# FIRST BIENNIAL TRANSPARENCY REPORT OF BOSNIA AND HERZEGOVINA UNDER THE PARIS AGREEMENT

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## List of abbreviations and acronyms

AVPS – Sava River Basin Agency

AVPJM – Adriatic Sea Watershed Agency

BD – Brčko District

BECCS – Bioenergy with Carbon Capture and Storage

Bosnia and Herzegovina – Bosnia and Herzegovina

CBAM – Carbon Border Adjustment Mechanism

CBD – Convention on Biological Diversity

CCS – Carbon Capture and Storage

CDM – Clean Development Mechanism

CEDAW - Convention on the Elimination of All Forms of Discrimination against Women

$CH_4$– methane

CNG – compressed natural gas

$CO_2$ – carbon dioxide

DERK – State Electricity Regulatory Commission

EBRD – European Bank for Reconstruction and Development

EIB - European Investment Bank

EMS – Energy Management System

ETF – Enhanced Transparency Framework (ETF)

ETS - Emissions Trading System

EU - European Union

FAO - Food and Agriculture Organization

FBiH – Federation of Bosnia and Herzegovina

FBUR – First Biennial Update Report

FIF – Financial Intermediary Funds

FMERI – Federal Ministry of Energy, Mining and Industry

GAP BiH – Gender Action Plan of BiH

GCF - Green Climate Fund

GEF – Global Environment Facility

GED – Green Economic Development

Gg – gigagram

GGF - Green Growth Fund

GHG – greenhouse gases

GWP – Global Warming Potential

HFCs – hydrofluorocarbon

IFI – International Financial Institutions

INC - Initial National Communication

INDC – Intended Nationally Determined Contribution for BiH

IPA – Instruments for Pre-Accession Assistance

IUCN - International Union for Conservation of Nature

KfW – German Development Bank

MBT – Mechanical-Biological Treatment of waste

MDGs – Millennium Development Goals

MMSP / MSMEs – micro, small and medium-sized enterprises

MRVA – Monitoring, Reporting, Verification snd Accreditation system

MSP / SMEs – small and medium-sized enterprises

MVTEO BiH – Ministry of Foreign Trade and Economic Relations of BiH

$N_2O$ – nitrous oxide

NAP – National Adaptation Plan of BiH to climate change

FNC - Fourth National Communication on Climate

NDC – Nationally Determined Contribution of Bosnia and Herzegovina

NECP – National Energy and Climate Plan

NEEAP – National Energy Efficiency Action Plan

NERP BiH – National Emission Reduction Plan for BiH

NbS – nature-based solutions

NREAP BiH – National Renewable Energy Action Plan for BiH
nZEB – nearly zero-energy buildings

OECD – Organisation for Economic Co-operation and Development

OECM – Other Effective Conservation Mechanisms

OiE / RES – renewable energy sources

OiEiEK / RES&EC – Renewable Energy Sources and Efficient Cogeneration

PFCs – Perfluorocarbon

PRTR – Pollutant Emissions and Transfer Register

RS – Republika Srpska

RX1day – maximum one-day precipitation

USA – United States of America

SBUR – Second Biennial Update Report

SDG – Sustainable Development Goals

SECO – State Secretariat for Economic Affairs of Switzerland

SF6 – sulfurhexafluoride

SKM / SPP – Standard Purchasing Power

SNC - Second National Report

SZO / WHO – World Health Organisation

TBUR – Third Biennial Update Report

TN – daily minimum temperature

TNA – Technology Needs Assessment

TNC - Third National Communication

TR 20 – number of tropical nights

TX – daily maximum temperature

UNFCCC - UN Framework Convention on Climate Change

WB – World Bank

WBIF - Western Balkans Investment Framework

WSDI – Warm Spell Duration Index

ZOE – Renewable Energy Communities

# 1 Introduction

By ratifying the UN Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol and the Paris Agreement, Bosnia and Herzegovina (BiH) has committed to report on greenhouse gas (GHG) emissions and to identify and implement measures and activities that will contribute to the achievement of the Convention's goals. In accordance with the requirements of the Convention, BiH has obligations related to preparation of national reports (communications), periodic reporting to the Convention bodies, international cooperation in the field of climate research and systematic observations, knowledge transfer and clean technologies, adoption and implementation of adaptation measures, education, training and informing the public about the causes and possible anthropogenic impacts on climate change. At the same time, the ratification of the Kyoto Protocol by BiH has not introduced new obligations in relation to the general obligations set out in the Convention.

