influence is made in terms of prevention of all processes that have a negative impact on the existing increment. Implementation of the aforementioned activities would certainly result in increased productivity of forests, i.e. binding of large quantities of carbon in wood biomass.
- Continued reforestation/afforestation of bare land, as well as the land with a different purpose, transforming degraded and coppice forests to the higher silvicultural form to maintain and preserve existing and increase of forest covers in the future.
- Demining existing mined forest areas that have the additional option to increase storage potential for carbon.
- Improving the existing system of fire protection of forests from forest fires, which includes the mechanisms of permanent monitoring and surveillance, and rapid and effective intervention in cases of their occurrence;
- Establishment of effective mechanisms for prevention of all illegal activities in the forestry in Bosnia and Herzegovina, which recently have very significant negative implications. This primarily relates to the illegal logging, which is quite intense in BiH both in terms of biomass and the number of stakeholders who are carrying it out.
- Certification of entire forests in BiH in order to improve the sustainable management of forest complexes.
- Continued increases of energy generated using biomass, in order to replace more carbon-intensive fuels that have high greenhouse effect.
- Increasing the area of protected forest land. This measure is based on the percentage increase in the area under different types of forests for the purpose of maintaining and enhancing commonly beneficial forest functions, conservation of biological diversity, expansion of protected areas, rehabilitation of degraded forests, protection of forests and wildlife, monitoring, scientific research and training of staff in forestry.

The combination of these measures in certain intensities three possible scenarios are estimated for the forestry sector. Based on the available documents in the forestry sector in Bosnia and Herzegovina, sectoral strategies, international commitments that BiH has taken over, as well as the economic situation and expectations of BiH to become an equal member of the EU by 2025, developed scenarios have been prepared by 2050 as follows:

- **The S1 scenario– baseline scenario** – is based on the detected trend of increased intensity of deforestation in the past 3 years compared to 2010. It should be noted that the basis taken includes the sink capacity in BiH calculated on the basis of historical data on the area under forests in BiH, and based on the last measurements it was established that there was an increase of the forest area. This scenario has a negative trend of sequestration capacity, as consequence of forest fund losses of an annual average rate of -1%. After 2025, all forests are managed in accordance with the recommendations of the certifying institutions, and the logging scope is brought down to the level of 2010. There is no excessive or illegal logging, neither the decrease of forest areas. The volume of reforestation and success is the same as to date activities.

- **The S2 scenario** – is based on the application of certain stimulus measures for preserving existing forest cover. The basic measure involves increasing the sinks capacity through practical ways of applying certain silviculture methods to increase the carbon sequestration in tree biomass in existing forest areas. An important measure is the reforestation of bare lands, which would increase the total annual biomass increment. Another very important activity is related to the enhancement of fire protection measures aimed at preventing and reducing the number of forest fires, which in the past several decades have usually been caused by climate and are more frequent. Result of the application of these measures would affect the maintenance of the current level and would cause a slight increase in sinks capacities of forest cover in BiH. The extent of logging in all forms is back at the level of 2010 with an immediate effect. 2,500 ha are forested per year with 100% success in planting and development of newly established forests.

• **The S3 scenario** – 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 all obligations and directives related to the forestry sector. This primarily refers to full certification of programs for the overall forest fund in BiH aiming to improve sustainable forest management. One of the special measures that the S3 scenario assumes is the continued reforestation of degraded forest cover and afforestation of woodland barrens with the aim of combating the negative trend in forest area reduction by increasing the area under forest cover in future. For this purpose, a very important activity under this scenario is demining forest areas (10% forest areas are currently mined), which will also enlarge carbon forest storage potential in BiH.
The extent of logging is at the level of 2010, with no increase in intensity. 2,500 ha are forested per year with complete success over the entire surface. In the next 20 years, every year new 100 ha of plantations is established in the form of energy plantations with fast-growing species. Activities and investments in fire protection are introduced from the first year of the observed period and are ongoing. These activities contribute to less burned area with an estimate of 1,000 ha per year. Protected areas are emphasized with the intensity of 100 ha per year.
The results of scenarios formed in this way, in terms of projections of CO_2 sinks (Gg) in the forestry sector by 2050 are given below.

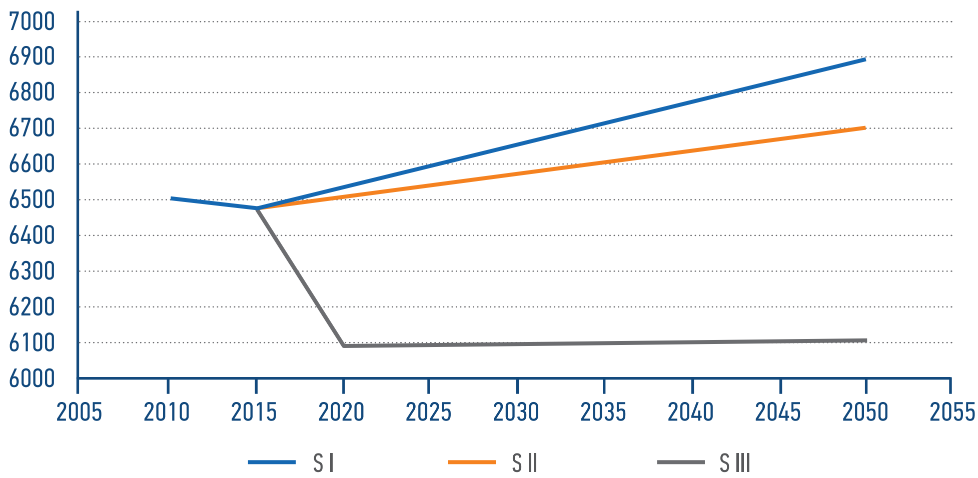


Chart 50. Projection of CO_2 sinks ($GgCO_2$) in the forestry sector by scenarios

According to S1, sequestering capacities are in decline by 2025 and after that they are almost stagnant, and according to this scenario, by 2050, sinks would be reduced to 6,119.19 $GgCO_2$.
Under scenario 2, with the ongoing activities of growing forests, afforestation of bare lands and improved fire protection measures, the projected value of the sink capacity in 2050 would increase by about 3.4% compared to 2010, and it would reach the value of 6,693.25 $GgCO_2$.

If all the activities as planned under the advanced S3 would be implemented, the size of the sink compared to 2010 would have increased by around 400 $GgCO_2$.

3.8. Waste

3.8.1. Overview of the situation in the waste sector

Quantities of waste generated in Bosnia and Herzegovina in 2010 and 2011 amounted to 1,152,690 t and 1,163,370 t, respectively, with a slight rise of 1%. According to the updated data, volumes in 2010 were slightly less than the volumes specified in the Second National Communication, which can be explained by examining new data and new assessments. Daily amount of waste generated per capita is 0.87 kg/capita/day, while the coverage by the services of collection and disposal is approximately around 72% and 75% (for 2010 and 2011, respectively).

For the given amounts of waste, calculated methane emissions are 85.14 and 89.70 GgCH4, in 2010 and 2011, respectively. Currently, there are 4 regional landfills in BiH (Smiljevići – Sarajevo, Mošćanica– Zenica, EkoDep – Bijeljina, DepOt–Banja Luka).
In the context of this report the emissions produced in 2010/2011 are covered, and they predict scenarios in the period by 2050. In the period since 2001, which is the final year of the Second National Communication on Climate Change by 2010, crucial things happened in the sphere of waste management, which have already significantly affected the situation in waste management, which will be presented below. These changes at least made an impact in terms of obtaining more reliable data generated and treated waste amounts. In addition to the aforementioned, the document also takes into account the new (of 2014) proposals of the European Commission to encourage increase in recycling, with targets of 70% for municipal waste by 2030.

In the field of legislation there have been significant developments in the period from 2001 to 2010/2011, and after this period it was only 2012 that saw the adoption of the Book of Rules on electrical and electronic waste in FBiH.

Implementation of this legislation and the level of implementation made an impact in changing the situation in the field of waste management. Unfortunately, the legislation is not harmonized in the entities (the level of transposition of the directives is not the same), nor did the same legal acts were adopted (e.g. Books of Rules on specific waste streams), making it difficult to predict the scenario for the entire BiH.

In the period after 2002, with the adoption of legal acts regulating waste management, National Environmental Action Plan was adopted, while drafting of entity/cantonal Waste Management Plans started much later.

Total amount of generated waste in BiH (t)	Total amount of disposed waste in BiH (t)	Total population	Amount of waste per capita (kg/capita/year)	Annual net emissions CH_4 $GgCH_4$
1,152,690	829,290	3,633,256	0.87	85.14
1,163,370	873,660	3,647,414	0.87	89.70

Table 45: Data on quantities of waste and emissions in BiH (2010, 2011)

In addition to the official acts of state institutions, the World Bank, the Czech Development Agency and SIDA implemented a range of important projects focused on establishment of an integrated waste management system that is mainly related to drawing up of the Waste Management Programme.

3.8.2. Overview of scenarios of greenhouse gas emissions from the waste sector by 2050

The S1 scenario – baseline scenario – This scenario assumes waste disposal in landfills that are not regulated (given that about 65% -70% of totally generated waste is collected and disposed of in partially regulated landfills (except Mošćanica, Bijeljina and Sarajevo), that is, in mainly unregulated municipal landfills, while the rest ends up in illegal dumping sites. Scenario 1 provides that all waste is disposed at illegal dumps by 2030. Considering that the illegal dumping sites are unregulated, the calculation was made on the basis of the total waste generated that ends on illegal dumping sites (regardless of whether it is collected and disposed of in unregulated municipal dumps or whether it is dumped at illegal landfills). After 2030, the regional landfills are foreseen, as well as waste disposal on legal dumping sites. In 2010 and 2011 recycling is not foreseen (since the data are irrelevant and amount to around 0.5%). Starting from 2012, an increase in the recycling of 0.5% is envisaged (currently it is around 0.5% in BiH) per year. The increase in the amount of generated waste is taken into account, as well as increase of the level of coverage by collection services. Other than recycling, no other treatment is foreseen. Environmental Management Strategy 2008 – 2013 and the Waste Management Plan 2013–2018 foresee the recycling level of 7% in 2014 and 10% in 2018. Current indicators suggest that recycling is not even close to that level.

The S2 scenario – As part of the SNC, this scenario envisages construction of several regional sanitary landfills with the systems for the collection and burning of biogas across BiH by 2025. In addition, in the context of this report, collection of the entire waste and increase in recycling will be foreseen, in accordance with the Waste Management Strategy in FBiH/Waste Management Plan FBiH 2012 – 2/17 (with the same level to be applied to the entire BiH, taking into account RS, for which a new plan has not yet been made), and which will take into account the recycling of packaging waste parts, as well as electrical and electronic waste (since the by-laws are already in force in FBiH), in accordance with Waste Management Plans of the operators for these types of waste. Scenario 1 takes into account increase of generated waste as in the baseline scenario, but it predicts a significant increase in recycling and treatment using other methods, such as biological treatment or incineration. Accordingly, increase in recycling of 2% annually by 2018 is foreseen, and then 1% by 2030 and 0.5% by 2050. In addition, other waste treatment methods are foreseen, such as biological treatment or incineration by 0.5% in the period 2015 – 2020 and as of 2020 the increase of 0.5% each year or 16% by 2050. Moreover, disposal of residual waste only on regional landfills is foreseen by 2025. In 2030 about 70% of the waste will be disposed on the landfills, and 50% in 2050. Neither with the given plans nor in the Scenario 2 will it be possible to reach the new targets set by EU Directives.

The S3 scenario – In the context of this report the predictions set out in the SNC will be maintained and an increased level of recycling will be introduced at the source and on the landfills (including batteries and accumulators, tires, glass and other waste from specific streams which currently ends up in landfills), as well as the change of billing services based on the produced amount of waste. This stage did not take into account construction of incinerators for incineration of mixed utility waste (i.e. treatment after recycling). Even Scenario 2 takes into account increases as in the baseline scenario, but it predicts a significant increase in recycling (44% by 2050), as well as treatment using other methods, such as biological treatment or incineration (up to 36.5% by 2050). It also assumes the disposal of residual waste only on regional landfills by 2020.

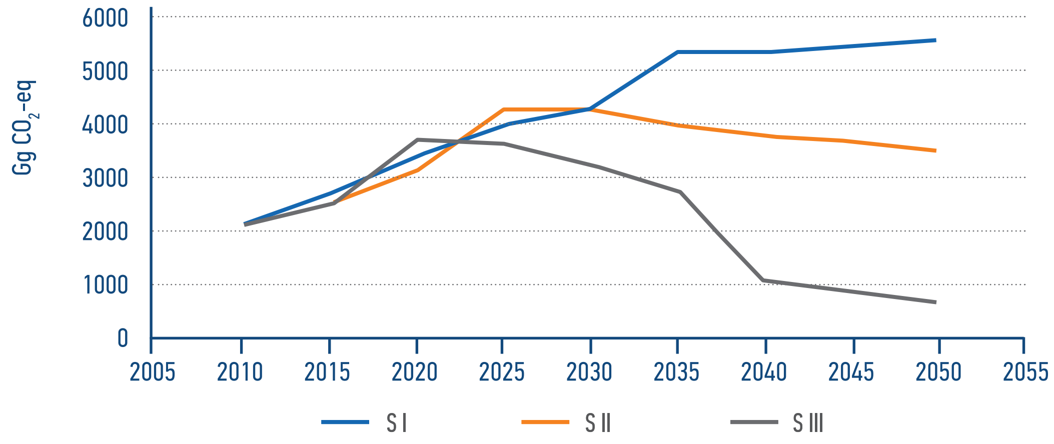


Chart 51: Total emissions of CO_2eq from the waste sector in BiH by scenarios[47]

From the aforementioned it is evident that significant reduction of emissions of methane are not expected by 2020, although some measures have been taken. In the scenario 2 even greater increase is expected, but that is caused based on the assumption of earlier construction of regional landfills, with the higher amounts of waste arriving to the landfill. Retention of the current waste management policy and lower growth in recycling lead to milder growth in the quantity of emitted methane, in the Scenario 1, but it is evident that the measures are not sufficient and do not lead to emission reduction. Introduction of higher degree of recycling and return to Scenarios 2 and 3 lead to a reduction, because the amounts of disposed waste are thus becoming lower. Scenario 3 foresees rather high percentage of recycling (about 45% by 2050) and of mechanical biological treatment, which is reflected in a major reduction in emissions. Disproportionate growth and decline in the displayed chart is in line with changing a number of factors that influence the emissions from the waste: population growth, increase in production per capita, increase in coverage by collection services, introduction of recycling and mechanical and biological treatment.

3.9. Summary results for mitigation scenarios

Based on the obtained results of developing scenarios of individual sectors, a consolidated/ summary result was made, which unifies all effects for each individual scenario. Summary review foresees the total mitigation potentials for each of the scenarios, not including the effects of sinks in forestry.

[47]It is worth noting that in order to calculate emissions, national DOC was calculated, i.e. the share of DOC in the waste, according to available data, which is 0.25 and it is a lot higher than in other developing countries. This value will eventually become smaller, by decreasing the share of organic waste. In addition, IPCC 1996 values were used for the correction factor CH4 (0.8 for landfills that are not controlled and which are deeper than 5m and 1 for regulated landfills).

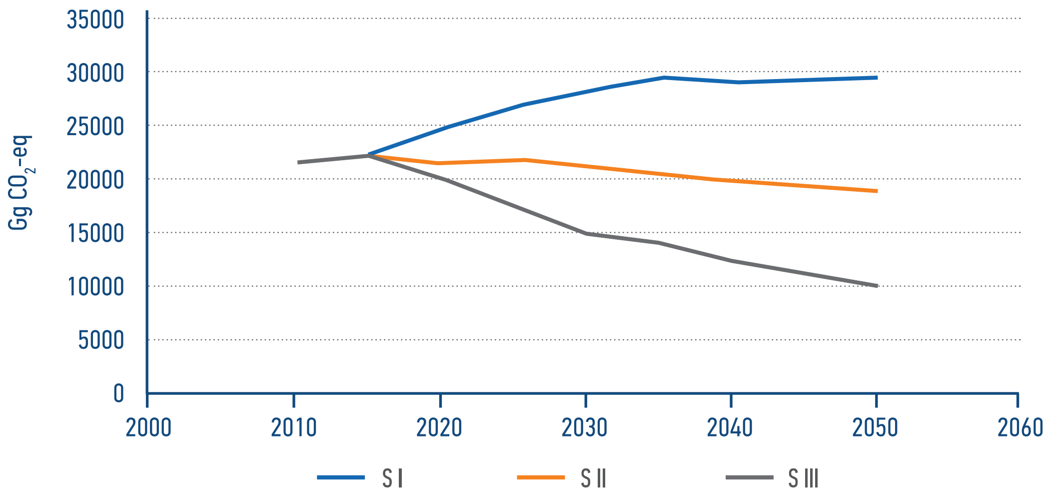


Chart 52: Total (sink in the forestry sector is not included) emissions by scenarios for the period 2010 – 2050

The most influential sector in the emission projections is the power sector, which in the total amount takes the share of 40-65%, depending on the scenario and the observed period. With that in mind, it is clear why the trend of individual scenarios is equal to the trend of the power sector.

According to the projected emissions, the baseline scenario, which corresponds to the "business as usual" is headed towards continuously slower growth, and by 2035 it is expected to have the emissions higher by approximately 36% compared to 2010 and to remain at approximately the same level by 2050.

The Scenario 2 is characterized by moderate constant drop in emissions, which by 2050 shall decrease by 14% compared to 2010. Advanced scenario S3 records more intense decline in emissions by the end of the observed period and in 2050 they are recorded with values less than the baseline of 2010 by 55%.

4. OTHER RELEVANT ACTIVITIES

This chapter provides an overview of the activities that have been implemented in order to fulfill the tasks and goals – needs in relation to the Second and Third National Communication. An analysis was made of the state of progress and the needs for technology transfer in BiH for mitigation and adaptation to climate change, as well as the status in the field of research, monitoring and forecasting of climate and systematic observing, describing the improvement in the field of meteorological and hydrological system. Furthermore, gaps, needs and priorities in the field of education-especially in the area of higher education were considered, including raising of public awareness, as well as proposed activities for implementation under Article 6 of the Convention on education, training and raising of public awareness.

4.1. Technology needs assessment for mitigation and adaptation

4.1.1. Access to the United Nations Framework Convention on Climate Change (UNFCCC)

4.1.1.1. Clean Development Mechanisms and NAMA

Although for the economies of developing countries the projects related to adaptation in terms of vulnerability are more significant, implementation of projects aiming to reduce global emissions of greenhouse gases, provided that such projects aim towards sustainable development of the country, also bring knowledge, equipment and employment. A mechanism for approval and submission of NAMAs to the UNFCCC registry was established, whose purpose is to record demand for international support for the implementation of NAMA in order to facilitate obtaining of the funds, technology and support through capacity building by applying these measures.

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

During 2014, Bosnia and Herzegovina has prepared the first Biennial Report of Bosnia and Herzegovina on Greenhouse Gas Emissions in line with the United Nations Framework Convention on Climate Change, which, inter alia, defines the establishment of NAMA mechanism in Bosnia and Herzegovina in accordance with the COP's Decision 17 (2/CP.17, Annex III), according to which non-Annex I parties to the UNFCCC should establish a transparent system for measuring, reporting and verification (MRV) of data and information on implemented nationally-appropriate mitigation actions (NAMA).

At its 113th meeting held on 27 November 2014, the Council of Ministers of BiH adopted the Decision on Amendments to 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, which, in addition to the existing activities of the DNA, has added development, receipt and approval/rejection of NAMAs.

Nationally Appropriate Mitigation Actions (NAMAs) – are programs of mitigation or voluntarily implemented policies of developing countries in the context of sustainable development, which are supported and enabled, in whole or in part, by technology, financial resources and capacity building activities provided by developed countries. Measurement, reporting and verification (MRV) are an important part of the process of measures adoption. Measurement, reporting and verification include parameters for measuring progress in the implementation of a measure, as well as the measurement or assessment of its impact in terms of reducing the amount of emissions and achieving related sustainable benefits in the development.

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 the 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 perform activities of reporting 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 the 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.

4.1.1.2. Climate Change Adaptation and the Low-emission Development Strategy

A Climate Change Adaptation and Low-Emission Development Strategy was initiated based on the climate and mitigation scenarios developed under the SNC. The strategy has the following main two objectives: increase resilience to climate change and reach a peak and stop annual growth values of greenhouse gas emissions in 2025. The Strategy, which was adopted by the Council of Ministers of Bosnia and Herzegovina in October 2013, clearly defines the results and activities, as well as the funds necessary for their implementation, all in order to achieve sustainable development.

The country's vision for its development is that, by 2025 Bosnia and Herzegovina will be sustainable and prosperous 'green economy'. When Bosnia and Herzegovina joins the European Union (EU) as a member state it will have low emissions, a high quality of life for everyone, preserved natural ecosystems, sustainable natural resources management and high level of climate resilience. Increasing levels of energy efficiency, greater renewable energy use, and improved energy and transport infrastructure and services will lead to international investment, job creation and business enterprise in a resource-efficient economy. Negative impacts of climate change will be minimised by reducing vulnerability and taking advantage of opportunities brought about by climate change. The transition to a 'green economy' will particularly benefit the vulnerable and disadvantaged by being socially inclusive and contributing positively to gender equality.

This will be achieved through the implementation of the Climate Change Adaptation and Low-Emission Development Strategy for Bosnia and Herzegovina, which has two main goals on adaptation and on greenhouse gas emission reduction to:

• increase resilience to climate variability and climate change, and in so doing secure development gains;

• reach a peak in greenhouse gas emissions around 2025 at a level that is below the EU27 average per capita emissions.

The approach outlined in this document encompasses two closely linked components: an adaptation to climate change and low-emission development.

While mitigation is essential to minimise impacts and ensure that they remain manageable, adaptation is also required so as to ensure that Bosnia and Herzegovina reduces the risk and vulnerability of society and the economy from climate change and maximise opportunities from arising from such change. An Adaptation Strategy has been developed, approaching adaptation in a coordinated way and focusing on the implementation of practical adaptation measures to increase Bosnia and Herzegovina's resilience to current climate variability and long-term climate change, and in so doing secure development gains.

4.1.2. Technology Needs Assessment for mitigation and adaptation

Bosnia and Herzegovina is a European country that is significantly threatened by climate change and that has few resources for addressing the resultant problems and it is also relatively under-developed in terms of international cooperation in climate change. Taking into consideration that non-Annex 1 countries are suffering the greatest impacts from climate change, it is very important that they undertake analysis of development scenarios and formulate policies supporting sustainable development that contain adaptation and mitigation measures. Technology Needs Assessment for mitigation and adaptation was conducted while developing TNC, and the main findings thereof are provided further below.

Technology Needs Assessment (TNA) is a set of activities determining priorities for reducing emissions and adaptation to climate change. The purpose of the TNA is to identify technology needs (needs for new equipment, techniques, practical knowledge and skills, approaches, etc.) and prepare programs and projects that will help speed up the transfer of technology and knowledge, in accordance with the negotiations on a global level under the auspices of the UNFCCC and the recommendations stemming from them. The process of technology needs assessment is consultative and implies involvement of a broad spectrum of stakeholders in order to consider priorities, identify barriers and propose priority measures for application of technologies with low emissions and adaptation to climate change.

This is implemented in accordance with Handbook for conducting Technology Needs Assessment prepared by UNDP and UNFCCC on the basis of the mandate entrusted to them by COP13 (thirteenth Conference of the Parties to the Convention). The Handbook contains detailed instructions and recommends methods for implementation of the TNA process with a multi-sectoral approach and bearing in mind the long-term development vision of Bosnia and Herzegovina and the related economic, social, and environmental priorities. In addition to the TNA Handbook, tools and supporting resources that have been used in various stages of the process also include:

- TNAssess program, which, inter alia, provides for the assessment of priority sectors and technologies based on multiple criteria and records the results of the process;
- Climate TechWiki – an online database with descriptions of a number of technologies;
- Publications UNEP DTIE-UNEP DTU,
- Climate-ADAPT – online database and other available sources.

The aim of preparing this document is to strengthen the capacities of all stakeholders in Bosnia and Herzegovina, primarily decision makers, as well as other relevant stakeholders to define development strategies based on low emissions and adapted to climate change, by identifying priority technologies that will ensure:

1. maximum benefits in terms of economic, social and improvements related to the environment;
2. contribution to reducing GHG emissions in the context of national, EU and the UNFCCC policies; and
3. contribution to the increased resilience to climate change in priority sectors.

