



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

UNDER THE UNITED NATIONS FRAMEWORK
CONVENTION ON CLIMATE CHANGE

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EXECUTIVE SUMMARY

COUNTRY CONTEXT

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, 42% is mountains, 24% hills, 29% karst regions, and 5% lowlands. Average altitude is 500 meters, with less than 8% of the surface area situated at an altitude below 150 meters. Bosnia and Herzegovina has common borders with the Republic of Croatia (931 km) in the north, north-west and south, the Republic of Serbia (375 km) and the Republic of Montenegro (249 km) in the east, while in the south it has access to the Adriatic Sea in Neum, with 21.2 km long coastline.
Population trends	According to the internationally recognized population estimates and projections prepared by the Population Division of the Department for Economic and Social Affairs of the United Nations Secretariat, Bosnia and Herzegovina will have a population of 3.212 million in 2025, and 2.685 million in 2050.
Climate	There are three dominant climate types in Bosnia and Herzegovina: (i) continental and temperate continental climate in the north of Bosnia and the valleys of the middle courses of the Una, Sana, Vrbas, Bosnia, and Drina rivers, (ii) mountainous and sub-mountainous climate covering continental mountainous region of Bosnia and Herzegovina, extending from the northern border area to the southern border represented by a line stretching from Posušje and southern slopes of the Čabulja, Velež and Bjelašnica mountains to Bileća; and (iii) Mediterranean and modified Mediterranean climate – prevailing in the country's south-west, that is, Herzegovina region.
Economy and industry	According to the information of the Bosnia and Herzegovina Agency for Statistics for 2018, the GDP value was at BAM 33,408 million, with nominal GDP 6.48% higher than in 2017 and the real growth of 3.62%. Average GDP per capita was BAM 9,556. In 2018, production growth was recorded in the fields of mining industry and particularly in manufacture and power and gas supplies (11.3% annual growth), while a significant decline occurred in the processing industry (annual decline of 1.1%).
Energy	In 2018, total gross electricity generation in Bosnia and Herzegovina was 19,160 GWh, which is an increase of 16.5% when compared to 2017 (16,438 GWh). (Gross) Electricity generation in hydropower plants was 6,519 GWh, in thermal power plants 12,079 GWh, and in industrial power plants 562 GWh. Own consumption in the energy sector was 1,248 GWh.
Transport	Bosnia and Herzegovina's road network has a total length of 24,358 km. When broken down by categories, motorways account for 198 km; trunk roads 4,787 km; regional roads 5,173 km; and other/local roads 14,200 km. According to air traffic information, there are 27 officially registered airports in Bosnia and Herzegovina. However, only 4 have been registered for international traffic: Sarajevo, Banja Luka, Mostar and Tuzla airports.
Agriculture	The share of the agriculture, hunting and accompanying service industries sector in the 2018 GDP structure was 5.89% or BAM 1.97 billion. Out of the total surface area of Bosnia and Herzegovina which covers 5.113 million ha, agricultural land accounts for about 47%. Only about 0.65% of land suitable for agriculture is irrigated.
Forestry	In 2017, forests in Bosnia and Herzegovina covered 2.60 million ha which is 50.77% of the country's total surface area. With the increasing surface area occupied by forests and extent of logging there is a downward trend in the extent of afforestation.
Waste management	Municipal waste generated in Bosnia and Herzegovina in 2018 was estimated to 1,243,973 tonnes, or 355 kg per capita annually, or 0.97 kg per capita per day. The total quantity of collected waste is comprised of municipal mixed waste (90.9%), collected municipal waste separated at the source

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	(4%), waste from gardens and parks (3.1%), and packaging waste (2%).
Water resources management	In terms of hydrography, 75.5% of Bosnia and Herzegovina belongs to the Black Sea basin, with the Una, Vrbas, Drina, Bosna and Sava rivers as major tributaries, while 24.5% belongs to the Adriatic Sea basin with the Neretva and Trebišnjica rivers as main tributaries. Total water intake in Bosnia and Herzegovina in 2018 was 319,851,000 m ³ which is by 3.5% less than in 2017.
Tourism	The period between 2008 and 2018 saw a rise in the number of tourists and overnight stays at the level of Bosnia and Herzegovina at a rate of 8.7% and 7.8% per year, respectively. According to the official tourism statistics, as of 2010 the average increase was approximately 14% per year with sufficient room still remaining for more effective use of tourism potentials.
Health	Circulatory system diseases and malignant diseases make up nearly four-quarters of all causes of death in Bosnia and Herzegovina. Respiratory system diseases are also included among five leading causes of death in the country.
Education	At the beginning of 2017/2018 school year, 282,946 pupils were enrolled in 1,817 primary schools, which is by 1.7% less than in the preceding school year, while 124,148 students were enrolled in 311 secondary schools, which is by 2.1% less than in the preceding year. There are 8 public universities and 29 private universities in Bosnia and Herzegovina (including independent higher schools and colleges) offering about 500 courses in total.

GREENHOUSE GAS INVENTORY

Developing greenhouse gas inventory is a continuous process. To date, the inventories were prepared for years between 1990 and 2016, and for purposes of this report, greenhouse gas inventories were prepared for years 2017 and 2018.

The energy sector remains the main contributor to CO₂ emissions, with 80% share. It is followed by the industry sector with 9% share, agriculture sector with 6% share, and waste sector with 6% share for years 2017 and 2018. When compared with 1990, a reduction in total CO₂ emissions without sinks by 10.58% and 8.43% was observed in 2017 and 2018 respectively.

The inventory quality assessment or accuracy of results have not been verified by independent experts. Indirect greenhouse gas emissions calculation has not been made nor inventory recalculations by sectors for the period between 1990 and 2016.

CLIMATE CHANGE MITIGATION

By signing the Sofia Declaration on the Green Agenda for the Western Balkans, Bosnia and Herzegovina has committed itself to achieving climate neutrality by year 2050. Considering that approximately 70% of electricity is generated by coal-fired thermal power plants with relatively low efficiency levels, the highest potential for reduction of GHG emissions lies in the energy sector. Power generation from RES, such as wind power plants and solar power plants has increased over the past few years. However, considering the potentials, the quantities generated are relatively low. Analysed scenarios envisage an intensified construction of RES power generation plants until 2030. Ambitious and decarbonisation scenarios developed in the preparation of this document include 500 MW of installed capacity in both wind power plants and solar power plants by 2030, with total installed power of the plants amounting to 2 GW by 2050. The scenarios also include construction of new large 250 MW hydro power plants that will have an additional role in the system balance. Although coal-fired thermal power plants have major role in the system until 2030, according to the decarbonisation scenario, the energy sector emissions will be reduced by 2030 by nearly 50% when compared with 2016. Main effects on GHG reductions result from the introduction of emission permits (taxation) and

emission limits compatible with the European Emissions Trading System (ETS), and RES competitiveness, leading to a reduction in the number of operating hours of coal-fired thermal power plants. Biomass cofiring in thermal power plants and full transition to wood biomass have additional potential for GHG reduction. This is particularly the case with fast-growing biomass cultivated on degraded mining lands. Closure of part of thermal power plants is expected to take place by 2030. According to the ambitious and decarbonisation scenarios, coal-fired thermal power plants' operation will phase out by 2050.

In addition to power generation, RES have significant potential for thermal energy generation. This primarily refers to wood biomass potentials. Part of the potentials is not being utilized (wood chips from forest wood residues, wood waste, etc.), whereas the utilised portion is mainly used traditionally with relatively high energy losses. Besides wood biomass, the agricultural biomass potentials such as manure and straw are also useful. So far, only three biogas plants have been built in Bosnia and Herzegovina. Geothermal energy heating and sanitary water preparation potentials amount to 1,421.75 TJ per year. Only a negligible percentage of the potential has been used so far. Using solar energy for sanitary water preparation is cost-effective in many parts of Bosnia and Herzegovina despite the subsidised electricity prices. According to the most ambitious scenario, total potential for GHG reductions utilizing RES for heat generation is about 70Gg in 2030 and 200 Gg in 2050. Although the GHG reductions are relatively low, the primary benefits of using the potentials is reduction of energy costs, local employments, air pollution reduction, waste reductions, etc.

District heating is the top priority of all strategic documents in Bosnia and Herzegovina primarily because the district heating system development is seen as part of the solution for the air quality issue. However, the situation in this sector is rather complex. In 2017, the share of district heating in covering heating needs in buildings in Bosnia and Herzegovina was approximately 7%. Despite the trend of recent years of transferring to biomass, about 50% of heat in district heating is still directly or indirectly obtained from coal. Most systems have excessive heat sources. Payment for services based on consumption has been introduced in only a few systems. The systems receiving heat from thermal power plants are faced with the challenge of changing the source of heat after thermal power plants phase out. According to the mitigation scenario, the potential for GHG reductions in 2050 is about 300 Gg, while the potential in 2030 is very modest due to the envisaged network extension based on the existing heat generation capacities with no considerable decarbonisation. Buildings have great potentials for GHG reductions given their present condition and potential for implementation of energy efficiency and RES. However, utilizing such potentials will require active policy measures that will initially be focused on awareness raising and providing subsidies for measures leading to GHG reductions but primarily on energy cost and pollutant emission reductions. The buildings sector which covers households and public and commercial service provision facilities consumes about 58.44% of total energy. Potentials for GHG reductions lie in changing energy sources and increasing energy efficiency. Mitigation scenarios envisage higher use of RES, primarily through the use of solar collectors for DHW heating and heat pumps for buildings. Higher energy consumption for sanitary water preparation is expected to occur with the improvement in the standard of living. In mitigation scenario, the potential for GHG reductions in 2050 is about 1,200 Gg CO_{2ekv}. With policy measures, approximately 50% of the potential may be utilized by as early as 2030.

GHG emissions from the transport sector have a trend of increasing. The main reason is the increase in the volume of traffic (as presented in chapter 1.6.3.) with electricity share in transport stagnating or growing rather slowly. The goal of BiH as member of the Energy Community was to increase the share of RES in transport to 10% by 2020. This goal was to be reached by combining increase in the electricity and liquid biofuel shares. This will require introducing active policy measures, such as fuel consumption-related vehicle taxation and stimulating purchase and use of electric vehicles including infrastructure building (charging stations, spare parts etc.) Furthermore, GHG reduction potential also lies in the reduction of distance between towns by building new roads, increase in railway transportation, electrification of public transportation and

promotion of non-motorised transport. Determining objectives for 2030 RES share in transport is ongoing. According to the mitigation scenario analysed in this document, GHG emissions from transport in 2050 are approximately 25% lower than in 2016. Although this reduction may seem insufficiently ambitious, it should be emphasized that despite a significant increase in the volume of traffic it is being achieved and can be rightfully expected to occur, as, by all indicators, the transport in Bosnia and Herzegovina is currently undeveloped when compared with transport in the EU countries.

Potentials for climate change mitigation in the field of Bosnia and Herzegovina's agricultural production may be seen from two perspectives: as potentials for GHG sinks and as GHG emission sources. Potentials for GHG sinks are defined by spatial coverage and methods of use of agricultural land. Existing greenhouse gas sink capacity of land and methods of its use in Bosnia and Herzegovina amounts to about 1,305 Gg CO₂eq per year. Another aspect of exploring the potential for climate change mitigation refers to annual GHG emissions generated by the agricultural sector. According to the mitigation scenario, the expected emission from the agricultural sector in 2050 is 1,760 Gg CO₂eq, which means a reduction of about 30% in total when compared with 2016. It is concluded that with a strict application of latest developments in all aspects of production segments, the potentials for GHG emission reduction in the agricultural sector in Bosnia and Herzegovina are very large.

Applying stimulus measures for forest cover preservation could significantly increase the amount of carbon sink in Bosnia and Herzegovina and, primarily, stop its negative trend. The basic measure involves discontinuing the increasing trend in the volume of logging and thus also increasing the sink capacity through practical ways of applying certain silviculture methods to increase 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. According to the mitigation scenario, the estimated carbon sink potential in 2050 amounts to 6,830 Gg CO₂eq, which is highly important for climate neutrality.

The potentials for waste emission reductions lie in introducing stimulus and measures to reduce waste quantities, increased recycling, and return. The mitigation scenario foresees rather high percentage of recycling (about 80% by 2050), reduction of mechanical biological treatment due to separation of organic waste at the source, and significantly increased awareness. This would result in nearly twice as less emission in 2050 than in 2016 or a reduction by approximately 400 Gg CO₂eq.

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. According to the full mitigation scenario, emissions in 2030 will be reduced by approximately 34% when compared with 2016. Coal-fired thermal power plants will phase out by 2050. However, emissions in 2050 still exceed the projected sinks. In the mitigation scenario the emissions are higher by 3,425 Gg CO₂eq. The potentials of industry for emission reductions have not been analysed, but if taken into account, this scenario could mean climate neutrality of Bosnia and Herzegovina. Further reduction potentials may be possible depending on technology development, particularly in the field of transport.

MEASURING, REPORTING AND VERIFICATION OF NATIONALLY APPROPRIATE MITIGATION ACTIONS

In 2015, through amendments to the Decision of the Council of Ministers of Bosnia and Herzegovina 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 (Official Gazette of BiH, 102/10, and 45/15), 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. According to the Decision, the Designated National Authority of BiH is the body competent for implementation of activities falling within obligations defined under the Clean Development Mechanism of the Kyoto Protocol and the implementation of NAMAs.

In October 2016, the Ministerial Council of the Energy Community adopted Recommendation for the implementation of the Monitoring Mechanism Regulation which is to serve as the basis for the member countries in harmonizing their legislations to enhance capacities and meet their reporting obligations under UNFCCC, introduce equal standards, create better policy and define clearly the main emission sources. The primary objective of the monitoring, reporting and verification (MRV) is to establish a reliable data collection and GHG emissions reporting system and data verification method. Bosnia and Herzegovina does not have a clearly defined MRV system for GHG emission data. However, rules on developing emission inventories have been mainly prescribed under the Entity-level air protection laws. In this context, the arrangement as to who will be responsible for the operation of the GHG emissions inventory and data maintenance at the state level remains unclear. Bosnia and Herzegovina needs to adopt legislation and assign MMR by establishing a state-level GHG inventory, strengthen institutional capacities, and formally define competencies and responsibilities. Through preparation and submission of national communication on climate change, biennial GHG emission reports, and participation in CDM projects, Bosnia and Herzegovina has established the key elements of the international MRV under UNFCCC for developing countries. Further efforts are needed to develop local MRV, including MRV for NAMA projects and other mechanisms for international cooperation in the field of climate change.

1 NATIONAL CIRCUMSTANCES

1.1 STRUCTURE, INSTITUTIONAL AND LEGAL FRAMEWORK

Bosnia and Herzegovina is a sovereign state comprised of two entities: the Federation of Bosnia and Herzegovina (FBiH) and the Republika Srpska (RS), as well as Brčko District (BD). The Federation of Bosnia and Herzegovina is further sub-divided into 10 Cantons.



Figure 1: Administrative organisation of Bosnia and Herzegovina

Pursuant to Annex IV of the Dayton Peace Accord, which is the Bosnia and Herzegovina's Constitution, matters such as foreign policy, foreign trade policy and customs policy fall within the competence of the institutions of Bosnia and Herzegovina. Any functions or powers not explicitly assigned by the Constitution to the institutions of Bosnia and Herzegovina belong to the Entities.

In the environmental sector, the Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina is responsible, inter alia, for carrying out tasks and discharging duties which are within the competence of Bosnia and Herzegovina and relate to defining policy, basic principles, coordinating activities and harmonizing plans of the Entity authorities and bodies at the international level in the fields of: agriculture, energy, protection of the environment, development and use of natural resources and tourism.¹

¹Law on Ministries and other Bodies of Administration of Bosnia and Herzegovina (Official Gazette of BiH nos. 5/03, 42/03, 26/04, 42/04, 45/06, 88/07, 35/09, 59/09 and 103/09 2009)

Institutions responsible for environmental management are the following:

- In the Federation of Bosnia and Herzegovina – the FBiH Ministry of Environment and Tourism and relevant Cantonal Ministries within their respective competencies
- In the Republika Srpska–the Ministry of Spatial Planning, Civil Engineering and Ecology of Republika Srpska
- In Brčko District–the Department for Spatial Planning and Property Affairs of Brčko District.

At its 66th session held on 16 May 2002, the Council of Ministers of Bosnia and Herzegovina adopted proposals and issued conclusion adopting proposed organisational arrangements and bodies for coordination of international environmental agreements (conventions) in Bosnia and Herzegovina. It was determined with the Conclusion that activities relating to the implementation of the United Nations Framework Convention on Climate Change (UNFCCC) would be coordinated by the Ministry of Spatial Planning, Civil Engineering and Ecology of Republika Srpska. The Council of Ministers of Bosnia and Herzegovina is a party to a number of international environmental agreements and conventions and is fully committed to meeting the requirements laid down in these agreements.

Bosnia and Herzegovina is a potential candidate for EU membership. The Stabilization and Association Agreement between the European Communities and their Member States and Bosnia and Herzegovina was signed in Luxembourg on 16 June 2008 and entered in force on 01 June 2015, replacing the Interim Agreement on trade and trade-related matters which had been in force since 01 July 2008. Bosnia and Herzegovina's application for EU membership was submitted in February 2016. By adopting the Decision on the coordination system of the European integration process in Bosnia and Herzegovina (Official Gazette of Bosnia and Herzegovina, nos. 72/16 and 35/18) operational and institutional systems and methods have been defined for coordination of institutions in Bosnia and Herzegovina in conducting activities relating to the process of BiH's integration in EU. However, progress towards EU reforms has been limited.

Bosnia and Herzegovina ratified the United Nations Framework Convention on Climate Change on 06 December 2000. Following the ratification, Bosnia and Herzegovina has made a series of efforts to establish an appropriate political, institutional and legal framework to meet the commitments of the Convention. The Bosnia and Herzegovina's Focal Point for the UNFCCC is the Ministry of Physical Planning, Civil Engineering, and Ecology of Republika Srpska. According to the Convention, Bosnia and Herzegovina has a status of a developing country, meaning, inter alia, an obligation to report on GHG emissions and participate in the international collaboration mechanisms for reducing emissions and adjusting to climate change. Bosnia and Herzegovina joined the Kyoto Protocol on 16 April 2007.

Three national communications and two biennial greenhouse gas emissions reports have been adopted by Bosnia and Herzegovina so far. As party to UNFCCC, Bosnia and Herzegovina is obligated to prepare and submit such reports pursuant to Decision 17/CP.8 and other relevant Convention documents.

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. Bosnia and Herzegovina's Third National Communication (TNC) and Second Biennial Update Report on Greenhouse Gas Emissions (SBUR) under the UN Framework Convention on Climate Change were adopted by the Council of Ministers of Bosnia and Herzegovina on 23 May 2017 and submitted to the Convention Secretariat in Bonn. The TNC and SBUR reports contain updated and improved information regarding climate change, greenhouse gas inventory, climate change mitigation, vulnerability to climate change and steps taken to adapt to climate change, as well as information regarding public awareness, education, training, systems exploration, and technology transfer.

Additionally, working on TNC and SBUR has enhanced the individual ability of experts involved in climate research in government institutions, academic community and non-governmental organizations in Bosnia and Herzegovina and further improved organisational capacities of the Ministry of Spatial Planning, Civil Engineering and Ecology of Republika Srpska as UNFCCC's Focal Point in Bosnia and Herzegovina and of the two Entity-level hydrometeorological institutes.

The Fourth National Communication under the UN Framework Convention on Climate Change was finalized in October 2021 and submitted to the institutions of Bosnia and Herzegovina for adoption process.

Bosnia and Herzegovina has ratified the Paris Agreement through Decision on ratification of Paris Agreement under UNFCCC (Official Gazette of Bosnia and Herzegovina – International Agreements, no. 01/17), acknowledging thereby its activities at climate change mitigation. Bosnia and Herzegovina's first Intended Nationally Determined Contribution (INDC) was submitted in October 2015 emphasizing clearly its use of market mechanisms to facilitate, expedite and improve development and transfer of technology, capacity building and access to financial resources supporting low carbon emissions and climate change resilience/adaptation. The provisions of the Paris Agreement stipulate that the countries are obligated to submit in five-year cycles updated and increasingly ambitious documents regarding climate change mitigation activities. In March 2021, Bosnia and Herzegovina adopted the Nationally Determined Contribution (NDC) which was prepared in accordance with the Decision 1/CP.21 of the Paris Agreement and constitutes a revision of the First Intended Nationally Determined Contribution of Bosnia and Herzegovina (INDC).

1.2 ENVIRONMENTAL STATISTICS

The status of the development of emissions inventories in Bosnia and Herzegovina is primarily stipulated by the air protection laws for the Federation of Bosnia and Herzegovina and Republika Srpska 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 in April of each year (including dissemination from natural resources) for the year two years prior, as provided under the Law on Air Protection (Official Gazette of FBiH, nos.: 33/03 and 4/10).
- Pursuant to Article 23 of the Law on Environmental Protection (Official Gazette of the Federation of Bosnia and Herzegovina, no. 15/21) and Article 2 of the Regulation on the Register of Plants and Pollutants (Official Gazette of the Federation of Bosnia and Herzegovina, no. 82/07), the FBiH Ministry of Environment and Tourism is responsible for the establishment and maintenance of the Register of Plants and Pollutants in the Federation of Bosnia and Herzegovina.
- According to the Law on Environmental Protection of RS (Official Gazette of RS, nos. 71/12, 79/15, 70/20) and the Rulebook on methodology and methods for maintenance of the Register of Plants and Pollutants (Official Gazette of RS, no. 92/07), a Pollutant Release and Transfer Register (PRTR) containing information on release of pollutants into air, water and soil, and waste transfer will be maintained by the RS Hydrometeorological Institute. Pursuant to Article 49 of the Law on Air Protection (Official Gazette of RS, no. 124/11, 46/17), the RS Hydrometeorological Institute will also maintain a GHG register that includes carbon dioxide (CO₂), methane (CH₄), nitrous suboxide (N₂O), fluorocarbons (HCFs), perfluorocarbons (PFCs) and sulfurhexafluoride (SF₆). Pursuant to Article 67 of the Law, the information system of air quality is an integral part of a unified information system for environmental protection which is also maintained by the RS Hydrometeorological Institute.

It should be noted that a new air protection law is being drafted for the Federation of Bosnia and Herzegovina that will introduce substantial novelties when compared with the existing law. According to the draft law, the establishment and operation of the information system of air quality in the Federation of Bosnia and Herzegovina will be within the competence of the FBiH Ministry of Environment and Tourism, in collaboration with the Environmental Protection Fund and FBiH Hydrometeorological Institute. The information system of air quality will be an integral part of the unified information system for environmental protection. The FBiH Hydro-meteorological Institute will be responsible for the conduct of the Emission inventory and projections of emissions for the territory of the Federation of Bosnia and Herzegovina as well as for the conduct of a greenhouse gas emissions inventory including the following gases: carbon dioxide (CO₂), methane (CH₄), nitrous suboxide (N₂O), fluorocarbons (HCFs), perfluorocarbons (PFCs) and sulfurhexafluoride (SF₆).

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: SO₂, N₂O, CO₂, CO, NH₃, NO_x, CH₄, NMVOCs, C₆H₆, and PM₁₀. 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.

Statistical institutions in Bosnia and Herzegovina (the Bosnia and Herzegovina Agency for Statistics, FBiH Institute for Statistics, and RS Institute for Statistics) gather particular environmental data, as defined under the Statistical Research Programme. The legal framework for the development, production and dissemination of the European statistics has been determined by the Regulation (EC) no. 223/2009 of the European Parliament and of the Council of 11 March 2009 on European statistics. The European Statistical System works as a network where statistics are aligned by Eurostat in close collaboration with national statistical offices. Eurostat, in close partnership with the European Environment Agency, provides environmental statistics, accounts and indicators supporting the development, monitoring and evaluation of the EU's environmental policies, strategies and initiatives. The Eurostat statistical requirements are implemented by the Bosnia and Herzegovina Agency for Statistics through annual Statistical Research Programme, for the following environmental domains:

- Environmental accounts;
- Sustainable development;
- Climate change strategies;
- Circular economy monitoring statistics;
- Europe 2020 strategy;
- Natural resources, water and waste initiatives.

1.3 GEOGRAPHICAL CHARACTERISTICS

Bosnia and Herzegovina is situated at the centre of the Balkan Peninsula, between the Adriatic and Pannonian regions, surrounded by the Republic of Croatia (931 km) in the north, north-west and south and the Republic of Serbia (375 km) and the Republic of Montenegro (249 km) in the east, accessing the Adriatic Sea in the south, at Neum, with 21.2 km long coastline. According to its geographical position, Bosnia and Herzegovina belongs to the Adriatic and Black Sea basins.

Bosnia and Herzegovina has a total surface area of 51,209.2 km², composed of 51,197 km² of land, and 12.2 km² of sea. Of the total land area, 42% is mountains, 24% hills, 29% karst regions, and 5% lowlands. Average altitude is 500 meters, with less than 8% of the surface area situated at an altitude below 150 meters.

There are seven main river basins in Bosnia and Herzegovina (the Una, Vrbas, Drina, Bosna, Sava, Neretva, Trebišnjica and Cetina basins). In terms of hydrography, 75.5% of Bosnia and Herzegovina belongs to the Black Sea basin with the Una, Vrbas, Drina, Bosna and Sava as main tributaries, whereas 24.5% belongs to the Adriatic Sea basin with the Neretva and Trebišnjica as main tributaries.

1.4 POPULATION TRENDS

According to the internationally recognised population estimates and projections prepared annually by the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat – UN DESA) and published in the World Population Prospects publication, Bosnia and Herzegovina had a population of 3.324 million in 2018 and 3.281 million in 2020. According to the same source, it is estimated that in 2025 Bosnia and Herzegovina will have a population of 3.212 million, and 2.685 million in 2050 (Figure 2 Observed in five-year periods, this would mean that Bosnia and Herzegovina would lose about 596.000 people in the period between 2020 and 2050).

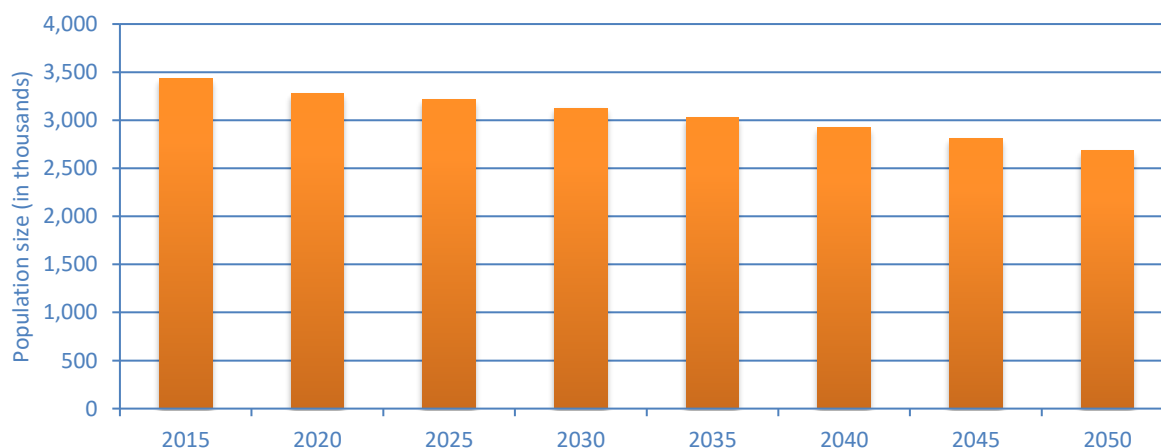


Figure 2: Estimate of change in population size in Bosnia and Herzegovina for the period 2015–2050
/Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat^{2/}

1.5 CLIMATE CHARACTERISTICS

There are three dominant climate types in Bosnia and Herzegovina (Figure3) conditioned by geographical position, geological substrate, relief, ground coverage by plant communities and proximity to the Adriatic Sea:

- Continental and temperate continental climate prevailing in the north of Bosnia and the valleys of the middle courses of the Una, Sana, Vrbas, Bosnia, and Drina rivers.
- Mountainous and sub-mountainous climate covering the continental mountainous region of Bosnia and Herzegovina, extending from the northern border area to the southern border, represented by a line stretching from Posušje and southern slopes of the Čabulja, Velež and Bjelašnica to Bileća.
- Mediterranean and modified Mediterranean climate – prevailing in the country's south-west, that is, Herzegovina region. Owing to the close proximity of the Adriatic Sea and its direct influence on the character of climatological elements, the region has characteristics of maritime climate.³

²Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat: World Population Prospects 2019, available at: <https://esa.un.org/unpd/wpp/>

³Source: FBiH Hydrometeorological Institute, available at: <https://www.fhmzbih.gov.ba/latinica/KLIMA/klimaBIH.php>

According to a meteorological data analysis for the period between 1961 and 2016, the coldest month in Bosnia and Herzegovina is January with average temperature ranging between -3.8°C in Sokolac and 5.3°C in Mostar. The warmest month is July with the highest average air temperature in the east and south parts of the territory (Bijeljina 21.8°C , Bileća 2.1°C and Mostar 25.4°C). Of the ten warmest years in the period 1961–2016, nine were recorded after 2000 (one of the ten warmest years was only in 1994) with 2000, 2007, 2008, and 2014 as the warmest. In most parts of Bosnia and Herzegovina 2014 was the warmest year. All warm temperature extremes indices had positive trends in the analysed period, whereas the cold temperature extremes indices had a downward trend. Both, however, indicate climate warming in the territory of Bosnia and Herzegovina. A negative trend in the number of frost days per year is present across Bosnia and Herzegovina and statistically relevant in nearly all areas. The negative trend values range from 2.1 to 6.4 days per decade. The numbers of summer days (5.3 days in a decade), tropical days (4.8 days in a decade) and tropical nights (in Mostar, 6.3 days per decade) show a positive trend.