Given the status of BiH as a member of the Convention and the Kyoto Protocol, outside the so-called Annex I (group of developing countries), BiH had no obligation to reduce GHG emissions by 2020. After 2020, this obligation is determined by the Nationally Determined Contribution (NDC) as an obligation under the Paris Agreement.

According to the UNFCCC, in accordance with the status of a developing country, BiH can be a beneficiary of climate funds in proportion to its gross national income and level of exposure to climate change. At the same time, UNFCCC mechanisms and financial resources will certainly be needed to meet the goals of the Paris Agreement. The key challenges in terms of ensuring continuous financing in BiH relate to the system of data collection and emission inventory and their verification, investment projects whose implementation affects the reduction of emissions, and damage monitoring due to climate change as well as adaptation measures. The list of priority activities is listed in the Strategy for Adaptation to Climate Change and Low-Emission Development.
Following the ratification of the UN Framework Convention on Climate Change, BiH has made a number of efforts to establish appropriate political, institutional and legal frameworks to meet its obligations under the Convention. BiH's focal point according to the UNFCCC is the Ministry of Spatial Planning, Construction and Ecology of Republika Srpska (RS).
So far, BiH has developed the following:

- Four National Communications on climate change for Bosnia and Herzegovina (NC),
- Three Biennial Update Reports on GHG emissions (BUR).

The preparation and submission of these reports is an obligation that BiH, as a Party to the UNFCCC, has in accordance with Decision 17/CP8 and other relevant documents of the Convention.
The Initial National Communication under the UNFCCC was submitted in 2010. In October 2013, the Second National Communiction under the UNFCCC was adopted and forwarded to the Secretariat of the Convention. The Third National Communication and the Second Update Report on BiH GHG Emissions in accordance with the UNFCCC were adopted by the Council of Ministers of BiH on 23.05.2017 and submitted to the Secretariat of the Convention in Bonn. Within the Third National Communication and the Second Update Report on BiH GHG Emissions, information related to climate change, GHG inventory, climate change mitigation, vulnerability to climate change and steps taken for adaptation to climate change were updated and improved, as well as information on public awareness, education, training, system research, and technology transfer.

The Fourth National Communication and the Third Update Report on BiH GHG Emissions under the UNFCCC, were adopted on 05.04.2023 at the session of the Council of Ministers of BiH (following adoption by the entity-level governments) and was forwarded to the UNFCCC Secretariat. These two reports contain an overview of updated activities and information on achieving adequate progress in the context of combating the consequences of climate change, where an integral part is the analysis of vulnerability and adaptability to climate change by sectors, with the definition of courses of action in order to further adjust them.

At its session held on 26.10.2022, the Council of Ministers of BiH adopted the National Adaptation Plan of BiH to climate change (NAP BiH) with a proposal of measures, with the aim of achieving the goals of the Paris Agreement and the 2030 Agenda for Sustainable Development. Before that, NAP BiH was supported by the RS Government and the competent ministries of the Federation of BiH (FBiH) and the Brčko District of BiH (BD BiH). It is a comprehensive document drafted primarily by domestic experts in direct coordination with the competent institutions of state entities and BD BiH, with the support of the Green Climate Fund (GCF) and coordinated by the United Nations Development Program (UNDP), with the aim of preparing for an adequate response to climate change, with a better understanding of their vulnerabilities and increasing resilience and further capacity building to combat climate change.

In BiH, the obligation to make a GHG inventory is regulated by laws at the entity level. In the FBiH, the Law on Air Protection (Official Gazette of the Federation of BiH No. 72/24) defines the obligation to establish a GHG inventory for the FBiH, which is managed by the Federal Hydrometeorological Institute. In the RS, the obligation to prepare the GHG inventory for the RS is defined by the Law on Air Protection (Official Gazette of Republika Srpska Nos. 124/11, 46/17)), and the competent institution for keeping the GHG inventory is the RS Hydrometeorological Institute. In the BD, the institutional competence for the preparation of the GHG inventory for BD is not clearly defined. Currently, BiH has not established or clearly defined an institutional system for collecting data and reporting on GHG emissions according to the Convention on Climate Change. Greenhouse gas inventories (GHG inventories) have so far been made on a project basis. The EU4Energy project, in cooperation with the competent institutions, is working on the development of proposals for the institutional system and regulatory framework at all levels necessary for MRVA and the development of GHG inventories.
The institutions responsible for the environmental management are:

- According to Article 9 of the Law on Ministries and Other Administration Bodies of BiH, MVTEO BiH is in charge of performing duties and tasks within the competence of BiH related to defining policy, basic principles, coordinating activities and harmonising the plans of entity-level authorities and institutions at the international level in the segments of agriculture, energy, environmental protection, development and use of natural resources and tourism,
- In the FBiH – the Federal Ministry of Environment and Tourism and relevant cantonal ministries, within the scope of their competences,
- In the RS – Ministry of Physical Planning, Construction and Ecology (which is the contact institution – Focal point for the UNFCCC),
- In BD BiH – Department for Spatial Planning and Property-Legal Affairs of the Government of the Brčko District.

So far, BiH has submitted two Nationally Determined Contributions for Bosnia and Herzegovina (NDCs) to the Convention, and during 2025 the development of a third one was initiated. At the same time, due to its status as a developing country, BiH has financial and other types of support (technology transfer, capacity building, etc.) available to meet its obligations under the UNFCCC.
BiH has developed an integrated National Energy and Climate Plan for BiH (NECP), which is currently in form of a draft document. Finalisation of development of entity-level energy and climate plans is

underway. NECP entails an increase in electricity production capacity in BiH by 2030. A significant increase is expected with plants for production of electricity from renewable energy sources (OIE). On the other hand, a reduction in capacity of plants with fossil fuel combustion (coal-fired power plants) is also planned. Also, the plan introduces new subcategories of plants from OIE, so that capacities within incentive programs (programs) and association with renewable energy communities (ZOE) are especially envisaged. It is planned to increase the capacity for the production of electricity from hydropower, most of which is obtained by building new capacities of large hydro power plants. The capacities of small hydro power plants are also growing, but to significantly lower extent. An increase in the capacity of wind farms is expected, most of which are large wind farms not using any support, while a smaller part is directed through support programs and through ZOE.

The largest growth is planned in capacities for electricity production in photovoltaic plants, of which the dominant plants are for the electricity production for the general market and for own consumption within the prosumer status. Also, one part of capacities is to be established through ZOE. The existing policy instruments in BiH, which regulate the framework for reducing GHG emissions, are listed in the table below.

*Table 1: Existing framework for emission reduction and reporting on GHG emissions in BiH*

| **Measures in BiH** | | |
|---|---|---|
| **Measure** | **Document/Legal basis** | **Brief description of the measure** |
| **Participation in international financial mechanisms to reduce GHG emissions** | Decision on Establishment of the Designated Authority for Implementation of the Clean Development Mechanism (CDM) of the UNFCCC Kyoto Protocol in BiH (Official Gazette of BiH No. 102/10) | It allows entities developing GHG emission reduction projects to convert emission reductions into tradable units. |
| **Forming a GHG inventory** | Law on Air Protection (Official Gazette of RS, Nos. 124/11, 46/17), Law on Air Protection of FBiH (Official Gazette of FBiH No. 72/24). Law on Air Protection of the Brčko District of Bosnia and Herzegovina – Consolidated Text (“Official Gazette of the Brčko District of Bosnia and Herzegovina”, No. 17/22)” | The GHG inventory for BiH is done on a project basis. By 2025, inventories for the period 1990 - 2018 were formed, and through the development of BTR1, the inventory for the period 2019 - 2022 was also formed. The RS Hydrometeorological Institute is the competent institution for the preparation of annual inventories in the RS, and the FBiH Hydrometeorological Institute is the competent institution for the preparation of annual inventories in the FBiH. Both Institutes are emmissions reference centres and deal with reporting. According to Article 69 of the Law on Air Protection (RS Official Gazette Nos. 124/11, 46/17), the RS administrative organisation in charge of hydrological and meteorological affairs is the RS Reference Centre for Air Quality, Air Emissions and Climate Change Mitigation, which exchanges data on air quality and emissions for reporting purposes, in accordance with the assumed international obligations of BiH, with the prior consent of the Ministry. Also, in accordance with |