4.1.3. Status of Technology Transfer in BiH

Lately, there are some evident efforts to integrate climate change concerns into sector policies, strategies and plans. The Initial and Second National Communications on Climate Change were completed and submitted to UNFCCC Secretariat and they represent significant documents for understanding and monitoring the climate change phenomenon in Bosnia and Herzegovina. In addition, Climate Change Adaptation and the Low-emission Development Strategy was produced and adopted in Bosnia and Herzegovina, as well as the first Biennial Report of Bosnia and Herzegovina on Greenhouse Gas Emissions and the preparation of the National Adaption Action Plan (NAP) is underway.

TNA process fits very well in the context of Bosnia and Herzegovina since it can play an important role in the process of harmonising the domestic legislation with that of the EU policy and the practice in the field of climate change and contribute to fulfilment of obligations towards UNFCCC. Time of preparation and future implementation of this document coincides with the increased importance that is globally given to the technology transfer and the increase of global funds for climate change issues, which is an opportunity that Bosnia and Herzegovina should not miss. In addition, the results of this process can also serve as inputs for preparation of other strategic development documents and give its contribution in preparation of the Third National Communication under the UNFCCC.

Implementing measures to reduce GHG emissions provides a real opportunity to initiate technology transition through international professional and financial support. However, there are numerous obstacles, ranging from a lack of knowledge to mistrust and inadequate legal regulations. Therefore, it is important to demonstrate technologies in BiH in a way that addresses all their aspects: technical, economic, ecological, market related, legal and social. It is also very important to monitor how this technology will be implemented from the start, in order to monitor results and eliminate any difficulties in new projects.

The Second National Communication (SNC) for BiH identified numerous measures-technological needs in different sectors to reduce the impacts of climate change in Bosnia and Herzegovina. These measures were presented in the SNC, however very little has been done to implement these measures in the reporting period.

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

The section on climate change mitigation focuses on sectors where the greatest potential for reduction of greenhouse gas emissions was identified: electricity generation, district heating, buildings, transport, waste management, agriculture, and forestry. Scenarios were developed for each of those sectors, modeling possible pathways of GHG emissions until 2050, without an analysis of measures that would lead to these results. Specific modeling involved a quantitative evaluation of time-series GHG emissions and considered three development scenarios: S1—a baseline scenario ("business as usual"); Scenario S2 assumed partial implementation of mitigation measures, and S3 — the advanced scenario -- assumed implementation of a comprehensive set of mitigation measures.

Based on the analysis of the existing situation there are two main axes along which the possible development scenarios could be defined. The first is related to the level of energy efficiency and sustainability, and the second to the distribution of investment in new electricity generation between coal and renewable energy sources. The possible scenarios are presented in the Figure below (Climate Change Adaptation and Low-emission Development Strategy for Bosnia and Herzegovina, 2013).

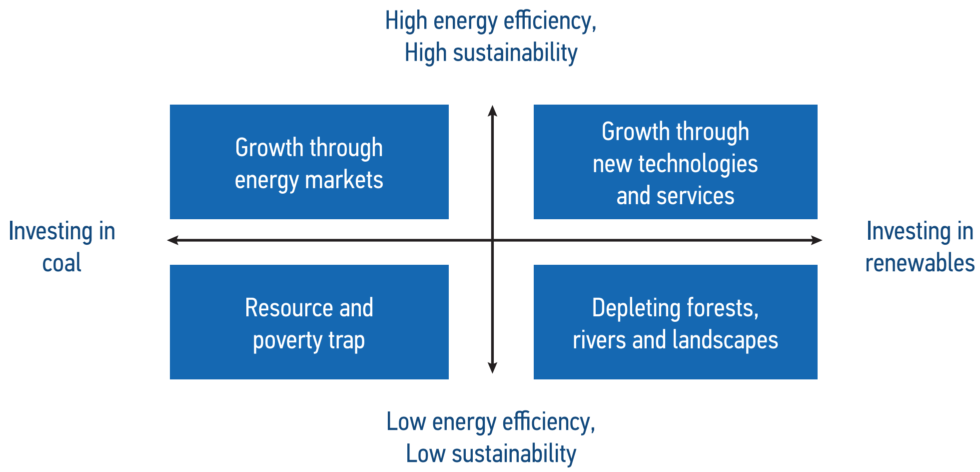


Figure 9: Choices affecting future development and emissions scenarios

Source: Climate Change Adaptation and Low-emission Development Strategy for Bosnia and Herzegovina, 2013

Description of the possible scenarios is as follows (Climate Change Adaptation and Low-emission Development Strategy for Bosnia and Herzegovina, 2013):

• Resource and poverty trap: Bosnia and Herzegovina continues to depend heavily on coal for its electricity production as well as heating of buildings. Modern thermal power plants are built with higher efficiency and lower emissions, but energy demand and energy prices grow. Households and industry, which cannot afford investments in energy efficiency, pay rising costs for energy, especially after the energy sector enters EU ETS and has to pay for the emission quotas;

• Depleting forests, rivers and landscapes: Bosnia and Herzegovina attracts major investment in hydropower, biomass and wind energy, accounting for a significant share of energy supply. At the same time, coalmining areas are in decline and require additional government support for restructuring. Due to low energy efficiency, energy demand grows faster than supply, leading to over exploitation of natural resources, such as forests, rivers, and landscape and biodiversity in general. This causes additional problems for adaptation to climate change, and reduces quality of life and tourism potential of the country;

• Growth through energy markets: Bosnia and Herzegovina attracts investment in its coal power sector with imported technology, significantly improving its efficiency and reducing specific emissions. The lifespan of coalmines is extended for another generation, making it possible to gradually restructure their economy at low cost. At the same time energy efficiency measures in households and industry keep energy demand below supply, and energy costs within reason. Bosnia and Herzegovina exports electricity to other EU countries and can thus afford the necessary emission quotas under the EU ETS.

• Growth through new technologies and services: An energy sector transformation is achieved combining investment into renewable energy and energy efficiency. This generates new business opportunities and workplaces replacing the lost workplaces in the coalmining regions. High technology manufacturing, service and financing businesses emerge that increase the exports of industrial products and services. Energy demand and energy prices are stable; households and industry are not exposed to increasing prices of carbon or the volatility of global energy markets. In the area of climate change mitigation, the first priority should be the involvement of local researchers in on going international research on greenhouse gas emissions and methods of their reduction. More research is required on:

- emissions from various sectors within Bosnia and Herzegovina;
- mitigation potential of these sectors;
- costs and benefits of mitigation actions;
- energy efficiency approaches and technologies;
- social and consumptions patterns influencing emissions and mitigation actions;
- role of and impact on gender equality;
- socio-economic modeling.

The most promising areas of technology development are those related to energy efficient buildings, including using domestic wood as construction material, and more efficient use of wood for energy, components and equipment for hydro and wind power. Science-policy interactions are core to developing and implementing adaptation and mitigation strategies. It is essential that climate change strategies are based on reliable scientific evidence. Robust scientific evidence of long-term changes in the climate system, and associated impacts, ensures that climate change is a scientifically-constructed policy problem. The scientific evidence gathered in recent decades has put climate change high on political agendas across southern Europe, due to the increased understanding of the vulnerability of sectors, regions and individuals.

In the Climate Change Adaptation and the Low-emission Development Strategy for Bosnia and Herzegovina, which was adopted by the entity and state government institutions, following seven priority sectors were identified: biodiversity and sensitive ecosystems, energy (hydropower), forestry, human health, tourism, and water resources/water management of which four sectors had priority.

Starting from the recommendations provided in TNA Handbook, during drawing up Technology Needs Assessment for Climate Change Mitigation and Adaptation for BiH, all the planned steps were implemented through a range of activities of members of closer and extended TNA team, involvement of technical experts for identification of technology, cost estimates and emission reduction, as well as through organization of project workshops and several consultative and working meetings throughout development of the document. During drawing up of TNA for climate change mitigation and adaptation in BiH, equal attention was paid and all project activities were implemented for both mitigation and adaptation to climate change. However, due to availability of data (both on the national level and in tools and sources recommended in the TNA Handbook) and the nature of technologies, certain differences appeared in the details of assessment for mitigation and adaptation. These differences can be summarised in the following way:

1. In the technology identification stage, information available from ClimateTechWiki and Climate-ADAPT for adaptation technologies and measures have proved to be quite limited, which is why publications of UNEP DTIE-UNEP DTU and other available sources, have been mainly used. As a result, description of adaptation technologies was much more general and contained less quantified elements than emission reduction technologies

2. Measures and technologies that were recognised as desirable for adaptation contained much more non-market or so called "soft technologies". Together with difficulties to quantify certain parameters for the deployment of such technologies, this has led to a situation where costs for adaptation technologies and measures could not be estimated. For each technology/measure, certain values within these 5 cost categories were entered in TNAssess programme (in the description of technologies), in order to enable continuation of the prioritisation process by using TNAssess. However, the ratio between costs and benefits as one of the results of technology prioritisation was not used for further considerations (priority technology/measures were instead decided solely based on the prioritisation of benefits) in the field of

adaptation. Unlike adaptation, for mitigation technologies costs were estimated in detail and the ratio between costs and benefits was taken in consideration when the final decisions were made about priority technologies.

3. Finally, identification of barriers that are currently impeding or slowing down the use of prioritised technologies/measures was done on a general level for adaptation, without analysis of specific categories of barriers (enabling environment, market chain and support services), as it was the case for emissions reducing.

One of the first activities in the TNA process in Bosnia and Herzegovina was consideration of development priorities and an attempt to define a long-term vision of sustainable development in the context of climate change. With this in mind, expert consultations were made on development priorities for the environment, economic and social development. Conclusions were then compared with the overview of development priorities from official planning and strategic documents. Lastly, a final selection of development priorities for TNA process was made which is shown in the Table below and it served as a reference framework for checking further decisions in the TNA process including determination of priority sub-sectors, prioritisation of mitigation and adaptation technologies, and definition of the strategy for acceleration of technology innovations as a way to achieve climate and development goals.

Social priorities	Economic priorities	Environmental priorities
Poverty reduction	Reducing dependence on energy imports	Sustainable forest management
Climate change education	Improved mobility of the population	Preserving and maintaining air quality
Improvements in the public health system in the context of climate change	Enhancing agricultural production and food industry	Improvements in waste management
Improving the quality of life for most vulnerable categories	Raising competitiveness of wood processing industry	Sustainable water management
Improving construction standards	Enhancing construction standards (planning and building)	Protection of biodiversity
Strengthening social cohesion	Better use of tourism potentials	Sustainable renewable (new) and alternative energy sources
Reducing sensitivity to CC in agriculture and forestry	Reducing unemployment	Sustainable land management
Strengthening the governance system, especially on the local level	Science and technology development	Adequate urban planning
	Selection of favourable options and technologies in energy	

Table 46: Development priorities

Technology prioritisation process in TNA in Bosnia and Herzegovina was implemented in three steps:

1. Identification, categorization and familiarization with technologies/measures in order to allow to a group of involved stakeholders to assess the applicability of given technologies in the national context;

2. Technology prioritisation by using the TNAssess programme and evaluation of the participants in the process; and

3. Making final decisions on priority technologies.

Identification of technologies for priority sub-sectors started with the engagement of several technical experts for different sectors for mitigation (emission reduction) and adaptation. Based on Chapter 5 and Annex 7 of the TNA Handbook, technology descriptions from the website ClimateTechWiki, UNEP DTIE-UNEP DTU manuals and other available sources, the experts:

- Identified possible technology options for priority sub-sectors and developed a long list of available technologies;

- Recommended the available technologies/measures that are applicable and adequate for conditions in Bosnia and Herzegovina, thus developing a short list of technologies;

- Collected data about technology options/measures from the short list in a form requested by TNAssess program, thus creating technology option pages for each technology;

- Estimated costs (capital, operational and other) of deployment of the proposed technology options; for mitigation sub-sectors costs were estimated in detail whereas for adaptation technologies/measures the constituting elements of costs were only identified and the cost categories were estimated – ranging from low to very high.

As a result of this process, 101 technologies for mitigation and adaptation were identified in total for all sectors and sub-sectors and assessed to be of interest for climate and development policy in Bosnia and Herzegovina. When the identification process was completed, information about selected technology options was entered in TNAssess program in appropriate categories. Data processed and categorised in this way served as a basis for the next step in the process – determining priority options, i.e. options that will make the largest contribution to the achievement of climate and development goals in the country.

Technologies for mitigation and climate change adaptation	
ENERGY SUPPLY	ENERGY CONSUMPTION
1. Large hydropower plants	1. Solar systems
2. Large wind plants	2. Heat pumps
3. Small HPP	3. Insulation
4. Efficient coal-fired power plant	4. Efficient lighting
5. Biomass CHP Plant	5. Efficient refrigerators (efficient household appliances)
6. Solar photovoltaic panels	6. Use of natural gas
7. Waste-to-energy plants	7. Efficient air conditioning systems
8. Natural gas plants (combined cycle)	8. Automated control of energy consumption in buildings
9. Coal-mine methane	
10. Wind plants on buildings	

TRANSPORT

1. Public Transport (PT) improvement
2. Liquefied petroleum gas
3. Bike lanes
4. Electric vehicles
5. Biofuels
6. Intelligent transport system (ITS)
7. Promotion and regulating non-motorized transport (NMT) in urban areas

WASTE

1. Waste-to-energy
2. Post-consumer recycling
3. Biological treatment including composting, anaerobic digestion and MBT
4. Thermal processes (incineration and industrial co-incineration, MBT with the disposal of residues and anaerobic digestion)

WATER RESOURCES

1. Regular maintenance of waterbeds
2. Flood warnings
3. Structural measures flood control measures (levees)
4. Water losses management
5. Water-saving measures in the industrial use, irrigation, etc.
6. Amelioration
7. Construction of reservoirs
8. Ensuring conditions for sustainable use of groundwater (monitoring, assessment of available quantities, protection of water sources)
9. Improvement of monitoring and other measures for combatting drought
10. Rainwater harvesting

PUBLIC HEALTH

1. Heat - health warning system
2. Public awareness and information campaigns
3. Adjusting groundwater management
4. Disaster recovery management systems
5. Orientation of buildings and open spaces
6. Shadowing
7. Water recycling
8. Adapting plans for drought and water conservation
9. Early warning system introduction
10. Information campaigns for behavioral change
11. Economic incentives for behavior change
12. Systems of monitoring, modeling and forecasting

BUILDINGS

1. Insulation of buildings
2. Carbon adsorbents and low-emission building materials
3. Passive house project
4. Energy savings in buildings
5. The life cycle of buildings and integrated design process
6. Greening the built environment
7. Sustainable designing of the community and practice
8. Solar technology

DISTRICT HEATING

1. Biomass combustion and combustion of different materials in order to obtain electricity and heat
2. Combustion of municipal solid waste for district heating or electricity generation
3. Heat pumps for heating or cooling and water heating
4. Energy services in the community
5. Solar cooling and hybrid systems for heating and hot water
6. Solar technologies for heating

BIODIVERSITY AND SENSITIVE ECOSYSTEMS

1. Adapting the plans for fire extinguishing
2. Agro-forestry and crop diversification
3. Adjusting the practice of cleaning the bottom
4. Adaptive natural habitats management
5. Public green and blue surfaces
6. Restoration and rehabilitation of coastal wetlands
7. Adapting plans for drought and water conservation
8. Adapting integrated land-use planning
9. Land-use Planning in Flood management
10. Rivers rehabilitation and restoration of rivers
11. Information campaigns
12. Economic incentives for behavior change
13. Systems of monitoring, modeling and forecasting

AGRICULTURAL PRODUCTION AND LAND

1. Conservation tillage
2. Reduction of emissions of nitrogen compounds by introducing best practices of manure management
3. Management in livestock production
4. Management of the plant production
5. Organic farming
6. Sustainable pasture management
7. Livestock management: straw ammoniation and silage
8. Crop residue management
9. Crop varieties with enhanced carbon sequestration
10. Application of agro-technical measures for water harvesting and moisture conservation:
    - Changes of timing of operations in the field and density of sowing,
    - Biological methods of protection,
    - Change manner of tillage (no tillage)
    - Careful use of fertilizers taking into account the changed efficiency of fertilizers due to changed climate conditions
11. Reconstruction and construction of irrigation system in agriculturally developed areas
12. Reconstruction and construction of the drainage system in the lowland floodplains and heavy soils
13. Construction of micro reservoirs

FORESTS

1. Afforestation (new technologies starting from the selection of seedlings tolerant to drought to the manner of planting and maintenance of plantations)
2. Raising intensive plantations for biomass production
3. Preventing forest fires (satellite monitoring)
4. Agroforestry (production for the needs of agriculture and forestry in the same space and time)
5. Biotechnology in the function of adaptation to climate change (breeding, bio-engineering ...)
6. Monitoring system for monitoring the impact of climate change on forest ecosystems
7. Biofuel production
8. Production of biopolymers
9. Urban forestry

Table 47: Technologies for mitigation and climate change adaptation

Information about the identified technologies were entered into TNAssess program for different categories. The program allowed for prioritisation to be executed based on Multi Criteria Decision Analysis (MCDA) for all categories within which three or more technologies were identified. Practically, using MCDA in TNA process means that the levels of priority of certain technologies within the same category are determined by evaluating benefits from each of these options in relation to several parameters. As a minimum, TNAssess enables assessment against four criteria – development benefits for environment, economy and society, as well as emission reduction or adaptation benefits. Besides these four basic criteria, TNAssess enables inclusion of other criteria, such as a market potential (possibilities for market expansion) and internal rate of return on investments, or creation and adding of new criteria (e.g. ease of implementation etc.). The results of prioritization process are given as a separate appendix to the TNA document.

Methodology and recommendations of the new TNA Handbook (prepared in 2010 by UNDP under the auspices of UNFCCC) were used to conduct TNA process in Bosnia and Herzegovina. Experiences with the application of the new Handbook and other available tools can be summarised in the following way:

• TNA methodology represents a solid framework for systematic implementation of the process with clear links between various process stages;

• Methodology proposed in the TNA Handbook is not always easy to follow in an environment where a wide range of stakeholders is working together;

• Application of TNA methodology in Bosnia and Herzegovina has been made more difficult because of uncertainties and lack of information that were particularly pronounced for adaptation sub-sectors; these have hindered quantification of certain elements and made assessment of benefits less precise;

• Introduction of multi criteria decision analysis (MCDA) in the procedure of technology assessment has given a new quality to the entire process and offered a possible model for further consideration of sustainable development options in the country;

• Tools and information sources recommended in the Handbook (such as the ClimateTechWiki database and TNAssess program) have facilitated the process, especially when it comes to emission reduction mitigation technologies; at the same time, the need to improve information and technical solutions for supporting the process have been identified;

• Flexible approach and adjustment of certain recommendations from the Handbook to local conditions, participants in the process and available time and information is necessary.

TNA strategy can be implemented i.e. priority technologies can be deployed at desired level only if systematic support measures are carried out. Cross-sectoral measures that should be paid special attention include:

• Fiscal (lowering of customs and VAT rates) and financial (subsidies, favourable loans) incentives;

• Awareness raising and educational campaigns (changing mind sets);

• Trainings to transfer and disseminate necessary specialists knowledge and skills;

• Discouraging unsustainable behaviours (by adopting and implementing appropriate instruments, regulations and standards);

• Improved cooperation and coordination among competent institutions as well as with other stakeholders (private sector, scientific and research community, civil society organizations);

• Enhancing databases and information systems;

• Conducting studies, analyses and research for better understanding of implications of climate change for society, economy and the environment.

4.2. Overview of plans and programs for systematic observing

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

The inventory compilers faced a number of obstacles and inconsistencies while collecting activity data. Namely, statistical data are not harmonized with methodology of inventory compilation in terms of data availability and inadequate data format. This refers to all sectors (waste, transport, industrial processes, energy industry, LULUCF, agriculture), with special accent to energy sector (a key sector from the aspect of GHG emission), but also to waste sector (linked indirectly with number of population and their distribution), to wastewaters (data on industrial and communal wastewaters are either lacking or missing completely), to agriculture (data on fertilizers consumption are almost completely missing, so expert judgments have to be made), etc.

In order to develop a sustainable system for the estimation of greenhouse gas emissions and their elimination in the long-term it is recommended to revise relevant environmental and air protection laws in accordance with general requirements of the Directive (EU) no. 525/2013 on a mechanism for monitoring and reporting GHG emissions in order to stipulate preparation and enforcement of secondary legislation which shall primarily establish mandatory data flow system between competent authorities with clear responsibilities and timing. Secondly, it is recommended to establish clear connection between QA/QC Program, QA/QC Plan (which has yet to be developed) and capacity building and training needs for GHG inventory team in order to focus on those parts of GHG inventory, IT applications and databases and methodological issues which are critical. Finally, it is recommended to develop alternative calculation methods (see IPCC GPG, section 7) based on expert judgment, drivers and/or cluster analysis in cases when emission sources or sinks have occurred but activity data could not be obtained. Suggestion is also to harmonize statistical methodology data with IPCC methodology requirements to the extent to which the methodological requirements of the IPCC coincide with the requirements and standards of the relevant statistical methodology.

4.3. Education, training and raising awareness

Under Article 6 of the UNFCCC, each party is strongly encouraged to build a system for promoting and development of education, training and raising awareness regarding climate change. It is not only the obligation created under the UNFCCC, but it is about developing a system that will allow each country for a more professional and active participation in their own planning activities. Global climate change is putting fundamental dilemmas before humanity in the 21st century. Almost all ‘action goals’ highlighted in the UN Decade of Education for Sustainable Development (2005–2014) include the essential environmental issues, in particular: climate change, rural development, sustainable consumption, sustainable tourism, reducing the number of disasters, biodiversity and water protection. This Declaration states that the paradigm of sustainable development should be incorporated in the curriculum at all levels and in all parts of the world, and that the implementation thereof must be initiated also at the level of education, which is of fundamental importance.

Analysis of the share of the content in the field of environmental protection in the school curricula in primary and secondary schools showed several interconnected basic characteristics. The first one is under-representation of content that addresses environmental issues. The second characteristic is the dominant role of the theory of substantive education in the choice of teaching content and organization of teaching subjects in general, and consequently those dealing with environmental protection issues. The third, an implicit characteristic is actually a lack of inter-curriculum approach of an individual when it comes to environment, and his/her sensitization about the problems that are put before the future development and course of humanity. Instead of focusing on one fundamental subject it is necessary to apply the cross-cutting principle of all subjects that touch upon the issues mentioned above. In this regard, UN declared the Decade of Education for Sustainable Development 2005 –2014, which provides guidance and recommendations for the incorporation of the environmental content in subjects at all levels, emphasizing inter-curriculum and interdisciplinary approach. Somewhat better situation is noted in higher education where the increasing involvement of subjects in the field of the environment is evident and hence the climate change, within the growing number of universities. The reason for this lies in the fact that the modification of curricula is much easier in the higher compared to primary and secondary education. Detailed analysis of the situation and the need to integrate climate change into curricula, along with the training of teachers is thoroughly prepared as a separate chapter in the development of the Third National Communication.

Activities conducted so far in the field of education and raising awareness about climate change were not well organized and the results are quite modest. Therefore, a better education in the sphere of environmental protection and raising awareness are of particular importance because it can help in the implementation of long-term strategies and policies related to climate change. It is very important to organize coordinated joint implementation between the different stakeholders, particularly government institutions and civil society.

4.3.1. Gaps and needs in education and capacity strengthening

In the BiH education system, none of the Entities paid much attention to environment or climate change, even though the Constitution clearly emphasizes this issue. Entity-level education strategies, where environment and climate change should be integrated into the curriculum of primary, secondary and vocational schools, as well as universities, particularly technical, bio-technical, economic, law universities and natural science universities, have not been passed yet.

Southeast European countries allocate low funds per capita for basic and applied research and, due to the relatively small populations, they also have low funds in absolute terms. Therefore, it is suggested to establish certain scientific cooperation among them in order to achieve sustainable development. These measures are crucial for establishing the nucleus of future professional staff in administration and economy and they contribute to the creation of a civil society aware of environmental issues. These measures must be implemented in the long term.

There is a need to strengthen the capacity of existing staff in the environmental protection sector at all administrative levels and to develop annual staff training programs to enhance the skills of existing staff working in the area of environment, based on the needs assessment. Training should be organized in cooperation with one or more professional institutions capable of providing these programs.

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

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

The priorities for capacity building in Bosnia and Herzegovina are described in detail in the Initial National Communication and, as such, remained unchanged also during the preparation of the Second National Communication.

4.3.2. Raising awareness

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

There is a need for a higher level of awareness and knowledge regarding the impact of climate change among decision-makers and the general public so as to enable a systematic response and build resilience.

Regardless of the fact that media are the main source of information on climate change, so far the media has not been sufficiently active in strengthening public awareness about climate change; hence, more should be done in that direction. It is necessary to provide a greater number of documentary programs on climate change, public discussions and discussions on TV stations with politicians, and representatives of public enterprises and private enterprises; i.e., decision makers for strategic decisions and projects. The need for additional training for local journalists, public sector employees in the domain of their contribution to sustainable development, including low-carbon development strategies and adjustment to risks from climate change, is evident.
The focus of the activities will be on supporting organizations and communities across BiH to respond to the climate change impacts, instead of working only on raising awareness about climate change and the impacts thereof. The communication should be supported and lead towards the individual, community and organizational response to climate change and the implementation of adaptation measures.