Figure3: Climate of Bosnia and Herzegovina
/Source: FBiH Hydrometeorological Institute/

In the analysed period, most of the Bosnia and Herzegovina's territory was characterized by a slight increase in the annual precipitation. Linear trends for multi-year period from 1961 to 2016 indicate stagnation or a slight increase in the amount of rainfall on the entire territory of Bosnia and Herzegovina. Although significant variability in precipitation has not been recorded, pluviometric regime has been greatly disrupted, that is, the annual distribution. The Bosnia and Herzegovina extreme daily precipitation indices have shown mainly weak, insignificant or mixed trends. The probability density functions analysis also confirmed no major changes for most indices in the extreme rainfall indices for the period from 1991 to 2016 when compared with the period from 1961 to 1990. However, obtained results point to an overall increase in abundant rainfall.

An increasing trend in the intensity and frequency of maximum wind gusts has also been observed in Bosnia and Herzegovina over the past two decades.

1.6 SECTOR ANALYSIS

1.6.1 Economy and industry

Industry in Bosnia and Herzegovina represents a very important economic sector and is extremely important in the realm of social development. Effective adaptation measures to climate change are necessary in order to reduce vulnerability and increase resilience, both of the population and of the major economic sectors.

The recovery of the economy, and therefore the industry as its component, was significantly better compared to the period covered by the TNC. Data from the Agency for Statistics of Bosnia and Herzegovina for the year 2018 show that the value of the GDP was 33,408 million KM, and compared to the year 2017, the nominal BDP increased by 6.48%, while the real growth rate was 3.62%. The average GDP per capita was 9,556 KM.

In terms of the share of GDP by sectors, the largest growth is recorded in the production and supply of electricity, gas, steam and air conditioning (25.14%), agriculture, forestry and fishing (12.03%), administrative and support service activities (10.34%).⁴

Table 1: Main economic indicators for Bosnia and Herzegovina in the period 2014–2018⁵

Indicators	2014	2015	2016	2017	2018
Nominal GDP (EUR billion)	14.0	14.6	15.3	16.0	17.1
GDP per capita (EUR)	3,967	4,155	4,355	4,578	4,891
Real growth rate of GDP	1.2	3.1	3.1	3.1	3.6
Average net salary (EUR)	424	424	428	435	449
Annual inflation (%)	-0.9	-1.0	-1.1	1.3	1.4
Annual unemployment rate (%)	27.5	27.7	25.4	20.5	18.4
Foreign currency reserves (EUR million)	4,001	4,400	4,873	5,398	5,942

Table 2: Share of Entities in GDP (%)⁶

Indicators	2014	2015	2016	2017	2018
Bosnia and Herzegovina	100.00	100.00	100.00	100.00	100.00
Federation of Bosnia and Herzegovina	64.97	65.38	65.34	65.46	65.69
Republika Srpska	32.76	32.20	32.22	32.12	31.97
Brčko District	2.27	2.42	2.44	2.42	2.34

⁴Agency for Statistics of Bosnia and Herzegovina: Gross Domestic Product of Bosnia and Herzegovina 2018–Production approach, First results

https://bhas.gov.ba/data/Publikacije/Saopštenja/2019/NAC_02_2018_Y1_0_BS.pdf

⁵Economic indicators_september

2021.pdf, http://www.fipa.gov.ba/informacije/statistike/pokazatelji/Ekonomski%20pokazatelji_rujan%202021_H.pdf

⁶Agency for Statistics of Bosnia and Herzegovina: Gross Domestic Product of Bosnia and Herzegovina 2018–Production approach, First results

https://bhas.gov.ba/data/Publikacije/Saopštenja/2019/NAC_02_2018_Y1_0_BS.pdf

In 2018, an increased output was recorded in the industrial areas of mining and particularly production and supply of electricity and gas (annual increase of 11.3%), while a considerable decline was recorded in manufacturing industry (annual decline 1.1%). The most significant contribution to the industrial output (Figure4), observed by areas of activities, was that of the production and supply of electric power and gas, while a negative contribution to growth was that of manufacturing industry.⁷

After the end of deflationary pressures in the beginning of 2017, the growth of consumer prices continued, which resulted in the annual inflation growth in 2018 in the amount of 1.4%, which was mainly caused by the increase of excise duties on oil and oil products and external oil prices. At the same time, local prices, measured by GDP deflator, were in the inflation zone. In the labour market, according to administrative data and the data from the Labour survey in 2018, a significant decrease of the number of the unemployed was recorded and the growth of the number of employees, with increasingly strong negative demographic changes. Nominal net wages recorded a strong growth, while a slower growth was recorded in real net wages.⁸

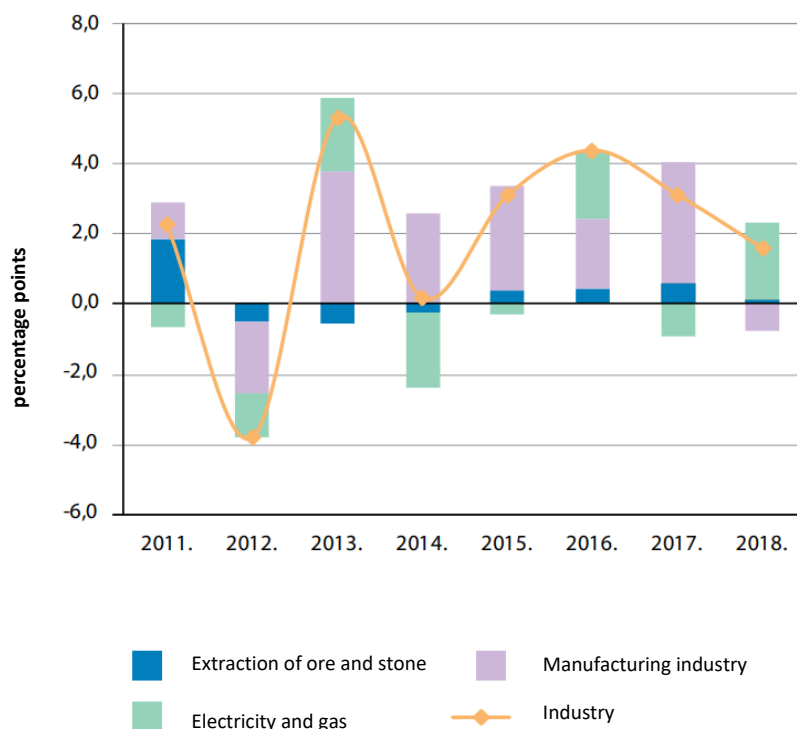


Figure4: Contribution to Annual Changes in Industrial Production by Areas
/Source: Central Bank of Bosnia and Herzegovina, Annual Report 2018/⁹

According to official data for 2018, the standard of living in Bosnia and Herzegovina, measured by GDP per capita adjusted for purchasing power parity (hereinafter referred to as PPP)¹⁰, remained at the level of the previous two years. For the sake of comparison, PPP in Bosnia and Herzegovina was almost at the level of a third of the EU-28 average (31%), according to EUROSTAT. For years, Bosnia and Herzegovina, as well as several countries in the region (Albania, Serbia, North Macedonia), has been at the bottom of the list of countries published by EUROSTAT. Economic indicators for the period 2014-2018 indicate a stable growth of GDP in Bosnia and Herzegovina. In the past 4 years, GDP has increased at a rate of approximately 3.1%, which

⁷Central Bank of Bosnia and Herzegovina, Annual Report 2018

⁸Central Bank of Bosnia and Herzegovina, Annual Report 2018

⁹Available at: <https://www.cbbh.ba/content/DownloadAttachment/?id=f4319537-b300-4eb9-908e-8beb1b299b3d&langTag=bs>

¹⁰Purchasing power parity shows the relationship between currencies expressed in the amount of goods and services that can be purchased for a unit of different currencies; it should demonstrate the existence of equal purchasing power, expressed in different currencies at a given exchange rate, which is not achievable due to different limitations and peculiarities of national economies

is still an insufficient growth rate for citizens to feel any economic improvement and higher standard of living in everyday life. In order to catch up with and reach the current EU average (measured by GDP per capita adjusted for purchasing power parity), Bosnia and Herzegovina would have to achieve an annual GDP growth of 5.8% in the next 30 years (provided that there are no changes in the population number and the EU average growth of 1.5%).¹¹

1.6.2 Energy

The total gross production of electricity in Bosnia and Herzegovina in 2018 was 19,160, which represents an increase of 16.5% compared to 2017 (16,438 GWh). Production in 2020 amounted to 16,874 GWh, which is lower than in 2018 and at the same level as in 2017. In 2018, the production of electricity (gross) in hydropower plants was 6,519 GWh or 34%, in thermal power plants it was 12,079 GWh or 63%, while in industrial power plants it was 562 GWh or 3%. Own consumption in the energy sector amounted to 1,248 GWh. Total electricity consumption in 2018 in households amounted 40.9% (4,685 GWh), while the consumption in industries amounted to 37.6% (4,304 GWh). The share of households in electricity consumption increased to 48.3% in 2020. In 2018, construction, transport, agriculture and other consumers accounted for 21.5% of the total consumption. Total production of thermal energy in Bosnia and Herzegovina in 2018 was 5,759 TJ (5,850 TJ in 2020), of which 3,412 TJ (59.2%) was generated in heating plants, 1,757 TJ or 30.5% in thermal power plants, and 590 TJ or 10.43% in industrial power plants. In the final consumption of thermal energy in 2018, households had the largest share with 74.6%, followed by industry and other consumers with 25.4%.¹²

1.6.3 Transport

The total length of the road network in Bosnia and Herzegovina in 2018 was 24,358 km. In terms of road categorisation, the network is comprised of 198 km of motorways, 4,787 km of trunk roads, 5,173 km of regional roads¹³, and 14,200 km¹⁴ of other/local roads.

Of the total number of registered road motor vehicles in 2018, 85.0% were passenger vehicles, 9.0 % were cargo vehicles, and 6.0 % were from all other categories of vehicles. Out of the total number of registered motor vehicles, 8.3 % were road motor vehicles registered for the first time in 2018. With respect to the type of fuel used, 71.0 % of vehicles use diesel, 24.0 % use petrol, and 5.0% use all other types.¹⁵

The volume of road transport in Bosnia and Herzegovina is shown through two indicators: (i) cargo transport and (ii) passenger transport. Comparison with data from previous climate change reports and available data for the years 2015, 2016, 2017 and 2018, indicate a growth trend in the volume of transport in Bosnia and Herzegovina. More detailed indicators on the volume of transport by years are presented in Table below.

¹¹ Directorate for Economic Planning of Bosnia and Herzegovina 2019, available at: file:///C:/Users/x/Downloads/Informacija_o_konkurentnosti_ekonomije_Bosne_i_Hercegovine.pdf

¹² BiH Agency for Statistics (2019.): First Release - Energy Statistics, Electricity and Heat 2018

¹³ BiH Agency for Statistics (2020.): Thematic Bulletin – Transport 2019

¹⁴ Framework Transport Strategy in Bosnia and Herzegovina, <http://www.mkt.gov.ba/aktivnosti/default.aspx?id=5029&langTag=bs-BA>

¹⁵ BiH Agency for Statistics (2019.): First Release – Transport, Registered Road Motor Vehicles for 2018

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Table3: Volume of transport in Bosnia and Herzegovina

Transport	Type of transport	Year			
		2015	2016	2017	2018
Public road transport	Cargo transport				
	Kilometres travelled	458,147,000	507,985,000	586,216,000	590,509,000
	Tons of goods transported	8,288,000	9,377,000	9,899,000	9,799,000
	Ton/km	3,405,231,000	4,015,177,000	4,236,356,000	4,350,172,000
	Passenger transport				
	Vehicles – kilometres travelled	87,254,000	85,475,000	93,982,000	95,190,000
	Transported passengers	20,471,000	16,505,000	15,906,000	16,580,000
	Passenger – kilometres	1,690,393,000	1,706,372,000	1,661,840,000	1,715,348,000
Urban and suburban transport	Vehicles – kilometres travelled,000	60,592,000	62,937,000	63,572,000	65,097,000
	Transported passengers, 000	138,705,000	131,776,000	130,502,000	127,463,000

/Source: Agency for Statistics of Bosnia and Herzegovina/

The volume of the rail transport, by cargo transport and passenger transport, in Bosnia and Herzegovina is presented in Table4.

Table4: Volume of rail transport in Bosnia and Herzegovina

Cargo transport	2015	2016	2017	2018
Tons of goods transported	13,819,000	13,156,000	13,254,000	13,514,000
Ton/km (1,286,480,000	1,142,639,000	1,116,731,000	1,178,328,000
Passenger transport	2015	2016	2017	2018
Transported passengers	518,000	409,000	472,000	550,000
Passenger – kilometres	34,305,000	23,701,000	29,518,000	39,934,000

/ Source: Agency for Statistics of Bosnia and Herzegovina /

There was a noticeable decrease both in the number of passengers and in transported tons of goods in 2016 compared to 2015, which was followed by an increase in 2017 and 2018. A similar decrease followed by an increase is also noticeable in the number of passenger kilometres, while the situation is slightly different when it comes to ton kilometres. A slight decrease in the number of ton kilometres is present progressively through years up until 2018, when the number of ton kilometres increased.

Air traffic data show that there are 27 officially registered airports in Bosnia and Herzegovina. However, only 4 are registered for international traffic, specifically airports in Sarajevo, Banja Luka, Mostar and Tuzla. Data on air traffic refer to these 4 airports. The number of airport operations growing year by year and in 2018 it was 19,864.¹⁶

¹⁶BiH Agency for Statistics (2020.): Thematic Bulletin - Transport 2019

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 Bosnia and Herzegovina, 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 VI. 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.

1.6.4 Agriculture

The share of agriculture, hunting and related services comprised 5.89% or BAM 1.97 billion of GDP in 2018. There was a slight increase in GDP compared to 2017 when it was 5.6%.

Of the total area of Bosnia and Herzegovina, which is 5,113 million hectares, approximately 47% is agricultural land. In the structure of agricultural land in 2016, arable land and vegetable gardens cover 1,025,000 ha. The total sown area in 2016 was 531 thousand ha, fallows and uncultivated land 490 thousand ha, and nurseries and other on arable land 4 thousand ha¹⁷. There is approximately 0.66 ha of agricultural land per capita, of which 0.31 ha is arable land and vegetable gardens¹⁸.

According to the data of the Agency for Statistics of Bosnia and Herzegovina for the year 2018, in the structure of the total sown area, grains account for 60%, industrial crops 3%, vegetables 13%, fodder crops 23%, berries 0.9%, and aromatic, medicinal and culinary plants 0.2%.¹⁹Total achieved production in 2018 was as follows: 1,272,606 tons of cereals, 960,260 tons of fodder, 655,511 tons of vegetable crops and potatoes, and 26,047 tons of industrial crops.²⁰

Forty-five percent 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 (low temperatures and snow), 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 ground waters. Despite the abundance of water, water supply is a limiting factor for production in many areas. Only about 0.65% of the land suitable for agriculture is irrigated.

Total commodity exchange in agricultural products in 2018 was BAM 3.97 billion. In 2018, agricultural products accounted for 7.5% of total BiH exports, and 16% of total BiH imports. Agricultural products recorded a

¹⁷Agency for Statistics of Bosnia and Herzegovina (2017.): Agriculture, Environment and Regional Statistics, Harvested Area, Total Production and Yield by Main Crops 2016

¹⁸Calculation based on population estimate (for 30 June 2016), Agency for Statistics of Bosnia and Herzegovina (2017): Bosnia and Herzegovina in Figures

¹⁹Agency for Statistics of Bosnia and Herzegovina (2018.): Agriculture, Environment and Regional Statistics, Areas Sown and Plantations at the End of Spring Sowing 2018

²⁰Agency for Statistics of Bosnia and Herzegovina (2019.): Agriculture, Environment and Regional Statistics, Harvested Area and Production of Late Crops, Fruit and Grapes, 2018

decrease in exports (17%) and a decrease in imports (2%), while the deficit in the exchange of agricultural products increased by 5.91%.²¹

1.6.5 Forestry

There is no harmonized data on forest area in Bosnia and Herzegovina. Inaccurately established condition of forests (primarily the surface area) compromises the accuracy of the assessment of adaptation and/or mitigation, as well as the development of all further strategic goals. At the same time, forestry is considered among major sectors in terms of mitigation, and among most vulnerable sectors in terms of adaptation. Although still not officially published, the results of the Second National Forest Inventory in Bosnia and Herzegovina (2006–2009)²² show that forests and forest land in Bosnia and Herzegovina encompass an area of 3,231,500 ha or 63.08%, while the area covered with forest is 2,904,600 ha or 56.7% of the total territory of Bosnia and Herzegovina. As compared to the First National Inventory (1960–1970), this means a significant increase of forest area in all categories (more than 15% – total forest area and forest land then amounted to 2.73 million hectares).

According to the data from the Statistical Yearbooks of the Institute for Statistics of Republika Srpska and the Federal Institute for Statistics,²³ in 2017 forests in Bosnia and Herzegovina covered 2.60 million hectares, which is 50.77% of the total area of Bosnia and Herzegovina (51,209.2 km² out of which 51,197 km² is land and 12.2 km² is covered with sea). Of the total land area, 5% are lowlands, 24% are hills, 42% are mountains and 29% are karst areas.

Trends in felling and afforestation volumes in the Federation of Bosnia and Herzegovina and Republika Srpska are shown below.

Table 5: Felling and afforestation volumes in the Federation of Bosnia and Herzegovina

	Forest exploitation					Artificial afforestation (ha)
	Volume of timber felled (m ³)			Hardwood	Softwood	
	Total	State-owned	Privately-owned			
2014	2,565,600	2,469,844	95,756	1,237,062	1,328,538	1,362
2015	2,571,867	2,462,097	109,770	1,274,185	1,297,682	1,129
2016	2,563,899	2,538,516	115,383	1,307,043	1,346,855	1,613
2017	2,503,898	2,382,159	121,739	1,303,963	1,199,935	1,151
2018	2,552,625	2,382,997	169,648	1,212,609	1,340,016	1,439

/Source: Federal Institute for Statistics²⁴/

²¹Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2019.): Analysis of Foreign Trade Exchange of Bosnia and Herzegovina 2018

²²UNDP (2014.): *Possibilities of using biomass from forestry and wood industry in Bosnia and Hercegovina*, 1–21

FAO (2015.): *The Forest Sector in Bosnia and Herzegovina Preparation of IPARD Forest and Fisheries Sector Reviews in Bosnia and Herzegovina*, 1–146

²³The management of natural resources, including any activities related to forest management, is under the competence of entity authorities in Bosnia and Herzegovina (Republika Srpska, Federation of Bosnia and Herzegovina) and the authorities of the Brčko District of Bosnia and Herzegovina. Some responsibilities are also under the competence of the state and are related to the implementation of international agreements and obligations of Bosnia and Herzegovina, which is mainly the responsibility of the Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina, and to a lesser extent the Ministry of Civil Affairs of Bosnia and Herzegovina. Respecting the constitutional competences and the responsibility for the condition of forests, most of the data is presented for the Federation of Bosnia and Herzegovina and the Republika Srpska, and collectively for Bosnia and Herzegovina.

²⁴Federal Institute for Statistics (2019.) Statistical Bulletin 299, Forestry, 2018.

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Table 6: Felling and afforestation volumes in Republika Srpska

	Forest exploitation					Artificial afforestation (ha)
	Average gross timber felled (m ³)			Hardwood	Softwood	
	Total	State-owned	Privately-owned			
2014	3,015,667	2,742,000	273,667	1,550,000	1,465,667	611
2015	3,274,112	2,912,582	361,530	1,763,262	1,510,850	817
2016	3,357,504	2,921,290	436,214	1,802,246	1,555,258	643
2017	3,259,056	2,782,000	477,056	1,856,246	1,402,810	652
2018	3,224,288	2,743,411	480,877	1,791,732	1,432,556	816

/Source: RS Institute for Statistics²⁵/

The trend of afforestation volumes both in Republika Srpska and the Federation of Bosnia and Herzegovina is generally unfavourable, and the issue of success on registered afforested areas should also be taken into account. The volume of afforestation in Republika Srpska for the period 2014–2018 is almost twice as low as that in the Federation of Bosnia and Herzegovina.

Table 7 shows burned areas in the Federation of Bosnia and Herzegovina and in Republika Srpska. Current trend in the number of forest fires shows that they are significantly more frequent in dry years, in particular in the Mediterranean area, while forecasts indicate that in future the risk of forest fires will be greater the entire territory of Bosnia and Herzegovina. Also, the forest fire season will be longer. Generally, the number of forest fires and area affected by them are strongly correlated with climatic characteristics during the summer months (primarily rainfall). The problem of forest fires has already been identified as a cross-border problem, and a number of projects are being implemented in Bosnia and Herzegovina and the neighbouring countries as part of cross-border cooperation to address this problem.

Table 7: Damage from fires in the Federation of Bosnia and Herzegovina and Republika Srpska

	Burned area (ha)					
	Federation of Bosnia and Herzegovina			Republika Srpska		
	Total	Ground fire	High fire	Total	Ground fire	High fire
2014	747	740	7	290	288	2
2015	7,813	7,672	141	5,804	5,786	18
2016	6,473	6,175	299	3,860	3,789	71
2017	27,975	24,034	3,941	22,977	22,941	36
2018	904	885	19	166	99	77

/Source: Federal Institute for Statistics and RS Institute for Statistics/²⁶

Land mine contamination of forests and forest land is still a significant problem in forest management in Bosnia and Herzegovina. In 2017, land areas which were still mined in Bosnia and Herzegovina covered 1,091 km² or 2.2% of the total area of Bosnia and Herzegovina.

²⁵RS Institute for Statistics (2019.) Statistical Bulletin, Forestry, 2019.

²⁶Federal Institute for Statistics (2019.) Statistical Bulletin 299, Forestry, 2018, RS Institute for Statistics (2019.) Statistical Bulletin, Forestry, 2019.

A significant number of authors state that the ratio of forest area in the context of ownership is 70:30 in favour of state-owned forests. According to data from the Federal Institute for Statistics, in the Federation of Bosnia and Herzegovina, in 2017 and 2018, the share of state-owned forest land was 82%, while the share of privately-owned forests was 18%. In Republika Srpska, according to the data of the RS Institute for Statistics, in 2017 and 2018, the share of state-owned forests was approximately 73%, and of privately-owned forests 27%. Privately owned forests are primarily characterized by a large number of forest owners. This refers to small plots, fragmented property, numerous owners, unresolved property rights, where some owners do not know the exact location of their forests or do not actively manage them at all.

Total production of forest assortments in Bosnia and Herzegovina in 2018 increased by 2.98% compared to 2017. Production of coniferous assortments increased by 11.2%, while the production of broadleaf assortments decreased by 4.6%.

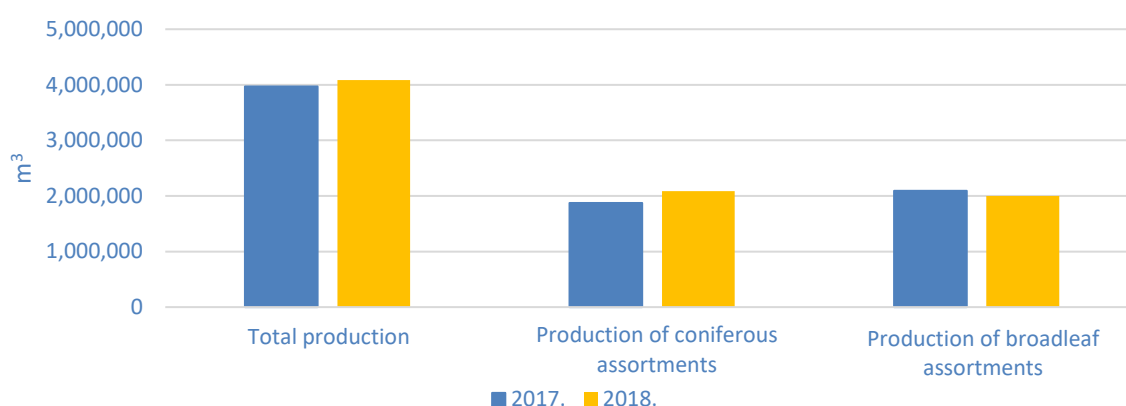


Figure 5: Production of forest assortments in Bosnia and Herzegovina
/Source: Agency for Statistics of Bosnia and Herzegovina²⁷

1.6.6 Waste management

The estimated quantity of municipal waste generated in Bosnia and Herzegovina in 2018 was 1,243,973 tons, i.e. 355 kg per year per capita or 0.97 kg per capita per day. The estimated quantity of municipal waste generated in 2017 was 1,235,449 tons, i.e. 353 kg per year per capita or 0.97 kg per capita per day. In 2018, the amount of municipal waste collected by public waste collection services was 920,540 tons, which is an increase of 0.7% compared to the previous year.

The total quantity of waste collected is comprised of municipal mixed waste (90.9%), collected municipal waste separated at the source (4.0%), waste from gardens and parks (3.1%) and packaging waste (2.0%).²⁸

Table 8: Quantity of municipal waste generated in Bosnia and Herzegovina

Year	2017	2018
Generated municipal waste, tons	1,235,449	1,243,973
Waste per year per capita, kg	353	355
Waste per day per capita, kg	0.97	0.97

/Source: Agency for Statistics of Bosnia and Herzegovina/

²⁷Agency for Statistics of Bosnia and Herzegovina (2020.): Production, Sales and Stocks of Forest Assortments in BiH in 2019, Agency for Statistics of Bosnia and Herzegovina (2018.): Production, Sales and Stocks of Forest Assortments in BiH in 2017

²⁸Agency for Statistics of Bosnia and Herzegovina (2019.): First Release – Environment, Public Transportation and Disposal of Municipal Waste 2018

Out of the total amount of waste collected, waste collected by public waste collection services accounted for 920,540 tons in 2018 and 914,232 tons in 2017, i.e. the share increased by 0.68%. The largest share of waste is collected from households: 712,844 tons (2018) and 700,062 tons (2017). The total quantity of waste collected in 2018 is comprised of municipal mixed waste (91%), collected municipal waste separated at the source (4%), waste from gardens and parks (3%) and packaging waste (2%)²⁹.

The total amount of waste disposed of at landfills in 2018 was 957,494 tons, which is by 0.7% higher compared to 2017 (950,537 tons). 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 total quantity of waste from production and service activities generated in Bosnia and Herzegovina in 2018 was 5,299,174, which is an increase of 12.7% compared to 2016. Quantity of hazardous waste generated was 14,157 tons (0.27%). Most of the hazardous waste comes from the manufacturing industry and amounts to 12,967 tons, and its share in the structure of total hazardous waste generated is 91.5%.³⁰

1.6.7 Water resources management

The management of water resources in Bosnia and Herzegovina is regulated by water laws of the Federation of Bosnia and Herzegovina³¹ and Republika Srpska³² respectively, which are to a large extent already harmonized with the EU Water Framework Directive in terms of assessment and management of flood risks. Water laws in Bosnia and Herzegovina and related bylaws are implemented through three main branches of water management: usage of water, protection of water and protection from harmful effect of waters.