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| | | |
|---|---|---|
| | | Article 69 of the FBiH Law on Air Protection (FBiH Official Gazette No. 72/24), for purpose of reporting on international obligations of BiH, the FBiH Hydrometeorological Institute participates in the exchange of data on air quality and emissions with the prior consent of the FBiH Ministry. |
| **Exclusion of ozone-depleting substances** | Decision on Conditions and Manner of Implementation of the Montreal Protocol and Gradual Exclusion of Ozone-depleting Substances in Bosnia and Herzegovina (BiH Official Gazette No. 36/07), FBiH Law on Air Protection (FBiH Official Gazette Nos. 33/03 and 4/10) - Rulebook on Gradual Exclusion of Ozone-depleting Substances (FBiH Official Gazette No. 39/05), Law on Air Protection - Decree on the Treatment of Ozone-Depleting Substances and Substitutes (RS Official Gazette No. 66/20), Law on Air Protection, Rulebook on Gradual Exclusion of Ozone-depleting Substances (BD Official Gazette No. 30/06) | Prescribed conditions and methods for gradual exclusion of the use of controlled substances and their substitution with alternative (substitute) substances, the handling of these substances, substitutes as well as new controlled substances, the handling of products containing or produced with substances, the treatment of substances after the end of use of products and equipment containing them, manner of their collection, renewal and processing, and the procedure for granting authorisations for the import, export and placing on the market of substances that deplete the ozone layer. |
| **Special environmental fees when registering a vehicle** | RS Law on Air Protection - Decision on Environmental Pollution Unit Chrges for Motor Vehicles (RS Official Gazette No. 116/2018), Decree on Special Environmental Charges Paid at Registration of Motor Vehicles (FBiH Official Gazette Nos. 14/11 and 26/11) | Prescribed unit charges for certain types of motor vehicles, based on which the environmental pollution charge is calculated, whereas vehicles with higher energy consumption pay a higher charge. |

Activities are underway to prepare for the introduction of the Emissions Trading System (ETS) in accordance with the ETS principles of the European Union (EU). A roadmap for the ETS has been developed (but has not yet been adopted), and work is underway on the development of a legislative framework for the ETS and the Monitoring, Reporting, Verification and Accreditation System (MRVA). For purposes of reporting on implementation of NECP, it is necessary to create an estimated GHG inventory each year for n-1 year and a final inventory for n-2 year. This means that BiH should have an inventory for 2024 by the end of 2025. During the development of BTR1, an inventory of greenhouse gases was prepared for the period 2019 – 2022. The project Technical Assistance for Countrywide Reporting System related to International Environmental Obligations (EEA, EIONET, EUROSTAT and International Conventions) is underway, which aims to establish a functional and sustainable reporting system according to international obligations. GHG emissions are an integral part of such reporting. Although numerous projects are being implemented that result in certain reduction in GHG emissions, there is no reporting system on these reductions. In most such projects, emission reductions are not calculated, and where there are such calculations - data are not provided because the system of collecting, processing and reporting emissions is not defined. Such a system must be created for purposes of reporting on NDC implementation.

# 2 National Circumstances

## 2.1 Country Structure, Institutional and Legal Framework

BiH is a complex and decentralised state with a specific political and administrative arrangement resulting from the 1995 Dayton Peace Accord. The state consists of two entities: FBiH and RS, and BD BiH, which has a special status. This structure of government directly affects the management of sectors such as environmental protection, energy, economy, judiciary and other areas.

At the BiH level, certain competencies are entrusted to state institutions, while the entities are in charge of most areas, including the environment, energy and resources. Key institutions at the BiH level include:

- BiH Presidency – a collective three-member body consisting of representatives of the three constituent peoples,
- Parliamentary Assembly of BiH – a legislative body composed of two Houses: the House of Representatives and the House of Peoples,
- Council of Ministers of BiH – an executive body that coordinates the work of ministries and implements decisions at the level of BiH.