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

Although more than 100 non-governmental organizations in BiH said that they are primarily oriented towards environmental protection, as well as climate change, only at the end of May 2012, BiH opened its first Aarhus Centre. The Aarhus Centre and Aarhus Network (established in May 2013 by several Aarhus centres) promotes the understanding and application of the Aarhus Convention, as well as cooperation between the relevant authorities, civil society, the judiciary, the private sector, the media and the public regarding environmental issues, and it has achieved significant cooperation with many environmental non-governmental organizations which provided support for establishment of the Green Parliamentary Group in the Parliamentary Assembly of Bosnia and Herzegovina.

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

Climate change priorities in education, training and awareness raising imply the following objectives:

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

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

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

• Conduct outreach to state officials, including representatives of ministries of education, on climate change causes and effects and their integration into curriculum and standards;

- Implement teacher training on the need to introduce climate change into the curriculum and on appropriate teaching methods;

- Nominate an expert group in education and economic sectors to introduce education on climate change in each sector;

- Organize scientific gatherings on linking informal education and private and public enterprises aiming to adjust to climate change and alleviate its impacts;

- Politicians, businessmen, and journalists should be educated about the causes and effects of climate change through projects in accordance with development strategies;

- Politicians, businessmen, and journalists should be educated on the international mechanisms for financing projects in the areas of mitigation and adaptation to climate change, as well as on project submission;

- A campaign on climate change and its impacts should be initiated with an identifying logo and slogan in the short term.

4.4. Preparation of operational programs to inform the public

Knowledge and awareness of climate change in BiH is not sufficient, although there's been an obvious improvement in relation to the previous period. Neither the public nor the business community nor politicians are aware that the territory of BiH is vulnerable to climate change and that the impacts of climate change will affect the quality of life and work. That is why the provision of relevant information to all stakeholders should be a high-priority task.

Basic information that needs to reach the public is as follows:

1. Bosnia and Herzegovina is vulnerable to climate change,

2. There are adaptation methods (coping with, partial or complete adaptation) and adaptation through the application of measures to decrease global emissions (mitigation),

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

In order to implement adaptation and mitigation programs, it is necessary for the information to reach all levels, types, and profile of education of all citizens, economic organizations, and all employees in state bodies.

Basic concept for the overall information system remains unchanged when compared to the Second National Communication and additional efforts should be invested for this concept to become active.

4.4.1. Functioning of the climate web portal and establishment of an integrated information system

In the period between the two Communications, the website www.unfccc.ba continued to inform the public about the state of climate change in the world and in Bosnia and Herzegovina. Nevertheless, it is necessary to expand the existing information system to include additional information sources, primarily meteorological institutes and research institutions, as well as expanding the number of users.
In addition to existing content, the climate web portal should contain the following information:

- data and forecasts of climate change in BiH,

- vulnerability of BiH, vulnerable natural resources, and impacts on living conditions, all related to climate change,

- climate change adaptation programs in BiH and abroad,

- information on incentive mechanisms for

mitigation measures (domestic and foreign),
- information on NAMA projects and initiatives in BiH,
- information on "activity data" for BiH.

4.5. International cooperation

4.5.1.International cooperation within global environmental agreements

With the signing and ratification of the UNFCCC back in 2000, Bosnia and Herzegovina officially became a part of international cooperation in the area of climate change. From the very beginning BiH regularly attended all conferences of the parties, as well as at professional bodies' meetings within the UNFCCC Secretariat, including meetings of the IPCC and CTCN.

In addition to this, it would be good to emphasize cooperation among countries in Southeast Europe in environmental protection and climate change. Confirmation of this type of cooperation is the active participation of BiH in the Belgrade Conference, which was held in 2007 to discuss regional activities related to climate change adaptation.

Bosnia and Herzegovina ratified the Beijing amendments of the Montreal Protocol of the Vienna Convention on Ozone Layer Protection, thus joining the decision made at the 22nd meeting on the global phase-out of hydrochlorofluorocarbons (HCFCs) and chlorofluorocarbons (CFCs). However, it is necessary to undertake further steps in harmonising with EU legislation on ozone depleting substances and fluorinated gases. Even though BiH is a party to the Copenhagen Agreement, BiH still does not have plans to formulate requests for reduction of GHG emissions.

Complementary activities amongst three UN Conventions – climate change, biodiversity and desertification – are necessary to harmonize activities in BiH, but they are also an excellent opportunity for international cooperation that would help BiH in achieving sustainable development.

4.5.2. Regional cooperation

Regional cooperation is defined here as cooperation that takes place within the framework of Southeastern Europe and the Western Balkans (the description does not include the EU member states Bulgaria and Romania). Regionalism is a strategic way of adapting to global changes, as an increasing number of countries do not have the capacity and resources to independently address the challenges that these changes impose. The creation of regional networks and structures can increase economic stability and establish an open and stimulating business environment. The creation of a regional economic zone can also contribute to the removal of investment barriers and facilitate conflict resolution in the business sector (SEE – FAP, 2008).

Generally speaking, regional cooperation simplifies securing "public goods;" such as water, energy, transportation or free movement. Regional cooperation encompasses many areas of economic and social life, political structure, internal security, environmental protection, culture, etc. It is a complex and multifaceted process of building links within the region that is not limited to relations amongst states and national administrations but also includes other stakeholders of the society such as the business community and civil society.

Regional cooperation and neighbourhood relations constitute the core process of accession of Bosnia and Herzegovina to the European Union. Bosnia and Herzegovina still actively participates in regional initiatives, including the Cooperation Process in Southeast Europe (SEECP), Regional Cooperation Council (RCC), Central European Free Trade Agreement (CEFTA), Agreement on Energy Community, Belgrade Initiative on Climate Change, Igman Initiative, EU Strategy for Danube Region, and EU Agreement on Joint Airspace. BiH is a host of the RCC Secretariat, which organized many regional activities.

The most significant activities related to regional cooperation in the past period are as follows: the Contract on Joint Energy Market of South East Europe, Regional Cooperation Council, Belgrade Initiative for Climate Change and Igman Initiative, which are all described in detail in the Initial National Communication.

In addition, BiH participation in ECRAN program (Environment and Climate Regional Accession Network) should be noted, in which Bosnia and Herzegovina has taken an active part from the very beginning.

Finally, one more successful network that should be noted and that is constantly developing is the Covenant of Mayors. The Covenant of Mayors was initiated in 2008 by the European Commission, and its main task was to support local authorities in the implementation of sustainable energy policies. Local authorities play an important role in CO_2 emission reductions. In the past period, 17 BiH cities and municipalities have already signed the Covenant of Mayors, who have already submitted their action plans in the past period. The Covenant is an extraordinary example of a successful model of self-government. The signatories to this agreement seriously take their responsibility towards their residents and they strive to improve their living conditions.

5. CONSTRAINTS AND GAPS

This chapter provides an overview of limitations and obstacles related to institutional, legal, financial, technical, and human resource capacities in BiH that affect the implementation of obligations under the United Nations Framework Convention on Climate Change (UNFCCC).

Information about these obstacles and limitations is based on the findings of previous studies and projects in BiH, as well as the results of the analysis of the sector in the previous chapters.

Some of the suggested measures imply the implementation of various forms of research and building of a system of monitoring the climate change impact, and their implementation requires an adequate support. It is necessary to provide financial resources as one of the first steps in implementing these measures. Another important area of focus is to improve insufficiently developed research capacity to understand climate change impacts and address climate change adaptation. It is also important to define the roles of various stakeholders tackling these issues. At the same time, it is necessary to work on promoting understanding of the importance of climate change, and a special task is to preserve the established system and capacity, as well as strengthening their values.

5.1. Institutional constraints

Climate change should not be addressed by governments in isolation. The success of the response to climate change will depend on organizations, local communities and businesses preparing for a changing climate, and implementing appropriate responses. Governments in BiH must raise this issue and provide leadership, support and an enabling environment, but ultimately they must work collaboratively with a range of local, community, national and international partners.

International experience has shown that developing and implementing various adaptation strategies is often constrained by a range of institutional complexities and horizontal issues. Governance institutions were established when climate change issues were of low importance. Due to its multi-faceted nature, climate change adaptation does not always fit into various sectoral, departmental or ministerial areas. To date, climate change issues have been peripheral to most institutions in Bosnia and Herzegovina

Institutions in Bosnia and Herzegovina (and in other countries) are facing with challenges that reduce the capacity of adaptation and the possibility of implementation and further development of adaptation strategies. The key problems are conflicting and overlapping mandates, poor coordination and lack of an efficient agreement.

Pursuant to the Dayton Agreement, the implementation of the environmental policy in Bosnia and Herzegovina (BiH) falls within the competence of the Entities and the District Government in Brčko District. The BiH Coordinating Committee for Environment was established by the decisions of the Entity Governments, based on the adopted laws, whose task is harmonization and coordination of the environmental policy at the level of Bosnia and Herzegovina. Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina is responsible, along with the entity-level ministries, for the international obligations of BiH in the field of environmental protection, while the responsibility for obligations under the UNFCCC and development of the National Communications of BiH rests with the UNFCCC Focal Point, a position that is located at the Ministry of Physical Planning, Civil Engineering and Ecology of RS.

Jurisdiction of the state administration in environmental matters is quite limited and reduced to functions that are mainly related to international cooperation and necessary coordination. There is an evident lack of both vertical and horizontal cooperation and coordination among competent institutions, and these mechanisms are of particular importance for international and national activities. Environmental protection policy in BiH has been is neglected due to the insufficient utilization of economic and financial resources. Policies for introducing new economic instruments and using existing ones must be strengthened so as to change the behaviour of both people and institutions respectively towards better environmental protection and provision of incentives for reduction of pollution and allocation of resources for investments and improvement of environmental quality. Currently, some existing economic instruments do not function as they are supposed to, while other instruments do not function at all. For example, there are no emission fees charged to companies that emit air pollutants, nor is there any oversight of their activities. In short, the institutional capacity to implement effective and forceful policies remains weak.

In BiH there is no overall supervision of environment and data collection system, resulting in a lack of systematic information on environmental protection. For the time being, different institutions are collecting different data without sufficiently developed coordination and unique databases. Data exchange and communication between institutions collecting data and governmental organizations is insufficiently developed, and there is no information exchange on existing data. Even though there are some data on environmental issues, those figures are either outdated, incomplete or inapplicable. Current data on the environment, as well as statistical data more generally, are not shared between the entities, which prevents them from getting the complete picture of the links between development activities and environment quality or of indicators that could support and improve decision making.

Preparation of the National Communications included a comprehensive overview of all available documents developed for BiH and entities with financial support from abroad (UN, WB, and other bilateral and multilateral donors) or from the entities' budgets. These documents are important, because they contain necessary information for the preparation of national reports; however, many documents have not been endorsed using the standard BiH political procedures, and hence cannot be considered as official state documents. These substantial challenges require constant improvements and updates with the engagement of entity governments and the Council of Minister. There have been limited opportunities for civil society engagement in Bosnia and Herzegovina to date (particularly for NGO and Community-based organization participation), due to financial, human resource and political constraints. International NGOs have dominated climate change agendas in Bosnia and Herzegovina. This needs to be rectified by increased civil society engagement and ownership, demonstrated by on-the-ground adaptation activities at the local level.

5.2. Financial constraints

Two funds are active in BiH – the RS Environmental Fund (2002) and the FBiH Environmental Fund (2003) – as financial institutions for the collection and distribution of environmental funds. However, they still do not deliver expected results. New RS Law on Environmental Fund and Energy Efficiency was adopted in November 2011 that introduced the allocation of funds for supporting the implementation of energy efficiency projects and renamed the Fund to the RS Fund for Environmental Protection and Energy Efficiency. Changes in the law on funds both in FBiH and Brčko District are in progress.

It is expected that limited funding will be available from domestic public sources in the foreseeable future. Thus, financing of actions will be structured between the private sector, population, companies, banks, etc., classical donors and EU funds, as they develop in the process of accession and through financial mechanisms under UNFCCC (including GCF, Adaptation Fund, and new market-based mechanisms). Where possible, actions will involve the private sector, public private partnerships, local communities and NGOs.

The most significant funding opportunities are EU IPA funds and the UNFCCC GCF. Resources from both of these sources will be sought to support implementation. Other important potential funding opportunities include GEF, EC FP8 and bilateral donor funding. Innovative partnerships will need to be developed with multilateral funding agencies that are currently reviewing their development assistance in the context of climate-resilient development. In addition, as many of the activities outlined above are linked with further infrastructural developments, loans from the World Bank and

European Bank for Reconstruction and Development (EBRD) can be sought.

5.3. Human resource constraints

Administrative capacities in the environmental sector are still low. State bodies tackling environmental issues do not have the capacity to apply and/or implement legislative regulations at cantonal, entity and local level. Administrative capacities for environmental issues have not been developed, and there is no staff or funding allocated for this purpose.

5.4. Addressing gaps and constraints: mitigation and adaptation measures

A lack of knowledge and awareness regarding climate change risks has resulted in insufficiently developed capacity to identify climate change adaptation measures in BiH. Having in mind different climates in BiH, climate change adaptation must rely on specific features of climate in specific regions. The previous two national communications of Bosnia and Herzegovina under the UNFCCC have determined a strong climate change impact in the most sensitive sectors but they have also defined possibilities of adaptation. Climate change and increased frequency and intensity of extreme climate events have caused increased pressure in the sectors of agriculture, water management, health, forestry and tourism, as well as in management of water resources and protected areas. There was an increase in variability in weather conditions, recorded in all seasons, with the rapid changes occurring during short periods (five to ten days) from the extremely cold to warm weather, or from the period of extremely large amounts of precipitation to extreme drought periods. Since 2000, Bosnia and Herzegovina has been facing with several significant extreme climate and weather episodes that have caused substantial material and financial deficits, as well as casualties. The two most important events are drought during 2012 and flooding during 2014.

In order to implement the adaptation measures, it is necessary to develop an indicator system compatible with EU standards that will be adjusted to the specific needs of Bosnia and Herzegovina. Capacity building in climate change impacts monitoring is a priority; hence, it is necessary to undertake capacity building measures to manage development in climate change:

1. It is necessary to choose one stable system of statistical data on climate change that uses an internationally recognized assessment methodology and is able to monitor sustainable development in spite of adverse climate change impacts. The components described in this Communication can be expanded and integrated into the existing system of meteorological information or regular statistical reports of entity institutions and the state-level Agency for Statistics of BiH.

2. It is necessary to improve the existing system of meteorological observation – observing climate change and adaptation results, including an early warning system. Professional capacity development should be integrated into the international observation system.

3. It is necessary to appoint professional and political bodies, responsible for managing the development in an unstable climate environment. Professional bodies at the state and entity level (except for classical planning and proposing economic measures in parliamentary structures), should be also trained for the involvement in the mitigation measures in terms of preventing adverse consequences of climate change (Council of Ministers of BiH, the entity governments, institutions in charge of economic and regional planning, agencies for water areas, companies, civil protection, etc.). It is necessary to determine the obligations of political authorities in Bosnia and Herzegovina for the political responsibility regarding care for sustainable development in changing climate conditions.

4. It is necessary to raise the awareness of the general public about the importance of the active engagement of society in climate change

issues, and it is necessary to invest financial and human resources for the implementation of sustainable development so that climate change becomes tolerable within a larger context of stable development. Key initiatives, policies and adaptation measures can be established at the BiH level and in the framework of international cooperation.

It is expected that the aforementioned will be fulfilled in 2016, bearing in mind that in Bosnia and Herzegovina is in the process of developing a National Adaption Action Plan (NAP), the completion of which is expected during 2016 and it will certainly have regard to the above stated and provide a complete and complex response to climate change in the form of an Adaptation Action Plan.

Simultaneously, mitigation measures should be based on decreasing the existing trend of GHG emissions and on preserving existing sinks (sequestration);

Primary mitigation measures are based on the reduction of existing GHG emissions growth. They include increasing energy efficiency in all production sectors; applying contemporary technologies in all production areas; increasing the share of electricity supply from contemporary technologies in all production areas; and stimulating employment in sectors where mitigation measures are implemented, etc.

Additional mitigation measures are based on the preservation of major sequestration capacity.

5.4.1. Priority needs by sectors

The sectors most affected by climate change in BiH are as follows: agriculture, water resources, human health, forestry and biodiversity and sensitive ecosystems, including, for the first time in BiH, the coastal area. Therefore, the TNC performed detailed analyses of long-term climate change impacts on these sectors. The assessments were based on the climate A1B, A2 and RCP8.5 scenarios developed for the needs of the Third National Communication (TNC). Bosnia and Herzegovina is a developing state, and its GHG emissions are significantly lower than they were in its reference year (1990) due to the war (1992 – 1995) and the resulting destruction of industry. However, even though the impact of BiH on global emissions is rather small, its economy is suffering significant pressure due to the climate change. Therefore, adaptation measures in the sectors analyzed should represent an imperative in combating climate change. The economy of BiH is at a low level, and in order to adapt to climate change, it will be necessary to provide international assistance; i.e., financing, knowledge, technology and good practice.

In parallel to the adaptation measures, a detailed analysis of climate change mitigation measures was carried out where for the priority sectors a set of scenarios was developed with appropriate indicators and the measures were proposed accordingly to mitigate climate change. Specific modeling involved a quantitative evaluation of time-series GHG emissions and considered three development scenarios: the S1 – a baseline scenario ("business as usual"); the Scenario S2 assumed partial implementation of mitigation measures, and the S3 – the advanced scenario -- assumed implementation of a comprehensive set of mitigation measures

Based on the obtained results of development of scenarios of individual sectors, a consolidated summary was made which combines all the effects by individual scenarios. The most influential sector in the emission projections is the electric power sector, which, in total takes the share of 40-65%, depending on the scenario and the period under review.

5.5. Multilateral/bilateral contributions to address constraints

Drafting of the Third National Communication itself implies participation in the creation and development of BiH capacity required under this document. In the long term, it is of utmost importance to integrate all activities in the process of long-term development and in the sectoral development plans.

From the moment when BiH signed and ratified the UNFCCC and designated a focal point institution, the establishment of the body that would harmonize all environmental activities, including climate change, was initiated. With the designation of the focal point institution for UNFCCC (RS Ministry of Urban Planning, Construction and Ecology) these activities are focused on ensuring BiH become an active member of UNFCCC as soon as possible, as a non-Annex I party.

Aiming to overcome perceived issues and with the full support of entity and state bodies as well as GEF and UNFCCC Secretariat, UNDP BiH organized the preparation of the Initial National Communication. The work was initiated in 2008, and the Initial National Communication was finalized and submitted to the UNFCCC Secretariat in 2010. Leaning heavily on instructions 17/CP8, with technical support and coordination of UNDP, the Initial National Communication was prepared by more than 45 local experts. The INC was adopted by both entity governments and the Council of Ministers, and the UNFCCC contact institution RS Ministry of Urban Planning, Construction and Ecology submitted the report to UNFCCC Secretariat. The same approach was also maintained in drafting the Second and Third National Communication.

In addition, in a similar way, Bosnia and Herzegovina has prepared Climate Change Adaptation and the Low-emission Development Strategy for Bosnia and Herzegovina, as the first in the region, and it successfully implemented drafting of the First and Second Biennial Update Report of Bosnia and Herzegovina on Greenhouse Gas Emissions.
It should be noted that in terms of overcoming the limitations in drafting of the TNC, Bosnia and Herzegovina, as already mentioned above, prepared a Technology Needs Assessment.

Moreover, by putting the CTCN in full operation, an opportunity was provided for technical assistance, which Bosnia and Herzegovina used and successfully applied for a technical assistance project for the implementation of the project “Rehabilitation and modernization of the district heating system of the City of Banja Luka” in 2015, the implementation of which is ongoing.

As already mentioned above, drafting of the Adaptation Action Plan will help in overcoming the constraints.

Members of the existing interdisciplinary expert group are in constant contact, and the group represents the seeds of future institutions that will eventually reach the level required for successful implementation of the activities foreseen by the Communication.

SECOND BIENNIAL UPDATE REPORT ON GREENHOUSE GAS EMISISONS IN BOSNIA AND HERZEGOVINA

UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

Appendix to the Third National Report consists of the Second Biennial Update Report of BiH on the emission of greenhouse gases under the United Nations Framework Convention on Climate Change. The inventory of greenhouse gas emissions in this report covers 2014 and the report also contains an overview of the areas of greenhouse gas emissions reduction and climate change mitigation by sectors. Although it covers only one-year period, it was prepared in accordance with the UNFCCC Guidelines for preparation of Biennial reports on GHG emissions for the Member Countries not parties to Annex I of the Convention pursuant to CP Decision 17 (2/CP.17, Annex III, section 3).

1. Inventory of Greenhouse Gas Emissions

1.1. Methodology

The inventory of greenhouse gases in this Report covers the year 2014. Even though it covers only one year, 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 Report, 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 2000 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 the IPCC. 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 $C0_2$ emissions from fuel combustion in two different ways: the more detailed Sectoral Approach and the simpler Reference Approach.

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.

Inventory for 2014 was compiled within the TNC report.

1.2. Data collection and processing system

Activity data needed for calculation of GHG emissions in 2014 are officially published statistical data.

1.2.1. Energy industry

Amounts of coal used for calculation of GHG emissions are based on data published in yearly balance of coal and other fuels in 2014. All coal is presented as lignite; following the input data on lower heating value of coal produced and used in 2014 (information provided by the coalmine and TPP operators). Namely, heating values of coal types used in 2014 did not exceed 16 TJ/kt.

1.2.2. Transport

Data on fuel consumption in 2014 were taken from the official publication of the Agency for Statistics of BiH – Balance of oil derivatives.

1.2.3. Industrial processes

Production data are obtained directly from the following industries:
• Iron and steel;
• Coke and Nitrate Acid production;
• Cement production (clinker production stage in

rotary kilns).

All other production data were taken from statistics; EF used for calculating CO_2 emission from iron and steel industry is 1,46 t CO_2/t steel produced, due to the integrated technology using basic oxygen furnace (BOF), and it is in accordance with Revised 1996 IPCC Guidelines.

EFs used for HNO3 production for N2O was 2 kg of N2O per t of nitric acid produced, due to the applied SNCR technology, and is in accordance with IPCC 1996 Guidelines.

EF used in ferroalloy production is 4,3 t CO_2 per t of ferroalloy production, which relates to production of silica metal, and is in accordance with IPCC 1996 Guidelines.

1.3. Results of emission estimations for 2014

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

Because certain greenhouse gases differ in terms of their radiating characteristics, their contribution to the greenhouse effect varies. In order to allow the aggregation and total overview of emissions, it is necessary to multiply emission of each gas by its Global Warming Potential (GWP). GWP is a measure of how much a specific gas contributes to the greenhouse effect in relation to the impact of CO_2. In this case, the emission of greenhouse gases is expressed in Gg CO_2eq (mass of equivalent CO_2). Table 48 shows the global warming potentials for individual gases for a period of 100 years.