In institutional sense, the responsibility for water management lies with the Ministry of Agriculture, Forestry and Water Management of Republika Srpska and the Public Institution "Vode Srpske", and the Federal Ministry of Agriculture, Water Management and Forestry in the Federation of Bosnia and Herzegovina, along with the Sava River Basin Agency and the Adriatic Sea Water Area Agency. In the Brčko District of Bosnia and Herzegovina, waters are under the jurisdiction of the Department for Agriculture, Forestry and Water Management of the Brčko District Government. Ministry of Foreign Trade and Economic Relations has an organizational unit for water resources which is responsible for overall coordination on national and international level.

Water resources in Bosnia and Herzegovina have already been directly affected by climate change and further negative changes can be expected. Although Bosnia and Herzegovina is not among the countries where a greater lack of water was an obstacle to development in the past, it can be expected that climate change will lead to significant changes in water availability in the future, along with frequent extreme events. Water management plays an increasingly important role in the society's adaptation to climate change.

In 2018, total water intake in Bosnia and Herzegovina was 319,851,000 m³, which is 3.5% less compared to 2017. In the structure of the total water intake, 45.7% of water came from underground sources, 36.8% came from surface sources, 15.5% from river courses, 0.8% from reservoirs, and 1.1% from lakes. The total amount of water taken from other water supply systems is 12.0% less compared to the previous year. In 2018, the amount of water delivered from public water supply systems was 149,462,000 m³, which is 2.3% less

²⁹ Agency for Statistics of Bosnia and Herzegovina (2019.): First Release – Environment, Public Transportation and Disposal of Municipal Waste 2018

³⁰ Agency for Statistics of Bosnia and Herzegovina (2020.): First Release – Environment, Waste from Production and Service Activities 2018

³¹ Law on Waters (Official Gazette of the Federation of Bosnia and Herzegovina, 70/06)

³² Law on Waters (Official Gazette of Republika Srpska, 50/06 and 92/09)

compared to 2017. The structure of water consumption shows that households were the largest water consumers, consuming 72.2% of the total water delivered by public water supply systems.³³

1.6.8 Tourism

Bosnia and Herzegovina is a country with a rich natural and social attraction base, where tourism is recognized as one of the most important drivers of economic development. Its importance and role are highlighted in the Tourism Development Strategy in the Federation of Bosnia and Herzegovina 2008–2018³⁴ and the Tourism Development Strategy of Republika Srpska for the period 2021–2027.

Analysis of the period 2008–2018 shows that the number of tourists at the level of Bosnia and Herzegovina grew at an annual rate of 8.7%, and the number of overnight stays at an annual rate of 7.8%. In the same period, the number of tourist arrivals and overnight stays in the Federation of Bosnia and Herzegovina doubled, while Republika Srpska recorded an increase at annual rate of almost 70% and an increase in overnight stays of 58%. In Brčko District, the number of tourist arrivals and overnight stays decreased in the period 2008–2014, followed by a constant increase. The World Tourism Organization (WTO) predicted a total increase of 10.5% for the tourist market of Bosnia and Herzegovina until 2020. Based on official tourism statistics, the average increase since 2010 is close to 14% per year, therefore there is still sufficient room for more efficient use of tourist potentials. Although the number of tourists has been increasing year in, year out, the tourism industry in Bosnia and Herzegovina still records a low level of income, primarily due to the lack of institutional and legislative support, which favours the development of the so-called gray economy.

1.6.9 Healthcare

The leading causes of mortality in Bosnia and Herzegovina in 2018 included circulatory system diseases with a share of 51.5% in the Federation of Bosnia and Herzegovina³⁵ and 47.34% in Republika Srpska³⁶), as well as malignant diseases, which are responsible for 21.8% deaths in the Federation of Bosnia and Herzegovina³⁷ and 19.9% in Republika Srpska³⁸. Therefore, diseases of the circulatory system and malignant diseases make up almost three quarters of all causes of death of the population in Bosnia and Herzegovina. Respiratory system diseases are ranked among the five leading causes of death.

The organization, financing and provision of health care in Bosnia and Herzegovina are under the jurisdiction of the Federation of Bosnia and Herzegovina, Republika Srpska and the Brčko District of Bosnia and Herzegovina, and are regulated by the Federal Ministry of Health, the Ministry of Health and Social Protection in the Government of the Republika Srpska and the Department for Health and Other Services of Brčko District. At the state level, the Ministry of Civil Affairs of Bosnia and Herzegovina, as a responsible ministry in the Council of Ministers of Bosnia and Herzegovina, has the mandate to carry out duties and tasks that are within the competence of Bosnia and Herzegovina, which relate to definition of basic principles for coordination of activities, harmonization of plans of entity-level authorities and definition of strategies on the international level in the field of healthcare and social protection.³⁹

³³ Agency for Statistics of Bosnia and Herzegovina (2019): First Release – Okoliš, Environment, Collection and Distribution of Water 2018

³⁴ Tourism Development Strategy in the Federation of Bosnia and Herzegovina 2022–2027 is in the drafting phase

³⁵ Public Health Institute of the Federation of Bosnia and Herzegovina (2019): Health Status of the Population and Health Care System in the Federation of Bosnia and Herzegovina, 2018

³⁶ Public Health Institute of Republika Srpska (2019): Analysis of Population Health in Republika Srpska, 2018.

³⁷ Public Health Institute of the Federation of Bosnia and Herzegovina (2019): Health Status of the Population and Health Care System in the Federation of Bosnia and Herzegovina, 2018

³⁸ Public Health Institute of Republika Srpska (2019): Analysis of Population Health in Republika Srpska, 2018

³⁹ Report "Strengthening health systems for BiH's EU integration", *EuropeAid/120971/C/SV/*

Although there is society's concern for the general health of the population, Bosnia and Herzegovina still does not have a system in place for monitoring of the incidence of diseases that could be linked to climate change. Legislation in Bosnia and Herzegovina and other relevant documents related to the health sector do not contain sufficient comprehensive information on the sector-related climate change impacts and adaptation. There are no health statistics on the impact of climate change on the health of the population, nor are there any results based on scientific research. For that reason, it is not possible to establish a specific association between weather conditions, i.e. biometeorological phases, and the incidence of chronic non-communicable diseases, primarily diseases of the circulatory and respiratory systems, as well as certain infectious diseases. However, although there is no data based on scientific research, climate change most certainly affects the health of the population in Bosnia and Herzegovina.

In its 2021 Health and Climate Change Global Survey Report, the World Health Organization published a qualitative analysis of climate change and health vulnerability and adaptation assessment documents. The 95 countries that participated in the survey were asked to submit their documents (strategies, plans, etc.) covering health and climate change. The analysis included 43 assessments from 31 countries. Some documents were excluded because data was not processed at state level or there were no plans and strategies for the country, documents were not translated or comprehensive enough. Number of documents that identified climate-sensitive health risks:

- 23 –vector-borne diseases
- 22- water-borne and food-borne diseases
- 20 – respiratory diseases
- 17 –injuries and deaths due to extreme weather conditions
- 15 – heat-related diseases
- 12 – malnutrition and health safety and food protection
- 10 – non-communicable diseases
- 7 – zoonosis
- 9 – mental and psychosocial health
- 6 – impacts on healthcare institutions (infrastructure).

1.6.10 Education

The education system in Bosnia and Herzegovina includes: pre-school education, nine-year primary education which is compulsory and free for all children from the age of six to fifteen, secondary education which is optional and higher education. In Bosnia and Herzegovina at the beginning of the 2017/2018 school year, 282,946 students were enrolled in 1,817 primary schools, which is a decrease of 4,783 students or 1.7%, compared to the previous school year, while 124,148 students were enrolled in 311 secondary schools, which is a decrease of 2,676 students or 2.1%. In the 2017/2018 school year 93,984 students were enrolled in the first cycle of higher education studies, including integrated studies, in the winter semester, of which 82,926 students were enrolled in all years of study, and 11,058 were graduate students. In 2017, 14,583 students graduated/completed academic or professional studies, which is 4.5% less compared to the 2016 school year.⁴⁰

In Bosnia and Herzegovina, there are 8 public higher education institutions and 29 private higher education institutions (including independent higher education institutions and colleges), which offer a total of about 500 study programs. The educational sector is under the jurisdiction of 14 ministries (1 state-level, 2 entity-level

⁴⁰Source: Federal Institute for Statistics; Institute for Statistics of Republika Srpska, Branch Office of the Agency for Statistics of Bosnia and Herzegovina, Agency for Statistics of Bosnia and Herzegovina

ministries, 10 cantonal ministries and the relevant department in the Brčko District Government), out of which 12 have direct responsibility with full authorities in higher education.

Each entity, canton, and Brčko District as a separate organizational unit in Bosnia and Herzegovina has its own law covering each of the four levels of education. Therefore, there are more than thirty laws at different levels governing this area.

In Republika Srpska, sectors of higher education and science are regulated at the entity level by the Ministry of Education and Culture and the Ministry of Science and Technology of the Republic of Srpska. In the Federation of Bosnia and Herzegovina, public universities are established by the cantons, whereas the Ministry of Education and Science of the Federation of Bosnia and Herzegovina performs administrative, professional and other tasks at the level of entity, including the protection of copyright and intellectual property rights, as well as the coordination of scientific and research activities. Cantonal ministries in the Federation regulate education and science policy for their cantons. Brčko District, as a separate administrative unit also has the authority for education and science policy.

1.6.11 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 Bosnia and Herzegovina.

1.7 THE TBUR PREPARATION PROCESS

The Third Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina has been prepared as part of the project “Preparation of the Fourth National Communication and Third Biennial Update Report on Greenhouse Gas Emissions in Bosnia and Herzegovina” implemented by UNDP in partnership with the Ministry of Spatial Planning, Civil Engineering and Ecology of Republika Srpska, as the UNFCCC Focal Point of Bosnia and Herzegovina. The overall coordination is the responsibility of the Project Board consisting of one representative from each of the following institutions: Ministry of Foreign Trade and Economic Relations

of Bosnia and Herzegovina, Ministry of Spatial Planning, Civil Engineering and Ecology of Republika Srpska, Federal Ministry of Environment and Tourism and the Brčko District Government through the Department for Spatial Planning and Property Relations.

The completion of the GHG emission inventory during the preparation of the Fourth National Communication and Third Biennial Update Report on Greenhouse Gas Emissions in Bosnia and Herzegovina was the result of the work of Consortium of companies⁴¹ selected by UNDP for the implementation of the project and institutions that were directly or indirectly involved in the preparation of the reports. RS Hydrometeorological Institute played an active role in the compiling the GHG inventory under the Third Biennial Update Report on Greenhouse Gas Emissions in Bosnia and Herzegovina (for the territory of Republika Srpska), while the data, wherever possible, was collected from the Agency for Statistics of Bosnia and Herzegovina and entity institutes of statistics, but also from emitters themselves. Federal Hydrometeorological Institute played an active role in collecting the necessary data from GHG emitters in the Federation of Bosnia and Herzegovina.

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

1.8 CONSTRAINTS AND GAPS

An overview of constraints and barriers related to institutional, legal, financial, technical and human capacities affecting the implementation of commitments under the UNFCCC is provided in the Fourth National Communication Report of Bosnia and Herzegovina in accordance with the UNFCCC. Since all the information on the constraints and gaps as presented in the Fourth National Communication Report are still valid, this document focuses on the needs that are relevant to the preparation of the biennial greenhouse gas inventory.

Bosnia and Herzegovina does not have standardized systems or methods of data collection, data transfer and reporting on environmental data. Statistical institutions in Bosnia and Herzegovina (Agency for Statistics of Bosnia and Herzegovina, Federal Institute for Statistics and the RS Institute for Statistics) collect certain data on the environment as defined by the Program of Statistical Research. In addition to the statistical institutions, environmental data in Bosnia and Herzegovina are collected by various institutions without sufficiently developed coordination and an integrated database. The process of data sharing and communication between different institutions, as well as the process of data sharing between entities, is insufficiently developed. This makes it difficult to create a complete picture of the state of the environment in Bosnia and Herzegovina, and of the links between development activities and the state of the environment, i.e. the indicators that support the decision-making process.

Administrative capacities in the environmental sector are still weak. There has been no improvement in administrative capacities to address the issue of climate change, for which there are neither adequate staff nor allocated funds.

Key shortcomings in the preparation of GHG inventory:

- lack of data;
- inconsistency between the existing data and those required under the IPCC methodology;
- lack of legislative requirements on the type and scope of data to be collected;
- no data quality assurance;

⁴¹"Enova" doo, Sarajevo, "Ceteor" doo, Sarajevo, "Jozef Stefan Institute", Ljubljana

- lack of staff in the authorized institution and lack of competencies (legal basis) for institutions to prepare the inventory;
- according to the current practice, individual experts are hired for the preparation of the inventory and they only prepare the calculation of the inventory for specific years and specific sectors, which is not sustainable in the long term;
- available trainings on the preparation of the inventory, as well as the software, and other accompanying activities should be attended by representatives of institutions that should carry out and work on data collection, data processing and inventory preparation, and not only individual experts who prepare inventories for certain years and certain sectors, which is the current practice;
- lack of permanent funding sources;
- insufficient cooperation between institutions;
- assessment of the quality of the inventory and of the accuracy of the results is not checked by independent experts, and all additional activities are not arranged with the external experts who are hired to calculate the inventory for certain years and certain sectors;
- lack of awareness of the importance of the inventory.

Recommendations for improvements in the GHG inventory:

- ensure implementation of institutional responsibilities for the systematic compilation of national GHG inventories;
- strengthen the capacity of the institution in charge of developing greenhouse gas inventory;
- ensure permanent sources of funding for the preparation of the GHG inventories and research projects in certain sectors, as well as for the development of national emission factors;
- engage other institutions in the inventory system (scientific and professional institutions, ministries, agencies, etc.) to provide scientific and professional contribution;
- provide up-to-date reports on greenhouse gas emissions;
- issue the necessary authorisations for the creation of individual emission databases in relevant institutions;
- increase public awareness about issues associated with climate protection and the potential consequences of climate change;
- assessment of the quality of the inventory and of the accuracy of the results should be checked by independent experts.

Capacity building in the area of GHG inventories should be ensured through close cooperation with entity hydrometeorological institutes which collect data and calculate emissions, statistical agencies/institutes, environmental protection funds and competent ministries. The following trainings are needed to strengthen capacities for GHG inventory compilation:

- Requirements of the Regulation on a mechanism for monitoring and reporting greenhouse gas emissions MMR/525/2013 (Monitoring Mechanism Regulation), legislation in accordance with the constitutional and legal framework, requirements of the Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action, repealing certain provisions of the Regulation MMR 525/2013, obligations under the UNFCCC;
- Inventory compilation system in Bosnia and Herzegovina (structure required for an efficient, reliable, transparent, timely and comparable inventory);
- Compilation of the inventory of emissions from the energy production sector specific methodologies and software tools, CRF-tables, calculation of emissions, preparation of emission factors of Bosnia and Herzegovina, estimates in case of non-existence of data);
- Calculation of emissions from the transport subsector (IPCC and COPERT V model);

- Calculation of emissions/sinks in LULUCF sector (preparation of land-use change matrix, use of Corine Land Cover data);
- Calculation of emissions from the waste sector (due to the lack of data in this sector, expert assessments are needed, which lead to unreliability of the calculation);
- QA/QC procedures (definition of steps necessary to ensure and improve the quality of calculations);
- Assessment of data uncertainty.

1.9 TECHNOLOGY NEEDS ASSESSMENT FOR THE AGRICULTURE AND WATER RESOURCES SECTOR

Technology needs assessment for the agriculture and water resources sector is given in detail in the Fourth National Communication Report of Bosnia and Herzegovina in accordance with the UNFCCC. All information on major challenges in the agriculture and water resources sector, including adaptation measures and technologies prioritized by the multi-criteria Analysis (MCA), as detailed in the Fourth National Communication Report, are still valid.

1.10 GENDER EQUALITY IN CLIMATE CHANGE-RELATED POLICY AND DECISION MAKING

Bosnia and Herzegovina, as a signatory to the United Nations Framework Convention on Climate Change, is obliged to fulfil its obligations, which, among other things, include inclusion of women and men in the activities of this Convention, as well as in the development and implementation of gender-sensitive national climate policies. Participation of women in climate change decision-making is a vital prerequisite for gender-sensitive and more effective climate change policies. In most countries, including Bosnia and Herzegovina, women are still underrepresented in decision-making positions and processes.

A Gender Study, which represents the first step towards raising the awareness about the mandatory inclusion of women and men in climate change-related policy and decision making, was prepared as part of the project "Preparation of the Fourth National Communication and Third Biennial Update Report on Greenhouse Gas Emissions in Bosnia and Herzegovina". This publication was intended to encourage consideration of the different perspectives of women and men, their roles, needs, priorities, vulnerability and interests in future planning and adoption of measures. While the Fourth National Communication and Third Biennial Update Report on Greenhouse Gas Emissions under UNFCCC include identification of priority measures for adaptation and reduction of greenhouse gases in numerous sectors, the Gender Study is focused on five sectors: energy, transport, agriculture, health and waste. The Study looks into the link between these sectors and climate change and gender, and gives recommendations for a more effective gender mainstreaming in all sectors.

2 CALCULATION OF GREENHOUSE GAS EMISSIONS

2.1 METHODOLOGY

Greenhouse gas emission sources and sinks are divided into five main sectors: energy; industrial processes and product use; agriculture and land use, land-use change; forestry and waste.

The inventory of greenhouse gas emissions in the Third Biennial Update Report covers the years 2017 and 2018. The inventory was prepared using the Intergovernmental Panel on Climate Change (IPCC) methodology prescribed by the Convention based on the reference manual IPCC 2006 Guidelines for National GHG Inventories. The inventory for 2017 and 2018 was prepared using the software, version 2.54.6396.19217 (6 July 2017). The software does not calculate NO_x, CO, SO₂, NMVOC emissions.

The 2006 guidelines are divided into five parts:

- Part 1: General Guidance and Reporting;
- Part 2: Energy;
- Part 3: Industrial Processes and Product Use;
- Part 4: Agriculture, Forestry and Other Land Use (AFOLU);
- Part 5: Waste.

The software, version 2.54.6396.19217, consists of five parts:

- Part 1: Energy;
- Part 2: Industrial Processes and Product Use;
- Part 3: Agriculture, Forestry and Other Land Use (AFOLU);
- Part 4: Waste;
- Part 5: Other.

IPCC 2006 Guidelines are useful for the preparation of the greenhouse gas inventory and the recommended IPCC emission factors were predominantly used.

The IPCC approach ensures accuracy, consistency, transparency and comparability of the calculations. It requires the estimation of uncertainty of calculations and verification of inputs in order to enhance the accuracy and reliability of results. In addition to that, IPCC enables another verification of the results in two different ways, the first, more detailed, way is the so-called Sectoral Approach, and the second, simpler, way is the Reference Approach.

Quality assessment of the inventory, including verification of the accuracy of data, has not been performed by independent experts.

2.2 DATA COLLECTION AND PROCESSING SYSTEM

A consortium consisting of companies ENOVA d.o.o., Sarajevo, CETEOR d.o.o., Sarajevo and Josef Stefan Institute, Ljubljana was selected for the preparation of the Third Biennial Report.

Data from large energy and industrial plants were collected based on answers to prepared questionnaires through the Federal Hydrometeorological Institute and the RS Hydrometeorological Institute, while other data were taken from the first releases published on the websites of the Agency for Statistics of Bosnia and Herzegovina, RS Institute for Statistics, Federal Institute for Statistics. The data for the calculation of F-gases were taken from the Indirect Taxation Agency of Bosnia and Herzegovina.

2.3 RESULTS OF EMISSION ESTIMATIONS FOR 2017 AND 2018

This section provides an overview of results of GHG emission calculation for Bosnia and Herzegovina. The results show total (aggregated) emissions of all greenhouse gases by sector, as well as emissions of specific greenhouse gases, also by sectors.

Given that certain greenhouse gases differ in their characteristics, their contribution to 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 CO₂. In this case, the emission of greenhouse gases is expressed in Gg CO₂-eq (mass of equivalent CO₂). Table 9 shows the global warming potentials for individual gases for a period of 100 years.

For the purposes of preparing the trend of greenhouse gas emissions in the Third Biennial Update Report, the data presented in the Third National Communication Report, Second Biennial Update Report and Fourth National Communication Report were used, including corrections for 2014 dated 21 December 2017.

Table 9: Global warming potentials for individual gases (period of 100 years)

Greenhouse gas	Global warming potential
Carbon-dioxide (CO ₂)	1
Methane (CH ₄)	21
Nitrous oxide (N ₂ O)	310
CF ₄	6,500
C ₂ F ₆	9,200
SF ₆	23,900

Carbon dioxide (CO₂) is one of the most important greenhouse gases, especially where the consequences of human activity are concerned. Carbon dioxide is estimated to be responsible for around 50 percent of global warming. Almost everywhere in the world, including Bosnia and Herzegovina, the most common anthropogenic sources of CO₂ 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 Bosnia and Herzegovina, 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.

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Table10: Inventory of emissions for 2017 and 2018

GHG source category /year	2017	2018
Total emissions (Gg CO₂-eq) – without sinks	30,438.88	31,170.94
Total emissions (Gg CO₂-eq) – with sinks	24,594.79	25,339.04
1. Energy	24,383.79	24,915.83
1.A Fuel combustion (sectoral approach)	23,917.86	24,369.65
1.A.1 Energy industries	18,461.84	18,535.53
1.A.2 Manufacturing industries and construction	966.20	1073.70
1.A.3 Transport	3,875.65	3,848.13
1.A.4 Other sectors	614.17	912.28
1.A.5 Other (please specify)	NO	NO
1.B Fugitive emissions from fuels	465.94	546.18
1.B.1 Solid fuels	463.92	544.15
1.B.2 Oil and natural gas	2.02	2.03
2. Industrial processes	2,565.3	2,814.43
2.A Mineral products	972.84	994.46
2.B Chemical industry	80.41	79.09
2.C Metal production	1,512.05	1,740.89
2.D Other production	NO	NO
2.E Production of halocarbons and sulphur hexafluoride	NO	NO
2.F Consumption of halocarbons and sulphur hexafluoride	NO	NO
3. Solvent and other product use	NO	NO
4. Agriculture	1,951.36	1,890.91
4.A Enteric fermentation	873.34	859.75
4.B Manure management	261.7	257.43
4.C Rice cultivation	NO	NO
4.D Agricultural soils	816.32	773.74
4.E Prescribed burning of savannahs	NO	NO
4.F Field burning of agricultural residues	NO	NO
5. Land-use change and forestry	-5844.09	-5,831.9
5.A Changes in forest and other woody biomass stocks	-5,844.09	-5,831.9
5.B Forest and grassland conversion	NO	NO
5.C Abandonment of managed lands	NO	NO
5.D CO ₂ emissions and removals from soil	NO	NO
6. Waste	1,507.06	1,526.25
6.A Solid waste disposal on land	1,104.85	1096.73
6.B Waste-water handling	402.21	429.52
6.C Waste incineration	NO	NO
7. Memo items	31.38	23.51
7.A International bunkers	31.38	23.51
7.A.1 Aviation	31.38	23.51
7.A.2 Marine	NO	NO
7.B CO₂ emissions from biomass	NO	NO

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Table11: Emission of CO₂-eq per years (Gg)

GHG source category /year	1990	2014	2015	2016	2017	2018
Total emissions (Gg CO₂eq) without sinks	34,043.49	26,062.19	26,884.61	29,677.06	30,438.88	31,170.94
Total emissions (Gg CO₂eq) with sinks	26,461.1	19,664.52	20,744.05	23,795.50	24,594.79	25,339.04
1. Energy	24,888.95	20,249.68	20,411.01	23,429.38	24,383.79	24,915.83
1.A Fuel combustion (sectoral approach)		19,631.89	19,952.58	22,915.65	23,917.86	24,369.65
1.A.1 Energy industries	16,510.14	14,480.94	13,948.28	16,635.06	18,461.84	18,535.53
1.A.2 Manufacturing industries and construction	534.73	857.03	1,507.60	1,117.53	966.20	1,073.70
1.A.3 Transport	2,357.65	3,053.20	3,198.60	3,726.56	3,875.65	3,848.13
1.A.4 Other sectors	3,889.38	1,240.72	1,298.08	1,436.50	614.17	912.28
1.A.5 Other (please specify)						
1.B Fugitive emissions from fuels	1,597.05	617.79	458.44	513.73	465.94	546.18
2. Industrial processes	3,554.07	2,247.36	2,906.94	2,660.39	2,565.3	2,814.43
2.A Mineral products	736.75	728.1	804.67	851.73	972.84	994.46
2.B Chemical industry	213.90	59.76	47.45	53.71	80.41	79.09
2.C Metal production	2,603.42	1,459.5	2,054.82	1,754.95	1,512.05	1,740.89
2.D Other production						
2.E Production of halocarbons and sulphur hexafluoride						
2.F Consumption of halocarbons and sulphur hexafluoride						
3. Solvent and other product use		NO				
4. Agriculture	4,608.01	2,504.96	1,924.27	1,995.82	1,951.36	1,890.92
4.A Enteric fermentation	1,548.3	799.64	900.01	895.72	873.3416	859.75
4.B Manure management	682.0	323.93	267.04	262.53	261.6974	257.43
4.C Rice cultivation		NO				
4.D Agricultural soils	2,377.7	1,381.39	757.22	837.58	816.3163	773.74
5. Land-use change and forestry	-7,423.53	-6,397.67	-6,140.56	-5,881.56	-5,844.09	-5,831.9
5.A Changes in forest and other woody biomass stocks	-7,423.53	-6,397.67	-6,140.56		-5,844.09	

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GHG source category /year	1990	2014	2015	2016	2017	2018
5.B Forest and grassland conversion						
5.C Abandonment of managed lands						
5.D CO ₂ emissions and removals from soil						
6. Waste	992.46	1,060.19	1,622.54	1,558.95	1,507.06	1,526.25
6.A Solid waste disposal on land	992.46	741.89	1,122.74	1,113.28	1,104.8	1,096.73
6.B Waste-water handling		318.3	499.8	445.67	402.21	429.52
6.C Waste incineration						
7. Memo items			19.85	32.52	31.38	23.51
7.A International bunkers			19.85	32.52	31.38	23.51
7.A.1 Aviation			19.85	32.52	31.38	23.51
7.A.2 Marine						
7.B CO ₂ emissions from biomass						

2.3.1 Summary of emission estimations for 2017 and 2018 by sectors

Shares of sectors in carbon dioxide emissions were the same in 2017 and 2018 (Figure6), energy sector is the greatest contributor to CO₂ - eq emissions, with the share of 80%, followed by the industrial sector (9%), agricultural sector (6%) % and waste (5%).

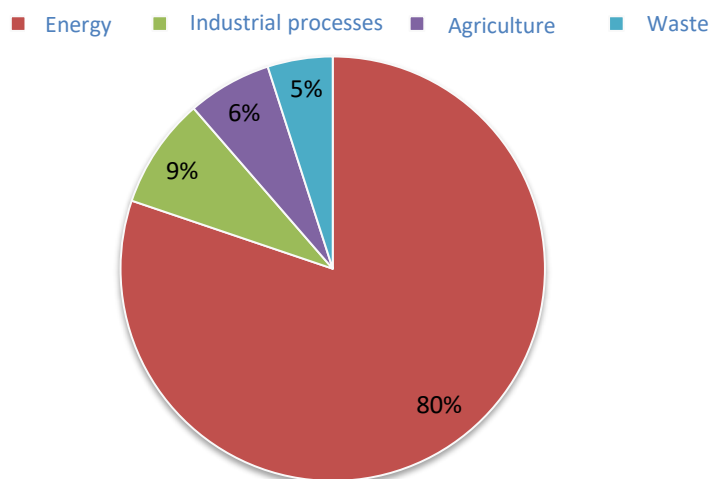


Figure6: Share of GHG emissions by sectors for 2017and 2018

This structure, with minor changes, was maintained during the period 1990-2018 (except for the period 1992-1995). In 2017, total CO₂ emission was 30,438.88 gG CO₂-eq, while in 2018, total CO₂ emissions was 31,170.94 gG CO₂-eq without sinks. Total emission with sinks was 24,594.79 gG CO₂-eq in 2017, and 25,339.04 gG CO₂-eq in 2018. The above data indicate an increase in total CO₂ emission of 3.36% in 2017 i.e. of 6.49% in 2018 compared to 2016. Compared to 1990 there was a decrease in emissions of -7.05% in 2017 and of -4.24% in 2018.