Greenhouse gas	Global warming potential
Carbon dioxide (CO_2)	**1**
Methane (CH_4)	**21**
Nitrous oxide (N_2O)	**310**
CF_4	**6.500**
C_2F_6	**9.200**
SF_6	**23.900**

Table 48: Global warming potentials for individual gases for a period of 100 years

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

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

GHG source category /Year			2014
Total emissions (Gg CO_2eq) - without sinks			**25.538,60**
Total emissions (Gg CO_2eq) - with sinks			**19.140,60**
1. Energy			**19.734,33**
	A. Fuel combustion (sectoral approach)		**19.631,88**
		1. Energy Industries	**14.480,94**
		2. Manufacturing industries and construction	**857,03**
		3. Transport	**3.053,20**
		4. Other sectors	**1.240,72**
		5. Other (please specify)	**NO**
	B. Fugitive emissions from fuels		**617,79**
		1. Solid fuels	**612,57**
		2. Oil and natural gas	**5,22**
2. Industrial processes			**2.247,36**
	A. Mineral products		**728,10**
	B. Chemical industry		**59,76**
	C. Metal production		**1.459,50**
	E. Production of halocarbons and sulphur hexafluoride		**NO**
	F. Consumption of halocarbons and sulphur hexafluoride		**0**
3. Solvent and other product use			**NE**
4. Agriculture			**2.453,00**
	A. Enteric fermentation		**798,00**
	B. Manure management		**415,00**
	C. Rice cultivation		**NO**
	D. Agricultural soils		**1.240,00**
	E. Prescribed burning of savannahs		**NO**
	F. Field burning of agricultural residues		**NE**
5. Land-use change and forestry [1]			**-6.398,00**
	A. Changes in forest and other woody biomass stocks		**-6.398,00**
	B. Forest and grassland conversion		**NE**
	C. Abandonment of managed lands		**NE**
	D. CO_2 emissions and removals from soil		**NE**
6. Waste			**966,00**
	A. Solid waste disposal on land		**735,00**
	B. Waste-water handling		**210,00**

	C. Waste incineration		**NO**
7. Other (please specify)			
Memo items			
	International bunkers		
		Aviation	**NO**
		Marine	**NO**
	CO_2 emissions from biomass		**NE**

Table 49: CO_2eq. emissions for 2014

Greenhouse gas source and sink categories	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NOx (Gg)	CO (Gg)	NMVOCs (Gg)	SOx (Gg)
Total national emissions and removals	**21.712**	**-6.398**	**120**	**6**	**80**	**136**	**24**	**516**
1. Energy	**19.524**	**0**	**31**	**0**	**79**	**118**	**22**	**513**
A. Fuel combustion (sectoral approach)	19.524		2	0	79	117	21	511
1. Energy Industries	14.416		0	0	43	3	1	479
2. Manufacturing industries and construction	853		0	0	2	1	0	12
3. Transport	3.037		0	0	31	100	19	5
4. Other sectors	1.218		1	0	2	14	1	16
5. Other (please specify)	0		0	0	0	0	0	0
B. Fugitive emissions from fuels	0		29		0	0	1	2
1. Solid fuels			29		0	0	0	0
2. Oil and natural gas			0		0	0	1	2
2. Industrial processes	2.188	0	0	0	1	18	2	3
A. Mineral products	728				0	0	0	0
B. Chemical industry	0		0	0	1	0	1	0
C. Metal production	1.460		0	0	0	18	0	2
D. Other production	0		0	0	0	0	2	0
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)	0		0	0	0	0	0	0

3. Solvent and other product use	0			0			0	
4. Agriculture			43	5	0	0	0	0
A. Enteric fermentation			38					
B. Manure management			5	1			0	
C. Rice cultivation			0				0	
D. Agricultural soils				4			0	
E. Prescribed burning of savannahs			0	0	0	0	0	
F. Field burning of agricultural residues			0	0	0	0	0	
G. Other (please specify)			0	0	0	0	0	
5. Land-use change and forestry[1]	0	-6.398	0	0	0	0	0	0
A. Changes in forest and other woody biomass stocks	0	-6.398						
B. Forest and grassland conversion	0	0	0	0	0	0		
C. Abandonment of managed lands		0						
D. CO_2 emissions and removals from soil	0	0						
E. Other (please specify)	0	0	0	0	0	0		
6. Waste			46	0	0	0	0	0
A. Solid waste disposal on land			35		0		0	
B. Waste-water handling			10	0	0	0	0	
C. Waste incineration					0	0	0	0
D. Other (please specify)			0	0	0	0	0	0
7. Other (please specify)	0	0	0	0	0	0	0	0
Memo items								
International bunkers	0		0	0	0	0	0	0
Aviation	0		0	0	0	0	0	0

Table 50: Emissions by sectors in 2014 on gas-by-gas basis

1.3.1. Total emissions of carbon dioxide (Gg CO_2eq)

Chart below shows total emissions for period 1990 – 2014.

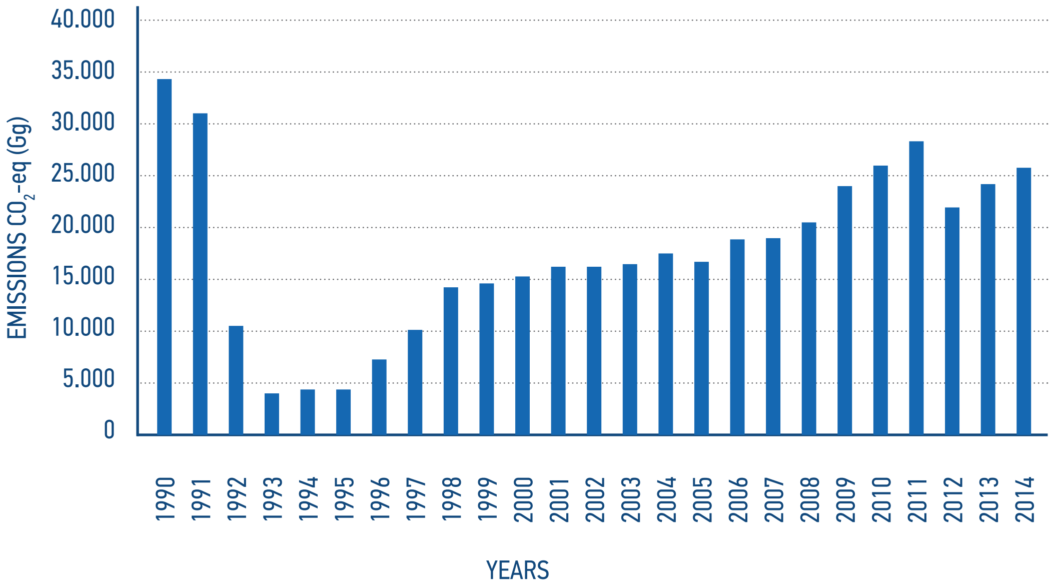


Chart 53: Total emissions for period 1990 - 2014

As it may be depicted from the Chart 53, emission quantity from the base year 1990 hasn`t been reached yet. It is clear that emission levels started to rise due to increased industrial activities, and in general have the trend of increasing.

1.3.1.1. Share of emissions by sectors

Chart below shows a share in CO_2eq emissions of each sector in total emissions in 2014.

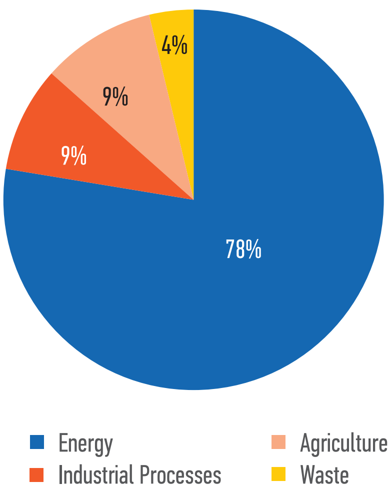


Chart 54: Share of each sector in total emissions of Gg CO_2eq (%)

As it may be seen from the Chart 54 energy sector is the greatest contributor to CO_2 emissions, with share of 78%, followed by agriculture sector (9%), industrial sector (9%) and waste sector (4%).

1.3.1.2. Energy production

The main source of CO_2 emissions is certainly the energy production sector, which contributes with 78% in 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. Fugitive emissions occur during production, transport, processing, storage and distribution of fossil fuels. The energy sector is the main source of anthropogenic emission of greenhouse gases. Emissions in energy sector in 2014 and 1990 are presented in Chart 55. Emission calculations have been based on fossil fuel consumption data obtained from statistics.

As it may be also depicted from the Chart 55, emission quantities from 1990 have not been reached yet.

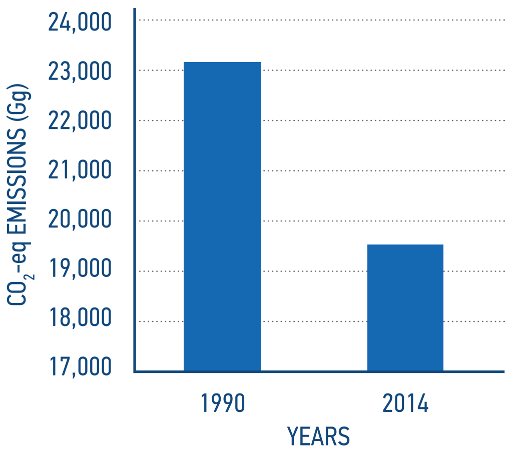


Chart 55: CO_2eq emissions from energy industry in 2014 and in 1990

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

As it may be seen from Chart 56, CO_2 emissions from transport in 2014 significantly increased comparing to 1990. The share of emissions from transport in energy sector emissions rose from almost 10% in 1990 to 15,5% in 2014.

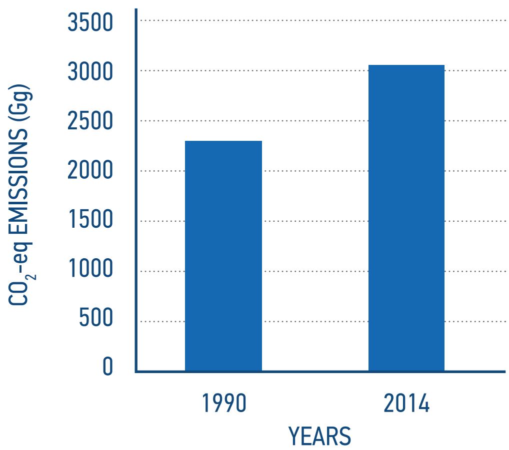


Chart 56: CO_2eq emissions from transport in 2014 and in 1990

1.3.1.3. Industrial processes

Greenhouse gases may also occur as a by-product of various industrial processes outside of the energy sector in which an input substance is chemically transformed into a final product. The industrial processes known as significant contributors to CO_2 emissions are the production of cement, lime, ammonia, iron and steel, ferroalloys, and aluminium, as well as the use of lime and dehydrated soda lime in various industrial processes. The recommended IPCC methodology was used for calculation of emissions from industrial processes[48]. Emissions of CO_2

[48]*Source: Revised IPCC Guidelines for National Greenhouse Gas Inventories from 1996*

from industrial processes in 2014 and in 1990 are presented in Chart 57.

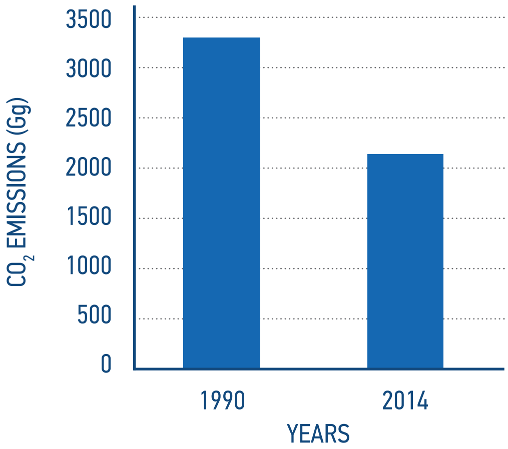


Chart 57: CO_2 emissions from industrial processes in 2014 and in 1990

Even though emissions from industrial processes have increasing trend through years, due to developing and increasing industrial activities, emission levels from 1990 have not been reached yet.

1.3.1.4. Sinks – LULUCF (Land Use, Land Use Change and Forestry)

When absorption of greenhouse gases occurs (e.g. absorption of CO_2 due to an increase in forest wood biomass), we talk about greenhouse gas sinks, and the amounts are shown with a negative value. Total emissions and sinks in the forestry sector and land use change for Bosnia and Herzegovina were calculated for year 2014. According to the data collected, the results of the calculation indicate that forests in BiH represent a significant CO_2 sink.

According to the data available for the baseline year, forests in BiH cover an area of approximately 2.28 million hectares[49]. Deciduous trees (which have a high capacity to absorb carbon) account for 68,8% of all trees, with beech dominating (39%) and sessile-flowered oak accounting for 18,9%.
Coniferous trees total 31,2% of all trees, with a significant proportion of fir (12,8%), spruce (8,6%), black pine (7,2%) and Scots pine (2,5%) trees and only a minute proportion of other coniferous trees (0,1%). Based on these indicators and the annual increment of 10.5 million hectares (GTZ, 2001), an annual increment factor was determined in tons of dry matter per hectare (2.375). Noble broadleaves and wild fruit trees have been also included in the calculations.

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

Using the IPCC values of carbon proportion in dry matter, the total carbon uptake was calculated at 3217.85 Gg. Based on these results and calculations of the annual release/emission of carbon, the final annual sink of carbon dioxide by forest ecosystems in BiH for the baseline year 1990 is 7,423.53 Gg CO_2, and for the year 2014 is 6398 Gg CO_2.

Detailed calculations of sinks were performed in accordance with the 1996 IPCC Guidelines, and the IPCC CRF tables are used for calculation in year 2014 and compared to those from 1990, as presented in Chart 58.

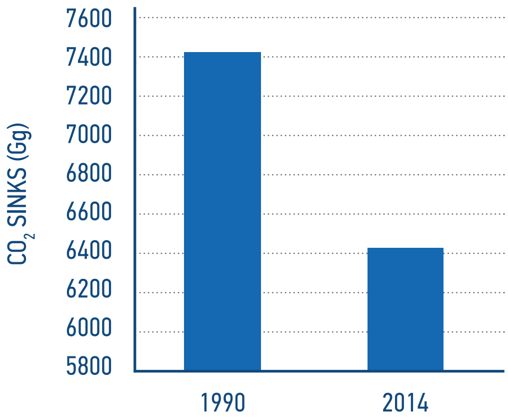


Chart 58: Sinks in 2014 and in 1990

[49]Source: FAO, 2005

1.3.2. Emission of methane (CH_4) by sectors

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, bulls, sheep, horses, swine and poultry). Methane emissions from waste disposal sites occur as a by-product of anaerobic decomposition of waste material with help of methanogenic bacteria. The amount of methane released firing 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.

The main sources of methane in Bosnia and Herzegovina are agriculture (enteric fermentation and manure management), fugitive emissions from coalmines, and waste disposal. IPCC emission factors were used for the calculation of all above mentioned sectors.

For 2014 only data on coal exploitation in surface coalmines were used for calculation of CH4 fugitive emissions. Therefore, fugitive emission of CH4 is significantly lower than in previous years, and the huge difference between methane emission in 1990 and 2014 may be explained by this difference in activity data.

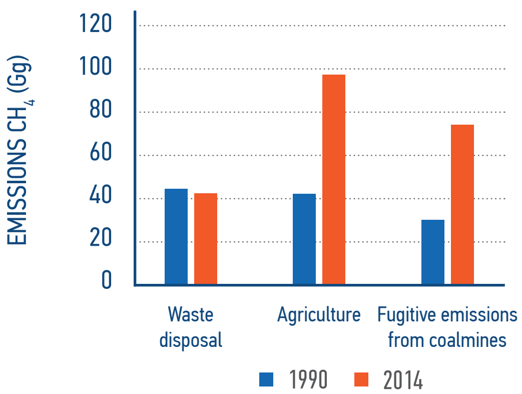


Chart 59: Emissions of methane by sectors in 2014 and in 1990

1.3.3. Emission of nitrous oxide (N_2O)

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

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

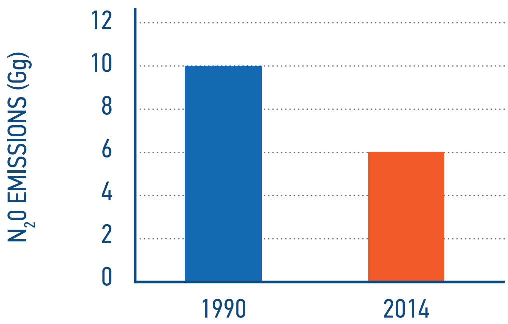


Chart 60: Total emissions of N_2O in 2014 and in 1990

Share of N_2O emission from industry in total emissions 1990 was 10%. Total N_2O emissions in 1990 amounted 10 Gg and in 2014 have not been reached. Share of N_2O emissions from industry in 2014 is negligible.

Majority of N_2O emissions (4 Gg out of total 5 Gg) comes from agriculture soils, as seen in the Chart 61.

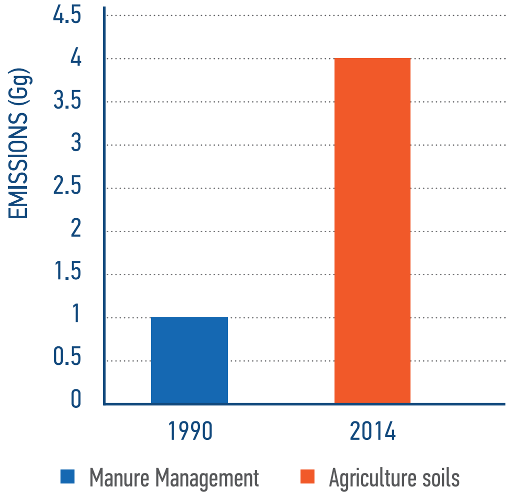


Chart 61: Share of N_2O emissions in agriculture sector

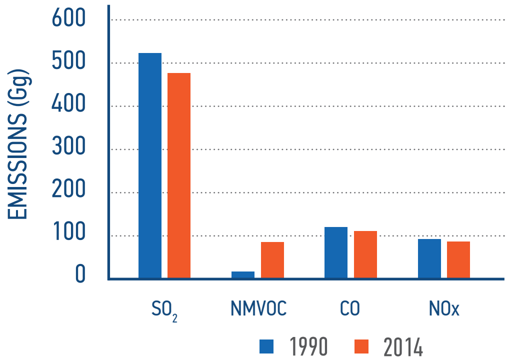


Chart 62: Emission of indirect greenhouse gases in 2014 and in 1990

Share of N_2O emission from agriculture in total CO_2eq emission is 6%, and may be considered as a key emission source

1.3.4. Emission of indirect greenhouse gases

Photo-chemically active gases, such as carbon monoxide (CO), nitrogen oxides (NOx) and non-methane volatile organic compounds (NMVOC) indirectly contribute to the greenhouse effect, although they are not technically greenhouse gases. They are commonly called indirect greenhouse gases, or ozone precursors 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.

Total emissions of indirect greenhouse gases in 2014 and in 1990 are presented in Chart 62.

Emissions of SO_2 are dominant from power production sector. Emissions of NMVOC are mainly generated in transport sector, and only negligible amount in industrial processes due to food and beverage production.

Solvent and other products use have not been estimated due to the lack of activity data.

1.3.5. Emission of F-gases

For calculation of potential bulk halocarbon emission only data on import of HFC R134a were available for 2014. There is no data on production, export, or destroying of F-gases. Potential emission of HFCs in 2014 is 26 Gg.

1.4. Key emission sources

Key categories in 2014 are presented in Table 51.

Key category 2014	Gas	CO_2e (Gg)	Level assessment (%)	Cumulative total (%)
1A1 Energy Industries	CO_2	14480,94	57	57
1A3b Road Transportation	CO_2	3053,20	12	69
2C1 Metal Production	CO_2	1459,50	6	75
1A4 Other sectors	CO_2	1240,72	5	80
4D Agricultural Soils	N_2O	1240,00	5	85
1A2 Manufacturing Industries and Construction	CO_2	857,03	3	88
4A Enteric Fermentation	CH_4	798,00	3	91
6A Solid Waste Disposal on Land	CH_4	735,00	3	94
2A1 Cement production	CO_2	728,10	3	97

Table 51: Key emission sources in 2014

Key emission sources were presented by CRF categories and in the tables above. The total amount of emissions from key sources covered approximately 97% of emissions.

A major share of these emissions comes from public electricity and heat production (1.A.1.a), followed by transport (1.A.3.b), metal production, residential energy consumption, agriculture, manufacturing industries and construction, etc.

1.5. Key category analyses

IPCC Source categories code	IPCC Source categories	Direct Greenhouse Gases	Current Year Estimate non-LULUCF	Current Year Estimate LULUCF
SUM			25,539	-6.398
1.AA.1	Energy industries	CO_2	14,416	0
5.A	Changes in forest and other woody biomass stocks	CO_2	0	-6.398
1.AA.3.b	Fuel combustion - Road transportation	CO_2	3,024	0
4.D	Agriculture soils	N_2O	1,240	0
2.C.1	Iron and steel production	CO_2	1,190	0
1.AA.2	Manufacturing industries and construction	CO_2	853	0
4.A	Enteric fermentation	CH_4	798	0
6.A	Solid waste disposal on land	CH_4	735	0
1.AA.4.a	Fuel combustion - Commercial/ Institutional	CO_2	617	0
1.B.1	Fugitive emission from solid fuels - coal mining	CH_4	609	0
1.AA.4.b	Fuel combustion - Residential	CO_2	575	0
2.A.1.a	Cement production	CO_2	419	0
4.B	Manure management	N_2O	310	
2.A.1.b	Lime production	CO_2	309	0
6.B	Waste-water handling	CH_4	216	0
2.C.2	Aluminium production	CO_2	197	0
2.C.3	Manure management	CH_4	105	0
1.AA.4.c	Ferroalloys production	CO_2	72	0

	Current Year Estimate Absolute Value	Level Assessment without LULUCF	Cumulative Total	Level Assessment with LULUCF	Cumulative Total
	31,936	1		1	
	14,416	0,564	0,564	0,451	0,451
	6,398	0	0,564	0,200	0,652
	3,024	0,118	0,683	0,095	0,746
	1,240	0,049	0,731	0,039	0,785
	1,190	0,047	0,778	0,037	0,823
	853	0,033	0,834	0,027	0,849
	798	0,031	0,894	0,025	0,874
	735	0,029	0,863	0,023	0,897
	617	0,024	0,942	0,019	0,917
	609	0,024	0,918	0,019	0,936
	575	0,023	0,801	0,018	0,954
	419	0,016	0,958	0,013	0,967
	310	0,012	0,999	0,010	0,976
	309	0,012	0,979	0,010	0,986
	216	0,008	0,967	0,007	0,993
	197	0,008	0,987	0,006	0,999
	105	0,004	1,003	0,003	1,00
	72	0,003	1,006	0,002	1,00

1.6. Uncertainty estimate of calculations

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

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

1.6.1. Uncertainty in calculation of CO_2 emissions

CO_2 emissions from fuel combustion depend on the quantity of fuel consumed (energy balance), its calorific value (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 (balance of coal and gas, balance of oil derivate) were used for compiling 2014 inventory. However, emission by reference and sectoral approach differs in more than 1.600 Gg, probably because of difference between consumption of anthracite, and its apparent consumption from the Reference approach assessment. Considering all given circumstances, the estimated total uncertainty for the energy sector data is from 7 – 10%, depending on fuel (see Table 52).

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%. Uncertainty estimates of the Inventory compilation team 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 un-oxidised 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 recommendations from 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), because the records for natural gas consumption were of sufficient quality.

Source category / GHG	Uncertainty of activity data (%)	Uncertainty of emission factors (%)	Total uncertainty (%)
Fuel combustion – coal, CO_2	± 8	± 6	± 10
Fuel combustion – liquid fuels, CO_2	± 12	± 5	± 13
Fuel combustion – natural gas, CO_2	± 5	± 5	± 7

Table 52: Estimated uncertainty in the calculation of CO_2 emissions for 2014

1.6.2. 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. Verification identifies flaws in calculations that indicate which parts of the inventory need to be improved, which indirectly leads to the improvement of the inventory`s quality. With an aim of improving the quality of calculations, the inventory team took the following steps:

- Activity data used were taken from official statistical reports;
- Emission factors were used in accordance with 1996 IPCC Guidelines;
- Verification through the Reference approach assessment.

Comparison of emission presented by Reference approach prepared by GHG inventory team could not be compared to International Energy Agency emission estimation, since the latest available year on the IEA website[51] is 2013.

2. Climate Change Mitigation

2.1. Electric power sector

2.1.1. The situation in the electric power sector of Bosnia and Herzegovina

Bosnia and Herzegovina (BiH) is a net exporter of electricity. Total gross electricity generation in 2014 was approximately 16,160 GWh, while net electricity generation was 15,172 GWh. The largest generation was in thermal power plants, net 8,921 GWh or 58,6%, then in hydro power plants in the net of 5,908 GWh or 38,94%. The remaining quantity was generated in industrial power plants in the net of 343 GWh or 2,26% (Agency for Statistics of BiH, 2015). Compared to 2013, net production in 2014 was lower by 7.79%. This is due to significantly lower production in hydro power plants (17.94%).

Final consumption of electricity in 2014 amounted to 10,587 GWh. Net export of electricity amounted to 2,836 GWh (Agency for Statistics of BiH, 2014). At the same time, electricity consumption per capita is relatively low (compared to European countries). Electricity consumption per capita in 2000 was 1,915 kWh, and in 2014 it reached 2,764 kWh, which exceeds the world average. Electricity consumption has increased in the period 2002 – 2014 from 9,150 GWh to 10,587 GWh. However, consumption in 2014 was lower than consumption in 2011, when it was at 11,880 GWh, as well as compared to 2013 when it was at 10,933 GWh. The growth of the share and the amount of electricity consumption in the industry is encouraging.

[51] *http://www.iea.org/statistics/statisticssearch/report/?year=2013&country=BOSNIAHERZ&product=Indicators*

In 2014, 58.8% of electricity was generated in domestic coal-fired power plants and that have fairly high specific emissions of carbon dioxide (around 1.2 tCO_2/MWh). The rest of the electricity is generated mainly in large scale hydropower plants, with a minor contribution of small hydropower plants. The emission factor of carbon dioxide network is about 764 kg/MWh. A conservative estimate of the potential of renewable energy sources for climate change mitigation by 2025 amounts to 0.88 Mt for biomass, 0.11 Mt for water energy and 0.15 for wind.