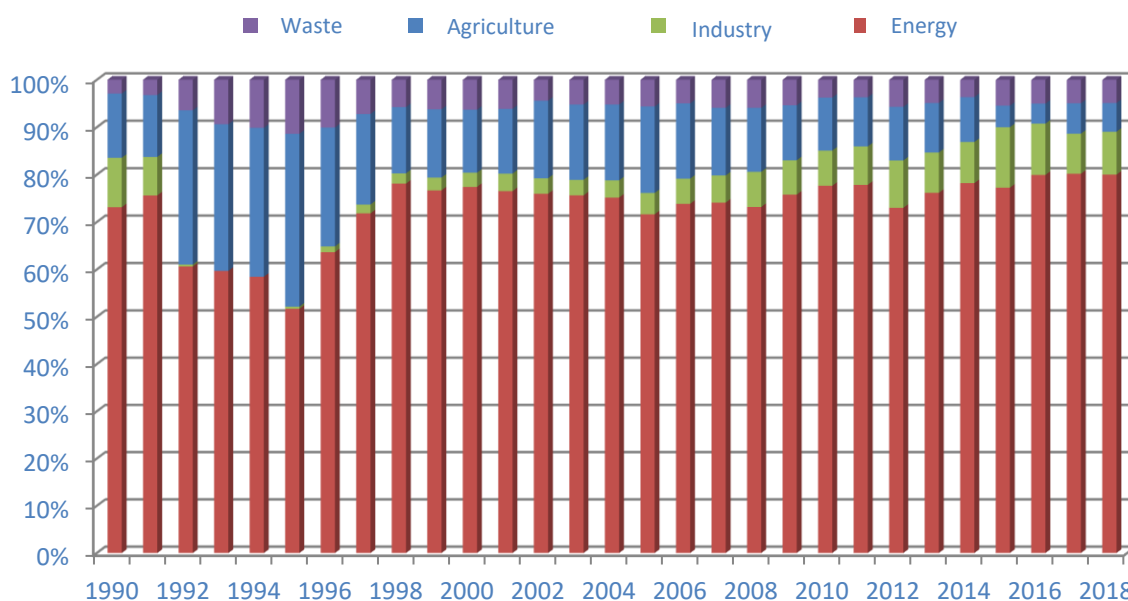


Figure7: Share of GHG emissions by sectors for the period 1990-2018

2.3.1.1 Energy

The energy sector is the leader when it comes to CO₂ emissions, with a share of 80% of total emissions. This sector covers all activities encompassing the consumption of fossil fuels, including 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. Emission calculations have been based on fossil fuel consumption data obtained by operators of thermal power plants, heating plants, 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. The sectoral approach calculation was done in accordance with IPCC guidelines.

Two the most carbon-intensive energy sub-sectors are energy conversion (thermal power plants, heating plants, transport) and industrial fuel combustion. Most of the CO₂ 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. Change of fuel in industry facilities contributes to these changing emission values.

CO₂emissions from fuel combustion depend on the quantity of fuel consumed (energy balance and data from thermal power plants, heating plants and industrial power plants), calorific value (chemical analysis of energy sources), CO₂ emission factor (value from the IPCC Guidelines 2006), the energy balance is based on data from all available sources. It used data provided by Federal Institute for Statistics, RS Institute for Statistics and the Agency for Statistics of Bosnia and Herzegovina –Branch Office Brčko about production and consumption of fuel. It also used data on annual consumption of coal, natural gas and other energy products. Energy balances for Bosnia and Herzegovina (balance of coal and gas, balance of oil derivate) were used for compiling the 2017 and 2018 inventory. However, emission by reference and sectoral approach differ because of the difference between consumption of anthracite, bituminous coal and its consumption from the Reference approach assessment.

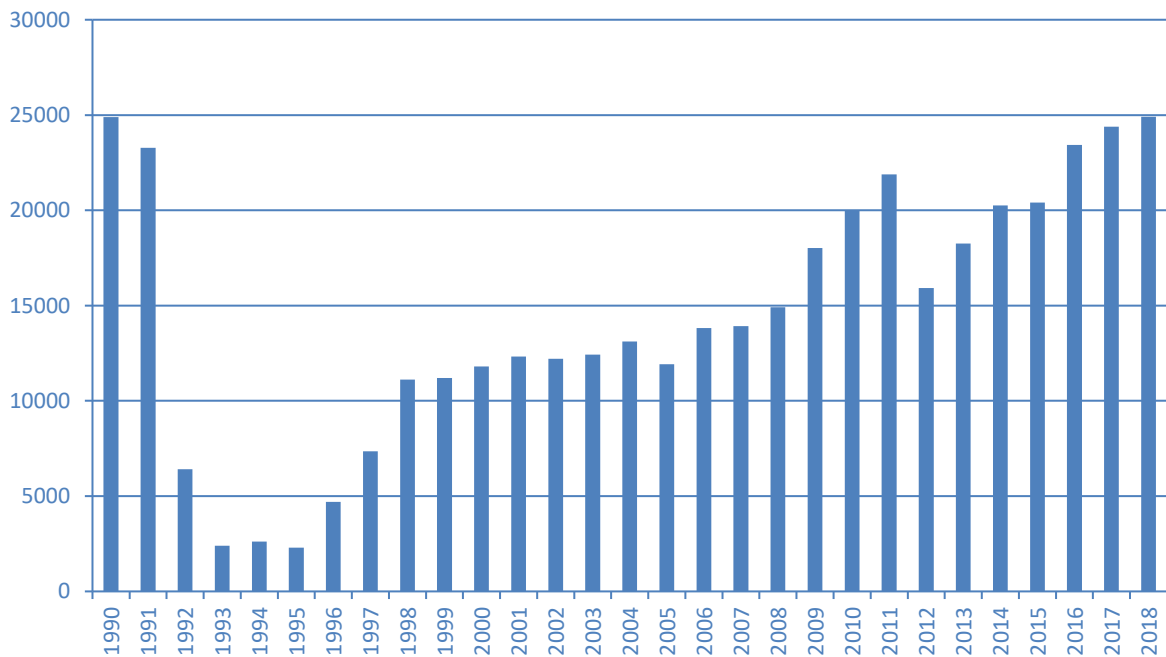


Figure8: Emission of CO₂-eq (Gg) for the period 1990–2018 – energy

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.

In 2017, CO₂ emission was 24,383.79 Gg CO₂, while in 2018, CO₂ emission was 24,915.83 Gg CO₂. The above data indicate an increase of 4.09% in 2017 i.e. of 6.34% in 2018 compared to 2016. Compared to 1990 there was a decrease in CO₂ emissions of -2.03% in 2017, and an increase of 0.11% in 2018.

2.3.1.2 Industrial processes

Emission of greenhouse gases from industrial processes for 2017 and 2018 was calculated based on the official publication of the Agency for Statistics of Bosnia and Herzegovina, RS Institute for Statistics and Federal Institute for Statistics.

In 2017, CO₂ emission was 2,565.3 Gg CO₂, while in 2018, CO₂ emission was 2,814.43 Gg CO₂. The above data indicate a decrease of -3.57% in 2017 i.e. an increase of 5.79% in 2018 compared to 2016. Compared to 1990 there was a decrease in CO₂ emissions of -27.82% in 2017 i.e. of -20.81% in 2018.

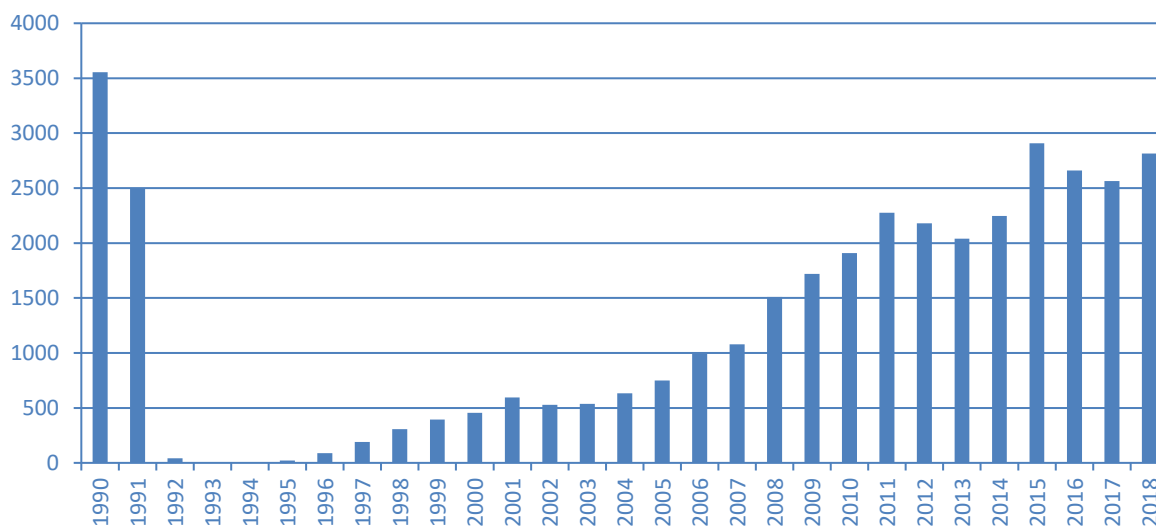


Figure 9: Emission of CO₂-eq (Gg) for the period 1990–2018 – sector of industrial processes

2.3.1.3 Waste

According to 2006 IPCC Guidelines, the waste sector includes the following categories: solid waste disposal, biological treatment of solid waste, waste incineration and wastewater management. This inventory does not cover waste incineration and biological treatment of solid waste. The IPCC methodology used for estimation of greenhouse gas emissions follows IPCC guidelines which give procedures for the estimation of greenhouse gas emissions provided by international experts from the Intergovernmental Panel on Climate Change (IPCC). greenhouse gases (GHG) from the waste management sector include carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Greenhouse gas emissions are expressed in terms of CO₂- equivalents, where the global warming potential of methane (the main component of landfill gas) and nitrous oxide is at the ratio of 21 for methane and 310 for nitrous oxide compared to CO₂.

The 2006 IPCC Guidelines prescribe a mandatory methodology for calculating the emissions of carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) that occur during waste management activities. Activities that

generate the largest emissions are solid waste disposal and processing and wastewater management. Emissions covered by the methodology include CH₄ emissions that occur during municipal waste disposal and processing, household wastewater disposal and indirect N₂O emissions from human secretions.

Due to the fact that all landfills (for the analysed period) in Bosnia and Herzegovina were non sanitary municipal landfills, deeper than 5 m, default IPCC 1996 Methane Correction Factor of 0.8 is used⁴². Data about total MSW disposed were obtained from the official documents of the Federation of Bosnia and Herzegovina and Republika Srpska, Agency for Statistics of Bosnia and Herzegovina, Federal Institute for Statistics and RS Institute for Statistics. Those data are used as an input for Activity data 4.A.

In terms of structure of municipal waste, factors applied in Eastern Europe were used, specifically:

- food waste – 30.1%,
- paper – 21.8%,
- wood – 7.5%,
- textile – 4.7% and
- plastic – 35.9%.

In Bosnia and Herzegovina, waste is predominantly disposed in landfills. This method of disposal and inadequate wastewater management causes a generally negative impact on the environment, and thus leads to an increase in greenhouse gas emissions.

The estimated quantity of municipal waste generated in Bosnia and Herzegovina in 2017 was 1,235,449 tons, while the amount of municipal waste collected by public waste collection services was 914,232 tons. The estimated quantity of municipal waste generated in 2018 was 1,243,973 tons, and the amount of municipal waste collected by public waste collection services was 920,540 tons.

According to 2006 IPCC Guidelines, waste inventory should be prepared as of the year 1950. In that case, the inventory for the waste sector included data available since 1950. For the purposes of calculating emissions from municipal waste, data on the number of inhabitants from official census documents from 1951, 1961, 1971, 1981, 1991 and 2013 were used. Amount of waste generated per capita used for the period between 1950 and 2009 was 380 kg/capita/year. For the purposes of calculating emissions from industrial waste, GDP data for the period 1950 to 1994 in the amount of 100 million USD were used. GDP data for the period 1994 to 2018 were taken from www.worldbank.org. Waste generation rate 5 Gg/Sm GDP/ year was used from 1950 to 2018. In that case, the emission caused by solid waste disposal amounts to 52.61 Gg CH₄ for 2017, i.e. 52.23 Gg CH₄ for 2018. Data from the Agency for Statistics was used to calculate emissions from household wastewater treatment⁴³.

Emissions from food industry wastewater treatment were calculated based on data obtained from statistical yearbooks for: beer and malt/syrup, meat, paper and pulp, vegetables, fruit and juices and wines. In that case, the emission from wastewater treatment and discharge amounts to 15.02 Gg CH₄ and 0.28 Gg N₂O for 2017, i.e. 16.33 Gg CH₄ and 0.279 Gg N₂O for 2018. In summary, if the available data from 1950 is included in the emission calculation, a total of 67.63 Gg CH₄ and 0.28 Gg N₂O was emitted in 2017, and 68.56 Gg CH₄ and 0.279 Gg N₂O in 2018. The total emission of eq CO₂ for the year 2017 would be 1,507.06 Gg, and for the year 2018 1,526.25 Gg.

⁴²Table 3.1. *Guideline Wast*

⁴³http://bhas.gov.ba/data/Publikacije/Saopštenja/2018/ENV_02_2018_Y1_0_BS.pdf

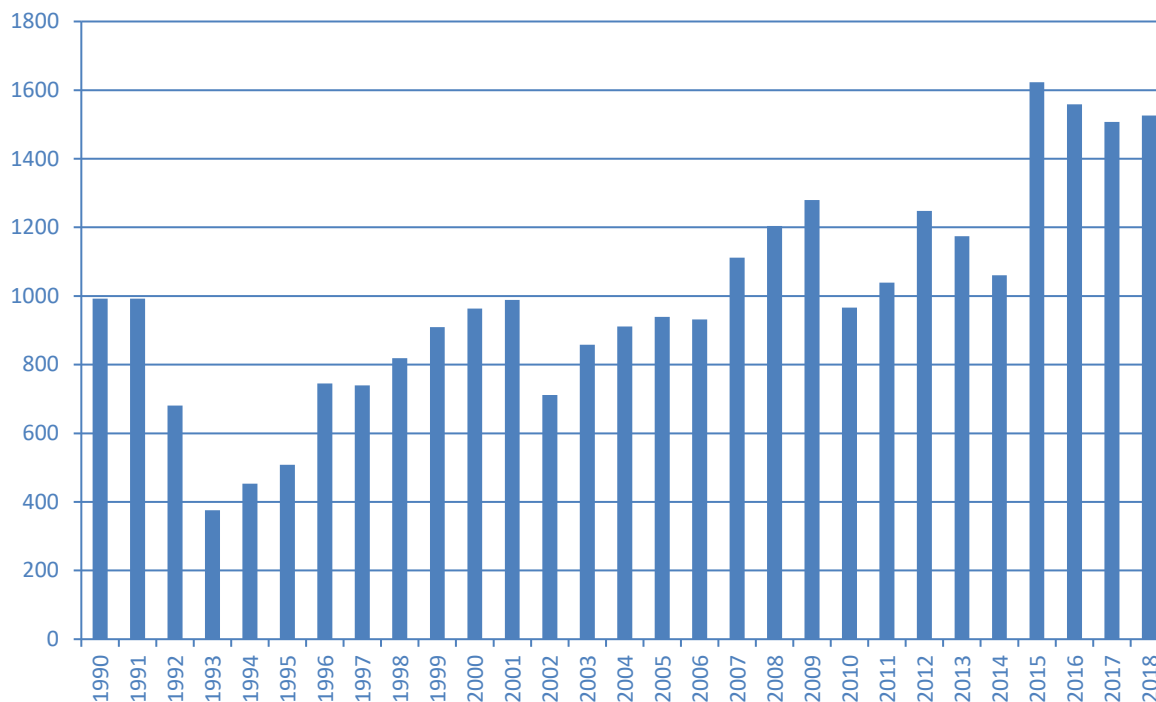


Figure10: Emission of CO₂-eq (Gg) for the period 1990–2018 – waste sector

2.3.1.4 Sinks– LULUCF (Land Use, Land Use Change and Forestry)

When absorption of greenhouse gases occurs (e.g. absorption of CO₂ due to an increase in forest wood biomass), we talk about greenhouse gas sinks, and the amounts are shown with a negative value.

The calculation of GHG gases for the forestry sector in Bosnia and Herzegovina was made on the basis of official instructions and methodologies of the Intergovernmental Panel on Climate Change (IPCC). The following documents were used for that purpose:

- Good Practice Guidance for Land Use, Land-Use Change and Forestry from 2003
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories – Volume 4: Agriculture, Forestry and Other Land Use, and Volume 12: Harvested Wood Products.
- The 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
- IPCC Inventory Software User Manual Version 2.54.6396.19217

Calculations were made for the years 2017 and 2018, for the following chapters:

- 3. Agriculture, Forestry and Other Land use
 - 3.B Land
 - 3.B.1 Forest lands
 - 3.B.1.a – Forest land Remaining Forest land.
 - 3.C. Aggregate sources and non-CO₂ emissions sources on land
 - 3.C.1 – Emissions from biomass burning
 - 3.C.1.a – Biomass burning in forest lands
 - 3.D. Other
 - 3.D.1- Harvested Wood Products.

Given the fact that data on the state of forests in BiH cannot be found in one place, they were collected at the level of: Republika Srpska (RS), Federation of Bosnia and Herzegovina (FBiH) and Brčko District (BD). Although the data relates to the same or similar types of forests, their sum and average values should not be combined, therefore all these data were used for these three "geographical areas" in BiH and the total inventory on the level of BiH was obtained by the simple sum in the program. Also, the format of the available data is not the same (same types of forests) at entity and BD level, which had to be taken into account.

Consequently, for 2017 and 2018, all forests in Bosnia and Herzegovina were divided into 25 categories (types), and surface areas and volume of fellings were taken from official sources.

It must be noted here that the data vary significantly depending on the source. For example, according to the Cadastre of Forests and Forest Land the surface area of state-owned forests in Republika Srpska in 2017 was 991,137.84ha (without usurpation), while according to the Statistical Yearbook it was 795,834ha, which is a difference of close to 200,000ha. Similar discrepancies have been observed with other data. In our calculations, we used sources that we considered to be more accurate and detailed or, in some cases, the only available data.

Surface area of unmanaged forests (mined forests) and of forest land with non-forest cover (definition of forest in line with the FAO terminology) were not taken into account when calculating the GHG inventory. This, primarily, refers to areas bare lands and scrubland, as well as areas that in forestry are defined as suitable and unsuitable for management. Also, in line with the recommendations given in the 2006 IPPC Guidelines and the 2003 GPG for LULUCF to apply the "20-year rule", areas afforested in 2017 and 2018 were not taken into account because, in accordance with this instruction, land will be transferred from a conversion category to a remaining category after it has been in a given land use for 20 years. At the same time, the areas that were afforested 20 years ago should have been recorded in the category of „forest cultures” which means that the increase in areas as a result of afforestation can be considered recorded through this data. Also, a significant portion of agricultural land is being converted into forest land (mainly due to migration of the population from rural to urban areas) which should be recorded as an increase in forest area, but currently there is no data on the size of these areas that could be used as land use change data. Therefore, GHG inventory was calculated only for category: 3.B.1a. Forest land Remaining Forest land.

Based on the instructions from the Manual, the basic parameters in the software are set in the "Application preferences" tab, which refer to:

- General
- Database
- Worksheet
- Reports
- Inventory year
- Grid.

The forest types listed above (25 in total) are defined as initial parameters in the Land Type Manager tab.

Definition of these categories allowed for a much more detailed analysis than before (including the inventory for 2015-2016). Thanks to this type of calculation it is possible to achieve greater precisions and obtain more relevant data. In the Land Type Manager tab, parameters for each of the 25 forest types were selected according to the instructions from the 2006 IPPC Guidelines and 2003GPG for LULUCF, and having entered the name of the country, continent and sub-category to which the data refer, we defined

- Climate region

- Soil type
- Ecosystem type
- Species
- Age class
- Growing stock level
- Other specific parameters namely:
 - carbon fraction of above ground biomass
 - root to shoot (R/T) ratio
 - biomass conversion and expansion factors (BCEF)
 - emission factors for drained organic soils in managed forests
 - above-ground biomass in forests
 - above-ground biomass growth in plantations/natural forests
 - reference soil organic (SOC) stock
 - litter carbon stock of mature forests)
 - abandoned managed land
 - relative stock change factor land use (FLU)
 - management (FMG)
 - input (FI)

Given the fact that there are different data for different categories, specific indicators for individual parameters can be analysed in detail in the provided database (xms_file). So, for example, increase for each specified forest type was selected in the drop-down menu as “<20m³/ha/year“. Biomass stocks per hectare were calculated based on total stocks and area in the given forest. The obtained values defined the selection of stock (in the drop-down menu), so the value “>200m³/ha” was selected for the category of high forests (conifers and deciduous trees), while the value “100-200m³/ha” was selected for degraded deciduous forests, coppice deciduous forests, forest cultures (conifers and deciduous trees).

Specific statistical data for defined categories of forests and forest land have been taken from official statistical data (publications), namely:

- RS Institute for Statistics, Forestry Sector in Statistical Bulletins for 2018 (data as of 31December 2017) and 2019 (data as of 31 December 2018) (<https://www.rzs.rs.ba>).
- Public Forestry Company "Šume Republike Srpske", Cadastre of Forests and Forest Land in RS for 2017 and 2018 (obtained from the Directorate of the Public Forestry Company upon personal request)
- Federal Institute for Statistics, Forestry in the Federation of BiH for 2017 and 2018 (<http://fzs.ba/>).
- Federal Ministry of Agriculture, Forestry and Water Management (2018). Inventory of state-owned forests and forest land for 2017. Federal Forestry Administration (<https://fmpvs.gov.ba/registri-usumarstvu/>).
- Management plans for forests in the Brčko District – state-owned and privately-owned (obtained from the Department for Agriculture, Forestry and Water Management of the Brčko District Government upon personal request).
- FAOSTAT_ Forestry Production and Trade (fao.org/faostat/en/#data/FO)

Data on fires

Data on fires were taken from the Statistical Yearbooks of Republika Srpska and the Federation of Bosnia and Herzegovina, as show in Table 12. These surface areas were divided into previously defined forest types in percentage of their area. As it can be seen, calculations for 2017 and 2018 were characterised by large

difference in the size of burned area. Only for Republika Srpska, the burned area for 2017 was almost 140 times larger, and in the Federation of Bosnia and Herzegovina, almost 6 times.

Table 12: Fire area in Republika Srpska and the Federation of BiH for 2017 and 2018

Entity/year	2017	2018
Republika Srpska	17,951 ha state-owned 5,026 ha privately-owned	119 ha state-owned 47 ha privately-owned
Federation of BiH	594	105

Input data for the calculation of the category HWP – Harvested Wood Products

The data used are the official data of FAO statistics, and their collection and input is at the level of the entire state of Bosnia and Herzegovina. Data taken from the FAO statistics on the volume of sales of different wood assortments (sawn wood; paper; industrial wood, wood chips, charcoal and waste) were used as starting parameters for the calculation. This data was processed using tables from 2006 IPCC Guidelines- Chapter 12.

Total emissions and sinks in the forestry sector and land use change for Bosnia and Herzegovina were calculated for the years 2017 and 2018. According to the data collected, the results of the calculation indicate that forests in BiH represent a significant CO₂ sink.

Data on CO₂ sinks for forest areas (*Forest land remaining forest land*) and wood products (HWP) show that the final annual sink of carbon dioxide by forest ecosystems in BiH for the year 2017 was -5.844,09 Gg CH₄, and for the year 2018 was -5.831,9 Gg CH₄.

The above data indicate a decrease of -0.63% in 2017, i.e. by 0.84% in 2018 compared to 2016. Compared to 1990 there was a decrease in emissions of -21.28% in 2017 i.e. of -21.44% in 2018.

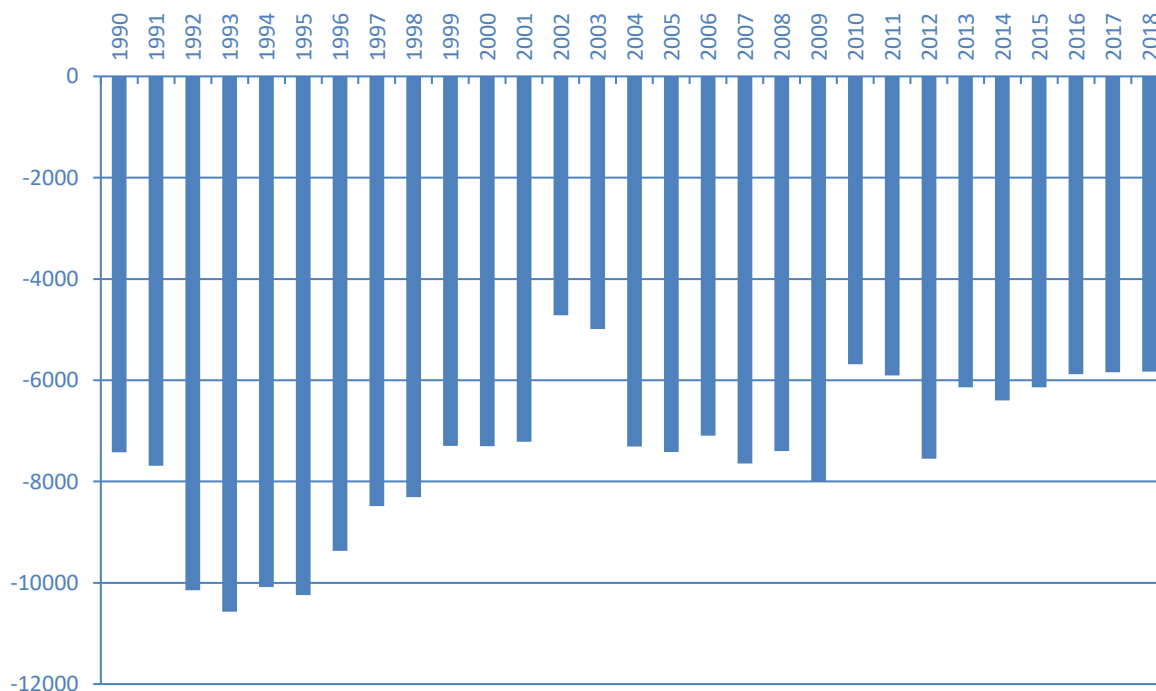


Figure 11: Sinks of CO₂ (Gg) for the period 1990–2018 – forestry sector

The largest amount of emissions comes from agricultural soils. According to IPCC methodology, this includes: mineral nitrogen, nitrogen from organic fertilizers, the amount of nitrogen fixed by N-fixing crops, the amount of N released from decomposition of plant residues, and the amount released from mineralization of soil through cultivation of histosols. A significant amount of N₂O is generated from the storage of manure and is attributed to livestock farming. This includes emissions from anaerobic lagoons, emissions from liquid systems, solid manure storage systems, etc. Emissions of N₂O s from pastures are included under agricultural soils.

2.3.2 Emission of methane (CH₄)

Methane is a direct product of the metabolism of animals. The biggest producers of methane are ruminants (cows, other cattle and sheep). There are two significant sources of methane emissions: intestinal fermentation resulting from ruminant digestion (dairy cows are the largest source) and various procedures related to storage and use of organic fertilizers (fertilizer management). Total emission of methane originating from domestic animals is obtained as the sum of emissions from intestinal fermentation and emissions related to fertilizer management.

The main sources of methane in Bosnia and Herzegovina are agriculture (enteric fermentation and manure management), fugitive emissions from coalmines, and waste disposal. According to IPCC methodology, methane emissions are determined for all types of domestic animals (dairy-cows, non-dairy cows and bulls, sheep, horses, swine and poultry). IPCC default emission factors were used for the calculation.

Methane emissions decreased between 1992 and 1996 due to the war, which significantly affected the animal population (significant reduction compared to 1990), crop production, consumption of mineral fertilizers, and agricultural practices in general. However, since 2006, methane emissions have not changed significantly, and it was 1,006.97 Gg CO₂eq in 2017, and 991.32 Gg CO₂eq in 2018.

2.3.3 Emission of nitrous oxide (N₂O)

The principal source of N₂O in Bosnia and Herzegovina is the agriculture sector. Nitrogen suboxide (N₂O) is produced in the soil by processes of nitrification and denitrification. The IPCC methodology estimates N₂O emissions based on addition of nitrogen to soils (artificial or organic fertilizers –manure, crop residues, sewage sludge or N mineralization in soil organic matter). Three main of N₂O emission sources have been identified in the agricultural sector: direct N₂O emissions from agricultural soils, direct N₂O emissions from animal husbandry and indirect N₂O emissions caused by agricultural activities.