According to the entity's strategic documents, domestic coal will remain the main source of electricity generation and the generating capacity could be increased more than twice. There are significant reserves of coal and it is the sector that employs a large number of people. At the end of 2015, thermal power plant Stanari was released in test production with the capacity of 300 MW. However, the competitiveness of the existing and new coal-fired thermal power plants in BiH, on the open market is very questionable. Therefore, in parallel with the construction of new and closure of existing units in thermal power plants, it is necessary to intensify capacity building using renewable energy sources. Given the potentials of BiH, the reference is primarily made to the hydropower plants, biomass power plants, and wind power and solar power plants.

After eight years from the completion of Energy sector Study in BiH and four years from the completion of the SCN it can be concluded that the forecasted growth of electricity consumption is not being met. However, due to the demand for electricity in neighboring countries, the movements in electricity generation in BiH is not conditioned by the movements in terms of domestic needs. All organizations dealing with electrical energy mainly continue with "business as usual", using the existing capacities with a slight increase in the share of RES from small plants. Total production is mainly dependent on hydrological conditions and the works on the revitalization of the individual blocks in thermal power plants. Under such circumstances, the carbon dioxide emission highly depends on hydrological conditions and dynamics of the maintenance of individual plants, which determines the ratio of hydro and thermal power plants in the total generation.

According to the Energy Community Treaty, by 2020 BiH has to achieve the share of renewable energy sources in total energy consumption by 40% (from the current 34%). This will contribute to reduction of greenhouse gases also in the electrical energy sector. Both entities have enacted laws on renewable energy sources and high efficiency cogeneration (in FBiH - Law on the use of renewable energy sources and efficient cogeneration, in RS - Law on renewable energy sources and efficient cogeneration) in 2013, which encourage electricity generation from RES. On the basis of the laws, the Entities have adopted Action Plans for renewable energy sources by 2020. These Action Plans define capacities of some renewable energy sources that will be encouraged by 2020 through the guaranteed purchase prices. It should be noted that the aforementioned laws and Action Plans came as a response to the commitments of BiH under the Energy Community Treaty. Given that the EU has already defined objectives pertaining to renewable energy sources, even beyond 2020, adoption of Action Plans in BiH in the field of renewable energy is expected also for the period beyond 2020, which will be along the lines of the defined objectives of the EU by 2030 and 2050. The goal is that in 2050 all the quantities of electricity are produced from renewable energy sources.

BiH has liberalized electricity market since January 2015. In the short term, market liberalization will not have a significant impact on reducing carbon dioxide emissions. The impact can be expected after 2020. Because of the slow progress towards the EU it is not realistic to expect that BiH will become a member of the EU ETS before 2025. In addition, the impact of the EU ETS on emissions of EU countries is almost negligible, because the current price of emission permits is very low, several times lower than the price that is expected after reaching a global agreement on reducing greenhouse gas emissions, which is expected in December 2015. After entering the EU, ETS competitiveness of the coal-fired thermal power plants will drop significantly, and the funds collected from fees for emission permits will be used for the promotion of RES.

Considering all the aforementioned, it can be concluded that the emissions from the power sector of BiH, at least by 2025, will follow the S1. Although some of the power plants will phase out by that time, they will be replaced by the new ones, somewhat more efficient. However, more efficient power plants do not necessarily imply lower total emissions.

2.1.2. Scenarios for the reduction of GHG emissions in the electricity sector

Three scenarios were developed for the greenhouse gas emissions from the power sector of Bosnia and Herzegovina by 2040:

1. The scenario 1 (S1, "business as usual") – includes phasing out the operation of existing coal-fired thermal power plants (efficiency degree about 30%) due to the end of their service life. Out of 1765 MW in the existing coal-fired thermal power plants, in 2030, 900 MW will remain in operation and by the end of the observed period, out of existing thermal power plants, 600 MW will remain in operation. In parallel with the termination of the operation of the existing blocks, construction of the new ones is foreseen with the new degree of efficiency of about 40%. The total capacity of new thermal power plants in 2030 will amount to 1,000 MW and by 2040 it will be1,200 MW. Although electricity generation from coal-fired thermal power plants is growing, carbon dioxide emissions are not growing because most of the electricity will be generated from new, more efficient power plants.

2. The Scenario 2 (S2, "moderate mitigation scenario") – this scenario envisages a faster phasing out of the existing thermal power plants from the operation due to the introduction of some of the mechanisms (open market, eliminating subsidies for electricity from fossil fuels, etc.) that result in reduced emission. Under such circumstances, owners of the existing thermal power plants will be more focused on faster construction of new coal-fired power plants that will be substituted with the new ones and, moreover, to the more intensive construction of power plants using renewable energy sources. This scenario is characterized by intensive use of renewable energy sources compared to the reference scenario.

3. The Scenario 3 (S3, "advanced mitigation scenario") – implies intensive use of potentials of RES and EE for joining of BiH in the European emission trading system for greenhouse gases (EU ETS) and creating competitive regional electricity market. Entry of BiH into the EU ETS also includes payment of emission permits for greenhouse gases for the power sector, which significantly reduces the competitiveness of fossil-fuel thermal power plants, particularly coal-fired. Therefore, a gradual phasing out of the operations of the existing thermal power plants is foreseen already by 2030, but also construction of new power plants.

Chart 63 gives a comparison of movements of carbon dioxide emissions from the electricity sector in BiH for three previously described scenarios.

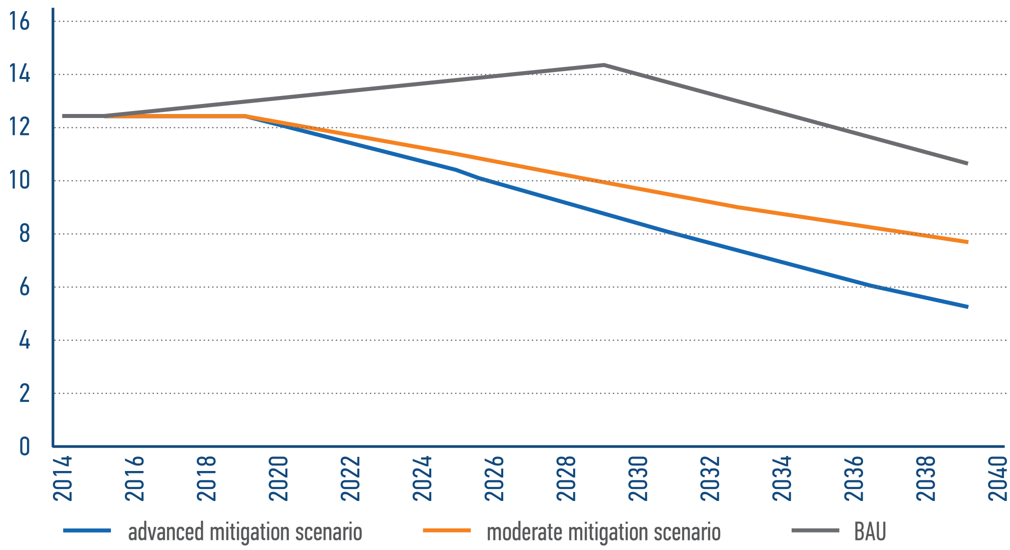


Chart 63: Comparison of movements of carbon dioxide emissions from the electricity sector in BiH for three scenarios (millions of tCO_2 annually)

From Chart 63 it can be seen that the emission decreases in any scenario in the observed period. This is the result of improving the efficiency of electricity generation from coal and increasing the share of electricity from RES, especially in scenarios S2 and S3.

In the BAU scenario the emissions show mild growth until 2030, because it is a scenario that until then relies mainly on the existing power plants. At the end of the period there is a drop of the emissions by about 18.5% from the baseline of 2014 (from 12.27 to 10.1 million tons).

In S2 and S3 the emission drops occur significantly faster because the existing thermal power plants are quickly being replaced with the new ones and the share of RES is also growing faster. In S3, at the end of the period, the emissions drop by about 60% compared to the baseline year (from 12.27 to 5.00 million tons), and in the S2 by about 39% (from 12.27 to 7.45 million tons).

2.2. Renewable energy sources

2.2.1. Overview of the situation in the renewable energy sector

A separate document that deals with the renewable energy sources sector analyses those forms and the amount of energy generated from the potentials of solar and geothermal energy only for the purpose of obtaining thermal energy and the biogas for obtaining both heat and electricity. This part does not deal with either the analysis of the use of biomass in cogeneration systems or for the production of thermal energy in the district heating systems or the use of other forms of renewable energy sources that are used solely for the purpose of electricity generation (wind, water).

2.2.1.1. Biogas

Based on the available data on livestock, potential biogas production was calculated at 800,000 to 850,000 m^3/day. So far there is only one biogas facility designed and constructed in BiH, in the municipality Srbac. The other biogas facility is in the stage of completion and experimental testing in Donji Žabari near Brčko. The installed generating capacity of the aforementioned first facility is 35 kW in electricity, and 70 kW of thermal energy. For the time being in households there is the individual use on several farms. However, these plants are too small, with a small power and influence on the savings or almost meaningless when it comes to describing the degree of savings.

2.2.1.2. 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 based on the already undertaken initiatives and unfortunately based on the poor statistics on the implemented projects in those cities. Estimates are that in BiH there are about 7,000 m^2 of the installed collectors, and that the annual rate of increase is about 28%. A great interest and increase in applying of solar collectors is noticeable in all sectors. A number of projects have been initiated, the activity is particularly significant in the public sector (such as solar roofs in schools, hospitals, etc.) covering electricity generation, whereas the part of the energy is used to cover the heating needs. It is estimated that the construction and use of solar collectors will proportionately increase in households through incentives and co-funding, as well as in public buildings.

2.2.1.3. Geothermal energy

Geothermal resources in BiH take the form of hydrothermal systems, geo-pressurized zones and hot dry rocks. These areas cover mainly central and northern parts of BiH. Out of the three mentioned forms, hydrothermal systems are the most interesting, because their exploitation is the most developed and the cheapest when compared to two other types. Total heating strength and geothermal energy of BiH were calculated by adding up the potentials of RS and FBiH. The total potential of installed capacity of geothermal sources on 42 sites amounts to 9.25 MWt for space heating, or 90.2 MWt for heating and recreational and balneological purposes (bathing). When using all of the stated resources with the utilization factor of 0.5, it is possible to produce 145.75 TJ in one year for space heating, that is 1,421.75 TJ of energy for both heating space and bathing. Researches have shown that a large part of the RS has a perspective in terms of the presence of geothermal waters, mostly in the area of Posavina, Semberija, Banja Luka valley and Lijevče polje. The energy potential is estimated at 1,260 TJ. The largest potential for the use of this energy source is in aquaculture, agribusiness, and for heating of the settlements. According to the conducted researches, it was established that about 25% of BiH is considered to be potential geothermal resource. Practically there are no significant projects by the level of installed capacities. Heat pump systems are used on small and medium-sized facilities, with still a small share but with the trend suggesting modest expansion. A step forward was made by initiation of implementation of the concession policies. Concessions are intensely implemented in Banja Luka, Sarajevo, Bijeljina and Doboj, as well as the plans related to the implementation of making deep boreholes for the purpose of city heating system.

2.2.2. Overview of GHG mitigation scenarios in the sector of RES

Mitigation scenarios of using renewable energy sources are based on estimated reserves and resources of individual forms of renewable energy sources, as well as technological, social, political and economic opportunities for their exploitation.

- The S1 scenario does not consider any mitigation measures and business as usual, which means that increase in the use of energy from renewable energy sources is not expected, as the prices of energy from these sources are still uncompetitive compared to technologies that use conventional energy sources. This scenario does not include any changes, incentives or specific additional research of the potentials and implies no change of the current position in relation to these forms of energy. A significant feature of this scenario is relatively low level of interest and activities of state and entity institutions in this energy sub-sector.

- The S2 scenario is characterized by the gradual introduction of new technologies (orientation towards RES and their greater use), start of the initiatives for more massive use and for domestic production of the equipment (e.g. solar energy), and accordingly assumes more intense and active analyzing of the cost-effectiveness, sustainability, and increasing energy efficiency, applying limited models of support and incentives.

- The S3 scenario assumes a high degree of climate change mitigation activities which are being implemented at different levels of government, the full implementation of legal provisions that deal with the obligation to use renewable energy sources in new buildings with the size exceeding 500 m^2 where this is technically and economically justified, accession of BiH to the EU in 2025, i.e. commitment and compliance with the requirements in terms of reductions of GHG emissions, the use of efficiently developed incentive models and funding the use of renewable energy sources, significant use of biogas (twice the installed capacity by five-year periods by 2040) from agriculture (livestock) in cogeneration plants for which the efficient siting is assumed and intensive use of solar energy with planned coverage of about 200,000 m^2 by 2025, and proportionally by 2040, as well as significant representation of the use of geothermal resources by using heat pumps in the household and SME sector.

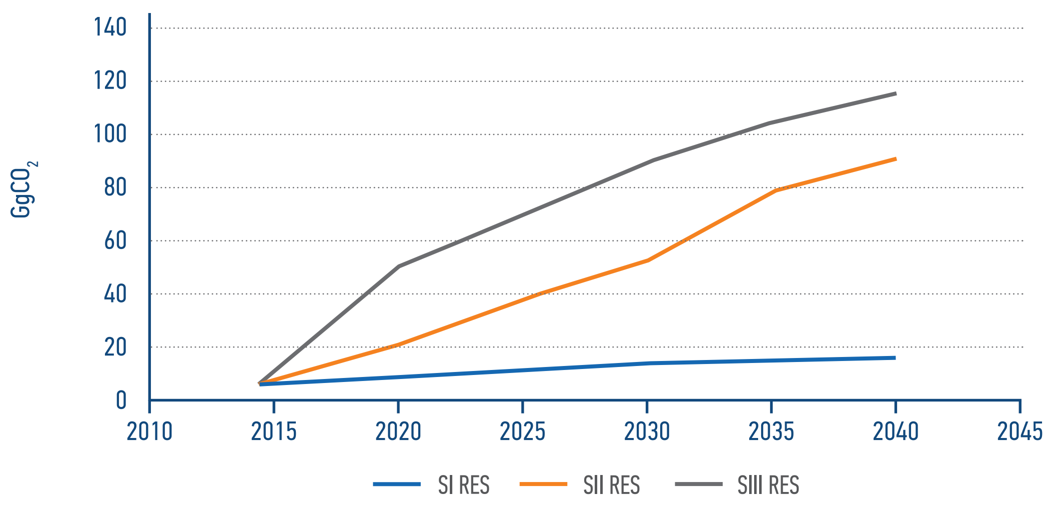


Chart 64: Comparisons of values for total savings of CO_2 emissions by using renewable energy sources in BiH, for all three previously described scenarios

Results of different scenarios of application and use of renewable energy sources for the needs of production of heat and electricity through biogas can be seen on the chart. Scenario 1 shows rather mild upward trend of the effects on CO_2 emissions, which is the result of quite limited and modest use of renewable energy sources in the observed period – 2010-2040. Compared to the emissions generated in the most efficient emission sectors (electricity sector, heating, etc.), the obtained values of savings can be considered almost negligible. Given that scenarios 2 and 3 imply significant use of the renewable energy sources, the effects of CO_2 emissions are more significant than in the case of the BAU scenario (S1). Although the growth rates of the installed capacity of the individual sources of renewable energy for scenarios 2 and 3 are linear in nature, projected CO_2 effects recorded a certain deviation from this linearity. The reason is the recognition of the parallel development of relevant scenarios in the sectors of district heating, building and electricity, where emission factors have a decreasing trend in the observed period.

2.3. District Heating

2.3.1. The situation in the district heating sector

According to the available data, there are currently 26 major 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 past 7 years a number of smaller district heating companies have started to work (Gračanica, Livno, Zenica, Srebrenik, Bugojno, etc.) but since the newly installed capacities are relatively small compared to the existing ones, it can be said that percentage of household coverage by district heating has not significantly changed since then.
District heating companies in Republika Srpska mainly have their own plants for the production of thermal energy. For fuel they mainly use heavy fuel oil (Banja Luka, Brod, etc.) and coal (Doboj, etc.), and lately there is an increase in use of biomass (plant in Pale, Sokolac, Gradiška, two boilers in Banja Luka, and in 2016 it is planned to release into operation the power plant in Prijedor. In Zvornik, natural gas is used as the energy source; for heating of the city Ugljevik the heat obtained from the thermal power plant RTE Ugljevik is used. According to the data from 2010 (SESRS, 2010), installed capacity of the heating plants in Republika Srpska is 483.5 MW, district heating covered around 40,000 flats with a total area of 2.3 million m^2, as well as 460,000 m^2 of office space.

In Federation of BiH, some district heating companies do not have their own plants for the production of thermal energy but they provide for it using the local thermal power plants (mostly thermal power plants – Tuzla, Lukavac, Kakanj). Currently, the most modern district heating system is the one in the city of Sarajevo in which natural gas is used as the energy source. This has enabled the development of a flexible heating system, consisting of a series of individual networks and the use of small, efficient boilers.

Other facilities that are not connected to the district heating network, such as medical centers (hospitals and clinics), some state institutions (courts, police), catering and other similar institutions generally have their own plants for the production of thermal energy, which as the energy source use heavy fuel oil, heating oil, coal, biomass or gas, where available.

Generally, in most district heating companies, particularly in Republika Srpska, heating plants and accompanying equipment are more than 30 years old. These systems operate with low efficiency and the losses of heat in some cases reach the value of up to 60%. In the last 25 years major reconstructions were carried out only in the district heating system of the city of Sarajevo. District heating companies in Banja Luka, Prijedor and Gradiška conducted the reconstruction and modernization of systems for the production of thermal energy, while very little investments have been made in the heating distribution systems. In most other systems only the most necessary reconstruction were made in order to ensure the minimum functioning of the district heating system. Lately, there is an increase of private suppliers of thermal energy in the form of

ESKO companies (Gračanica, Livno, Gradiška, etc.). One of the major obstacles to more intensive heating systems is insufficiently legally regulated area of district heating.

The biggest obstacle to the modernization of the district heating system in BiH and intensive implementation of the measures proposed in the strategic documents (ESSBiH Module 9, 2008, Strategic Plan and Program for Energy Sector Development in FBiH, 2009, SESRS, 2010, LEDS, 2013, FBUR 2014) in the district heating sector, is the difficult economic situation that causes difficulties in operations of all district heating companies. On the other hand, it is exactly the difficult financial situation that prompted some district heating companies in searching for new solutions, i.e. providing lower cost thermal energy by substituting the energy source that they use. Hence, during 2013/14, the plant in Gradiška started to use biomass instead of heavy fuel oil and during 2016 the same is expected in the case of the heating plant in Prijedor.

In most district heating systems prices of thermal energy from the district heating systems are determined in consultation with the local authorities and are not based on actual costs of production and supply of thermal energy, therefore these companies operate with subsidies by local authorities. Under such circumstances it is not possible to have significant allocation of funds for the modernization of district heating systems and only emergency intervention measures are being carried out, such as replacing worn-out distribution network, mainly on the most critical points of the network where frequent breakdowns occur during the heating season. All other investments in district heating systems are mainly completely suspended. Collection/billing for thermal energy supplied to consumers in many cases is still carried out on the basis of the surface of the heated area, rather than on the basis of consumption. This is contrary to the Consumer Protection Act of 2006, which obliges thermal energy providers to charge for the supplied thermal energy to consumers based on consumption and not based on the surface of heated space. The application of this Law has been totally reduced and it comes down to individual cases. In the application of the aforementioned Law the major progress has been made in the Sarajevo Canton.
Law on the production, distribution and supply of thermal energy has not been adopted yet at the level of Entities, although the adoption of this Law was foreseen in a number of strategic documents (ESSBiH Module 9, 2008, Strategic Plan and Program for Energy Sector Development in FBiH, 2009, SESRS, 2010, LEDS, 2013). The Law should define the conditions for the production, distribution and supply of thermal energy, the rights and obligations of both producers and consumers of thermal energy.

In 2013, three very important laws on energy efficiency and renewable energy sources entered into force in Republika Srpska that should significantly affect further development of district heating. It is the Law on Spatial Planning and Construction (RS Official Gazette 40/13), which should implement in the legislation of Republika Srpska requirements of the Directive 2010/31/EC – Directive on the energy performance of buildings, then the Law on energy efficiency (RS Official Gazette 59/13) which should implement in the legislation of Republika Srpska requirements of the Directive 2006/32/EC – Directive on energy end-use efficiency and energy services and 2010/30/EC – Directive on the indication by labeling of energy-related products, and the Law on renewable energy sources and efficient cogeneration (RS Official Gazette 39/13) which should implement in the legislation of Republika Srpska requirements of the Directives 2009/28/EC – on the promotion of the use of energy from renewable sources and 2004/08/EC– Directive on the promotion of cogeneration. The adoption of appropriate by-laws on thermal insulation of buildings is expected during 2015.

In Federation of BiH, since 2010, new regulations came into force on thermal insulation of buildings so the energy consumption in new buildings, which are connected to the district heating system, is considerably lower compared to the average consumption determined by the BiH Energy Sector Study, Module 1B, of 2008. In 2013, the Federation of BiH adopted the Law on the use of renewable energy sources and efficient cogeneration which ensured implementation in the legislation of

Federation of BiH provisions of the Directives 2009/28/EC – on the promotion of the use of energy from renewable sources and 2004/08/EC– Directive on the promotion of cogeneration. Currently, the Law on energy efficiency is in the draft stage, which should implement the provisions of the Directives 2006/32/EC – Directive on energy end-use efficiency and energy services, 2010/30/EC – Directive on the indication by labeling of energy-related products 2010/31/EC Directive on the energy performance of buildings (together with the Law on spatial planning and land use at the level of Federation of BiH). All these laws should also have a significant impact on the future development of district heating systems.

2.3.2. Overview of scenarios of greenhouse gas emissions from district heating sector

For all scenarios of district heating development an expansion of district heating systems is planned, as well as the use of renewable energy sources, but to different extents.

The Scenario S1 – Only new buildings, with lower energy consumption will be connected to the district heating system and the dispersion of energy sources remains as foreseen by the existing strategic documents (ESSBiH Module 9, 2008, SESRS, 2010). The percentage of share district heating will not be changed compared to the existing one, and the same goes for the efficiency of the production and distribution of thermal energy.

The Scenario S2 – New consumers are gradually connecting to the district heating system to a greater extent so that in 2040, in terms of percentages, the number of households covered by the district heating system will be about twice as high than the existing one. Due to application of the existing legislation energy consumption, the dispersion of energy products remains as envisaged by the strategic documents. This scenario also envisages a slight increase of efficiency in generation and distribution of thermal energy.

The Scenario S3 – This scenario envisages more intensive heating system so that in 2040 the number of households covered by the district heating system, in terms of percentages, will be about three times as high as the existing one. Specific consumption of the thermal energy is decreasing in line with the implementation of the existing legislation. Renewable energy sources are intensively being introduced in higher percentages in the district heating systems, particularly biomass and geothermal energy. This scenario envisages the construction of several smaller heating plants that will use municipal waste for energy, then the intensive introduction of cogeneration in district heating systems, as well as increased efficiency in production and distribution of thermal energy.

Assessment of emissions in the district heating sector by scenarios is shown in the next chart, without taking into account the emission from the plants for combined production of electricity and thermal energy.

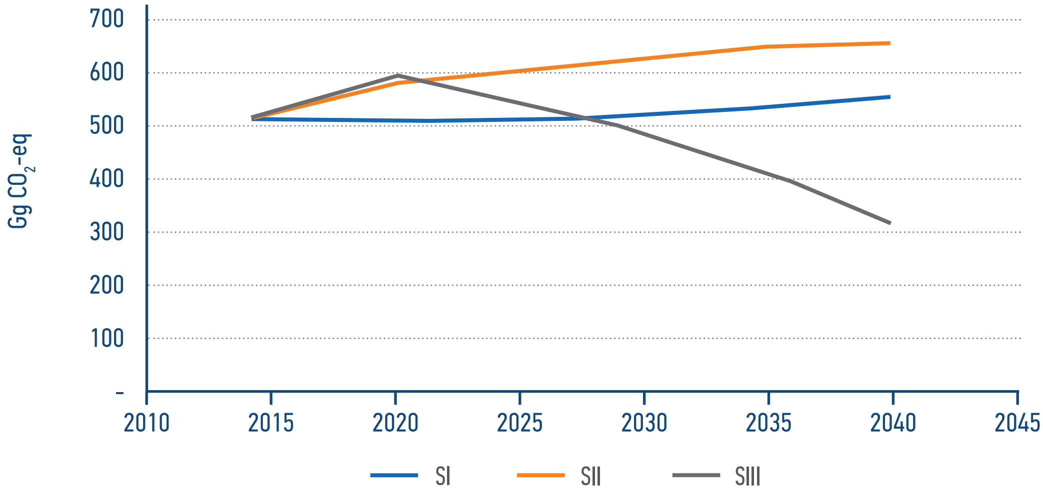


Chart 65: Assessment of CO_2 emissions in the district heating sector based on different scenarios

As can be seen, according to the scenario S1, in the next period in the first place there is a reduction in CO_2 emissions (due to the transition of some of the district heating systems to biomass, such as in the cases of Gradiška and Prijedor), and then again there is a rise (after 2035), as a result of connecting new consumers to the district heating system, which still use fossil fuels to a great extent.