The largest emission comes from direct emission from agricultural soils. According to IPCC methodology, this includes: mineral nitrogen, nitrogen from organic fertilizers, the amount of nitrogen fixed by N-fixing crops, the amount of N released from decomposition of plant residues, and the amount released from mineralization of soil through cultivation of histosols. A significant amount of N₂O is generated from the storage of manure and is attributed to livestock farming. This includes emissions from anaerobic lagoons, emissions from liquid systems, solid manure storage systems, etc. Emissions of N₂O s from pastures are included under agricultural soils.

emissions from agriculture amounted to 2.48 Gg in 2017 and 2.49 Gg in 2018, i.e. 770.94 Gg CO₂eq in 2017, and 773.26 Gg CO₂eq in 2018.

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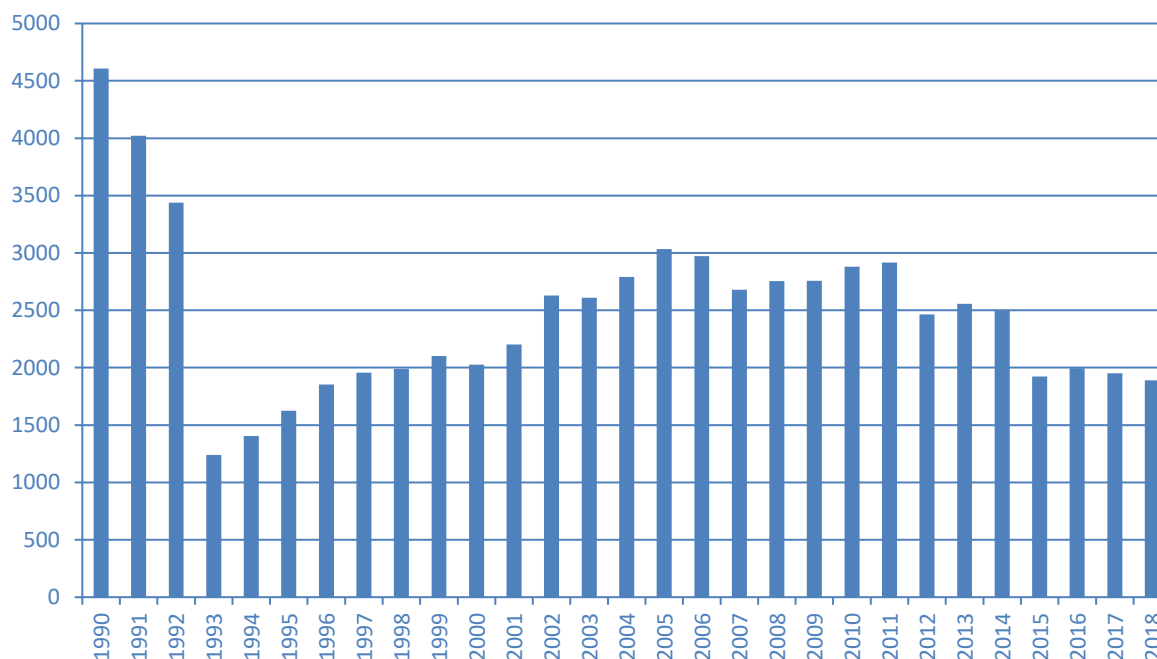


Figure 12: Emission of CO₂ (Gg) for the period 1990-2018 – agricultural sector

2.3.4 Emission of indirect greenhouse gases

Photo-chemically active gases, such as carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOCs) indirectly contribute to the greenhouse effect, although they are not technically greenhouse gases. They are commonly called indirect greenhouse gases, or ozone precursor gases, because they contribute to and participate in the creation and breakdown of ozone, which is one of the greenhouse gases. It is believed that sulphur dioxide (SO₂), as a sulphate and aerosol precursor, increases the greenhouse effect.

2.3.5 Emission of F- gases

For calculation of potential bulk halocarbon emission, only data from the Indirect Tax Administration of Bosnia and Herzegovina were available. Potential HFC emissions are 519.10 Gg CO₂eq in 2017, and 570.66 Gg CO₂eq in 2018. In this report, the emission of F-gases is presented separately.

Table 13: F-gases emissions in Bosnia and Herzegovina

	F-gases emissions (Gg CO ₂ eq)				Total
	R134a	R404A	R407C	R410A	
2012	72.242	153.762	32.971	52.118	311.09
2013	81.064	163.573	36.572	67.173	348.38
2014	90.053	171.347	39.657	85.353	386.41
2015	99.070	179.553	41.914	106.554	427.09
2016	108.744	188.993	43.244	131.229	472.21
2017	118.942	197.784	43.379	158.986	519.10
2018	130.005	208.475	42.390	189.790	570.66

/Source: HFC Outlook model for Bosnia and Herzegovina, based on data from the Indirect Taxation Administration of Bosnia and Herzegovina and the Ozone Unit of Bosnia and Herzegovina/

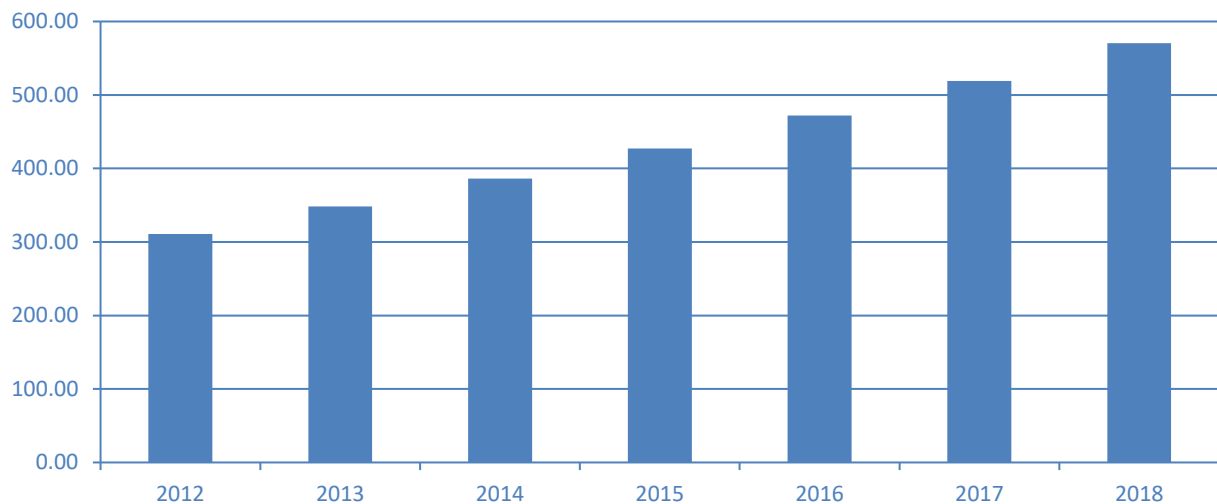


Figure 13: Emission of CO₂ (Gg) for the period 2012–2018 – F-gases sector

2.4 UNCERTAINTY ESTIMATE OF CALCULATIONS

The 2017 trend uncertainty estimate is 5,804, while the 2018 trend uncertainty estimate is 5,812. Baseline year for uncertainty estimate is the year 2015. Total uncertainty of inventory for 2017 is 8,596, while for 2018 it is 8,381.

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2.4.1 Key sources of emission

Analyses of key emission sources were conducted for the 2017 and 2018 inventory years. The base year for the assessment of key emission sources is 2015

Table14: Key emission sources trend assessment for 2017

IPCC categories code	IPCC category	Greenhouse gas	2015 estimate of Ex0 (Gg CO ₂ eq)	2017 estimate of Ext (Gg CO ₂ eq)	Trend assessment (Txt)	% contribution to trend	Cumulative Total of column G
1.A.1	Energy industries–Solid fuels	CO ₂	13238.38	17874.91	0.07	0.31	0.31
1.A.4	Other sectors –Solid fuels	CO ₂	769.17	210.96	0.02	0.10	0.41
2.C.1	Iron and steel production	CO ₂	1798.03	1429.34	0.02	0.10	0.51
3.B.1.a	Forest land - Remaining forest land	CO ₂	-5378.45	-5084.02	0.02	0.10	0.60
1.A.2	Processing industry and construction – Solid fuels	CO ₂	846.42	468.16	0.02	0.08	0.68
4.A	Solid waste disposal	CH ₄	1122.74	1104.85	0.01	0.03	0.71
2.C.3	Aluminium production	CO ₂	167.52	0.00	0.01	0.03	0.74
3.A.1	Enteric fermentation	CH ₄	900.01	873.34	0.01	0.03	0.77
1.A.4	Other sectors –Liquid fuels	CO ₂	368.28	254.15	0.01	0.03	0.79
4.D	Wastewater treatment and discharge	CH ₄	415.03	315.46	0.01	0.02	0.82
1.A.1	Energy industries –Liquid fuels	CO ₂	557.68	497.87	0.00	0.02	0.84
3.D.1	Harvested wood products	CO ₂	-739.68	-760.08	0.00	0.02	0.86
1.A.2	Processing industry and construction –Liquid fuels	CO ₂	482.98	421.35	0.00	0.02	0.88
1.A.2	Processing industry and construction –Gaseous fuels	CO ₂	169.07	72.18	0.00	0.02	0.90
1.A.1	Energy industries –Gaseous fuels	CO ₂	86.75	0.00	0.00	0.01	0.91
1.A.3.b	Road transport	CO ₂	3128.29	3804.57	0.00	0.01	0.93
3.C.4	Direct emissions of N ₂ O from managed soils	N ₂ O	516.25	527.50	0.00	0.01	0.94
1.B.1	Solid fuels	CO ₂	456.64	463.92	0.00	0.01	0.95
3.C.1	Emissions from biomass combustion	CH ₄	0.26	45.37	0.00	0.01	0.96
2.A.2	Production of lime	CO ₂	325.21	427.79	0.00	0.01	0.96
3.A.2	Manure management	CH ₄	137.80	133.63	0.00	0.00	0.97
3.C.5	Indirect emissions of N ₂ O from managed soils	N ₂ O	162.86	166.68	0.00	0.00	0.97
3.A.2	Manure management	N ₂ O	129.24	128.06	0.00	0.00	0.98
2.B.7	Production of baking soda	CO ₂	47.45	80.41	0.00	0.00	0.98
2.C.2	Production of ferroalloys	CO ₂	89.28	82.71	0.00	0.00	0.98

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IPCC categories code	IPCC category	Greenhouse gas	2015 estimate of Ex0 (Gg CO ₂ eq)	2017 estimate of Ext (Gg CO ₂ eq)	Trend assessment (Txt)	% contribution to trend	Cumulative Total of column G
2.A.1	Cement production	CO ₂	479.46	545.04	0.00	0.00	0.99
1.A.4	Other sectors –Solid fuels	CH ₄	16.92	0.44	0.00	0.00	0.99
1.A.4	Other sectors –Gaseous fuels	CO ₂	137.98	146.09	0.00	0.00	0.99
3.C.6	Indirect emissions of N ₂ O from manure management	N ₂ O	77.85	76.76	0.00	0.00	0.99
1.A.3.b	Road transport	N ₂ O	60.87	58.26	0.00	0.00	0.99
4.D	Wastewater treatment and discharge	N ₂ O	84.77	86.75	0.00	0.00	1.00
1.A.1	Energy industries –Solid fuels	N ₂ O	60.60	82.44	0.00	0.00	1.00
1.A.4	Energy industries –Solid fuels	N ₂ O	3.54	0.97	0.00	0.00	1.00
1.A.2	Processing industry and construction –Solid fuels	N ₂ O	3.95	2.18	0.00	0.00	1.00
1.A.2	Processing industry and construction –Biomass	N ₂ O	1.45	0.00	0.00	0.00	1.00
1.A.3.b	Road transport	CH ₄	9.44	12.82	0.00	0.00	1.00
1.A.2	Processing industry and construction –Solid fuels	CH ₄	1.78	0.99	0.00	0.00	1.00
1.A.1	Energy industries –Biomass	N ₂ O	0.27	1.36	0.00	0.00	1.00
1.A.2	Processing industry and construction –Biomass	CH ₄	0.74	0.00	0.00	0.00	1.00
1.A.1	Energy industries –Liquid fuels	N ₂ O	1.23	0.59	0.00	0.00	1.00
1.A.1	Energy industries –Biomass	CH ₄	0.13	0.69	0.00	0.00	1.00
1.A.4	Other sectors –Liquid fuels	CH ₄	1.00	0.66	0.00	0.00	1.00
1.A.1	Energy industries –Solid fuels	CH ₄	2.74	3.72	0.00	0.00	1.00
1.A.4	Other sectors –Liquid fuels	N ₂ O	0.86	0.54	0.00	0.00	1.00
1.A.1	Energy industries –Liquid fuels	CH ₄	0.43	0.25	0.00	0.00	1.00
1.B.2.b	Natural gas	CH ₄	1.79	2.02	0.00	0.00	1.00
1.A.2	Processing industry and construction –Gaseous fuels	N ₂ O	0.09	0.04	0.00	0.00	1.00
1.A.1	Energy industries –Gaseous fuels	N ₂ O	0.05	0.00	0.00	0.00	1.00
1.A.2	Processing industry and construction –Gaseous fuels	CH ₄	0.06	0.03	0.00	0.00	1.00
1.A.2	Processing industry and construction –Liquid fuels	N ₂ O	0.76	0.95	0.00	0.00	1.00
1.A.1	Energy industries –Gaseous fuels	CH ₄	0.03	0.00	0.00	0.00	1.00
1.A.4	Other sectors –Gaseous fuels	CH ₄	0.26	0.27	0.00	0.00	1.00
1.A.2	Processing industry and construction –Liquid fuels	CH ₄	0.29	0.33	0.00	0.00	1.00
1.A.4	Other sectors –Gaseous fuels	N ₂ O	0.08	0.08	0.00	0.00	1.00

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Table15: Key emission sources trend assessment for 2018

IPCC categories code	IPCC category	Greenhouse gas	2015 estimate of Ex0 (Gg CO ₂ eq)	2018 estimate of Ext (Gg CO ₂ eq)	Trend assessment(Txt)	% contribution to trend	Cumulative Total of column G
1.A.1	Energy industries–Solid fuels	CO ₂	13238.38	18078.06	0.06	0.29	0.29
3.B.1.a	Forest land –Remaining forest land	CO ₂	-5378.45	-5106.30	0.03	0.14	0.42
2.C.1	Iron and steel production	CO ₂	1798.03	1495.11	0.02	0.10	0.53
1.A.2	Processing industry and construction –Solid fuels	CO ₂	846.42	632.87	0.01	0.06	0.59
1.A.4	Other sectors –Solid fuels	CO ₂	769.17	600.93	0.01	0.05	0.64
1.A.1	Energy industries–Liquid fuels	CH ₄	557.68	365.95	0.01	0.05	0.68
1.A.4	Other sectors –Liquid fuels	CO ₂	368.28	146.08	0.01	0.05	0.73
4.A	Solid waste disposal	CH ₄	1122.74	1096.73	0.01	0.04	0.77
3.A.1	Enteric fermentation	CO ₂	900.01	859.75	0.01	0.04	0.80
1.A.2	Processing industry and construction –Liquid fuels	CH ₄	482.98	361.87	0.01	0.03	0.84
4.D	Wastewater treatment and discharge	CO ₂	415.03	342.97	0.00	0.02	0.86
3.D.1	Harvested wood products	CO ₂	-739.68	-725.60	0.00	0.02	0.88
1.A.2	Processing industry and construction –Gaseous fuels	CO ₂	169.07	73.55	0.00	0.02	0.90
1.A.1	Energy industries–Gaseous fuels	CO ₂	86.75	0.00	0.00	0.02	0.92
3.C.4	Direct emissions of N ₂ O from managed soils	CO ₂	516.25	533.36	0.00	0.01	0.93
2.A.2	Production of lime	CO ₂	325.21	445.85	0.00	0.01	0.94
2.C.3	Aluminium production	N ₂ O	167.52	163.07	0.00	0.01	0.95
1.A.3.b	Road transport	CO ₂	3128.29	3777.73	0.00	0.01	0.95
3.A.2	Manure management	CH ₄	137.80	131.57	0.00	0.01	0.96
2.A.1	Cement production	CO ₂	479.46	548.61	0.00	0.01	0.96
3.C.5	Indirect emissions of N ₂ O from managed soils	CH ₄	162.86	164.29	0.00	0.01	0.97
3.A.2	Manure management	N ₂ O	129.24	125.85	0.00	0.00	0.97
1.A.4	Other sectors –Gaseous fuels	N ₂ O	137.98	138.19	0.00	0.00	0.98
2.C.2	Production of ferroalloys	CO ₂	89.28	82.71	0.00	0.00	0.98
2.B.7	Production of baking soda	CO ₂	47.45	79.09	0.00	0.00	0.99
3.C.6	Indirect emissions of N ₂ O from manure management	CO ₂	77.85	75.61	0.00	0.00	0.99
4.D	Wastewater treatment and discharge	CH ₄	84.77	86.55	0.00	0.00	0.99
1.A.3.b	Road transport	CO ₂	60.87	58.11	0.00	0.00	0.99
1.B.1	Solid fuels	N ₂ O	456.64	544.15	0.00	0.00	1.00
1.A.1	Energy industries –Solid fuels	N ₂ O	60.60	83.31	0.00	0.00	1.00

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IPCC categories code	IPCC category	Greenhouse gas	2015 estimate of Ex0 (Gg CO ₂ eq)	2018 estimate of Ext (Gg CO ₂ eq)	Trend assessment(Txt)	% contribution to trend	Cumulative Total of column G
1.A.4	Other sectors –Solid fuels	N ₂ O	16.92	23.28	0.00	0.00	1.00
1.A.1	Energy industries –Biomass	N ₂ O	0.27	2.19	0.00	0.00	1.00
1.A.2	Processing industry and construction –Solid fuels	N ₂ O	3.95	2.96	0.00	0.00	1.00
1.A.2	Processing industry and construction –Biomass	N ₂ O	1.45	0.00	0.00	0.00	1.00
1.A.4	Other sectors –Solid fuels	N ₂ O	3.54	2.77	0.00	0.00	1.00
1.A.1	Energy industries –Biomass	CH ₄	0.13	1.11	0.00	0.00	1.00
1.A.2	Processing industry and construction –Biomass	CH ₄	0.74	0.00	0.00	0.00	1.00
1.A.2	Processing industry and construction –Solid fuels	N ₂ O	1.78	1.34	0.00	0.00	1.00
1.A.4	Other sectors –Liquid fuels	CH ₄	1.00	0.39	0.00	0.00	1.00
1.A.3.b	Road transport	N ₂ O	9.44	12.29	0.00	0.00	1.00
1.A.4	Other sectors –Liquid fuels	CH ₄	0.86	0.32	0.00	0.00	1.00
1.A.1	Energy industries –Liquid fuels	CH ₄	1.23	0.85	0.00	0.00	1.00
1.A.1	Energy industries –Solid fuels	CH ₄	2.74	3.76	0.00	0.00	1.00
1.A.1	Energy industries –Liquid fuels	N ₂ O	0.43	0.30	0.00	0.00	1.00
1.B.2.b	Natural gas	CH ₄	1.79	2.03	0.00	0.00	1.00
3.C.1	Emissions from biomass combustion	CH ₄	0.26	0.47	0.00	0.00	1.00
1.A.2	Processing industry and construction –Liquid fuels	N ₂ O	0.76	0.78	0.00	0.00	1.00
1.A.2	Processing industry and construction –Liquid fuels	N ₂ O	0.29	0.27	0.00	0.00	1.00
1.A.2	Processing industry and construction –Gaseous fuels	CH ₄	0.09	0.04	0.00	0.00	1.00
1.A.4	Other sectors –Gaseous fuels	N ₂ O	0.26	0.26	0.00	0.00	1.00
1.A.1	Energy industries –Gaseous fuels	CH ₄	0.05	0.00	0.00	0.00	1.00
1.A.2	Processing industry and construction –Gaseous fuels	CH ₄	0.06	0.03	0.00	0.00	1.00
1.A.1	Energy industries –Gaseous fuels	CH ₄	0.03	0.00	0.00	0.00	1.00
1.A.4	Other sectors –Gaseous fuels	N ₂ O	0.08	0.08	0.00	0.00	1.00

2.5 Verification of calculations

During the preparation of the greenhouse gas inventory for 2017 and 2018, no recalculation of previous calculations was performed. The data used in the inventory preparation phase have not been verified by a third party (independent expert or institution).

3 CLIMATE CHANGE MITIGATION

By signing the Declaration on the Green Agenda for the Western Balkans, on 10 November 2020 in Sofia, the countries of the region committed themselves to implement actions in the field of climate change mitigation, energy transition, sustainable mobility and circular economy, as well as the protection of biodiversity, sustainable agriculture and food production. The countries of the region have committed themselves to a series of specific actions, including introduction of a tax on carbon dioxide emission and market models to encourage renewable energy sources, as well as the gradual abolition of subsidies for coal.

The Green Agenda is foreseen under the European Green Deal, a set of measures aimed at making Europe climate neutral by 2050. The Sofia Declaration was followed by the Guidelines for the Implementation of the Green Agenda for the Western Balkans which give proposed activities and measures to be adopted by EU and the Western Balkans countries. Main measures are:

- Alignment with the EU climate law after its adoption which aims to make the EU climate neutral by 2050
- Definition of energy and climate goals by 2030 in accordance with the legal framework of the Energy Community and the EU acquis, as well as the development and implementation of National Energy and Climate Plans with clear measures to reduce greenhouse gas emissions
- Continued alignment with the EU Emissions Trading System (EU ETS), as well as the introduction of other emission taxation models, to promote decarbonisation in the region
- Analysis and revision of all regulations that support progressive decarbonisation of the energy sector and their full implementation, primarily through the Energy Community
- Cooperation in the preparation of an assessment of the socio-economic impact of decarbonisation on each country and at the regional level to ensure just transition
- Prioritization and improvement of energy efficiency in all sectors
- Increasing the share of renewable energy sources and providing the necessary conditions for investment, in accordance with the EU and the Energy Community acquis
- Reducing and gradually abolishing subsidies for coal, strictly respecting the rules of state aid
- Actively participate in the Initiative for coal regions in transition in the Western Balkans.

In order to achieve the goals contained in the Green Agenda for the Western Balkans, Bosnia and Herzegovina must further improve its approach to strategic planning, especially in areas related to decarbonisation, i.e. gradual reduction of the use of fossil fuels with the aim of achieving climate neutrality by 2050. It is clear how big a challenge it is for Bosnia and Herzegovina. The current goals of reducing greenhouse gas emissions are not sufficient to achieve climate neutrality, which is expected in accordance with the commitment expressed by signing the Green Program. Therefore, continued work to revise the goals for reducing emissions in line with the changes in respective areas is required. As part of the preparation of this document, two scenarios for the reduction of greenhouse gas emissions were analysed.

3.1 ELECTRIC POWER SECTOR

3.1.1 The situation in the electric power sector

According to the 2020 Report of the State Electricity Regulatory Commission, total installed capacity of power generation plants in Bosnia and Herzegovina is 4,530.64 MW, of which 2,076.6 MW is in large hydroelectric power plants, 2,065 MW in thermal power plants, and 92.85 MW was installed in industrial power plants.

Total installed capacity of RES power plants (without large hydropower plants) amounts to 296.19 MW. About 58% of the capacity refers to small hydropower plants, followed by wind power plants with a share of about 29%, and then solar power plants with a share of about 12%. Biomass and biogas plants have the smallest share.

According to the data of the Agency for Statistics of Bosnia and Herzegovina, gross electricity generation in Bosnia and Herzegovina in 2020 was 16,874 GWh, of which 4,663 GWh or 27.6% was generated in hydroelectric power plants, 11,557 GWh or 68.5% in thermal power plants, while industrial and other power plants (wind and solar power plants) generated 654 GWh was produced, i.e. 3.9%. Own consumption in power plants amounts to 1,240 GWh, and in the rest of the energy sector 304 GWh. Final thermal energy consumption in 2020 was divided among households with 48.3%, industry with 25.4%, and other consumers, including construction, transport and agriculture, with.

Total gross electricity generation in 2018 was 19,160 GWh, while final consumption was approximately 11,456 GWh. Net export of electricity amounted to 4,606 GWh (Agency for Statistics of Bosnia and Herzegovina, 2019). 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, while in 2018 it was 3,240 kWh, which exceeds the world average. Electricity consumption has increased in the period 2002–2018 from 9,150 GWh to 11,456 GWh, which is an increase of about 25%.

In 2018, 12,079 GWh or 63% of electricity was generated in domestic coal-fired power plants and that have fairly high specific emissions of carbon dioxide (around 1.3 tCO₂/MWh). The rest of the electricity is generated mainly in large scale hydropower plants, 6,519 GWh or 34%, while 562 GWh or 2.9% is generated in industrial power plants and RES power plants (solar and wind powered). Coal consumption in the energy sector (thermal power plants and industrial power plants) was about 13.4 million tons. Due to the large share of thermal power plants in the power generation, network emission factor for carbon dioxide in 2018 was about 820 kg/MWh (in 2013 it was about 720 kg/MWh). Figure 14 shows the structure of energy generation in Bosnia and Herzegovina in the period 2014–2018. The figure shows an upward trend in the generation in thermal power plants in the mentioned period, which results in an upward trend in greenhouse gas emissions.

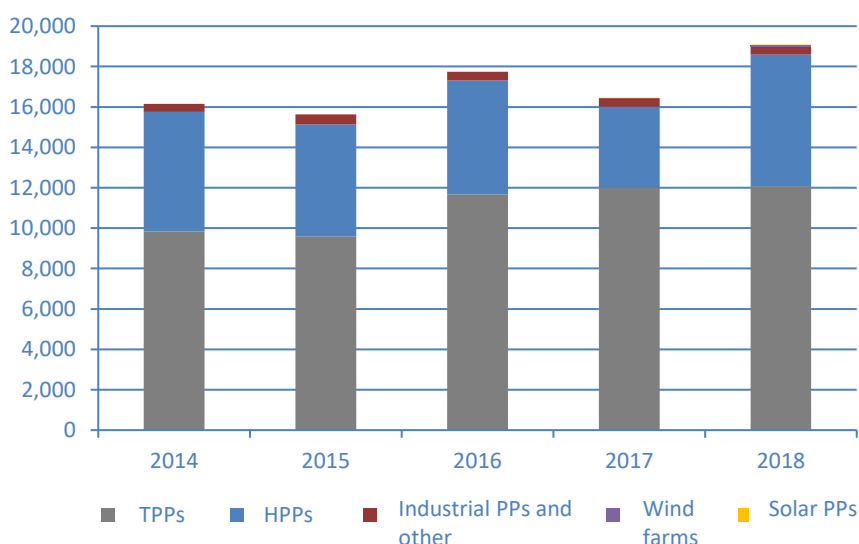


Figure 14: Structure of energy generation in Bosnia and Herzegovina in the period 2014–2018 (GWh)

In 2018, Bosnia and Herzegovina adopted the Framework Energy Strategy until 2035. Four scenarios were analysed in the energy sector. Of the four developed scenarios, only one leads to a certain reduction in emissions (referred to as “moderate renewable”). Other scenarios are based, among other things, on a

significant increase in the capacity of thermal power plants and their production. The main disadvantage of those scenarios is that they predict an unrealistic increase in electricity production. According to three scenarios, coal-fired thermal power plants will remain a significant source of electricity until 2035. 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 Bosnia and Herzegovina, on the open market is very low, which is also emphasized in the Strategy. Therefore, in parallel with the construction of new (replacement) and closing of existing blocks in thermal power plants, it is necessary to intensify the construction of capacities that use renewable energy sources. The fourth scenario (“moderate renewable”) predicts the largest share of renewable energy sources, and this refers to hydroelectric power plants, biomass power plants, wind power plants and solar power plants. In 2018, the first wind power plant in Bosnia and Herzegovina became operational. Several other wind power plants are in the development phase⁴⁴. As a result of the introduction of tariff guarantees and a guaranteed purchase period of electricity from renewable energy sources (RES) at the level of the Federation of Bosnia and Herzegovina and Republika Srpska and the increasing competitiveness of RES, the production of electricity from RES in Bosnia and Herzegovina is increasing. Nevertheless, the share of electricity from coal-fired thermal power plants is still very large and amounts, depending on hydrological conditions, from about 60% to about 75%.

When it comes to generation from RES in 2020, the total generation was 661.25 GWh. Small hydropower plants have a dominant share with 341.02 GWh (497.99 GWh in 2019, 469.39 GWh in 2018), wind power plants generated 262 GWh (254 GWh in 2019), while solar power plants generated 445, 62 GWh (30.04 GWh in 2019, 20.65 GWh in 2018), biomass and biogas power plants 12.56 GWh (8.84 GWh in 2019, 8.15 GWh in 2018), and wind power plants connected to the distribution system 0.07 GWh (0.02 GWh in 2018).

Entity action plans define quotas to stimulate renewable energy sources until 2020 through guaranteed incentive tariffs. The new Law on RES adopted in Republika Srpska introduced new methods of encouraging RES, in particular, it refers to the concept of prosumers, auctions and encouraging civil energy projects. A similar concept is foreseen in the draft of the new Law on RES in the Federation of Bosnia and Herzegovina. Activities on the adoption of the Law on Renewable Energy Sources in Brčko District are also underway.

3.1.2 Scenarios for the reduction of GHG emissions in the electricity sector

The GHG emission reduction targets adopted through the NDC are not sufficient to achieve climate neutrality by 2050, which means that more ambitious targets need to be set. A more ambitious should also be set for 2030 in order to achieve climate neutrality by 2050. Considering current emissions, the most important role in achieving climate neutrality is played by the power sector. Three scenarios of emission trends in energy sector by 2050 have been analysed:

- Baseline scenario (S1)
- Ambitious scenario (S2) and
- Decarbonisation scenario (S3).

All three scenarios include the introduction of the emissions trading system as of 2026 and implementation of NERP. This will affect the reduction of installed capacity (except in baseline scenario, which includes the construction of the replacement block 7 in Tuzla TPP) and the reduction of electricity generation.

According to the **baseline scenario (S1)** there is a decrease in installed capacity by 2030 due to the closure of a certain number of thermal power blocks in accordance with the NERP. In the period 2025-2030, the baseline scenario predicts commissioning of Tuzla TPP 7, but also closure of blocks in accordance with the NERP (blocks

⁴⁴At the beginning of 2021, two wind power plants are operational, and one is in test phase. Total capacity of all three wind power plants is 134.6 MW.

4 and 5 in Tuzla TPP will be closed upon the commissioning of block 7). After 2030, generation from coal-fired thermal power plants declines slightly, and from 2040 this decline significantly intensifies. In 2050, Tuzla TPP 7 and Stanari TPP are in operation. Specific emission of carbon dioxide decreases as a result of closure of less efficient blocks. Specific emissions in power plants built before 1990 are about 1.1 t CO₂/MWh, from Stanari TPP 0.92 tCO₂/MWh, and from Tuzla TPP 7 0.82 tCO₂/MWh. Generation in 2030 is 6.7% higher than the average generation in 2018 and 2019. However, emissions are lower due to increased efficiency (block 7 of the Tuzla Thermal Power Plant). Total generation in 2050 is about 1/3 of the average generation in 2018 and 2019.

Ambitious scenario (S2) does not include the construction of block 7 at the Tuzla TPP. However, unlike the baseline scenario, block 4 of Tuzla TPP remains in operation. Block 6 in Tuzla TPP is revitalized and used for district heating Tuzla. Generation from thermal power plants due to market conditions, i.e. non-competitiveness of coal-fired thermal power plants on the market. In this scenario, generation from thermal power plants in 2030 is lower by about 13% compared to the baseline scenario and by about 7% compared to the average generation in 2018 and 2019. After 2030, in this scenario, generation, and therefore emissions, decline faster than in the baseline scenario. This is the consequence of lower efficiency due to the fact that the construction of the replacement block in Tuzla TPP is not envisaged. By 2050, power generation from coal-fired thermal power plants will cease.

Decarbonisation scenario (S3) includes a reduction of total GHG emissions in BiH by 40% by 2030 compared to 2016. Total required reduction for that target amounts to 11,868 Gg CO_{2ekv}. Energy sector has the largest share in this reduction and will reduce generation by about 48% or 6,494 Gg CO_{2ekv} in 2030. Installed capacities in this scenario are the same as those with the fact that the thermal power plants have less working hours due to more intensive construction of renewable energy sources. Additionally, this scenario includes the introduction of biomass co-combustion in block 7 at Kakanj TPP and block 6 at Tuzla TPP with a percentage of biomass energy input of 15% (in both mentioned blocks). This will result in the reduction of specific emission of carbon dioxide from the mentioned blocks. Generation from thermal power plants in 2030 is almost 35% lower compared to the same year in the baseline scenario. After 2030, generation and emissions decline at a similar rate as in the ambitious scenario. Like in the ambitious scenario, power generation from coal-fired thermal power plants will cease by 2050.

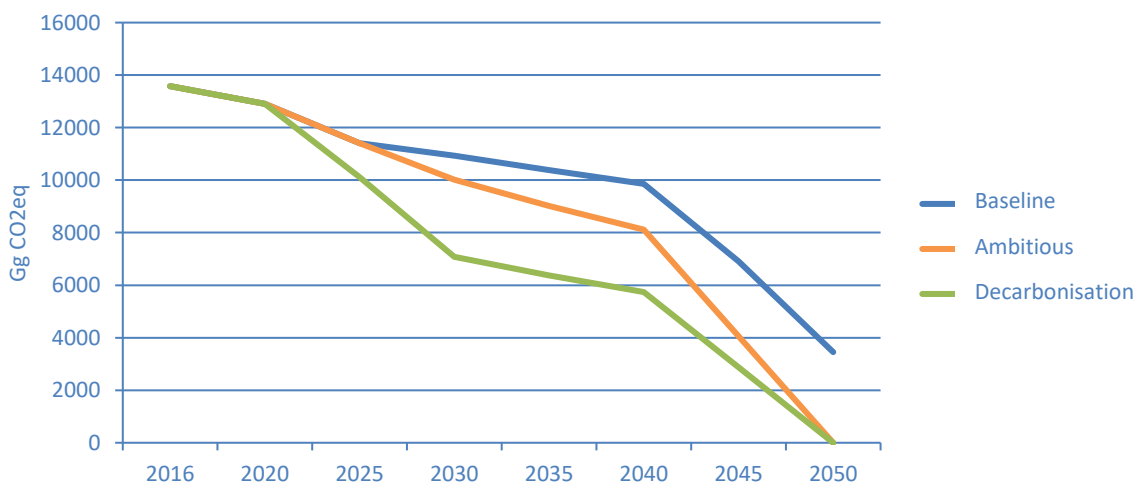


Figure 15: GHG emissions from the energy sector by scenarios

Since Bosnia and Herzegovina has signed the Sofia Declaration on climate neutrality by 2050, the baseline scenario is unfavourable from that aspect because it does not include complete decarbonisation of the energy sector. It should be noted that in this case lower quotas of GHG emissions will remain in other sectors, such as

transport and industry, where full decarbonisation is much harder to achieve. In this scenario, more work is needed to increase the GHG sinks.

All described scenarios include intensive construction of plants for the generation of electricity from RES. Ambitious and decarbonisation scenarios include installed capacities in wind power plants and solar power plants by 2030 of 500 MW each, and by 2050 the total installed capacity of the said power plants will be 2 GW. These scenarios also include construction of new large hydropower plants with a capacity of 250 MW, which will have an additional role in balancing the system.

3.2 RENEWABLE ENERGY SOURCES

The separate section 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 Situation in the renewable energy sector

Considering the development of technologies, the energy market and the defined goals of Bosnia and Herzegovina, 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.

3.2.2 Biomass and biogas

There is great energy potential in residues from agriculture, forestry and the wood industry. The theoretical potential of biomass in Bosnia and Herzegovina amounts to 10.2 million tons of dry mass per year. The technical potential is 7 million tons per year, of which 2 million tons of dry mass is unused, which is about 36 PJ or about 850,000 tons of oil equivalent.

Based on the available data on livestock for 2015 and 2016, potential biogas production was calculated at 850,000 m³/day, which is the energy equivalent of about 550 equivalent tons of oil. The potential of installed electric capacity is about 70 MW. Electricity generation in biomass and biogas power plants in 2020 was 12.56 GWh (8.84 GWh in 2019). So far, four plants for the production and use of biogas have been constructed in Bosnia and Herzegovina. Total generating capacity of those plants is about 1.85 MW. The largest plant is located in Donji Žabari with an installed generating capacity of 950 kW. The second plant consists of four power plants with the generating capacity of 150 kW.

The biggest obstacle to greater utilization of potentials are lengthy procedures for obtaining permits, securing funding and sufficient amounts of substrate. In addition, there is a lack of farmer education programs on the concept of biogas plants. Farmers see biogas plants almost exclusively as plants for power generation, and they ignore generation heat and organic fertilizer which is essential for the sustainability of such plants. Investment in agricultural production is a necessary condition for encouraging the use of biogas. It is expected implementation of such measures through rural development policy will result in energy savings in firewood, and especially in electricity and thermal energy from fossil fuels.

Bosnia and Herzegovina currently does not have a plan for the systematic production of fast-growing biomass for power generation. There are individual initiatives that focus on the use of areas degraded by mining

operations. According available data, there is not a single active commercial plant for the production of biofuels (bioethanol or biodiesel) in Bosnia and Herzegovina.⁴⁵

3.2.3 Solar energy

Solar energy potentials in Bosnia and Herzegovina amount to 70.5 million GWh per year, and with solar radiation of 1,240 kWh/m²/year in the north of the country and 1,600 1240 kWh/m²/year in the south, the conditions for using solar energy are quite favourable.

In 2020, solar power plants generated 45.62 GWh, which is almost a third more than in the previous year. The installed capacity of solar power plants in 2020 was 34.89 MW. This means that the average number of hours of operation at full capacity of solar power plants in Bosnia and Herzegovina in 2020 was about 1,300 hours. According to the adopted NDC, an additional 400 MW of solar power plants are expected to be installed by 2030. There is great interest from investors, considering that power plants with relatively large capacities are already competitive on the market.

Results of research on the possibility of using solar energy to produce heat by using solar collectors for 15 cities in Bosnia and Herzegovina are proving to be justified based on the already undertaken initiatives. There is a noticeable upward trend in home installations for the preparation of domestic hot water. According to estimates, based on the sales of several of the largest distributors of solar collectors, approximately 15,000 m² of collectors were installed in Bosnia and Herzegovina. With an average solar insolation of 1,200 kWh/m² per year and an efficiency of 70%, solar collectors generate about 12.6 GWh/a of heat. If it is assumed that all the mentioned heat replaces electricity for the preparation of sanitary water, solar collectors reduce the emission of carbon dioxide by about 9,000 tons per year. Based on the same source, the estimated annual growth (2017-2018) is around 15%. A great interest and increase in applying of solar collectors is noticeable in all sectors. A relatively large number of projects have been initiated, the activity is particularly significant in the public sector (such as solar roofs in schools, social protection institutions, hospitals, etc.) and commercial buildings. 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.

There is a great potential for the use of solar energy for the preparation of domestic hot water in buildings. The participation of solar energy for heating and preparation of hot drinking water is predicted to be 3% by 2030, with the installation of around 50,000 solar systems. This is particularly significant in the context of climate change, which causes ever-increasing peak loads on the power grid during the summer.

To increase the use of solar energy for heat production, it is necessary to encourage the development of district heating that supplies heat for sanitary water heating as well. In particular, a solar feasibility study should be required for design and construction of new buildings. In addition, with the reduction of electricity price subsidies, solar collectors will become more and more competitive.

3.2.4 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. Geothermal energy in Bosnia and Herzegovina was researched in the previous four decades primarily with the aim of determining the amount of hot water. However, deep drilling for the purpose of exploitation was never undertaken. According to the conducted researches, it was

⁴⁵System *Ecologica* near Srbac, the only major biodiesel plant in Bosnia and Herzegovina, which was in operation since 2008 and exported all its production to the EU, Serbia and Macedonia, ceased production in 2013.

established that about 25% of BiH is considered to be potential geothermal resource of three types: hydrothermal systems, geo-pressurized zones and hot dry rocks. Average temperature gradients for individual areas are determined as follows: Pannonian area 50 K/km, Adriatic Sea 25 K/km, Dinarides 15 K/km. Prospective areas for the exploitation of geothermal energy are the central and northern parts of Bosnia and Herzegovina. These are the tectonic lines Zvornik – Dobož – Bosanski Novi – Ilidža – Kiseljak – Busovača.

Research has shown that in the territory of Bosnia and Herzegovina there are 44 sources of geothermal water with a fluid temperature above 20 °C, of which 28 sources are in the territory of the Federation of Bosnia and Herzegovina, and 16 in the Republika Srpska. The temperature of these thermal waters ranges between 35 and 150°C. Total thermal power that can be obtained directly (sources with water temperature above 50 °C) is about 24 MW, and with the help of heat pumps sources with lower temperature can provide about 155 MW of thermal power. This is about 10% of the total power of existing district heating in Bosnia and Herzegovina. The thermal power of the sources was calculated assuming the use of thermal energy for space heating until the temperature drops to 40 °C. In the second case (heat pumps), the thermal power of geothermal sources was calculated with the assumption of lowering the temperature to 5 °C also for heating purposes.

If all registered geothermal sources in Bosnia and Herzegovina were put into use with a utilization factor of 0.5, it would be possible to generate 145.75 TJ of energy in one year only for space heating, i.e. a total of 1,421.75 TJ of energy, if space heating is considered together with hot domestic water.

The main problem of insufficient utilization of geothermal potentials with higher temperature levels (50 °C and above - direct use) is the distance between locations of head demands and sources. So far, there is no significant use of geothermal energy for energy purposes in Bosnia and Herzegovina, except for heating greenhouses in Posavina, and several studies for the construction of a central heating system in the municipality of Gračanica based on the combined use of geothermal energy and energy from biomass. There are preliminary designs for the construction of a geothermal power plant in the area of Ilidža (Sarajevo), where electricity is expected to be generated from three new wells that should produce 100 kg/s of geothermal water at a temperature of 120 °C. The same source could be used for the development of district heating for residential areas in Ilidža. However, funds for exploratory drilling are lacking. The situation is similar in the vicinity of Tuzla, where a maximum temperature of 118.3 °C and a source yield of 30 l/s were found at a drilling depth of 3,532 meters.

There is a relatively large number of examples of the use of low-enthalpy geothermal sources using heat pumps. The largest number of these examples is related to the area of northern Bosnia where underground water is used in the heat pump system. Examples of the use of geothermal waters can be found in spa resorts (e.g. Fojnica), ethno-villages, etc. An example of the first relatively small district heating using geothermal energy can be found in Višegrad and Andrićgrad.

Several cities have the potential to develop district heating based on geothermal energy. UNDP has developed a NAMA project for Višegrad, and preliminary analysis have also been prepared for Breza. An analysis is being prepared for heating the urban part of Fojnica with geothermal energy.

Estimated prospectives for the use of geothermal energy in Bosnia and Herzegovina in the future are related to several areas, specifically:

- in agriculture for food production (agriculture and aquaculture),
- in the municipal sphere for heating and cooling buildings,
- in the healthcare industry,
- for tourism, and
- for the generation of electricity through mini power plants.

However, realistically looking at the previous research into the potential of this resource and the current available technology for the application of geothermal energy, the application of geothermal energy in Bosnia and Herzegovina will be limited to the current application sectors (agriculture, health, recreation), possibly heating and tourism, while generation of electricity is not expected in the coming period, nor are there any incentives planned. There are several reasons for this state of affairs, the main one being insufficient research of the locations and potential of geothermal energy, in general, and especially for the purpose of heating and possibly electrical power generation.

3.2.5 Scenarios for the reduction of GHG emissions in the RES sector

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. These scenarios do not take into account the potential for reducing emissions in the energy sector, which was taken into account in the previous chapter.

Reference scenario (S1) 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.

Moderate mitigation scenario (S2) 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 analysing of the cost-effectiveness, sustainability, and increasing energy efficiency, applying limited models of support and incentives.

Mitigation scenario (S3) 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 m² where this is technically and economically justified, definition of a GHG emission reduction target at 40% by 2030, 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 100,000 m² by 2030, 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.

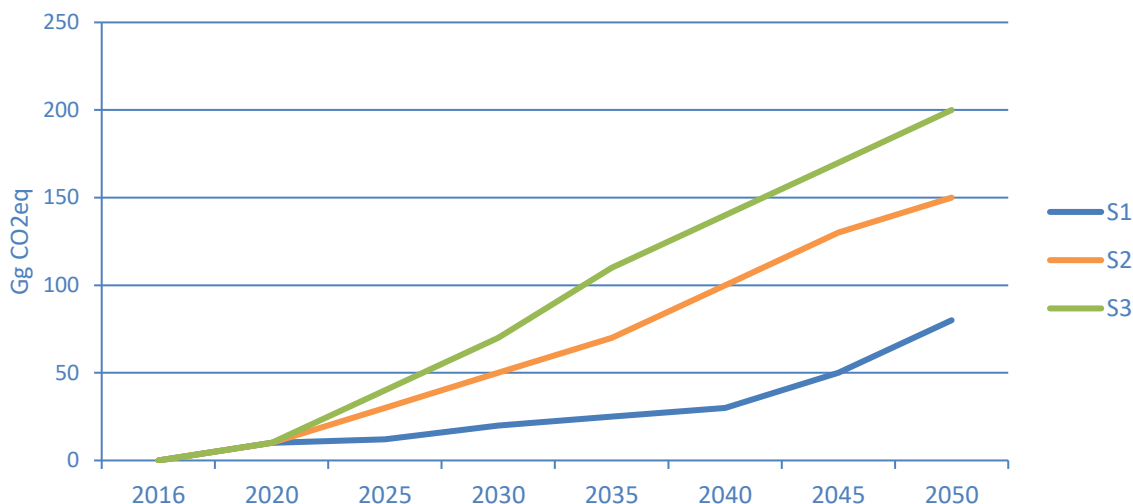


Figure 16: Savings in GHG emissions as a result of use of RES in Bosnia and Herzegovina for the three described scenarios

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 a rather mild upward trend of the effects on emissions, which is a result of quite limited and modest use of renewable energy sources in the observed period. Emission savings at the end of the period are higher in this scenario as well, which is a consequence of the market competitiveness of RES (even without active policy measures). Compared to the emissions generated in the most efficient emission sectors (electricity sector, heating, etc.), the obtained values of savings can be considered modest. However, their overall benefit is significantly greater. Given that scenarios S2 and S3 imply significant use of the renewable energy sources, the effects of emission reduction are more significant than in the case of 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 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 Situation in the district heating sector

District heating in Bosnia and Herzegovina is at the top of the priorities of all strategic documents, but the situation in that sector is quite complex. Many district heating systems are outdated and require significant investments, and if we add to that the fact that many of them are subsidized, then we come to the conclusion that their long-term sustainability is at risk. Furthermore, the regulatory framework is created differently from case to case, e.g. there are significant differences in tariff systems in different municipalities and cities. Thermal energy is still predominantly billed per square meter and not per delivered heat, which is not sustainable in the long term.

In the early 1990s there were about 30 district heating systems (DHS) in Bosnia and Herzegovina which were available exclusively in urban areas or in certain cases only in parts of urban areas. The operation of these plants was mainly based on outdated technology and inefficient heat energy production. In addition, buildings that are connected to district heating systems are mostly energy inefficient, which generates costs that exceed income, which ultimately affects the increase in the price of heating, and consequently also the reduction of consumption, i.e. of using district heating. The purchasing power of customers has decreased, which has made district heating very sensitive to sociological and political issues.

According to the available data, in 2018 there were 32 companies in Bosnia and Herzegovina, i.e. major district heating systems that supply of thermal energy to consumers. Total heated area of all district heating systems at the level of Bosnia and Herzegovina in 2018 was about 10 million m², with the largest systems located in Sarajevo (about 3,000,000 m² of heated area), Banja Luka (about 1,350,000 m² of heated area) and Tuzla (about 1,000,000 m² of heated area). According to the thermal energy balance for 2015, losses in the distribution of thermal energy amounted to 6.53%.⁴⁶ In the period 2011-2015, Bosnia and Herzegovina had a downward trend in the thermal energy generation by an average of 3.0% per year.

The share of district heating in meeting heat demands in buildings in Bosnia and Herzegovina in 2017 was about 7%. Heat generation from district heating in 2017 amounted to 1.61 TWh (5,793 TJ), while the losses from production to consumption amounted to 438 TJ (Agency for Statistics of Bosnia and Herzegovina). Assuming that the average efficiency of heat generation is 20%, it is concluded that the amount of energy in fuels that was consumed in district heating in 2017 was 7,241 TJ. Figure 17 shows the share of individual fuels from district heating in 2017.

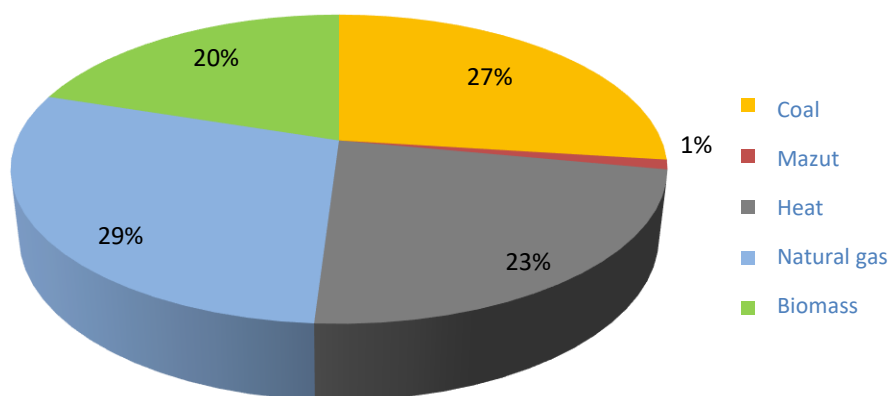


Figure 17: Share of individual fuels in heat generation in district heating in 2017

Natural gas, heat from coal-fired thermal power plants and industry, biomass and coal are used as fuels. District heating systems that are located near thermal power plants and industrial capacities are normally supplied with thermal energy from these plants (Tuzla, Lukavac, Kakanj, Ugljevik, Zenica). Some of these plants required steam for their technological processes. Due to this connection between district heating and industrial plants, district heating systems that rely on such plants are designed to use steam to obtain hot and/or warm for heating purposes. Small communities also have district heating systems, but those are mainly small systems used for the needs of public institutions and smaller settlements. Concentration of district heating systems in the areas of coal deposit basins is evident, and a certain number of business entities that provide thermal energy supply services are connected to local thermal power plants that use local fuel.

A general problem of almost all systems constructed before late 90s is that they are oversized. The plants are designed for a much larger number of customers than they currently have. In addition, the calculation method used ensured that the system can heat premises adequately at extremely low outdoor temperatures. This also represents a great potential for expansion, because many SDGs can increase consumption by up to 30% based on existing capacities. Given that all systems only provide heat for space heating (not for domestic hot water), their annual utilization amounts to about 20%. In addition to high heat losses, hot water leaks are also a problem. An additional problem is the low energy efficiency of buildings. Bearing in mind the tariff system, which in most cases is payment per square meter of heated space, this has a particularly negative impact on the sustainability of the district heating system.

⁴⁶Framework energy strategy of Bosnia and Herzegovina until 2035 (Official Gazette of Bosnia and Herzegovina, 70/18)

3.3.2 Scenarios for the reduction of GHG emissions from district heating sector

To overcome the current situation, it is necessary to undertake a series of measures that would lead to an increase in the overall efficiency of the generation and distribution of thermal energy, and thus the competitiveness of companies for the generation and distribution of thermal energy, which is a prerequisite for increasing the share of district heating in the total heated area. The applicability and representation of these measures will be different for each of the district heating systems, but in general, these measures would lead to a significant improvement in the functioning of the entire district heating system. In general, the mentioned measures can be divided into measures related to generation and those related to distribution, as well as measures related to consumption.

According to GIZ data⁴⁷, in 2015, the consumption of energy products based on wood residues amounted to about 220,000 tons. In 2020, utilization of the natural potential of wood residues is expected to be slightly more than 11%. This speaks of the growth potential of the share of biomass in district heating.

The strategic goal is that by 2050 the share of district heating in total heat needs is three times higher than the current one (in 2017), i.e. about 25%. This means that Bosnia and Herzegovina will get closer to the EU's target for 2030 (share of district heating in total heat needs 30%). Specific consumption of thermal energy is decreasing in line with the implementation of the existing legislation, but significant improvement of legislation is envisaged during the next period. Renewable energy sources are intensively being introduced in higher percentages in the district heating systems, particularly biomass (mainly in cogeneration plants) and geothermal energy, whereby a portion of the thermal energy would be used for central preparation of domestic hot water (DHW). These measures, along with appropriate legal solutions (e.g. banning the use of coal in individual fireplaces in some cities), would significantly contribute to the improvement of air quality in those cities, increase the comfort of living, and would also improve the business conditions of district heating companies. Construction of several cogeneration plants for the thermal treatment of waste is also foreseen, as well as phasing out of coal and fuel oil in district heating systems as of 2035, and increase in efficiency in thermal energy generation and distribution. 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.

Reference scenario (S1) – Only new buildings, with lower energy consumption, will be connected to the district heating system and the dispersion of energy sources remain as foreseen by the existing strategic documents. The percentage of district heating share will not be changed compared to the existing one, and the same goes for the efficiency of the production and distribution of thermal energy, and the scenario does not envisage the establishment of new district heating companies.

Moderate mitigation 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 district heating system will be about twice as large as the current one. Dispersion of energy products remains as envisaged by the strategic documents, with greater share of renewable energy sources (biomass, geothermal energy directly and via high-power heat pumps). All these measures should contribute to the improvement of living comfort, a higher overall degree of usefulness of thermal power plants and the improvement of air quality in cities with district heating systems. This scenario also envisages a slight increase of efficiency in generation and distribution of thermal energy.

Mitigation 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 three times higher than the existing one, and the share of district heating in covering heating needs will be 30%. Specific consumption of thermal energy is decreasing in line with the implementation of the existing legislation. Renewable energy

⁴⁷ *Conduction of a biomass market survey in Bosnia and Herzegovina*, GIZ, 2018.

sources are intensively being introduced in higher percentages in the district heating systems, particularly biomass (mainly in cogeneration plants) and geothermal energy (especially high-power heat pumps based on low-temperature heat sources such as purified waste water, whereby a portion of the thermal energy would be used for central preparation of domestic hot water (DHW)). These measures, along with appropriate legal solutions (e.g. banning the use of coal in individual fireplaces in some cities), would significantly contribute to the improvement of air quality in those cities, increase the comfort of living, and would also improve the business conditions of district heating companies. This scenario envisages construction of several smaller heating plants that will use municipal waste for energy, phasing out of coal and fuel oil in district heating systems as of 2035, as well as increased efficiency in production and distribution of thermal energy.

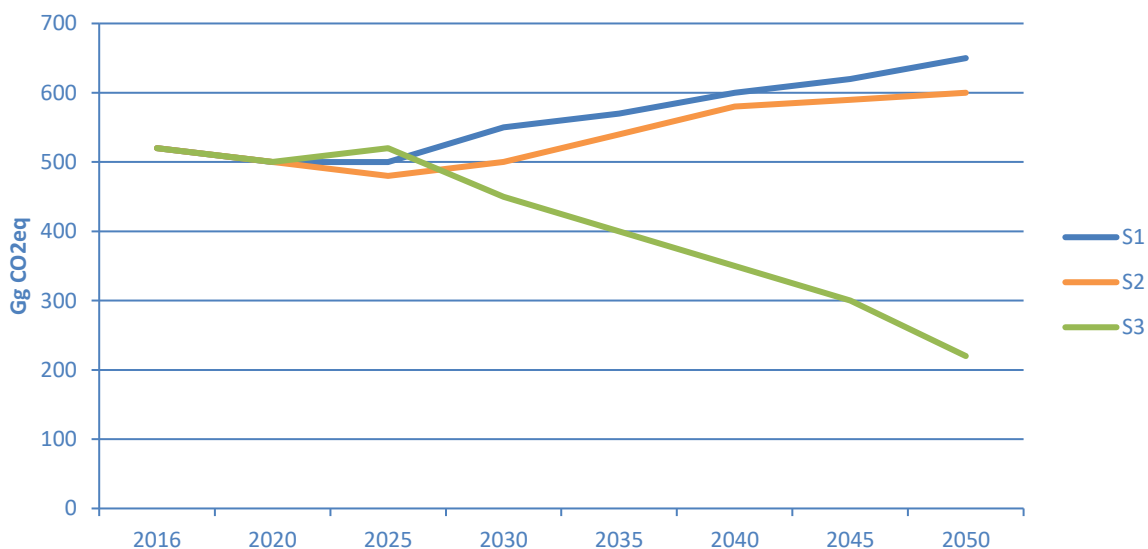


Figure 18: Emissions from district heating systems by scenarios

In S3, there is an increase in emissions until 2025 due to the overall growth of the DHSs, i.e. their expansion with a low level of decarbonisation. In other words, this means that systems are expanded based on existing capacities. After that, there is a downward trend in emissions due to the reduction in the use of fossil fuels with the increase in consumption. In S1 and S2 there is an increase in emissions, because growth is based on existing capacities, without a significant improvement in efficiency and with a low rate of decarbonisation.