The Scenario S2 envisages continuing rise in CO_2 emissions by 2040 from district heating systems, although the scenario S2 assumes a reduction of specific consumption of the energy. Such trend is the result of intensive connecting of new consumers to the district heating system, as well as gradual transition of a smaller number of district heating systems (as planned in the existing strategic documents) to the renewable energy sources.

According to the scenario S3, in the first place there is an increase (by 2020), and then follows the intensive reduction of CO_2 emissions from district heating systems, whereby new consumers continuously connect to a greater extent. Reduction of CO_2 emission after 2020 is a consequence of intensive transition of district heating systems to renewable energy sources, as well as continued reduction in specific consumption of the energy by 2040. Through implementation of the scenario S3, CO_2 emissions from district heating systems in 2040 would be lower for approximately 35% of CO_2 emissions in 2014.

2.4. Buildings

2.4.1. Overview of the current situation in the field of building construction

Preliminary results of the census of 2013 indicate that the number of dwellings in Bosnia and Herzegovina is 1,617,308 while the number of households is significantly lower and amounts to 1,163,387. The big difference between these figures indicates that a significant number of dwellings is not permanently inhabited, but their number cannot be determined without the results of the census. Lacking of these data and the accurate data on the heated surfaces of apartments point to the problem of reliability of data on the average energy consumption in residential buildings. However, current statistics on energy consumption by energy products can be considered relatively accurate, and data on emissions from this sector can be considered largely reliable.

Only upon processing and publication of complete data from Census of 2013 it will be possible to calculate accurately the average consumption expressed per unit of heated area, which would pave the way to more detailed analysis of all the measures in the building sector.

A much bigger problem is the lack of data on buildings dedicated to services, which were not subject to census, hence the data from the Energy Sector Study BiH have been used as the base. Buildings are very old, large number of them was built before the adoption of the regulations on thermal protection of buildings, they are poorly maintained, especially during the war and post-war years, and they represent a large potential for reducing power consumption and thus GHG emissions. In addition, a large number of new family houses, built after the war, has not been fully completed, and these facilities are a great resource for energy saving. Final completion of these buildings may have environmental benefits in terms of reducing GHG emissions, but also the social and economic ones. New buildings are being constructed in a more quality way with better energy performance, though the regulations are not yet in place that would be fully compliant with the EU regulations in the area of the maximum allowed energy consumption in buildings. In Bosnia and Herzegovina, in parallel to the increase in the number of apartments there is a noticeable decrease in the number of inhabitants, thus reducing the average number of residents in the household. It is evident that there is a significant increase in the number of residents in urban and a decrease in rural areas, as well as a decrease in the number of household members.

Services buildings are also old and poorly maintained, just as the residential ones, with obsolete and outdated technologies for heating and cooling. Older buildings are characterized by extremely high energy consumption, which is by far the largest in the hospital buildings. The new buildings are built in a more energy efficient manner, particularly commercial buildings, because investors pay much more attention to energy efficiency of buildings and possibilities of energy savings over the period of use of a building.

Progress in implementation of key documents for the reduction of GHG emissions caused by energy consumption in buildings is almost unnoticeable. In previous years, a number of strategic documents have been drafted and adopted, but there is no systematic way when it comes to their implementation. The new Law on Spatial Planning and Construction in Republika Srpska ("RS Official Gazette" no. 40/13) envisages the adoption of by-laws which define the maximum energy consumption in buildings and process of their certification within nine months from the adoption of the Law and such deadline has expired long time ago (February 2014). New by-laws were published in April 2015, and their compulsory application is foreseen as of 1 January 2016. The adoption of the legislation in FBiH did not give the expected results because it was not implemented from the entity to the cantonal levels. Currently, the activities are ongoing to amend the by-laws in order to reduce the maximum energy consumption in buildings, and even better coordination with the cantons can be expected.

Environmental Protection Fund of the Federation of Bosnia and Herzegovina is more actively involved in the implementation of energy efficiency improvement and currently the implementation of the five-year project Capacity building and decrease of energy costs within the public sector buildings in FBiH through increasing energy efficiency, energy management and reduction of emission to air is ongoing in cooperation with UNDP. In Republika Srpska the Fund did not begin with the financing of projects of this type because of lack of funds, that is, due to legally unregulated systematic way of fundraising for financing projects in the field of energy efficiency.

One of the key documents, NEEAP for Bosnia and Herzegovina by 2018, although accepted by the Energy Community Secretariat, has not yet been approved by the Entities and its implementation has not started yet. In addition, most of the measures provided for under SNC and LEDs are not under implementation.

The activities on improvement of the energy efficiency of the existing stock of public buildings in Bosnia and Herzegovina are mainly carried out thanks to the activities and the financial support of international organizations operating in BiH (UNDP, USAID, GIZ, the World Bank, etc.). For public purpose buildings such as schools, hospitals, municipal administrations, etc., in the first place the energy audits are done and then the projects and activities on improving their energy efficiency by implementing measures defined by the audit. Unfortunately, the number of buildings covered by these projects is small compared to the total number of public buildings. When it comes to the energy management in public buildings a progress has been made also thanks to the project funded by UNDP in BiH, which is related to the implementation of EMIS (EMIS - Energy Management Information System).

In Bosnia and Herzegovina twelve cities are signatories to the Covenant of Mayors and they have the adopted Sustainable Energy Action Plan (SEAP), which created preconditions to achieve the targets 20-20-20 through their implementation.
Owners of commercial buildings individually, in case of implementation of the measures of current maintenance, also improve the energy efficiency of their business buildings, but these are individual and still seldom cases.

In the area of residential buildings there are no major projects which would focus on improving their energy efficiency, except in the area of the Sarajevo Canton.

The research project Typology of residential buildings in Bosnia and Herzegovina, which is implemented with the financial support of GIZ, as a result will have defined types of residential buildings, their structure based on energy consumption, as well as proposals of typical measures to reduce energy consumption in them. Project outputs, along with legislative changes in the field of building maintenance, will create conditions for more intensive activities to improve the energy efficiency of residential buildings, envisaged by all the strategic documents, and thus the implementation of projects that will result in reducing GHG emissions caused by irrational energy consumption.

2.4.1.1. Overview of scenarios of greenhouse gas emissions from the building sector by 2050

The building sector considers all the energy that is consumed in buildings, not just the heat.
Different measures which result in reduced energy consumption and thus GHG emissions in the building sector are given in the two scenarios, separately for housing and separately for the service sector.

All measures envisaged by the scenarios are already envisaged in the entity strategies, NEEAP (which is in the process of acceptance), as well as other sectoral strategies and action plans, with a note that all these experience significant delay in implementation. Given that the new regulations have not yet become effective, and their application will result in a significant reduction in energy consumption for heating in new buildings, it is envisaged that these measures in the scenarios begin in 2016.

2.4.2. Residential buildings

The S1 scenario – This scenario assumes continuation of current trends and does not foresee any energy efficiency measures, apart from the implementation of the legislation that has already been enacted and the application of which prescribes lower energy consumption in buildings in the heating sector. The new legislation, which was adopted, but also the future one that will be issued in accordance with the European directives will result in reduction of energy consumption in buildings that will be constructed and by 2040 it will result in an average reduction of energy consumption in residential buildings to 140 kWh/m^2.

The S2 scenario – this scenario assumes that, in addition to the implementation of new legislation, more intense activities are undertaken in terms of reconstruction of the existing residential buildings in order to reduce energy consumption for heating. All these activities, along with application of the legislation, should reduce average consumption of the heating energy to around 90 – 95 kWh/^{2}. The increase of the share of the apartments heated through district heating is envisaged (in FBiH 18% and in RS 14%), as well as changes in the structure of energy sources in accordance with the adopted strategies at the level of Entities. Termination of use of coal and heating oil in the housing sector is planned for 2025. Increased consumption of hot water is foreseen, as well as greater use of renewable energy sources for its heating, primarily using solar collectors.

The S3 scenario – this scenario assumes intensified implementation of energy efficiency measures in the residential housing sector, especially through the reconstruction of the existing buildings, as well as the application of the legislation, which should lead to a significant reduction in the average energy consumed for heating at 50 –70 kWh/m² by 2040. The share of apartments heated through district heating intensively increases and it is expected that by 2040 it will amount to 25% in FBiH and 20% in RS. A change in the structure of energy sources is also foreseen in accordance with the adopted strategies at the level of Entities. Termination of use of coal and heating oil in the housing sector is planned for 2025. Consumption of hot water will grow more intensively (current hot water consumption per capita is relatively small compared to other European countries), and the greater use of renewable energy sources for its heating is foreseen, primarily by using solar collectors (solar energy) and heat pumps (geothermal energy).

2.4.3. Services buildings (commercial and public buildings)

The S1 scenario – the basic feature of this scenario is continuation of current trends, without any significant changes in consumption structure. It is expected that the heated area will be growing faster than in the housing sector given the expected trend in the construction of commercial buildings of 2% per year.

The S2 scenario – This scenario assumes the reduction of energy consumption, especially in the heating energy sector. Improvement in the energy efficiency of existing buildings and construction of new ones in accordance with the new regulations and new technologies will gradually result in the reduction of energy consumption by 2040. This scenario assumes change in the share of energy products used to generate heat, with more significant share of natural gas as an energy source, as well as termination in using coal and heating oil as energy sources. The use of renewable energy sources is foreseen, i.e. the use of geothermal energy for heating purposes. It is expected that the percentage of cooled surfaces will increase, and thus the demands for cooling energy.

The S3 scenario – This scenario is quite similar to the scenario S2 and the only difference is that the renewable energy sources are more intensively used, especially geothermal energy, as well as measures to improve the energy efficiency of existing buildings which will result in reducing the necessary thermal energy. The needs for cooling will grow and the percentage of cooled surfaces will more intensively increase in comparison to the previous scenario. This scenario assumes change in the share of energy products used to generate heat, with more significant share of natural gas as an energy source, as well as termination of use of coal and heating oil as energy sources. It is anticipated that by the end of the observed period the efficiency of all systems in the buildings that are consumers of energy will improve significantly. Summary view of the results of CO_2 emissions for Bosnia and Herzegovina, observing both sub-sectors (residential and commercial) is shown in the following chart.

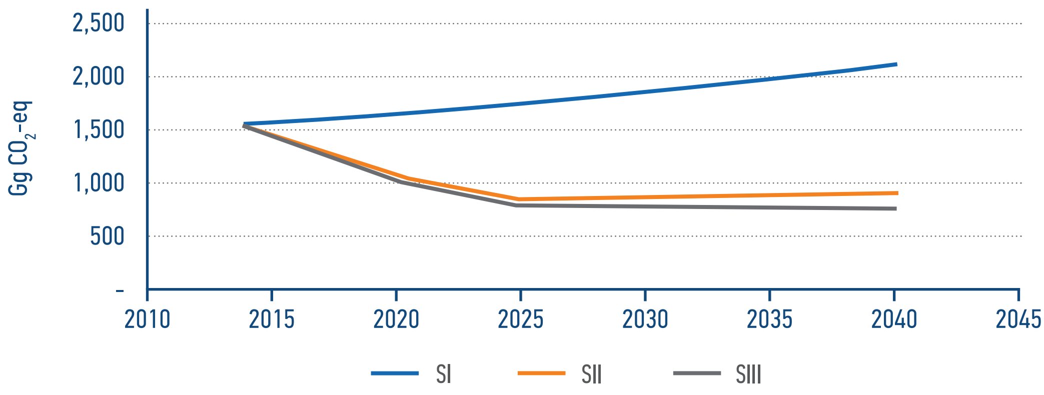


Chart 66: Summary view of the results of CO_2 emissions for Bosnia and Herzegovina for residential and commercial sub-sectors

The reference scenario does not envisage reduction of CO_2 emissions, but an increase due to increased construction of new buildings, particularly more intensive in the service sector, which would result in increased emissions for 25% by 2040, compared to 2014.

Reducing CO_2 emissions is envisaged by scenarios S2 and S3, according to the applied measures, however the scenario S3 provides for more intensive use of renewable energy sources. With the development based on the assumptions of the scenario S2, emissions in 2025 would have decreased by more than 40% compared to the emissions in 2014, and then they would gradually and moderately grow by 2040. Such movement would result in emissions in 2040, which would be for almost 40% less than the emissions in 2014. The reduction occurs as a result of changing energy sources, primarily after termination of use of oil and heating oil as energy source, greater use of gas and in particular renewable energy sources, both for hot water and for the heating and cooling systems. Greater centralization of heating system of buildings with the use of biomass and other renewable energy sources as energy products will also lead to the reduction of CO_2 emissions.

2.5. Transport

2.5.1. Overview of the situation in the transport sector

In 2014, a total of 921,643 road vehicles were registered, which is by 2.93% more than in 2013 (895,425 vehicles), or 26,218 vehicles more. Out of the total number of registered road vehicles in 2014, 86.95% were passenger motor vehicles, 8.27% cargo vehicles and 4.78% all other categories of vehicles. Broken down by type of power generation, 63% of passenger motor vehicles used diesel and 33% petrol, and 4% used other energy sources[51]. In 2014, for the first time there were 78,213 registered road motor vehicles, which is 4.6% more than in the previous year.

The volume of road transport in BiH for 2014 is represented by two indicators: freight transport and passenger transport. According to freight transport indicator there was an increase in comparison to the previous years, i.e. around 12% in relation to 2013, while the indicator of passenger transport records a continuing decline in the last three years.
Given that in the transport sector, road transport sub-sector in BiH accounts for over 90% in greenhouse gas emissions, in this chapter we focused only on this sub-sector. The road network

[51] *Release: Transport, year IV, no. 1, BHAS, 2014*

in BiH is among the less developed in Europe, which is clearly visible from the data on the density of the road network of 45 km/100 km^2, or 5.7 km/1000 inhabitants, which is 2.5 to 4 times less than in Western European countries. In the Federation of BiH density of main roads is 7.77 km per 100 km^2 and in Republika Srpska it is 7.11 km per 100 km^2. In the past 2014, a total of 921,643[52] motor vehicles were registered in Bosnia and Herzegovina, and based on the available data we can conclude that on 1,000 kilometers of roads there are 40,295 motor vehicles.

Currently there are no major programmes or projects in Bosnia and Herzegovina, which focus on reducing emissions in the transport sector. Still, the legislation at the level of the state and Entities in BiH governing transport (e.g. Law on traffic safety in BiH and other laws) and environmental protection (Law on Air Protection and associated implementing regulations) define the framework for import, purchase, registration of motor vehicles, approval, quality of fuel, compulsory annual inspection of motor vehicles, and they define commitment of the competent authorities of not allowing the owner of the motor vehicle to register vehicles that exceed certain emission limit values. In addition, in FBiH, vehicle owners are required to pay a special fee when registering their vehicles, or during technical verification, depending on the type of engine, fuel, engine capacity and age of the vehicle. In Republika Srpska there are attempts to introduce the same mechanism in early 2016. These activities, directly or indirectly, influence the reduction of CO_2 emissions in the transport sector. It is expected that further and somewhat more intensive application of EU directives in the area of reductions of emissions, more efficient motor vehicles and fuel quality in the transport sector in BiH will contribute to reducing emissions. Activities of regular maintenance and construction of new transport infrastructure by the competent authorities also contribute to reduction of emissions.

2.5.2. Overview of scenarios of greenhouse gas emissions from the transport sector

Three scenarios of CO_2 emissions in the transport sector, which are being developed for the period 2010 – 2040:

• **The S1 scenario /BAU scenarios –** is based on the development of the sector based on the already present trends. It assumes retained share of road and rail transport by 2040. Increasing the number of road vehicles by an average annual rate of about 5.8% with the average age of the vehicle fleet from 12 to 15 years, without the implementation of measures of approval and with a decrease in the share of diesel vehicles in passenger kilometers by 2.5% by 2040, petrol vehicles 5% and introduction of electric cars and their share in passenger kilometers by 10%. It is also assumed that the share of passenger kilometers of passenger vehicles will decline by 10% while at the same time the share of buses will rise by 10%. The present scenario assumes that the energy intensity of passenger vehicles per year will see a decline of 0.2% and greenhouse gases emission produced by motor vehicles will proportionally grow with the increase in consumption of fossil fuels energy. In relation to the age of the vehicle fleet in BiH, it is calculated that the average CO_2 emission from road vehicles is around 185 g of CO_2/km. Reduction in the volume of ton/k is assumed in the area of freight transport and the increase in rail ones. This scenario is also based on the currently applicable local legislation and trends in other sub-sectors of transport in BiH.

• **Scenario S2 –**is based on the introduction of additional technical measures for road vehicles to improve the efficiency of motors and decrease fuel consumption. This scenario implies an average reduction in the intensity of all types of vehicles by 0.5%, a significant decrease in the share of diesel and petrol vehicles in passenger kilometers at the expense of the increased share of electric vehicles, as well as a decrease in the share of passenger vehicles per passenger kilometer and increase

[52] *Agency for Statistics, BiH*

of bus transport. Another assumption is increase in the share of electric and the decrease in diesel locomotives by 10%. Improvement of the quality of fuel is assumed, as well as improvement of the road infrastructure. Reduction in the volume of ton/k is assumed in the area of freight transport and the increase in rail ones. An important element of this scenario is the reduction of the average age of road vehicles to 12 years by 2025. The main objective of this scenario is to reduce the emission coefficient from 185g of CO_2/km in the base year to 150 g of CO_2/km in 2025, with a further reduction to 130g of CO_2/km by 2040. In addition, the introduction, implementation and enforcement of EU directives in the field of transport by 2025 are also assumed.

• **Scenario S3 –**is based on a significant mitigation, that is, significant reduction in emissions in the transport sector through the implementation of EU directives in BiH by 2025 (better fuel quality, efficient motor vehicles, better tires, exclusion of vehicles without catalytic converter from the traffic, introduction of new regulations on the importation of road vehicles, introduction of the EURO 6 standards, compliance with the EU Regulation 443/2009 on the limitation of emissions of CO_2 from new passenger cars to gCO_2/km by 2021), construction of more efficient road infrastructure and flow of vehicles, introduction of measures in the urban traffic which result in reducing emissions, as well as the impact of the ETS directive in air traffic and significant increase of railway transport (50% by 2025 and stabilization by 2040). Typical assumptions of this scenario include reducing energy intensity per passenger kilometer for all types of vehicles by 1% per year, reducing the share of road passenger kilometers and increasing the share of rail passenger kilometers, share of electric vehicles by 35%, resulting in a significant reduction of diesel and petrol vehicles in road traffic, as well as a decrease of 14% in the share of passenger cars in passenger kilometers, as well as significant increase in bus passenger kilometers. Reduction in the volume of ton/k is assumed in the area of freight transport and the increase in rail ones by 17%.

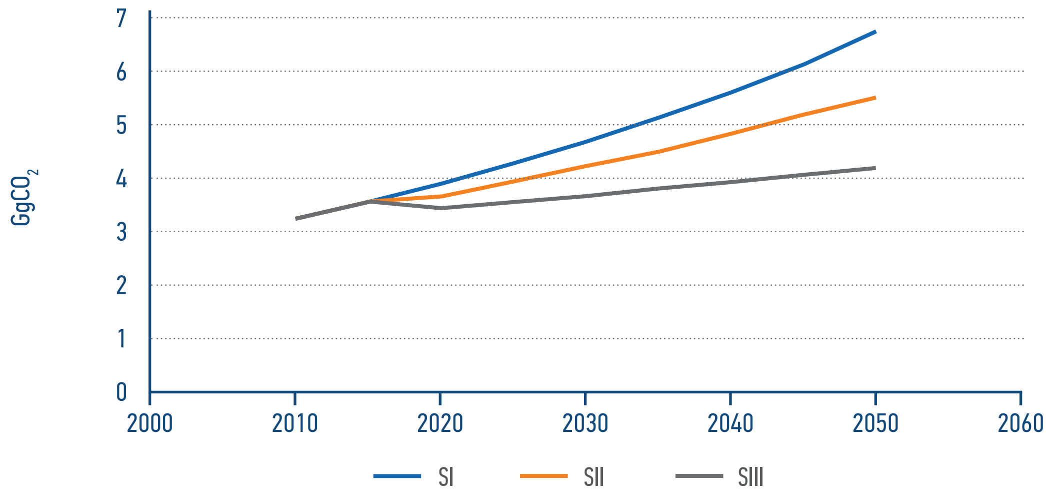


Chart 67: Graphic illustration of projections of total CO_2 emissions in the transport sector by scenarios for the period 2010 – 2040

According to the projection of the total CO_2 emissions from the transport sector of the scenario 1 (S1/BAU), the average growth in emission is foreseen by about 1.5% annually. It can be concluded that the relevant scenario follows the historical trend of increase in CO_2 emissions in the transport sector, typical for the previous decade and that it results in an increase in CO_2 emissions for 53% compared to 2014.

Scenario S2 also results in continued growth in CO_2 emissions in the period 2010 – 2040, however compared to S1/BAU it records an average trend of increase of emissions by about 0.6% annually in the period 2010 – 2040. Scenario S2 results in increase of CO_2 emissions by 33% compared to 2014. According to the projection of scenario S3, effects of mitigation measures for CO_2 emissions are gradually becoming achieved resulting in the annual growth in the entire observed period of around 0.3%. Scenario S3 results in an increase of CO_2 emission by approximately 10% compared to 2014.

2.6. Agriculture

2.6.1. Overview of the situation in the agricultural sector

Agricultural land in Bosnia and Herzegovina takes up approximately 2,161,300 hectares, or approximately 42% of the total land area (BHAS, 2016).
Official data on irrigated areas in BiH do not exist, but this is a very symbolic percentage which amounted only 0.4% before 1992. There is an evident trend of continuous reduction of total agricultural areas, especially arable land. According to Ljuša et al. (2015), agricultural lands decreased by 11,323 ha in the period 2000 –2012, whereby decreasing trend clearly indicates the conversion of agricultural to artificial surfaces (8,658.45 ha), land abandonment and the transition to the forest area (2,329.47 ha), and water areas (318.70 ha). According to MoFTER of BiH (2015), floods and subsequent landslides affected about 70,000 hectares of the most productive agricultural land. Agricultural management units in BiH are small (average 3.3 ha) and divided into smaller units, which is the cause of low productivity and modest total economic efficiency. The farms are mainly mixed.

When it comes to the livestock, extensive way of farming is predominant. A small part of the production is organized in modern, well-equipped farms.

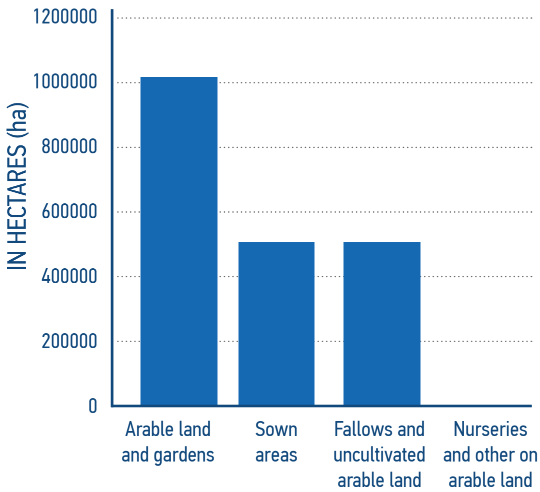


Chart 68: Arable land by land utilisation (in 2014)

Legislation related to the application of measures of good agricultural practice does not exist in our circumstances, but through the implementation of individual projects such measures are being promoted and the farmers are being trained.

The reasons for the constant changes in the sown areas, range of cultures, above average yield, etc., and the great stagnation of the sector in general lie in the agrarian policies that are led in the country. This is supported by the fact that, in 2014, 50.2% of arable land has not been cultivated (BHAS, 2016). It is expected that the area of uncultivated arable land and gardens will grow and partly these surfaces will be affected by the processes of succession and degradation, especially in marginal areas and small-scale estates. Without a strong turnaround in policies, clearly defined goals for placing agricultural land under protection and in function, it is hard to expect any significant changes in the sector.