3.4 BUILDINGS

3.4.1 Situation in the field of building construction

The building sector in Bosnia and Herzegovina, which includes households and facilities where public and commercial services are provided, consumes about 58.44% of total energy. In developed countries, this consumption amounts to about 40%, but due to the relatively high energy needs (primarily for heating) of the existing building stock on the one hand and insufficiently developed industry, the share of the building sector is significantly higher compared to developed countries. Therefore, one of the priority goals should be finding ways to reduce energy consumption in both existing and new residential buildings.

The main source of energy for heating in Bosnia and Herzegovina is wood biomass and coal. About 88% of the housing sector is heated by individual boilers and furnaces. The basic characteristic of these energy conversion technologies for both coal and biomass is a relatively low degree of efficiency, lower than 60%. The market of boilers and furnaces is not regulated so that some manufacturers on the market do not have adequate certificates for the efficiency of their products.

On the other hand, imported boilers and furnaces, which are not designed for domestic coal, are used which causes low efficiency of conversion of primary energy into useful energy and greater air pollution. According to data from the Survey on Energy Consumption in Households conducted by the Agency for Statistics of Bosnia and Herzegovina in 2015,⁴⁸ the dominant method of heating is with household furnaces with a share of 72.90%, 7.9% of households are heated by district heating, and approx. 19% of households have their own central heating systems - floor heating.

According to data from TNC, the following fuels are used for household furnaces: logs 77%, electricity 12%, natural gas 2% and coal 9%. The previous data shows that the share of coal in individual heating systems is very small. The reason for this is that official statistics do not take into account the coal black market (private pits and coal theft).

The housing stock of buildings in Bosnia and Herzegovina consists of 861,965 buildings, with 1.619.865 1,619,865 housing units - apartments, with a total gross area of 162,928,630m². The dominant type of residential buildings are detached family houses with 93.91% of the total number. Their total area is 120,100,130 m² (73.71% of the total housing stock). They contain the largest number of residential units (63.49%), while the lowest is in skyscrapers (0.79%).

The final draft of the long-term Strategy for the renovation of buildings in Bosnia and Herzegovina until 2050 has been prepared. The Building Renovation Strategy of BiH consists of the following segments: The Renovation Strategy for Buildings Owned by Administrative Bodies at the BiH Level, The Renovation Strategy for Buildings in the Brčko District, The Renovation Strategy for Republika Srpska, and the Renovation Strategy for Buildings in the Federation of BiH. Currently, activities are being carried out to update the mentioned draft documents.

3.4.2 Scenarios for the reduction of GHG emissions from the building sector

Building sector has great potential for reducing GHG emissions considering the current state and the potential of applying energy efficiency and RES. However, to take advantage of these potentials, active policy measures are needed that will initially be aimed at raising awareness and providing subsidies for measures that will lead to a reduction in GHG emissions, but will primarily reduce energy costs and reduce emissions of pollutants. This document analyses three scenarios for the reduction of greenhouse gas emission from the building sector.

Reference scenario (S1) foresees no major changes in current trends without any special measures to improve the energy efficiency of existing and new buildings. The only measure is the implementation of new legislation in the area of energy efficiency of residential buildings, which has already been adopted or is being updated, and which should result in an average reduction of energy consumption in residential buildings by 2050 to maximum 140 kWh/m²a.

Moderate mitigation scenario (S2) envisages implementation of energy renovation measures for existing buildings, as well as the construction of new energy-efficient buildings, which should result in average consumption of energy for heating of residential buildings of 95 kWh/m²a by 2050. In addition to the renovation of old residential buildings with the aim of improving their energy efficiency, and thus reducing energy consumption for their heating, the percentage of centrally heated apartments through city heating plants is expected to increase to 25% in the Federation of Bosnia and Herzegovina and 14% in Republika Srpska. Also, a gradual reduction in the use of coal and fuel oil for heating is foreseen, which should lead to full termination of their use by 2025. Greater use of RES through solar collectors for the heating of DHW is

⁴⁸Preliminary results of the survey on energy consumption in households, Agency for Statistics of Bosnia and Herzegovina, 2015, <http://www.bhas.ba/tematskibilteni/PotrosniaEnergijeFinalSR.pdf>

foreseen. An increase of 1.2% per year in the consumption of energy used for the preparation of DHW is predicted due to the increase in the standard of living.

Mitigation scenario (S3) is quite similar to S2, except that RES are applied more intensively, as well as measures to improve the energy efficiency of existing buildings by carrying out works on their renovation, and intensive implementation of the provisions of EU directives and regulations. It is predicted that all this in combination should lead to a reduction of average energy consumed for heating residential buildings to 70 kWh/m²a. Also, the share of apartments heated through district heating increases, due to increasing rate of urbanisation, and will amount to 35% in the Federation of Bosnia and Herzegovina, and 20% in Republika Srpska. In accordance with the enacted entity strategies, a change in the structure of energy sources can also be expected, as well as termination of the use of coal and heating oil by 2025. Greater use of RES is also foreseen, primarily through the use of solar collectors for heating DHW, as well as heat pumps for heating buildings. Due to the increase in the standard of living of citizens, an annual increase of 1.5% in energy consumption for the preparation of DHW is expected.

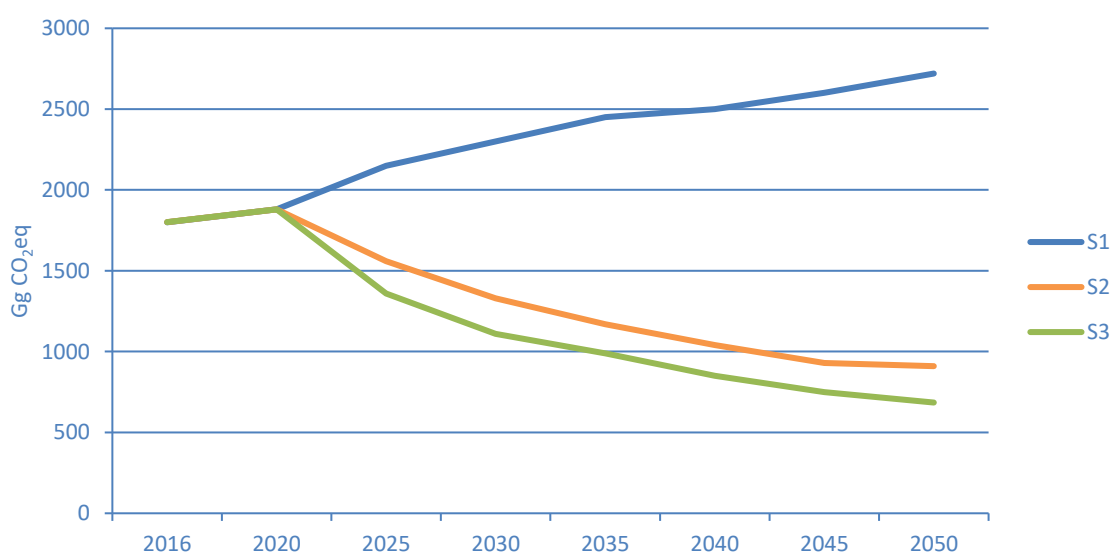


Figure 19: Emissions from the housing sector (residential and non-residential building) by scenarios

In case of failure to take policy measures to reduce emissions, emissions will increase by over 50% by 2050. On the other hand, in the mitigation scenario, emissions will be reduced by about 62% until 2050.

3.5 TRANSPORT

3.5.1 Situation in the transport sector

There is an upward trend in GHG emission from transport. The main reason for this is the increase in the volume of traffic (shown in chapter 1.6.3) combined with stagnation or very slow growth of the share of electricity in transport. As a member of the Energy Community, aims to increase the share of RES in transport to 9% by 2030. This goal should be achieved through a combination of increased share of electricity and liquid biofuels. This requires introduction of active policy measures such as taxing vehicles based on fuel consumption and stimulating purchase and use of electric vehicles, which should be accompanied by the construction of infrastructure (charging stations, spare parts, etc.). In addition, the potential for reducing GHG emissions lies in shortening the distance between cities by building new roads, increasing rail transport, electrifying public transport and promoting non-motorised transport.

3.5.2 Scenarios for the reduction of GHG emissions from the transport sector

Three scenarios of GHG emissions in the transport sector for the period 2016–2050 were analysed.

Reference scenario (S1) – is based on upward trends where increase in the number of road vehicles is expected by an average annual rate of about 3% (increase rate for the period 2012–2017), with the average age of the vehicle fleet from 12 to 15 years, without the implementation of measures of approval and with an average annual rate of increase in diesel and gasoline fuel consumption of 2%. The scenario assumes that greenhouse gas emissions produced by road motor vehicles will grow somewhat slower than the increase in the number of vehicles (due to a slight increase in vehicle energy efficiency). In relation to the age of the vehicle fleet in Bosnia and Herzegovina, it is calculated that the average carbon dioxide emission from road vehicles is around 185 g CO₂/km (at an average consumption of 6.5 l/100 km for diesel and about 7.0 l/100 km for petrol vehicles). This scenario is also based on currently applicable local legislation and trends in other subsectors of transport in Bosnia and Herzegovina. S1 also predicts growth in the volume of freight transport and maintaining the existing ratio of road and rail transport in total tonne and passenger kilometres.

Moderate mitigation scenario (S2) – is based on the introduction of additional technical measures for road vehicles to improve efficiency of engines and decrease fuel consumption. According to this scenario, the rate of increase in the number of road motor vehicles is identical to that in S1, with the provision that the quality of the fuel used as well as the road infrastructure (shortening the distances between individual cities) will be improved. An important element of this scenario is the reduction of the average age of road vehicles to 12 years by 2025. The main feature of this scenario is the reduction of the emission coefficient from 185 g of CO₂/km in the base year to 150 g of CO₂/km in 2025, with a further reduction to 120 g of CO₂/km by 2040, and then to 100 g of CO₂/km by 2050. This trend is, among other things, the result of the increase in the share of hybrid, electric and *plug-in* vehicles as well as compressed natural gas vehicles). In addition, the introduction, implementation and enforcement of EU directives in the field of transport by 2025 are also assumed. Like in S1, the volume of freight transport is expected to grow with a continuous increase in the share of rail transport in total ton-kilometres.

Mitigation scenario (S3) – is based on a significant mitigation, that is, significant reduction in emissions in the transport sector, compared to the reference scenario, through the implementation of EU directives in Bosnia and Herzegovina by 2025 (better fuel quality, more efficient motor vehicles, better tires, introduction of new regulations on the importation of road vehicles, compliance with the EU Regulation 443/2009 on the limitation of carbon dioxide emissions from new passenger vehicles to 95 gCO₂/km by 2021, and subsidizing the purchase of electric and plug-in vehicles), 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 significant increase of railway transport (50% by 2030, and 75% by 2050 share in freight transport). The result of all measures is the reduction of the emission factor by 2030 to 100 g CO₂/km, and in 2050 to 70 g CO₂/km. This scenario includes the same trend of increasing the number of vehicles as the previous scenarios. According to this scenario, the share of alternative fuel vehicles in 2050 is 40%.

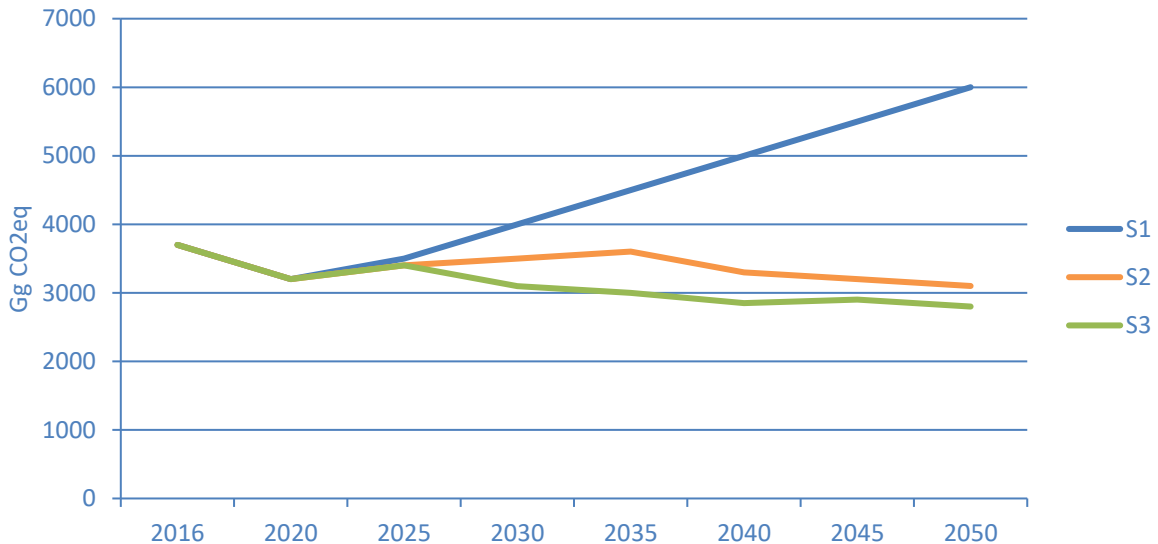


Figure 20: Emissions from transport by scenarios

In 2020, there was a noticeable drop in emissions caused by the COVID-19 pandemic. The development of transport according to S1 causes continuous growth of emissions. is a consequence of the constant growth in the volume of both passenger and freight transport without active policy measures aimed at reducing emissions. At the end of the analysed period, the emission was about 62% higher compared to 2016. Taking into account the share of GHG emissions from transport in total emissions in Bosnia and Herzegovina, this scenario would mean a significant increase in total greenhouse gas emissions. Unlike S1, S2 keeps emissions at the current level with the application of win-win measures (efficiency, growth in the share of railway transport, etc.), with relatively small incentives for vehicles with alternative fuels. It can be said that up until 2035 the emission is practically at the level of 2016, which means that the mentioned measures compensate for the increase in the volume of traffic. At the end of the period, the emission is about 16% lower compared to 2016. In S3, despite the increase in the volume of transport, already in 2030 emissions will decrease by around 16% compared to 2016. Emissions in 2050 are about 25% below emissions in 2016. Although the reduction in S3 seems insufficiently ambitious, it should be emphasized that this reduction is achieved despite a significant increase in the volume of traffic, which can rightly be expected considering that transport in Bosnia and Herzegovina is, by all indicators undeveloped now compared to transport in EU countries.

3.6 AGRICULTURE

3.6.1 Situation in the agricultural sector

According to the level of generating GDP, agriculture is an important economic activity in Bosnia and Herzegovina. Data from the Agency for Statistics of Bosnia and Herzegovina show that the GDP of agriculture, forestry and fishing in 2018 amounted to 1.968 billion KM, which is 6.90% of the GDP structure of Bosnia and Herzegovina. Agriculture, forestry and fishing recorded a slight growth compared to 2017, when the share of this sector in GDP amounted to 6.57%.

According to data from the 2018 Workforce Survey, the number of individuals employed in the agriculture sector was approximately 129,000 (62% of men and 38% of women), which is 15.7% of the total number of employed individuals in Bosnia and Herzegovina. The average number of employees compared to 2016 decreased by approximately 15,000. Existing analyses and studies indicate a decrease in rural population, and an increase in the aging trend of the rural population.

Statistical data show that agricultural land in Bosnia and Herzegovina takes up approximately 47% of the total land area. In the structure of agricultural land, the largest area is occupied by arable land and vegetable gardens (46.5%), pastures (26.8%) and meadows (19.4%).

Official data on irrigated areas in Bosnia and Herzegovina do not exist, but this is a very symbolic percentage of only 0.65%.

The share of agricultural land per capita, on average, is 0.66 ha, and for arable land and vegetable gardens it is 0.31 ha. There is an evident trend of continuous reduction of total agricultural areas, especially arable land. According to Ljuša et al. (2015.)⁴⁹, agricultural land 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 transition to the forest area (2,329.47 ha), and water areas (318.70 ha). The trend of reduction of agricultural land continued in the period 2012 - 2018, but on a much smaller scale. Data show that there was a decrease in agricultural land in the amount of 2,382 ha (Čustović et al., 2018). 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 .

According to data from the Census of Population, Households and Dwellings (2013.), the total number of households engaged in agricultural activity is 363,394, of which 16% are commercial. Holdings are small and fragmented, causing low productivity and modest overall efficiency. Production is mostly mixed. The total number of agricultural farms registered in the Register of Farms and the Register of Clients in 2016 was 100,693 and it is continuously increasing. These registered farms are entitled to incentive funds for agricultural production.

A small part of the production is organized in modern, well-equipped farms. Data from the Agency for Statistics of Bosnia and Herzegovina for 2016 show that, in terms of numbers, the highest number is that of poultry (20.2 mil.), sheep (1.01 mil.), pigs (0.54 mil.), and cattle (0.45 mil.). The number of breeding cattle and fattening animals has decreased, which is partly caused by the lack of local fodder, which was further decreased due to bad weather. The trend of inadequate disposal and utilization of manure is also evident.

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 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 GHG emissions below the current level. Legislation related to the application of measures of good agricultural practice in terms of does not exist, however, through implementation of individual projects such measures are being implemented and farmers are being trained.

The reasons for constant changes in the sown areas, assortment of cultures, below average yield, etc., as well as the great stagnation of the sector in general lie in the agricultural policies applicable in the country.

⁴⁹Ljuša, M., Cero, M., Čustović, H. (2015.): Promjena namjene poljoprivrednog zemljišta i funkcija tla u Bosni i Hercegovini u periodu 2000–2012. godine, Radovi Poljoprivredno-prehrambenog fakulteta Univerziteta u Sarajevu, Godina LX, broj 65/1, 7–16

3.6.2 Scenarios for the reduction of GHG emissions from agriculture sector

Potentials for mitigation of climate change effects in the agricultural production in Bosnia and Herzegovina can be observed from two aspects: 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 Bosnia and Herzegovina for the main greenhouse gases amounts to approximately 1,305 Gg CO₂eq per year.

Another aspect of research of climate change mitigation potentials refers to the annual GHG emissions from the agricultural production sector.

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, accession of Bosnia and Herzegovina to EU, trade liberalization. Out of the internal factors, the most important ones include: vision for the development of agriculture and rural areas, legal framework in the country, policies, measures and investments that are directly linked to climate change - mitigation and adaptation, programmes and incentive measures for agricultural production, use of pre-accession funds, trends and levels of production, achieved level of technical and technological improvement in individual sectors, demand for domestic products. Further below we analyse three scenarios for mitigation of climate change in the agricultural sector, with the main starting points for each scenario as described.

Reference scenario (S1) – Starting point of S1 scenario, from the standpoint of greenhouse gas emissions in agriculture, is the least favourable. 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 overall economy remains at the same or similar level (up to 6.8% in GDP structure), which is significantly affected by climate change. Under this circumstance, the industrial sector is not developing significantly and therefore the 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, according to estimates up to 30% more nitrogen or 90 kg N on average. In addition to the above, an increase in irrigated areas of up to 3% is expected, which also increases the need to use mineral fertilizers, and thus the increased emission of greenhouse gases. Organic agriculture is not developing dynamically and it has a symbolic importance in the overall agricultural production. Generally, it is predicted that livestock production will increase by up to 20% in milk production, beef and pig breeding by 2050. An increase in poultry farming of up to 35 – 40% can be expected by 2050. Along with the increase in livestock and poultry production, the need for food production for livestock and poultry farming will also grow. It is expected that the trend growth will be the same or by 20-30% higher on average, which will require an increased change in mineral fertilizers, manure and irrigation.

Moderate mitigation scenario (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. The overall physical growth and productivity of agricultural and livestock production will be similar to scenario S1, with the fact that in this scenario gas emissions will be lower compared to S1 thanks to the application of a series of measures. . Climate change makes an integral part of sectoral policies, strategies and the incentive programmes.

Mitigation scenario (S3) – Starting point of the S3 scenario is the transposition of all the requirements of EU directives in agriculture and that the agricultural policy of BiH is developed in accordance with the EU Common Agricultural Policy. Total physical growth is similar to scenario S2, and the productivity of agricultural and livestock production will increase further. Measures to reduce emissions will be significantly improved and advanced, which should contribute to the reduction of total GHG emissions from agriculture. Efficient use of European funds and available funds for the promotion and development of the sector will be critical, including the so-called green payment for three measures: crop diversification, ecologically forced areas and permanent grass areas. Climate change is fully integrated into sectoral policies and incentive programs. Strategic documents are implemented in full accordance with action plans. Degraded land surfaces are successively restored through reclamation and remediation measures. Farms are modernized, high technical and technological measures and standards are applied, as well as Codes of good agricultural practice.

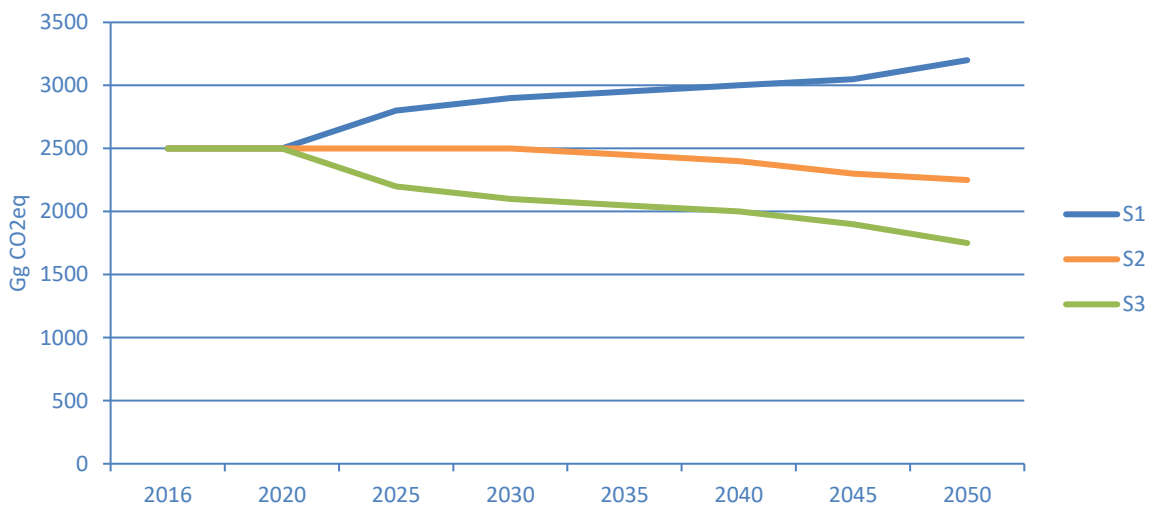


Figure 21: Emissions from agriculture by scenarios

According to the presented figures, the total GHG emissions in the sector of agricultural production based on the S1 scenario will rise by 2050, when it will amount to 3,268 Gg CO₂eq (approximately 30% more than the value of the emission in 2016). In S2, the total annual GHG emission will be reduced and in 2050 it will amount to 10% less compared to 2016. The expected emission from the agricultural sector in 2050, according to the scenario S3 is at 1,760 Gg CO₂eq, which compared to 2016 represents a total decrease by about 30%. The presented data suggest that the potentials in Bosnia and Herzegovina, with a strict application of the latest developments in all aspects of production, are very large. However, when it comes to all three scenarios, the volume of production will increase, but productivity and mitigation measures in S2 and S3 will be improved and implemented, which will affect the reduction of emissions.

3.7 FORESTRY

3.7.1 Situation in the sector of forests and forestry

Bosnia and Herzegovina is among the countries with the largest forest coverage in southern Europe, and with its wealth of flora and fauna, it represents one of the most important forest areas in Europe. This unique diversity ensures the resilience of forest ecosystems to the impacts of climate change and the flexibility to adapt to those changes with the risk that some of the unique and more sensitive ecosystems might be endangered. Although small, Bosnia and Herzegovina is a country of high bioecological potential at one of the "focal points" of world biodiversity. At the same time, forestry is considered to be one of the most important

sectors in terms climate change mitigation, and one of the most vulnerable sectors in terms of climate change adaptation.

Forests and forest land in Bosnia and Herzegovina encompass an area of 3,231,500 ha or 63.08%, while the area covered with forest is 2,904,600 ha or 56.7% of the total territory of Bosnia and Herzegovina. According to the data from the Statistical Yearbooks of the Federal Institute for Statistics and the Institute for Statistics of Republika Srpska, in 2017 forests in Bosnia and Herzegovina covered 2.88 million hectares, which is 56.33% of the total area of Bosnia and Herzegovina.

There is no integrated and harmonized data on surface areas, stocks of wood mass, and trends in the field of forestry in the territory of Bosnia and Herzegovina. Nevertheless, it is very certain that there is a large share of coppice forests (forests of lower economic value) on an area 1.25 million ha or 38.75% of the total area⁵⁰. These forests do not use the habitat to its full capacity and that in the coming period, with greater investments and better management systems, they could be “transformed into a higher cultivation form”, i.e. benefit more from them. The area of 187,200 hectares of bare land (or 5.7% of the area of forest land) is also an area where more work can be done in terms of their afforestation, thus increasing the direct area under forests and higher productivity.

Currently, beech forests cover the largest areas in Bosnia and Herzegovina (30.92%), followed by oak forests in various forms (30.89%) and finally by mixed deciduous-coniferous forests (23.61%). This composition of forests is the result of habitat conditions and can be evaluated as partially favourable from the aspect of climate change. However, it is certain that, in the coming period with the application of the “close-to-nature” management system and greater acknowledgement of the presence of climate change, the share of “better adapted species” will be more prominent. The total annual increase in wood stock (not including branches, stumps and underground parts) in all forests in Bosnia and Herzegovina is slightly higher than 14 million cubic meters, which is significantly more than the volume of felling (Mataruga et al., 2019)⁵¹, but at the same time, it is an indicator that the use of habitat conditions could be improved and greater growth and yield achieve.

3.7.2 Scenarios of GHG sinks in the forestry sector

The proven upward trend in the volume of felling in the last 10 years is not followed by an increase of the same intensity in areas covered by forests, which can be characterized as a negative effect in terms of GHG emission reduction. However, measures in the field of forestry can be identified now that can contribute to the overall potential of climate change mitigation. Based on the available documents, previously defined strategic documents in the forestry sector in Bosnia and Herzegovina, international commitments that BiH has taken over and international trend, and based on sinks in forestry in the period 2010–2014, the following scenarios for the period by 2050 have been developed:

Reference scenario (S1) – is based on the detected trend of increased intensity of deforestation which was recorded in the analysed period (175,000 m³ more every year). 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 Bosnia and Herzegovina, 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 about 3%. After 2025, all forests are managed in accordance with the

⁵⁰UNDP (2014.): *Possibilities of using biomass from forestry and wood industry in Bosnia and Hercegovina*, 1–21

FAO (2015.): *The Forest Sector in Bosnia and Herzegovina Preparation of IPARD Forest and Fisheries Sector Reviews in Bosnia and Herzegovina*, 1–146

⁵¹Mataruga, M., Ballian, D., Terzić, R., Daničić, V., Cvjetković, B. (2019.): *State of Forests in Bosnia and Herzegovina: Ecological and Vegetation Distribution, Management and Genetic Variability*, edited by Šijačić-Nikolić, M., Milovanović, J., Nonić, M. in “Forests of Southeast Europe Under a Changing Climate - Conservation of Genetic Resources”. Springer, p: 3–19.

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.

Moderate mitigation scenario (S2) – is based on the application of certain stimulus measures for preserving existing forest cover. The basic measure involves stopping the upward trend in the volume of felling and thus 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.

Mitigation scenario (S3)– is based on the assumption that by 2025 Bosnia and Herzegovina will align its laws with the EU acquis in the field of forestry, whereby it would commit itself to compliance 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 over the entire surface. Every year new 100 ha of plantations are 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.

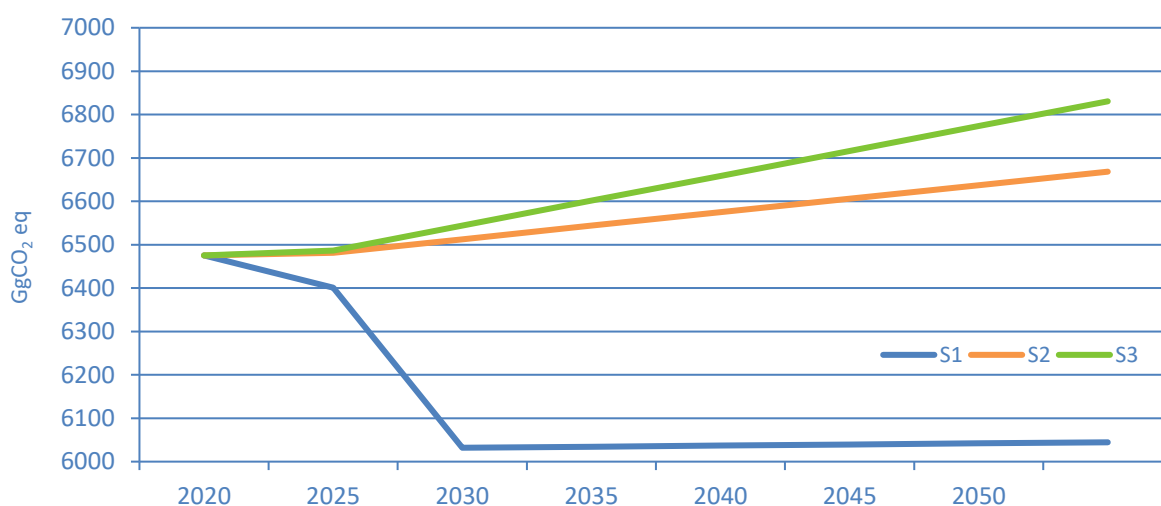


Figure 22: Projection of CO₂ sinks (Gg) in the forestry sector by scenarios

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 6,044 Gg CO₂. Under scenario 2, with the ongoing activities of the application of the adaptive system of management, afforestation of bare lands and

improved fire protection measures, the projected value of the sink capacity in 2050 would reach the value of 6,668 Gg CO₂. If all the activities as planned under the advanced S3 would be implemented, the size of the sink in 2050 would be 6,830 Gg CO₂.

3.8 WASTE

3.8.1 Situation in waste management

Based on the data available through the reports of the Agency for Statistics of Bosnia and Herzegovina and the reports of international organizations, the current situation in the waste sector in Bosnia and Herzegovina can be described using the indicators shown in Table 16.

Table 16: Indicators related to waste management in Bosnia and Herzegovina

Indicator	Unit	Value
Total amount of collected municipal waste ⁵²	tons	1,228,309
Population covered by the waste collection service ⁵³	%	77.02
Waste generation per capita ⁵⁴	kg per day	0.98
Collected municipal waste that is disposed of in landfills ⁵⁵	%	76
Municipal waste dumped in illegal landfills ⁵⁶	%	24
Regional landfills ⁵⁷	Number	7
Population covered by regional landfills ⁵⁸	%	47
Unmanaged municipal landfills ⁵⁹	Number	84
Inert waste landfills ⁶⁰	Number	1
Illegal landfills ⁶¹	Number	Approximately 1,400
The amount of waste from production and service activities ⁶²	tons	5,299,174
Waste recovery rate from the total amount of produced waste (households + industry) ⁶³	%	46
Waste that is subject to recycling ⁶⁴	%	14

Bosnia and Herzegovina has been implementing reforms in the waste management sector guided by the policy framework of the European Union for many years. Since environmental protection, i.e. waste management within the framework of environmental protection, is under the jurisdiction of two entities and the Brčko District of BiH (BD BiH), the entity governments and the Government of BD BiH are responsible for drafting and adopting their own regulations, policies and strategies. On the other hand, the competences assigned to the

⁵² BiH Agency for Statistics (2021) Public collection and disposal of municipal waste

https://bhas.gov.ba/data/Publikacije/VremenskeSerije/ENV_01.xls

⁵³ Ionkova K.M (2019) Analysis of the municipal solid waste management sector. Strategic Directions and Investment Planning by 2025, World Bank, Washington D.C.

⁵⁴ BiH Agency for Statistics (2021) Public collection and disposal of municipal waste

https://bhas.gov.ba/data/Publikacije/VremenskeSerije/ENV_01.xls

⁵⁵ Ibid.

⁵⁶ Ibid.

⁵⁷ Environmental Management Strategy FBiH 2008-2018 and Waste Management Strategy RS 2017-2026

⁵⁸ Ionkova K.M (2019) Analysis of the municipal solid waste management sector. Strategic Directions and Investment Planning by 2025, World Bank, Washington D.C.

⁵⁹ Ibid.

⁶⁰ Ibid.

⁶¹ Environmental Management Strategy FBiH 2008-2018 and Waste Management Strategy RS 2017-2026

⁶² BiH Agency for Statistics (2021) Waste from production and service activities

https://bhas.gov.ba/data/Publikacije/VremenskeSerije/ENV_03.xls

⁶³ Ibid.

⁶⁴ BiH Agency for Statistics (2020) Chemicals and waste in Agenda 2030 MD 57 Methodological document SSN 1840-488X

state administration include defining the national policy, basic principles, coordinating activities and harmonizing the plans of entity and BD BiH authorities and institutions on the international level.

In the field of legislation there have been significant developments in the period from 2001 to 2010/2011. In the Federation of Bosnia and Herzegovina, amendments to the Law on Waste Management were adopted, specifically the Law on Amendments to the Law on Waste Management was adopted in November 2017; while in Republika Srpska 2 amendments to the Law on Waste Management were adopted in 2015 and 2018.

In December 2011, the Rulebook on the management of packaging and packaging waste was adopted the Federation of Bosnia and Herzegovina, and in October 2012, the Rulebook on the management of waste from electrical and electronic products. In Republika Srpska, the Regulation on packaging and packaging waste management was adopted in 2015, and the first operator was registered in 2018.

As for by-laws, it is important to emphasize that in the period from 2012 to 2018, changes were made several times in the field of packaging and packaging waste management, as well as electrical and electronic waste management.

During that time, operators of packaging waste and electrical and electronic waste management systems were registered (a total of 4 operators from 2012 to 2018). The operator's goal is to collect the largest possible amount of packaging waste and electrical and electronic waste, and to dispose of them in the prescribed manner.

The implementation of this legislation and the level of implementation influenced the change in the waste management sector. Unfortunately, the legislation is still not harmonized in the entities of Bosnia and Herzegovina (the level of transposition of directives is not the same), nor have the same legal acts been passed (e.g. regulations on specific waste streams), which makes it difficult to predict the scenario for the whole of Bosnia and Herzegovina. In the period between the preparation of the Third and Fourth National Communication Reports on Climate Change, in November 2017 Republika Srpska adopted the Waste Management Strategy for the period 2017 - 2026, and in April 2020 RS Waste Management Plan for the period 2019-2029 was adopted. Waste management strategy in the Federation of Bosnia and Herzegovina was valid until 2018, and in most cantons, cantonal plans on waste management were drawn up (e.g. Sarajevo Canton, Zenica-Doboj Canton, Una-Sana Canton, etc.). In Brčko District, the Strategy for Environmental Protection for the period 2016-2026 was adopted, which also includes the Waste Management Strategy.

In the period after 2002 and 2003, along with the adoption of legal acts regulating waste management, the Environmental Action Plan of Bosnia and Herzegovina (NEAP) was adopted. In addition to the official acts of the institutions in Bosnia and Herzegovina, the World Bank, the Czech Development Agency and SIDA have implemented a number of significant projects aimed at establishing an integral waste management system, which are mainly related to the development of waste management programs. Also, the implementation of *the EU project for strengthening environmental institutions in Bosnia and Herzegovina and preparations for pre-accession funds*, which contributes to the progress of the environmental protection sector in the accession process to EU, has been completed. The project was completed in December 2014. As part of the project, a Directive Specific Implementation Plan for Bosnia and Herzegovina (DSIP) was drawn up⁶⁵, and Action Plans for the implementation of the EU Directive on landfills in the Federation of Bosnia and Herzegovina, Republika Srpska and the Brčko District of Bosnia and Herzegovina. The recommendations of the project for this area are that the Directive Implementation Plans (DSIPs) for each of the mentioned horizontal directives should be prepared in coordination with the Ministry of Foreign Trade and Economic Relations in cooperation with the Directorate for European Integration.

⁶⁵Landfill Directive (1999/31/EC)

3.8.2 Scenarios for the reduction of GHG emissions from the waste sector

This report predicts GHG emission scenarios for the period up to 2050. In the period from 2001 to 2010, we saw crucial developments in the waste management domain, which have already significantly affected the state of waste management. These changes affected the obtaining of reliable data on the generated and treated amounts of waste.

Reference scenario (S1) – This scenario assumes waste disposal in landfills that are not regulated (sanitary landfills Smiljevići - Sarajevo, Moščanica - Zenica, Uborak - Mostar and Korićina - Livno, Brijesnica - Bijeljina, Ramići - Banja Luka and Crni vrh - Zvornik), that is, in mainly unregulated municipal landfills, while the rest ends up in illegal dumping sites.

According to this Scenario 1, approximately 70% of totally generated waste is collected and disposed of in partially regulated landfills. The assumption is that waste disposal in unregulated landfills will continue until 2030. Considering that the illegal dumping sites are unregulated, calculation of GHG emissions 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).

Total increase in the percentage of recycling by 0.5% in the period between 2015 and 2050 indicates that the percentage of recycling will increase from 3.5% (2017) to 20% by 2050. Coverage for waste collection is increasing by 2.5% per year for the period 2016 to 2022, and from 2022 to 2030, the increase is 3% per year.

Moderate mitigation scenario (S2) – This scenario takes into account the objectives set by the Waste Management Strategy of the Republika Srpska (2017 – 2026) as well as data from the cantonal waste management plans of the Federation of Bosnia and Herzegovina (KS; ZDK; USK).

Based on the analysis of the aforementioned strategic documents, it is predicted that the annual percentage of recycling will decrease from 3% (2013) to 1% per year (2016); is 1.5% for the period 2017 - 2021, and grows by 4% per year until 2025, 1% per year from 2026 - 2032 and by 0.5% per year in the period 2033 - 2050. According to these calculations in Scenario 2, the total percentage of recycling in 2050 would be only 46%. The coverage of waste collection was 74% in 2014, and 70% in 2015 and 2016. In the period 2017-2023, coverage is expected to increase from 70% to 95%, and, and as of 2024 it should be 100%. As for treatment with other methods, such as biological treatment or incineration, a percentage of 16% is predicted by 2050. Waste treated by biological or other methods started with only 0.5% (2018).

Mitigation scenario (S3) – This scenario introduces an increased level of recycling at the source and on the landfills. This will be greatly supported by the regulations on the disposal of batteries and accumulators; rubber, glass and other waste from specific streams. This waste is currently still being disposed in landfills. The regulations will also introduce a change of billing services based on the produced amount of waste. This scenario did not take into account construction of incinerators for incineration of mixed municipality waste (i.e. treatment after recycling), production of RDF, etc. A chart was created based on the collected data which affect waste generation, such as: decrease in the number of inhabitants while at the same time an increase in waste production per capita, increase in coverage by collection services, increase in the percentage of recycling, reduction of methane emissions.

THIRD BIENNIAL UPDATE REPORT ON GREENHOUSE GAS EMISSIONS OF BOSNIA AND HERZEGOVINA
under the United Nations Framework Convention on Climate Change

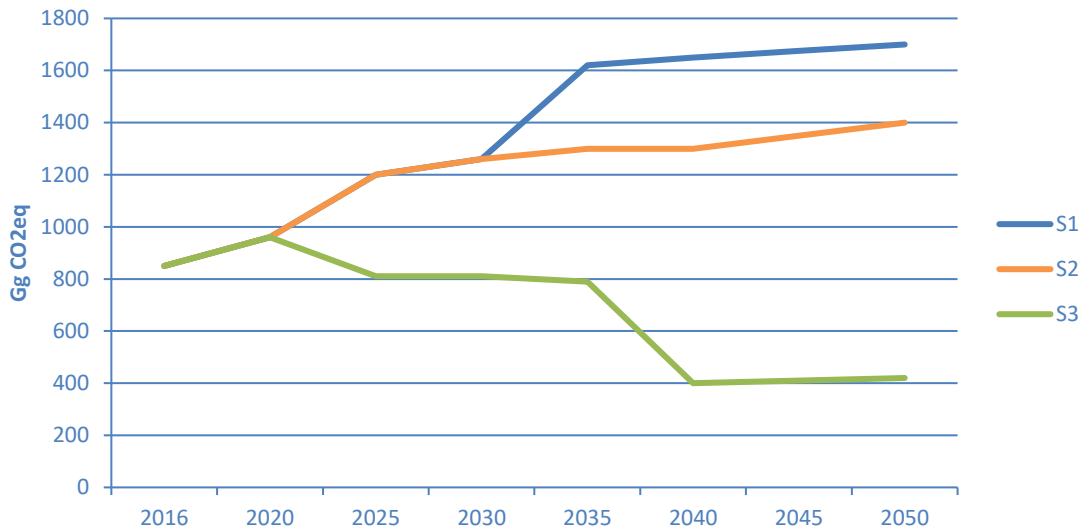


Figure 23: Emissions from waste management by scenarios

Introduction of higher degree of recycling and return Scenario 3 leads to emission reduction, because the amounts of disposed waste are thus becoming lower. Scenario 3 foresees rather high percentage of recycling (about 80% by 2025) and reduction in mechanical biological treatment due to the separation of organic waste at the point of origin and a significantly higher awareness of the population (12% by 2050). In S3, the emissions in 2050 will be about twice the emissions in 2016.

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 scenarios are obtained by summing up the respective scenarios by sectors. Summary review foresees the total mitigation potentials for each of the scenarios, not including the effects of sinks in forestry.

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. The second most significant sector in terms of GHG emissions is transport. The potential for reducing GHG emissions in the industry has not been analysed. Figure 24 shows summary scenarios of GHG emission trends until 2050.

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under the United Nations Framework Convention on Climate Change

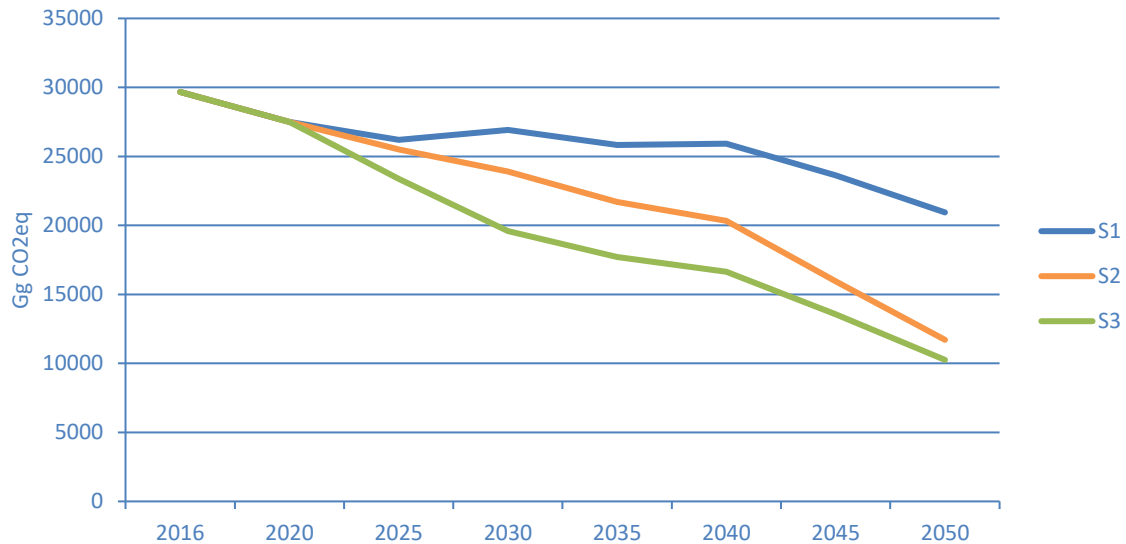


Figure 24: Total GHG emissions by scenarios

Each scenario foresees a reduction in emissions, mostly because emissions in the energy industry are reduced. According to the projected emissions, the baseline scenario, which corresponds to the “business as usual” to slight and gradual reduction in emissions, and by 2050 emissions are expected to be lower by around 29.5% compared to 2016. The emission reduction by 2030 is 11.7%, which can be considered insufficient or unambitious considering the goal for 2050 (climate neutrality). Scenario 3 is significantly more ambitious in 2030, when emissions are reduced by around 34% compared to 2016, while this amount in S2 is 19.5%. This difference is caused by a greater reduction in emissions in the energy sector in S3. In both scenarios, coal-fired thermal power plants phase out by 2050. However, in addition, the emissions in 2050 in both scenarios are higher than the projected sinks. In S2, emissions are higher by 5,042 Gg CO_{2ekv}, and in S3 by 3,425 Gg CO_{2ekv}. Given that the potentials for reducing emissions from industry were not analysed, if those potentials were also considered, S3 could mean climate neutrality for Bosnia and Herzegovina. Depending on the development of technologies, additional potentials may be in transport.

4 MEASURING, REPORTING AND VERIFICATION OF CLIMATE CHANGE MITIGATION MEASURES

4.1 NAMA MECHANISM IN BOSNIA AND HERZEGOVINA

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 of the Council of Ministers of Bosnia and Herzegovina on establishing the Designated National Authority for the implementation of Clean Development Mechanism projects under the Kyoto Protocol of the United Nations Framework Convention on Climate Change in Bosnia and Herzegovina (Official Gazette of Bosnia and Herzegovina, 102/10 and 45/15), designated authority DNA BiH is the national authority responsible for the implementation of activities that fall under the obligations defined by the Clean Development Mechanism (CDM) of the Kyoto Protocol and the implementation climate change mitigation measures (Nationally Appropriate Mitigation Actions - NAMA).

NAMA DNA's structure is composed of the Executive Board, DNA Secretariats and the Expert Councils, each with different but closely related functions, as shown in Figure 25.

The Executive Board of the NAMA DNA is consisted of representatives from the Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina, Federal Ministry of Environment and Tourism, Ministry of Spatial Planning, Civil Engineering and Ecology of Republika Srpska, and the Department for Spatial Planning and Property Affairs of Brčko District.

The Technical Secretariat has been established as part of the DNA BiH Executive Board within the Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina.

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.

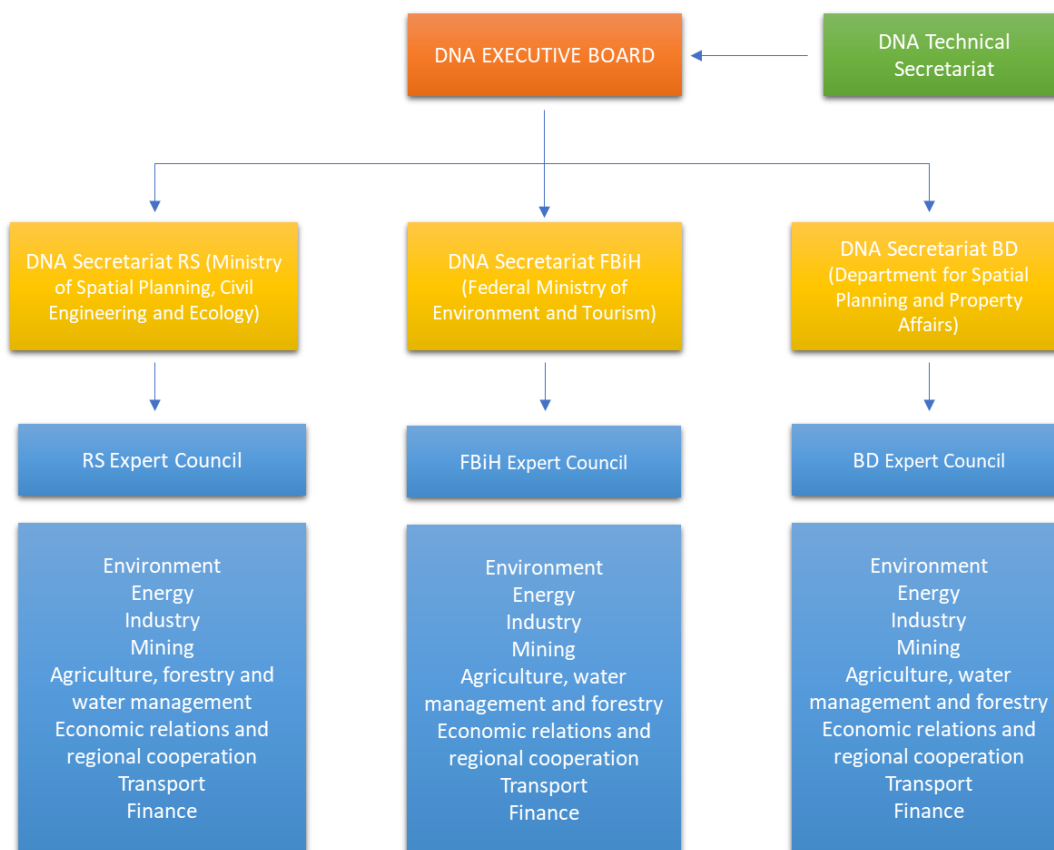


Figure 25: NAMA DNA structure

Several NAMA documents have been prepared so far. However, review of the records in the NAMA register of the UNFCCC has shown that only one project proposal is in that register. That is the housing energy efficiency project where support is sought for its implementation. In addition to that, four projects in the district heating sector have been prepared.

4.2 MEASURING, REPORTING AND VERIFYING NAMA PROJECTS

Recommendation on the Implementation of the Monitoring Mechanism Regulation (MMR) was adopted by the Ministerial Council of the Energy Community in October 2016. Based on this, member countries should harmonize their legislation to strengthen capacities and fulfil reporting obligations under the UNFCCC, introduce the same standards, create better policies and clearly define the main sources of emissions. Adequate data collection system, assessment of policies and measures as well as projection of GHG emissions are necessary prerequisites for integrated climate and energy plans.

The Energy Community currently does not have binding requirements (as stated, it is done through recommendations) related to the process of monitoring GHG emissions and other information on climate change, although there are positive developments in this direction with the adoption of the Recommendation on the Implementation of the Regulation on the Monitoring Mechanism – MMR in 2016. In accordance with the provisions of this Recommendation, the contracting parties from the Energy Community should prepare the legal and institutional preconditions for the implementation of the basic elements of the MMR Regulation in their jurisdictions. The MMR Regulation includes provisions for the monitoring and national reporting of

greenhouse gas emissions, as well as for the reporting of other information for the country relevant to climate change.

The primary goal of MRV is to establish a reliable system for data collection and reporting on GHG emissions and ways to verify that data. MRV is necessary for the valorisation of the contribution of measures to reduce GHG emissions and the achievement of development goals (of the state and/or local community). Bosnia and Herzegovina does not have a clearly defined monitoring, reporting and verification (MRV) system for data on GHG emissions. However, the rules on the preparation of the inventory of emissions are primarily prescribed by entity laws on air protection. In this context, there is no clear agreement on who will manage the GHG emissions inventory and store the data at the state level. Bosnia and Herzegovina should adopt legislation and transpose MMR by establishing a GHG inventory system at the state level, and strengthening institutional capacities and formally defining competencies and responsibilities.

By preparing and submitting national communications on climate change, biennial update reports on GHG emissions and by participating in CDM projects, Bosnia and Herzegovina has established key elements of the international MRV within the framework of the UNFCCC for developing countries. It is necessary to work on further development of the domestic MRV, which includes the MRV for NAMA projects, as well as other mechanisms of international cooperation in the field of climate change. The MRV plan should provide guarantees of credibility of measures to reduce GHG emissions by ensuring consistency, completeness, accuracy and transparency. Table 17 shows MRV characteristics.

Table 17: Characteristics of the monitoring, reporting and verification system for GHG emissions

Consistency	The same methodology is used for all years and a consistent data set is used for emission sources and sinks
Completeness	All GHG sources and sinks are reported
Accuracy	All uncertainties are minimized
Transparency	Assumptions and methodology are clearly explained

4.2.1 Monitoring

In accordance with MRV requirements, any project or program that aims to reduce GHG emissions should have an MRV plan that should include the following aspects:

- GHG emission reduction targets (target amount of emission reduction or sequestration and other benefits such as employment, air quality, etc.),
- Start and end of the activity,
- Geographic coverage,
- Indicators (estimates of trends in GHG emissions and sequestration and indicators of other benefits),
- Frequency of implementation of specific MRV activities (for example, certain data are collected every three months, reported every 6 months, verified annually, etc.),
- Responsible bodies for all activities,
- Instructions on how the collected data is reported and stored, and
- Details on the quality of the verification.

Figure 26 shows the MRV cycle for a GHG reduction project/program.



Figure 26: MRV cycle for GHG emission reduction projects/programs

The holder of the project/programme is obliged to prepare an MRV plan with the elements listed above. As part of the project/program approval procedure, the competent authority also approves the MRV plan.

For the purpose of participation in international cooperation mechanisms and receiving international assistance, it is necessary to establish and maintain a database of projects/programs for reducing GHG emissions at the state level. It is recommended that the NAMA Designated National Authority establish and maintain that database. The database should contain information on individual projects/programs in terms of the content of NAMA projects, including the MRV plan.

Monitoring of the implementation of an individual project/program is carried out by the holder who submits the data specified in the MRV at defined time intervals to the NAMA Designated National Authority.

4.2.2 Reporting

Based on the data from the monitoring of the implementation of individual projects, the designated body prepares an annual report on the results of implemented projects/programs. For the purpose of easier reporting, it is recommended to use a previously prepared reporting form that will contain the following as a minimum:

1. Data relevant to GHG
 - GHG emission sources and sinks
 - Greenhouse gas whose emission reduces or increases the sink
 - Unwanted impacts and their significance (e.g. transport emissions caused by the project/programme)
 - Impacts outside the geographical area of the project/program with an assessment of the magnitude of that impact (risk of so-called carbon leakage)
 - Risk of double calculation of GHG emission reductions or sink increases.

2. Other data

- Economic benefits (better standard of living)
- Social benefits (security of food supply, better thermal comfort)
- Environmental benefits (biodiversity, air quality)
- Resilience to climate change (reduction of soil erosion, better water availability).

The report should also contain a description of the method of data collection at the local level, the assessments used, how and where the collected data is stored and how it is used for reporting at the state level. The designated body forwards the report to the entity statistical institutes, the Agency for Statistics of Bosnia and Herzegovina, institutions that maintain the GHG inventory, the UNFCCC Secretariat, and the organization representing the partner country (if any) and the verifier.

In addition to the above, the report may contain, if applicable, corrective measures related to the method of collecting data on the effects of the project/program. For this reason, the report is also submitted to the project/programme holder.

4.2.3 Verification

The last step in MRV includes verification and quality assurance. These activities can be seen as means that ensure safety and quality, reliability of measurement and reporting. Moreover, a properly established quality control system is a guarantee that future sectoral mitigation measures and activities will be able to meet specific sectoral requirements as determined at the entity and/or state level. It follows that verification through quality control and assurance is a means to evaluate data continuously and to guarantee updates and improvements in sectoral and overall activities, projects and programs. Verification is a process of independent verification of the accuracy and reliability of the information from the report on the effects of the project/program. Verification represents quality assurance, thus contributing to the reliability of the entire MRV system.

The designated authority appoints a verifier, the so-called Designated Operational Entity (DOE) for individual projects/programmes. The costs of DOE engagement are paid by the project/programme holder. DOEs are international companies authorized by the UNFCCC Secretariat to verify projects to reduce emissions and increase GHG sinks. DOE submits the verification report to the UNFCCC Secretariat and the designated authority. If DOE identifies any deficiencies in the report, DOE provides measures to correct those deficiencies. For this reason, DOE report is forwarded to the project/program holder via the designated authority.

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List of acronyms

BD	Brčko District of Bosnia and Herzegovina
GDP	Gross Domestic Product
BiH	Bosnia and Herzegovina
CDM	Clean Development Mechanism
SERC	State Electricity Regulatory Commission
DNA	Designated National Authority
EU	European Union
EU ETS	EU Emission Trading System
EUROSTAT	Statistical Office of the European Union
FBiH	Federation of Bosnia and Herzegovina
GHG	Greenhouse gasses
INDC	Intended Nationally Determined Contribution
IPCC	The Intergovernmental Panel on Climate Change
MMR	Monitoring Mechanism Regulation
MRV	Monitoring, Reporting, Verification
NAMA	Nationally Appropriate Mitigation Actions
NDC	Nationally Determined Contribution
NERP	National Emission Reduction Plan
RES	Renewable Energy Sources
PPP	Purchasing Power Parity
RDF	Refuse-derived fuel
RS	Republika Srpska
SBUR	Second Biennial Update Report
SIDA	Swedish International Development Cooperation Agency
TNC	Third National Communication Report
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

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