Total allocated budget incentives for the implementation of programs and measures in agriculture and rural development in 2014 amounted to 139.1 mil. KM. Compared to 2013, the agricultural budget was reduced by 4%, or by 5.6 mil. KM. The model of agricultural policy, which is primarily reflected in the distribution of the incentives, shows the characteristics of obsolete support solutions (MOFTER of BiH, 2013). As a result of the devastating floods, a series of urgent and short-term measures were implemented in the sector in order to restore production in flooded areas.

In the observed period, at the state level, there was no activity on the preparation or adoption of strategic documents, apart from preparatory activities on drawing up the Rural Development Strategy. At the level of Entities, in 2014, Strategies for Development of Agriculture and Rural Areas were prepared.

It can be established that a progress has been made in the awareness of the entity ministries in charge of agriculture when it comes to climate change, its occurrence and the pertaining effects on the agricultural sector, given that the new entity agricultural strategies contain specific measures of mitigation/adaptation to climate change. However, it remains to be seen how the new agricultural strategies will be actually implemented and whether the annual action plans will keep up with the planned investments.

Since 2013, activities are carried out at the state level related to the development of regulations under the EU Council Regulation no. 834/2007, as well as implementation of standards which regulate the field of organic production in BiH. However, the views of the relevant institutions on the modality of drafting the Law on Organic Production at the BiH level are not concordant. In FBiH the Law on Organic Production is under preparation and it is expected that the activities will be finalized in 2015, while in Republika Srpska the Law on organic food was adopted in 2013. Other adopted laws and regulations at all administrative levels make no explicit reference to climate change or mitigation/adaptation to the climate change, therefore they can be considered as regulations having an indirect impact on mitigation/adaptation measures.

When it comes to the policies of EU accession, in the Report on progress in the field of agriculture for 2014 it was stated that there has been little progress in alignment with European standards in the field of agriculture and rural development[53], where, inter alia, it is stated that climate change do not make part of sectoral policies and strategies, the "Climate Change Adaptation and Low-Emission Development Strategy" has been adopted, but BiH needs to develop a comprehensive state level climate policy and strategy in accordance with the expected Framework for climate and energy policy of the EU by 2030.

2.6.2. Overview of the scenarios of greenhouse gas emissions from agriculture sector

Potentials for mitigation of climate change effects in the agricultural production in BiH can be observed from two perspectives: as sinks potentials and as a source of greenhouse gas emissions. Potentials for the sink of greenhouse gases are defined by spatial scope and manner of use of agricultural land. The existing sink capacity of land and manners of use in BiH for the main greenhouse gases amounts to approximately 1,305.3 Mt $C0_2$eq.

For the scenario analysis we referred to two groups of factors that influence the development of the agricultural sector, external and internal factors. The external factors, in addition to climate change, primarily include: general trends on global, EU and regional level, entry into EU and trade liberalization. Out of the internal factors the most important ones include: the lack of a common vision for the development of agriculture and rural areas, the lack of and/or non-harmonized legal framework in the country, lack of appropriate policies, measures and investments that are directly linked to climate

[53] *Bosnia and Herzegovina Progress Report 2014, EC, 2014.*

change and fight against drought, non-harmonized programme and incentive measures for agricultural production, trends and levels of production, use of technical and technological innovations, demand for domestic products.

Further below we analyze three scenarios for mitigation in the agricultural sector, with the main starting points for each scenario as described.

- **S1:** Starting point of the S1 scenario, from the standpoint of greenhouse gas emissions in agriculture, is the least favorable. In this scenario, no major changes can be expected in terms of the development of the agricultural sector and sectoral policies. In addition, the share of agriculture in the overall economy remains at the same or similar level. Under these circumstances, the industrial sector is not developing significantly and therefore pressure on agriculture will be significantly increased in terms of ensuring the living conditions of the population. In such circumstances, the focus will be on increasing yield per unit area by introducing large amounts of mineral fertilizers and manure, and in some cases natural meadows and pastures will be ploughed for the production of fodder for livestock. Organic agriculture is not developing dynamically and it has a symbolic importance in the overall agricultural production. Generally, increased growth of livestock production is foreseen. The emphasis is on the concept of concentrated farm production with a large number of units. Similarly, increased use of land for non-agricultural purposes is expected, particularly from the point of view permanent losses in construction of infrastructure, settlements, exploitation of raw materials and similar. The technologies used in agriculture and technical and technological measures will not follow world trends in this area. Measures of conservation and land development will be lacking, soil moisture conservation measures and reduced processing will be applied at a low level. Degraded land areas will be scarcely re-cultivated. Agricultural practices will remain at the current level and Nitrates Directive will not be applied. Conventional agriculture standards will be partially applied. Furthermore, what should also be added is non-harmonized development of agriculture, rural area, incentive programmes and legislation in the country. Incentive measures remain at the current or lower level, and the issue of climate change is not part of sectoral policies and strategies and there is no strategy to combat drought.

- **S2:** Starting point of S2 scenario is that there are positive changes and progress in the agricultural sector and this is the most realistic scenario for BiH. Starting points are that the share of agriculture in the overall economy of BiH increased, that the trends of use of agricultural land, as well as trends in production of agricultural products are improved, with an increase in average yields that still remain modest. Protected areas in all categories of protection are increasing and organic farming takes a significant share in the overall agricultural production. Advanced technical and technological measures are used. Modest number of farmers apply Code of Good Practice. The Nitrates Directive is partially applied. The number of livestock is slightly on the rise, productivity has increased. Degraded land area are becoming slightly smaller. There is a harmonized process of development of agriculture, rural area and villages in general. The concept of farm production is partially developed in accordance with the condition of the environment and available resources. Programmes of measures and incentives partially harmonized, funds slightly increased and targeted towards officially registered farmers, inter alia, in order to protect the environment and apply the best agricultural practices. Rural Development Strategy takes into account the principles of landscape design of rural areas in the concept of the construction of infrastructure, agricultural development and other secondary activities. Climate change make an integral part of sectoral policies, strategies and the incentive programmes. Climate Change Adaptation and Low Emission Development Strategy becomes the backbone of the activities, while the awareness of climate change increased, and the strategy to combat drought is being implemented.

- **S3:** Starting point of S3 scenario is the fact that BiH is a full member of the EU. Upon joining the EU, the agricultural policy of BiH is developed in accordance with the Common agricultural policy and the available resources are used to boost the development of the sector, which makes the development of the agricultural and environment sector sustainable. Degraded land areas are successively being renewed through the rehabilitation and remedial measures. The farms are modernized, high technical and technological measures and standards are used, as well as codes of good agricultural practice. Awareness of climate change is highly raised. Monitoring of the environmental conditions and changes in the area is very developed, and thus the transparent reporting to both domestic and international public.

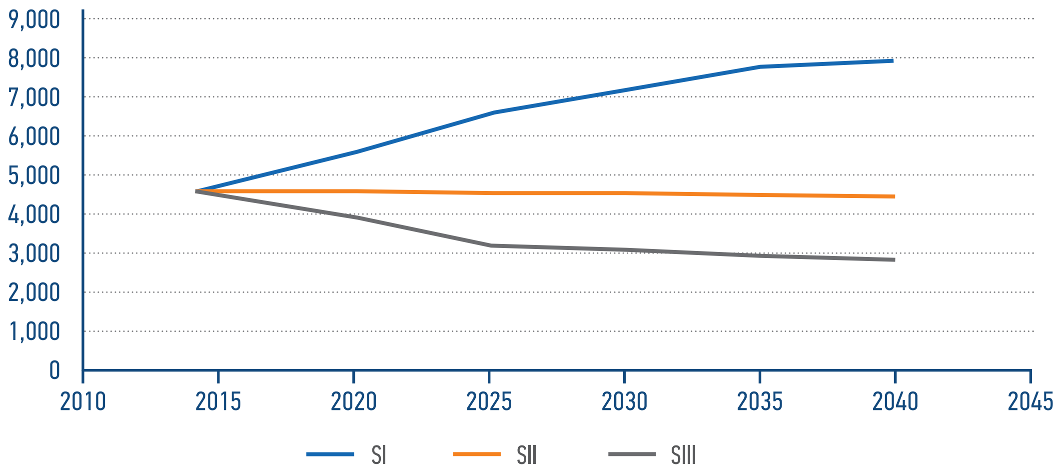


Chart 69: Total emissions CO_2eq from the agricultural sector in BiH for the period 2014-2040 according to S1, S2 and S3 scenario

According to the presented figures, the total greenhouse gas emissions in the sector of agricultural production based on the S1 scenario will rise by 2040, when it will amount to 7,884 GgCO_2eq (almost 80% more than in 2014).

Based on the scenario S2, the total annual emission of greenhouse gases will be reduced and in 2040, compared to 2015, it will amount to 4,425 GgCO_2eq, which is a total decrease of about 3.6%. We can draw a general conclusion that the measures applied in the agricultural sector must be of a significantly broader range and efficiency in order to result in more concrete effects.

The expected emission from the agricultural sector in 2040, according to the scenario S3 is at 2,822 GgCO_2eq, which compared to 2015 represents a total decrease by about 38%. However, with regard to this scenario after 2025 only a slight reduction can be expected, because the largest part of the problem will be regulated immediately before and after accession to the EU, therefore in the period from 2025 to 2040 it is a decrease of about 12%.

The presented data suggest that the potentials to prevent the causes of climate change in the agricultural sector in BiH, with a strict application of the latest developments in all aspects of production, are very large. However, in order to obtain more precise scenario indicators, this requires precise data. Currently we have no data at disposal on the actual number of farms involved in agriculture, the number of farmers, livestock etc., all of which significantly affects the final results of the analysis and scenarios.

2.7. Forestry

2.7.1. Overview of the situation in the sector of forests and forestry

BiH belongs to a group of European countries that are extremely rich in forest resources in terms of their distribution and biodiversity. The fact that according to the latest survey over 60% of BiH territory is covered with forests indicates their importance in providing multiple benefits, and hence as a sector to mitigate climate change. However, it is about 93% natural and only 7% of planted forests.

The extent of logging in the past three years in BiH increased by 5.74% compared to 2010. On the other hand, the extent of afforestation is becoming reduced. In addition to the fact that in 2011 there was an increase in the extent of the afforestation for 9.15%, due to a significant decrease in the extent of afforestation in 2012 and 2013, during these years 16.79% was afforested compared to 2010.

At the same time, due to lack of funding and lack of attention to the afforested areas (left to the competitive vegetation), in most cases 5 to 10 years later these areas become completely weedy, and the success of afforestation is undermined.

Among the strategic documents in the forestry sector, Forestry Development Strategy of Republika Srpska for the period 2012 –2020 can be singled out, which in some segments indicates the importance of climate change. Thus, in the context of multi-functionality of forests, one of ten planned criteria is the role of forests in mitigating climate change and their importance in storing SO_2. Among the 11 defined strategic objectives, the strategic objective of Ecosystem-based forest management, environmental protection, conservation of nature and biodiversity is largely devoted to climate change through the defined measures. In 2013, the Programme of conservation of forest genetic resources of Republika Srpska for the period 2013 –2025 was adopted. This Programme, which was adopted by the Government of Republika Srpska also defines the importance of climate change in terms of conservation of genetic resources (biodiversity) in forest ecosystems, whereby the partial measures also foresee the Assessment (scenario making) of the impact of climate change on forest genetic resources, as well as clearer (concrete) definition of the importance of preserving genetic resources in terms of adaptation of forest ecosystems based on forecasted climate change. In order to develop the Forestry Programme of the Federation of Bosnia and Herzegovina, the Study Forest and Climate Change was produced in 2011. This document, inter alia, provides an overview of the relevant international conventions, agreements, programmes, resolutions and declarations, as well as the Plan of climate change adaptation of Bosnia and Herzegovina according to the INC through the Climate Change Mitigation Plan and the Assessment of the potential for the development of reforestation, including the proposal of the Strategy to address possible future/expected EU commitments.

However, it should be noted that in the previous period (during the development of the Initial and Second National Communication) there were no significant changes in the forestry sector in terms of recognizing the existence of climate change, directly through the change management system, greater scope of reforestation, more intensive measures for protection from fire, diseases and pests, measures to preserve the diversity, genetic diversity, etc. It can be concluded that the sector strategy in this area is very slow and that developments in forestry do not give importance to climate change in terms of the significance of the existing forests in BiH. The capacities and strategic documents are lacking that would recognise forests in BiH as a huge potential in mitigating the effects of climate change. This is the only way to establish and define the cumulative effects of temperature increases and changes in the precipitation regime.

2.7.2. Overview of scenarios of sinks of greenhouse gases in the forestry sector by 2050

Essentially, few basic measures could be identified that can be applied so that the existing mitigation potential of forest complex in BiH is raised to a higher level. The essence of all these measures is mainly related to improving forest management systems through a range of different activities as well as through the reduction of recent negative trend in the forest cover change.

Based on the available documents in the forestry sector in Bosnia and Herzegovina, sectoral strategies, international commitments that BiH has taken over, as well as the economic situation and expectations of BiH to become an equal member of the EU by 2025, developed scenarios have been prepared by 2040 as follows:

- **The S1 scenario** –is based on the detected trend of increased intensity of deforestation in the past 3 years. It should be noted that the basis taken includes the sink capacity in BiH calculated on the basis of historical data on the area under forests in BiH, and based on the last measurements it was established that there was an increase of the forest area. This scenario has a negative trend of sequestration capacity, as consequence of forest fund losses of an annual average rate of -1%. After 2025, all forests are managed in accordance with the recommendations of the certifying institutions, and the logging scope is brought down to the level of 2010. There is no excessive or illegal logging, neither the decrease of forest areas. The volume of reforestation and success is the same as to date activities.

- **The S2 scenario** – is based on the application of certain stimulus measures for preserving existing forest cover. The basic measure involves increasing the sinks capacity through practical ways of applying certain silviculture methods to increase the carbon sequestration in tree biomass in existing forest areas. An important measure is the reforestation of bare lands, which would increase the total annual biomass increment. Another very important activity is related to the enhancement of fire protection measures aimed at preventing and reducing the number of forest fires, which in the past several decades have usually been caused by climate and are more frequent. Result of the application of these measures would affect the maintenance of the current level and would cause a slight increase in sinks capacities of forest cover in BiH. The extent of logging in all forms is back at the level of 2010 with an immediate effect. 2,500 ha are forested per year with 100% success in planting and development of newly established forests.

- **The S3 scenario** – 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 all obligations and directives related to the forestry sector. This primarily refers to full certification of programs for the overall forest fund in BiH aiming to improve sustainable forest management. One of the special measures that the S3 scenario assumes is the continued reforestation of degraded forest cover and afforestation of woodland barrens with the aim of combating the negative trend in forest area reduction by increasing the area under forest cover in future. For this purpose, a very important activity under this scenario is demining forest areas (10% forest areas are currently mined), which will also enlarge carbon forest storage potential in BiH. 2,500 ha are forested per year with complete success on the entire surface. In the next 20 years, every year new 100 ha of plantations is established in the form of energy plantations with fast-growing species. Activities and investments in fire protection are introduced from the first year of the observed period and are ongoing. These activities contribute to less burned area with an estimate of 1,000 ha per year. Protected areas are emphasized with the intensity of 100 ha per year.

The results of scenarios formed in this way, in terms of projections of CO_2 sinks (Gg) in the forestry sector by 2040 are given below.

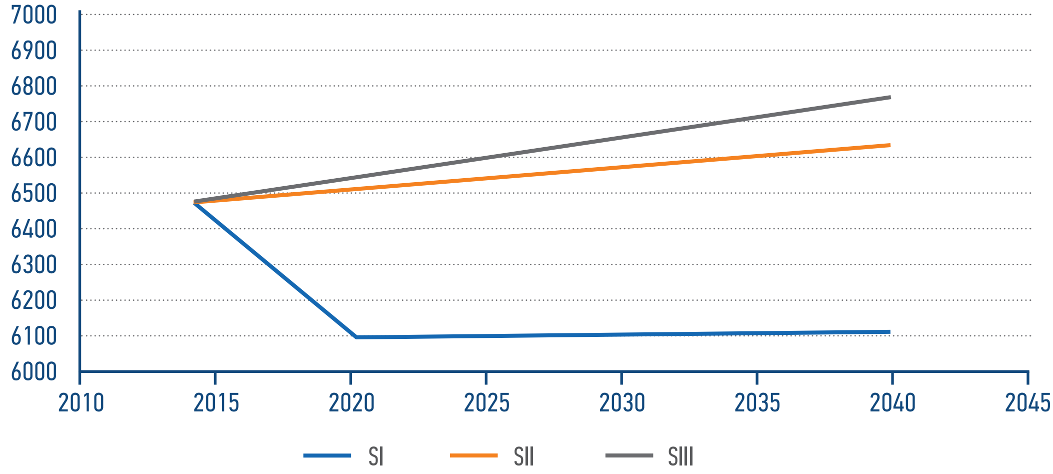


Chart 70: Scenarios of CO_2 sinks (Gg) in the forestry sector by 2040

According to S1, sequestering capacities are in decline by 2025 and after that they are almost stagnant, and according to this scenario, by 2040, sinks would be reduced to 6,114 $GgCO_2$.

Under scenario 2, with the ongoing activities of growing forests, afforestation of bare lands and improved fire protection measures, the projected value of the sink capacity in 2040 would increase by about 3% compared to 2014, and it would reach the value of 6,630 $GgCO_2$.

If all the activities as planned under the advanced S3 would be implemented, the size of the sink compared to 2014 would have increased by around 300 $GgCO_2$.

2.8. Waste

2.8.1. Overview of the situation in the waste sector

Quantities of waste generated in Bosnia and Herzegovina in the period 2010 – 2014 amounted to 1,152,690 t and 1,163,370 t, respectively, with a slight rise of 1%. According to the updated data, volumes in 2010 were somewhat lower than the volumes specified in the Second National Communication, which can be explained by examining new data and new assessments.

Coverage by the services of collection and disposal is approximately around 72% and 74%.

	Total amount of generated waste in BiH (t)	Total amount of disposed waste in BiH (t)
2010	1.152.690	829.290
2011	1.163.370	873.660
2012	1.304.240	965.138
2013	1.203.249	890.404
2014	1.332.418	985.989

Table 53: Data on quantities of waste (2010–2014)

The document also considers new (2014) proposals from the European Commission to encourage the improvement of recycling, with targets for municipal waste by 2030 of 70%. In addition, based on the inventory of GHG emissions for 2012, 2013 and 2014, the estimated values were substituted with the values of the inventory and based on these new values further calculations were made. The IPCC 1996 default values have been used for the share of DOC in waste (0.17) and the share of C released as CH_4 (0.5).

In the field of legislation there have been significant developments in the period from 2001 to 2010/2011, and after this period it was only 2012 that saw the adoption of the Book of Rules on electrical and electronic waste in FBiH.

Implementation of this legislation and the level of implementation made an impact in changing the situation in the field of waste management. Unfortunately, the legislation is not harmonized in the entities (the level of transposition of the directives is not the same), nor the same legal acts were adopted (e.g. Books of Rules on specific waste streams), making it difficult to predict the scenario for the entire BiH.

In addition to the official acts of state institutions, the World Bank, the Czech Development Agency and SIDA implemented a range of important projects focused on establishment of an integrated waste management system that is mainly related to drawing up of the Waste Management Programme.

2.8.2. Overview of scenarios of greenhouse gas emissions from the waste sector

The S1 scenario (business as usual) – This scenario assumes waste disposal in landfills that are not regulated (given that about 65%-70% of totally generated waste is collected and disposed of in partially regulated landfills (except Mošćanica, Bijeljina and Sarajevo), that is, in mainly unregulated municipal landfills, while the rest ends up in illegal dumping sites. Scenario 1 provides that all waste is disposed at illegal dumps by 2030. Considering that the illegal dumping sites are unregulated, the calculation was made on the basis of the total waste generated that ends on illegal dumping sites (regardless of whether it is collected and disposed of in unregulated municipal dumps or whether it is dumped at illegal landfills). After 2030, the regional landfills are foreseen, as well as waste disposal on legal dumping sites. The increase in the amount of generated waste is taken into account, as well as increase of the level of coverage by collection services. Other than recycling, no other treatment is foreseen. Environmental Management Strategy 2008-2013 and the Waste Management Plan 2013 –2018 foresee the recycling level of 7% in 2014 and 10% in 2018. Current indicators suggest that recycling is not even close to that level.

The S2 scenario – As part of the SNC, this scenario envisages construction of several regional sanitary landfills with the systems for the collection and burning of biogas across BiH by 2025. In addition, in the context of this report, collection of the entire waste and increase in recycling will be foreseen, in accordance with the Waste Management Strategy in FBiH/Waste Management Plan FBiH 2012 – 2017 (with the same level to be applied to the entire BiH, taking into account RS, for which a new plan has not yet been made), and which will take into account the recycling of packaging waste parts, as well as electrical and electronic waste (since the by-laws are already in force in FBiH), in accordance with Waste Management Plans of the operators for these types of waste. Scenario 1 takes into account increase of generated waste as in the baseline scenario, but it predicts a significant increase in recycling and treatment using other methods, such as biological treatment or incineration. Accordingly, increase in recycling of 2% annually by 2018 is foreseen, and then 1% by 2030 and 0.5% by 2040. In addition, other waste treatment methods are foreseen, such as biological treatment or incineration by 0.5% in the period 2015-2020 and as of 2020 the increase of 0.5% each year. Moreover, disposal of residual waste only on regional landfills is foreseen from 2025. In 2030 about 70% of the waste will be disposed on the landfills, and 50% in 2050. Neither with the given plans nor in Scenario 2 will it be possible to reach the new targets set by EU Directives.

The S3 scenario – In the context of this report the predictions set out in the SNC will be maintained and an increased level of recycling will be introduced at the source and on the landfills (including batteries and accumulators, tires, glass and other waste from specific streams which currently ends up in landfills), as well as the change of billing services based on the produced amount of waste. This stage did not take into account construction of incinerators for incineration of mixed utility waste (i.e. treatment after recycling). Even Scenario 2 takes into account increases as in the baseline scenario, but it predicts a significant increase in recycling (40% by 2040), as well as treatment using other methods, such as biological treatment or incineration (up to 35% by 2040). It also assumes the disposal of residual waste only on regional landfills by 2020.

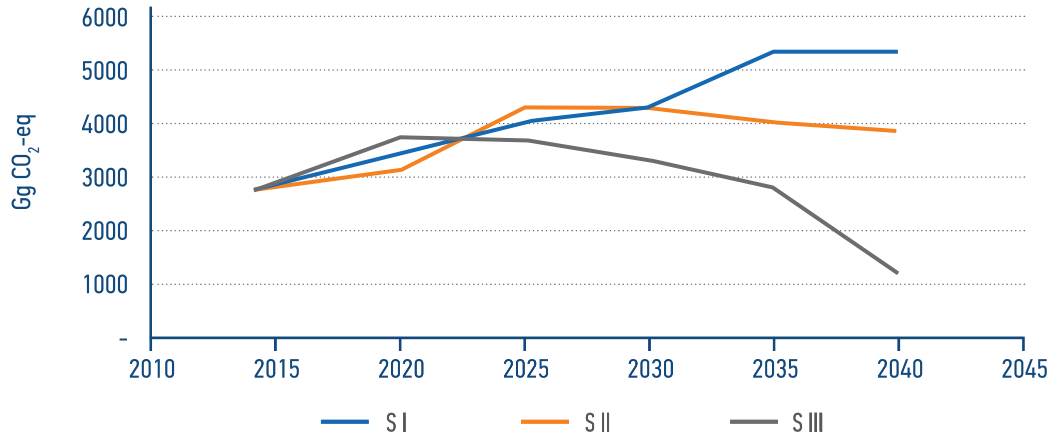


Chart 71: Mitigation scenarios in the waste sector[54]

From the aforementioned it is evident that significant reduction of emissions of methane are not expected by 2020, although some measures have been taken. In the scenario 2 even greater increase is expected, but that is caused based on the assumption of earlier construction of regional landfills, with the higher amounts of waste arriving to the landfill. Retention of the current waste management policy and lower growth in recycling lead to milder growth in the quantity of emitted methane, in the Scenario 1, but it is evident that the measures are not sufficient and do not lead to a reduction. Introduction of higher degree of recycling and return to the Scenarios 2 and 3 lead to a reduction, because the amounts of disposed waste are thus becoming lower. The scenario 3 foresees rather high percentage of recycling (about 40%) by 2040 and of mechanical biological treatment, which is reflected in a major reduction in emissions. Disproportionate growth and decline in the displayed chart is in line with changing a number of factors that influence the emissions from the waste: population growth, increase in production per capita, increase in coverage by collection services, introduction of recycling and mechanical and biological treatment.

[54]It is worth noting that in order to calculate emissions, national DOC was calculated, i.e. the share of DOC in the waste, according to available data, which is 0.25 and it is a lot higher than in other developing countries (Egypt and Nigeria 0.25). This value will eventually become smaller, by decreasing the share of organic waste. In addition, IPCC 1996 values were used for the correction factor CH_4 (0.8 for landfills that are not controlled and which are deeper than 5m and 1 for regulated landfills).

2.9. Summary Results For Mitigation Scenarios

Based on the obtained results of developing scenarios of individual sectors, a consolidated/summary result was made, which unifies all effects for each individual scenario. Summary review foresees the total mitigation potentials for each of the scenarios, not including the effects of sinks in forestry.

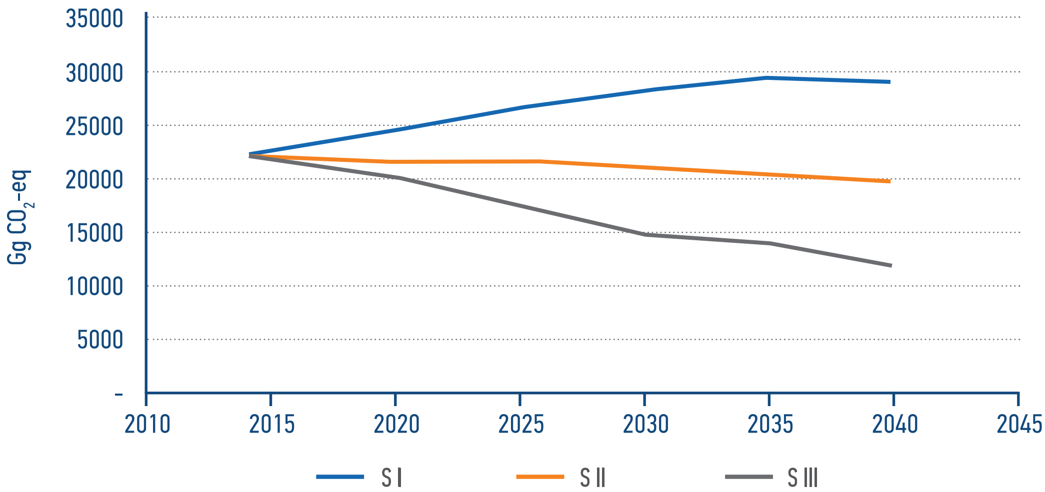


Chart 72: Total (sink in the forestry sector is not included) emissions by scenarios for the period 2014 – 2040

The most influential sector in the emission projections is the power sector, which in the total amount takes the share of 40 – 65%, depending on the scenario and the observed period. With that in mind, it is clear why the trend of individual scenarios is equal to the trend of the power sector.

According to the projected emissions, the scenario 1, which corresponds to the "business as usual" is headed towards continuously slower growth, and by 2040 it is expected to have the emissions higher by approximately 31% compared to 2014.

Scenario 2 is characterized by moderate constant drop in emissions, which by 2040 shall decrease by 11% compared to 2014. Advanced scenario S3 records more intense decline in emissions by the end of the observed period and in 2040 they are recorded with values less than the baseline of 2014 by 46%.

3. Measuring, reporting and verification of nationally appropriate mitigation actions

3.1. The NAMA mechanism in BiH

In 2015, Bosnia and Herzegovina 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.

Based on the initiative to amend the Decision on 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, so as to add the development, receipt and approval/rejection of NAMAs to the existing activities defined for the DNA, it was approved by the Council of Ministers, and the supplemented DNA's Rules of Procedure were passed at the first coming session of the Executive Board.

In line with the amended Decision, and as provided in the First Biennial Report, the NAMA DNA's structure is composed of the Executive Board, the DNA Secretariats and the Expert Councils, each with different but closely-related functions, as shown in the chart below:

NAMA DNA Structure

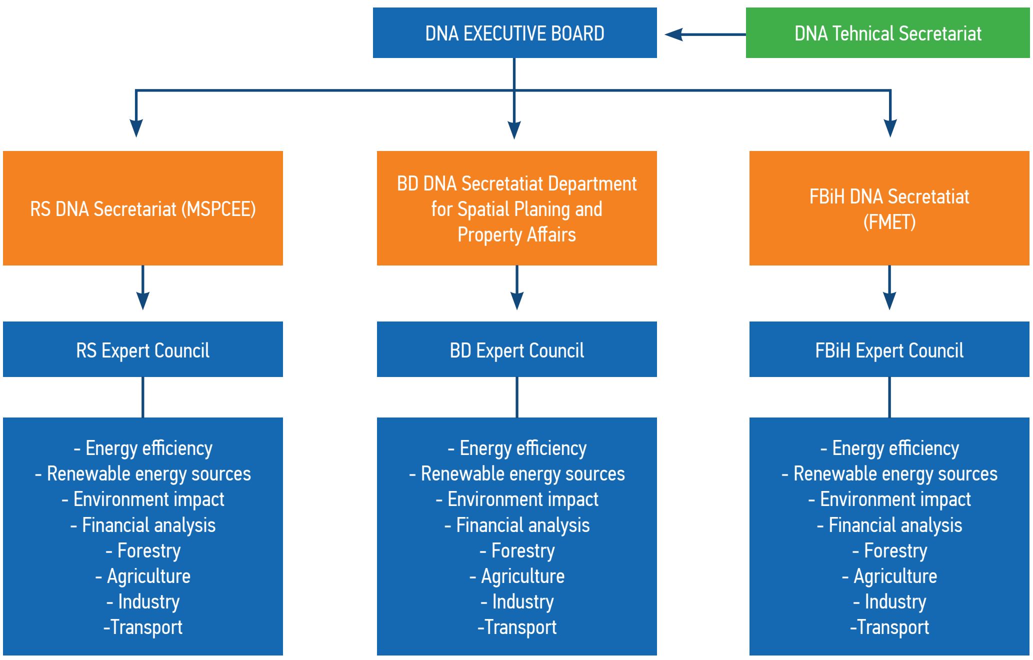


Figure 10: NAMA DNA structure (SNC BiH, 2012)

The Executive Board of the NAMA DNA is consisted 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 are formed at the entity and Brčko District levels and they 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 the 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. The first NAMA project proposals are under development and they will be submitted to the BiH DNA secretariats for approval in the coming period.

3.2. Measuring, reporting and verifying NAMA projects

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 the existing institutions. 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. It was established that BiH lacks the required capacity, however there are institutions 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, therefore, investing further effort in this segment is proposed.

3.2.1. Measuring

As provided in the First Biennial Report, measuring involves direct physical measurement of GHG emission reduction or calculation of emission reductions based on the measurement of activities and by using 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 failed 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. The following segments should be given special attention in the following period:

• 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 by direct measurements of emissions at the source.

• Increase the number of sites where consumption and emissions are measured accurately and reliably.

• Ensure reliable and timely data processing and conversion of these data into information that would be distributed both horizontally and vertically to all users.

• Given the complexity of NAMA monitoring, 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.

3.2.2. Reporting

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 Republika Srpska, which is the designated national focal point for coordination of cooperation with international structures and institutions of the UNFCCC and the Kyoto Protocol.

In accordance with the proposed measures under the Second Biennial Report, the next steps should include the work on the establishment of an information network between NAMA project and relevant line ministries within the entities[55] 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 all users with 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 the information relating to environmental protection, energy efficiency, renewable energy sources, etc. This information is used for monitoring emissions reduction and producing a GHG inventory by the hydro-meteorological institutes, 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 such report. All information collected in this way in the Federation of BiH, Republika 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.

3.2.3. 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.

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

List of charts

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List of acronyms

BD	Brčko District
BiH	Bosnia and Herzegovina
BHAS	Bosnia and Herzegovina Agency for Statistics
CDM	Clean Development Mechanism
CoP	Conference of the Parties (to the UNFCCC)
CORINAIR	CORE Inventory of AIR Emissions
CRF	Common Reporting Format
DNA	Designated National Authority for CDM projects
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EE	Energy efficiency
EEA	European Environment Agency
EEC	European Energy Community
EMIS	Energy Management Information System
EU	European Union
EU ETS	European Union Emission Trading System
FBiH	Federation of Bosnia and Herzegovina
FBUR	First Biennial Report of Bosnia and Herzegovina on GHG emissions
FDI	Foreign Direct Investments
FMOET	Federal Ministry of Environment and Tourism
GCF	Green Climate Fund
GDP	Gross domestic product
GEF	Global Environmental Facility
GHG	Greenhouse gases
GIZ	German Corporation for International Cooperation
IFC	International financing institutions
INC	Initial National Communication on climate change
IPA	Instrument for Pre-Accession Assistance (European Union)
IPCC	Inter-governmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
KM	Convertible Mark
MDG	Millennium Development Goals
M&E	Monitoring and Evaluation
MMF	International Monetary Fund
MOFTER	Ministry of Foreign Trade and Economic Relations of BiH
MPUGE, RS	Ministry for Spatial Planning, Civil Engineering and Ecology of Republika Srpska
MRV	Measuring, reporting and verification

NAMA	Nationally Appropriate Mitigation Actions
NEAP	National Environmental Action Plan
NEEAP	National Energy Efficiency Action Plan
NGO	Non-governmental organization
OECD	Organisation for Economic Co-operation and Development
OIE	Renewable Energy Sources
PPS	Purchasing power standard
PRTR	Pollutant Release and Transfer Register
PUC	Public Utility Company
QC	Quality control
QA	Quality Assurance
RS	Republika Srpska
SEAP	Sustainable Energy Action Plan
SEE	Southeastern Europe
SHPP	Small Hydropower Plant
SMEs	Small and Medium Enterprises
SNC	Second National Communication on climate change
SRES	Special Report on Emission Scenarios
SAA	Stabilization and Association Agreement
UN	United Nations
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WMO	World Meteorological Organization

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ANNEX I
REPORT 1.B SUMMARY REPORT FOR GREENHOUSE GAS INVENTORY (IPCC TABLE 7B)

Mitigation activity	Sector	Status (planned / in progress/ implemented	Specific objectives	Description (type of activity, type of emission reduction, gas for which emission is reduced, time frame)	
Construction of biomass coge-neration plants	Energy	For several plants the studies are underway	Reduction of heating costs, income of local communities from sale of electrical energy	construction of cogeneration plants using wood chips from forest wood residues and wood waste from wood processing industry, individual power of several MWe, the total potential of 200 MWe	
Improving the efficiency of co-al-fired power plants (building new ones)	Energy	For several plants conceptual designs and the necessary permits for construction prepared	Reducing costs of electricity generation and reducing emissions from the power sector	Substitution of existing thermal power plants with an average efficiency of 30% with the new ones that will have the efficiency of about 40% (total power of 1800 MW). The emission of pollutants by the new ones will be in accordance with EU Directives. Period 2018-2030.	
Use of methane from undergro-und coal mines	Energy	Feasibility study completed for one mine, there is a potential in additional three mines.	Energy production from methane and methane emission reduction.	Installation of equipment for the production of energy from methane from two underground mines (five pits)	

	Coordination and management	Assessment of the potential to reduce $GgCO_2$ emissions	Other effects	Type of support	Costs of preparation and implementation
	Entity Ministries of Energy, municipalities with the biomass potentials and forest management companies	1,080 (880 for electrical energy generation and 200 for heat generation)	Opening 2,500 permanent job posts, improving air quality, development of industry which needs heat, sustainability of forest management companies.	Some international development banks have are running projects regarding the financial support (IFC, EBRD)	preparation: 100,000 EUR per MWe Implementation: 3 million EURO per MWe (investment in plant and the primary line, it depends on the choice of technology)
	Entity Ministries of Energy and power companies	4,800	Maintenance of job posts in mining and thermal power, air quality improvement	For projects that are in progress funding model is through strategic partnership	Preparation 50 million EUR implementation 3 billion EUR
	Ministry of Energy, Mining and Industry of FBiH, power company – Elektroprivreda BiH	150 (100 for the electrical energy generation and 50 for the heat generation)	Extra income for mines, new jobs, increase in the level of occupational safety in mines	Technical assistance for the preparation of a feasibility study	Preparation 1 million Implementation 15 million EUR (in five pits)

Construction of large hydropower plants	Energy	Work on the construction of several plants initiated in the period 2014 –2016.	Production of competitive energy without greenhouse gas emissions	Construction of hydropower plants with capacity of 20 MW and more with multi-purpose water reservoirs, with the total power of 500 MW	
Construction of small hydropower plants	Energy	About 60 MW built by 2016	Exploitation of hydro potential	Installation of small hydropower plants up to 20 MW, with a total power of 150 MW, in the period 2016 – 2040.	
Construction of wind farms	Energy	Planned	Exploitation of wind potential	Installation of 500 MW of wind farms in the period 2016 – 2040	
Construction of solar power plants	Energy	Intensive construction from 2014 to 2016; several MW built	Exploitation of the solar energy potential	Installation of 40 MW of photovoltaic modules in the period 2016 – 2040	

	Entity Ministries of Energy and power companies	1,500	Competitiveness of power industry, new jobs, irrigation, tourism	Loans from development banks	Preparation 10 million EUR implementation 1 billion EUR
	Ministries of Energy, Ministries of Environment	250	Development of rural areas (infrastructure), technology transfer, potential for tourism development	Technical assistance provided by IFC for drafting legislation	Preparation 20 million EUR implementation 300 million EUR
	Entity Ministries of Energy	600	Development of rural areas (infrastructure), technology transfer	Technical assistance from KfW	Preparation 20 million EUR implementation 400 million EUR
	Entity Ministries of Energy	30	Technology transfer	There was no assistance	Preparation 0.5 million EUR Implementation 30 million EUR

Installation of cumulative (buildings) and individual (apartment) heat meters in all buildings which are connected to the district heating system	Energy	Partially implemented in the territory of BiH (all new buildings which are connected to the district heating generally have the installed cumulative heat meters and some of them have the meters for individual apartments. This activity is envisaged by the entity strategies for energy sector development, as well as by the project LEDS BiH).	Reduction of heat consumption and consequent reduction of CO_2 emissions	Cumulative and individual heat meters should be installed in all buildings connected to the district heating. Implementation of this measure should be implemented in the period 2015 – 2020.	
Introduction of renewable energy sources in existing district heating systems and construction of new capacity using renewable energy sources/biomass, geothermal energy	Energy	Partially implemented in Bosnia and Herzegovina. So far, out of the major projects only project in Gradiska was implemented (this activity is foreseen by the entity strategies for energy sector development and by the project LEDS BiH, SEAP plans of municipalities and cities).	CO_2 emission reduction, hiring new workforce, reducing heat costs	Introduction of biomass as a primary or auxiliary fuel in district heating companies that used fossil fuels and construction of new biomass heating plants. These projects should be implemented continuously by 2040, provided that the largest part should be implemented by 2025	
Reconstruction and modernization of district heating network, boiler rooms and heating substations	Energy	Partially implemented in Bosnia and Herzegovina (only those parts of the distribution network where frequent breakdowns used to occur were replaced. Significant reconstruction of the old boiler rooms has not started yet). This activity is envisaged by the entity strategies for energy sector development and by the project LEDS BiH).	Increase in the overall efficiency of the system	Reconstruction and modernization of district heating network, boiler rooms and heating substations. The measure should be implemented continuously by 2040	

	In Federation of BiH – Ministry of Energy, Mining and Industry, in Republika Srpska – Ministry of Industry, Energy and Mining, cantonal and municipal authorities, district heating companies	40,00	Lower bills for the consumed heat, Improved operations of district heating company, reducing BiH energy sector dependence on imported fuels	Financial assistance	110,00 million EUR
	In Federation of BiH – Ministry of Energy, Mining and Industry, in Republika Srpska – Ministry of Industry, Energy and Mining, cantonal and municipal authorities, district heating companies	45,00	CO_2 emission reductions, hiring new workforce, reducing heat costs, reducing BiH energy sector dependence on imported fuels	Financial assistance	100,00 million EUR
	Cantonal and municipal authorities, district heating companies	80,00	Reducing CO_2 emissions, lower bills for the consumed heat, Improved operations of district heating companies	Financial assistance	520,00 million EUR

Legal framework for implementation of energy efficiency measures in the building sector	Buildings	In progress	New legislation should limit the energy consumption in buildings, both in in the new and the existing ones. The transposition of the European directives which: - determine the maximum energy consumption per unit area of buildings - introduce compulsory certification of buildings - prescribe energy renewal in major reconstructions of buildings, - use "green" materials for the construction of buildings and equipping - create conditions for energy efficiency measures in residential buildings - use of energy efficient appliances and equipment.	Harmonization of BiH legislation with EU legislation, Accepting NEEAP BiH and EEAP of RS and FBiH, Amendments to the Law on Public Procurement – "green" procurement, Law on maintenance of buildings	

	Republika Srpska: RS Government, as well as individual ministries. Ministry of Spatial Planning, Civil Engineering and Ecology of RS, Ministry of Industry, Energy and Mining, FBiH: Ministry of Physical Planning FBiH; Cantonal ministries, BD Government		Economic and social benefit by reducing the costs of buildings use, Improvement of living comfort	Technical assistance for the adoption of the new Law on Green Procurement and the Law on maintenance of buildings	

Campaigns of raising awareness and education	Buildings	Continuously	By changing awareness and education about the possibilities of energy saving without reducing comfort and use of renewable energy sources for the society and individuals.	Various types of activities: 1. Training of professionals: contractors' architects, employees in administrative bodies (implementation of legislation) 2. Various campaigns for raising awareness and education of investors and users of buildings, (Energy Days, campaigns conducted by various NGOs, etc.)	

	BiH: MOFTER FBiH and RS: Government, and competent Entity Ministries and with the help of international organizations such as: UNDP, GIZ; USAID, and other international organizations, as well as NGOs, and others.		Energy saving and reducing GHG emissions, economic and social benefits, development of green jobs	Financial and technical assistance	18.40 million EUR i.e. the more funds the better end results

Improving energy efficien-cy of buildings	Buildings	In progress	Reducing the average heating energy consumption from >200 kWh/m^2 to 100 kWh/m^2, reduction in CO_2 emissions caused by energy consumption, improving the living comfort	1. Energy renovation of existing buildings, mainly on public buildings and collective residential buildings, but it is being implemented to a lesser extent and slower than planned 2. Completion of unfinished family houses, mostly built by socially vulnerable population (refugees and displaced persons) 3. Construction of energy-efficient buildings, based on new legislation	
Application of the directives in the field of emission redu-ction, efficient motor vehicles and fuel quality	Traffic	Planned	Using better quality fuel, reducing emissions from light-duty vehicles, prescribing standard emission values for new motor vehicles	Transposition and implementation of EU Directives into national legislation, 2016 – 2020.	

	BiH: MOFTER; FBiH: Government, Ministry of Physical Planning FBiH; cantonal ministries Environmental Protection Fund FBiH, Public utility company - Sarajevo district heating company, municipalities RS: Government, Ministry of Education and Culture, Ministry of Health, Ministry of Energy and Ministry of Spatial Planning, Civil Engineering and Ecology, Fund for Environmental Protection and Energy Efficiency of RS	Realistically it can be expected by 2025. Max. 58.17 Gg CO_2eq It can be expected at the end of the period, i.e. by 2050, total 149 Gg CO_2eq	Green economy, i.e. employment, protection of space from construction by renovation of the existing buildings, improving comfort for users of buildings, economic savings for users of buildings, reducing heating and cooling costs	Financial and technical assistance for projects implementation	By 2025 208 million € For the period by 2050 a total of 480 million € For completion of buildings of socially vulnerable persons 920 million, whereby the effect of reducing GHG emissions is minor, because they are mainly heated by using biomass.
	Entity Ministries of Transport		Reduction of air pollution, Increasing safety in the transport sector/road transport		

Fees for vehicle registration and excise tax on use of inef-ficient motor vehicles	Traffic	In progress	Payment of fees aiming to charge for air pollution and creation of an incentive fund to implement activities of more efficient use of transport fuels, use of renewable energy sources in transport	Creating polluter pays mechanism in the transport sector, gradual tightening of criteria and increase of the amount of fee	
Systematic reviews of technical requ-irements for motor vehicles	Traffic	In progress	Exclusion from transport those vehicles that do not meet the technical criteria, reducing CO_2 emissions	Systematic implementation of activities resulting in the exclusion of those motor vehicles from the traffic that do not meet the minimum required technical conditions	
Shortening of road sections by construction and moderni-zation of road infrastructure	Traffic	In progress	Increase in traffic efficiency	Building a network of highways across BiH, modernization and optimization of road signs, 2010-2025.	
Increase of forest area 2,500 ha/year	Forestry	In progress	Afforestation of barren areas suitable for afforestation, as well as coppice forests with more valuable species that will have higher growth rate and thus the accumulation of CO_2	Increase in forest area by afforestation of significant areas that are estimated as suitable for afforestation. In BiH there are over 300,000 hectares of barren land suitable for afforestation, and about 450,000 hectares of coppice forests.	

	Entity Ministries of Finance, Federal Ministry of Environment and Tourism, Ministry of Spatial Planning, Civil Engineering and Ecology of RS, Environmental Protection Funds	30	Reducing air pollution, co-financing emission reduction projects through the activities of the funds, encouraging innovative projects and solutions to reduce CO_2 emissions	Entity budgets	200,000 €
	Entity Ministries of Transport, Ministries of Internal Affairs	80	Reduction of air pollution, Increase in road traffic safety		10.mil €
	Entity Ministries of Transport	120	Reducing air pollution, employment, lower fuel consumption by vehicles, Increase in road traffic safety	Development banks, self-financing through toll collection, budget	>400.000.000 €
	Entity Ministries of Forestry, public companies, private owners	180	New employment opportunities. Increased stock of wood assortments		5-8.000KM/ha

Establishment of intensive plantations (energy crops and plantations)	Forestry	Planned	Ensuring significant amount of biomass	Growing intensive poplar plantations in the basins of major rivers. Possible biomass production from 20-40 m^3/ha. The area suitable for plantations of fast-growing species 2,000 ha.	
Protection of forests from fires (as well as diseases, pests and illegal logging)	Forestry	In progress	Ensuring less loss of forest area	Development of fire service for prevention of fire development over large areas, preventive measures against large-scale forest dieback	
Increasing the area of prote-ctive forests	Forestry	In progress	Reduction of the logging volume	Reduction of the logging volume through a specific protection regime ensures the CO_2 accumulation through the wood mass increment. The aim is to have around 7% of the total forest area and thus get close to the European average.	

	Entity Ministries of Forestry, public companies, companies for the management of river basins, businesses	56	New jobs. Increased stock of the wood assortments, biomass production (chips)		Establishment: of about 5,000 KM/ha plus the costs of ongoing maintenance
	Entity Ministries of Forestry and public companies	70	Stability of forest ecosystems that are at the same time more tolerant to climate change		1,5 mil. €
	Entity ministries of forestry	5	Preservation of biodiversity and genetic resources in our forests		

Improvements in the use of organic and mineral fertilizers	Agriculture	Planned	Reducing emissions of nitrogen oxide and increase in energy efficiency, prevention of volatilisation and contamination of surface and groundwater	Adoption and implementation of laws and bylaws on good agricultural practice In accordance with the Water Directive, Nitrates Directive and Directive on waste materials. Continuous activity by 2025	
Rehabilitation of existing landfills	Waste	Planned	Reducing CH4 emissions	Building of a system for degassing and reuse of gas or gas flaring; Preventing emissions	
Construction of regional landfills, without the return of gas	Waste	Planned	Control and reducing CH4 emissions	Building of a system for degassing and flaring	
Increasing recycling and composting levels – alternative waste management practices	Waste	Planned	Emission reduction (reducing the amount of deposited quantities)	Adoption of legislation (special waste streams), establishment of a system for recycling and reuse (operators for specific waste streams)	

REPORT 1.B SUMMARY REPORT FOR GREENHOUSE GAS INVENTORY (IPCC TABLE 7B)

[56] *Public Utility Companies*
[57] *International financing institutions*

	MOFTER, Entity Ministries of Agriculture, Entity Ministries of Environment, Institutes for agriculture and agricultural land		Quality of production, production safety, safer supply of the population, water protection, healthier environment and contribution to rural development in general	Program measures and incentives, EU funds	5-10 mil. €
	Municipalities	40	Reducing environmental impact	IPA funds, grants by DCF, WB loan	0.75 million EUR per landfill (each municipality has one - some have already been rehabilitated)
	Entity Ministries of Environment and municipalities (PUC[56])	50	Economically, a landfill can make a profit from the sale or use of landfill gas when certain conditions are achieved. Reducing the amount of waste on illegal landfills and reducing pressure on the environment	IPA grants and loans by IFIs[57]	Min 5 million EUR per landfill (planned 16 landfills)
	Entity Ministries of Environment, operators and municipalities (PUC), and other members of the system	80	Job creation, extending the life cycle of a landfill; Reducing the environmental impact	DCF grants and private investments of the operators of the system (for specific courses)	0.6 million EUR per landfill (includes recycling yard or building of a transfer station with recycling)

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