At the BiH level, competencies are limited, and key institutions dealing with environmental, energy policy and climate change issues include:

- According to Article 9 of the Law on Ministries and Other Administrative Bodies of BiH, MVTEO BiH is competent to perform duties and tasks within the competence of BiH related to the definition of policy, basic principles, coordination of activities and harmonisation of plans of entity-level authorities and institutions at the international level in the fields of agriculture, energy, environmental protection, development and use of natural resources,
- The State Electricity Regulatory Commission (DERK), which regulates the electricity sector at the BiH level and is responsible for inter-entity trade in electricity and relations with international organisations,
- The Agency for Statistics of Bosnia and Herzegovina, which prepares the energy balance, collects data on energy and other relevant environmental data and cooperates with the entity-level statistical institutes.

BiH faces challenges in policy coordination between different levels of government. The key and only legally prescribed role in this area is played by the Ministry of Foreign Affairs of BiH, while additional coordination mechanisms include:

- Inter-Entity Environmental Authority – a platform for the exchange of information between Entity Ministries and State Institutions and
- Working groups and projects supported by international organisations – key mechanisms for harmonisation of laws and policies between the entities and BD BiH.

In BiH, all competencies that are not explicitly assigned to the institutions of BiH belong to the entities. This means that issues of environmental protection, resource management, and climate change primarily fall under entity and cantonal competencies. The entities have significant autonomy and their own institutions that are responsible for a wide range of policies. The FBiH is divided into 10 cantons, each of which has its own government and legislative competence in specific areas. This cantonal structure further complicates the process of policy-making and implementation. The key institutions in the FBiH are:



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- President and Vice-Presidents of the FBiH – represent this entity at the highest executive level,
- Parliament of FBiH – consists of the House of Representatives and the House of Peoples,
- Government of FBiH – the main executive body that makes decisions at the entity level,
- Cantonal governments – have significant competences in areas such as education, health, environment and spatial planning,
- FBiH Ministry of Environment and Tourism, which is responsible for environmental protection, sustainable use of natural resources and environmental legislation, and prepares strategic documents and programs related to climate change and coordinates the work of cantonal ministries and institutions,
- FBiH Ministry of Energy, Mining and Industry, which is responsible for energy efficiency and OiE and creates emission reduction strategies in the energy sector,
- FBiH Ministry of Agriculture, Water Management and Forestry, which manages the agriculture and water management sectors, which are key to adapting to climate change,
- FBiH Administration for Inspection Affairs, which supervises implementation of the Law on Environmental Protection and Energy Efficiency,
- FBiH Hydrometeorological Institute is in charge of making the GHG inventory for the FBiH.

The RS has a more centralised government structure compared to the FBiH, without division into cantons. The key institutions are:

- RS President – represents this entity and has significant powers,
- RS National Assembly –legislative body of the entity,
- Government of the Republika Srpska – executive body that implements laws,
- RS Ministry of Spatial Planning, Construction and Ecology, which is responsible for environmental protection, spatial planning and environmental strategies and leads the process of drafting reports on emissions and climate change,
- RS Ministry of Energy and Mining, which is responsible for the development of the energy sector, including measures to reduce emissions,
- RS Ministry of Agriculture, Forestry and Water Management, which manages the sectors of agriculture and water resources, crucial for adapting to climate change,
- RS Administration for Inspection Affairs, which supervises implementation of the law and,
- RS Hydrometeorological Institute, which collects data on climate change, weather conditions and emissions of GHG and other pollutants.

BD BiH has a special status established by an arbitration award in 1999. Administratively, it is not part of the entities and has its own government and assembly. This administrative unit has autonomy in making laws and policies, including those related to the environment and climate change. The key departments that adopt and implement laws in the field of environmental protection in BD BiH are:

- Department for Spatial Planning and Property-Legal Affairs is responsible for environmental protection, including the implementation of the Law on Environmental Protection, the Law on Nature Protection, and the Law on Air Protection.
- Department for Utility Services is responsible for solid waste management and wastewater management, including the drafting of the legal framework governing these areas.

- Department of Agriculture, Forestry and Water Management of BD BiH, which monitors the condition of natural resources and climate change.

Brčko District has its own legislative framework, and all laws can be found on the official website of the Assembly of the Brčko District of Bosnia and Herzegovina.

Given the complex structure of BiH, the institutional framework is divided into several levels of government: state level, entity level (FBiH and RS), cantonal level (in FBiH) and local level (municipalities and cities). This structure directly affects the way sectors such as environmental protection, energy, resource management and climate change are managed.

At the local level (municipalities and cities), responsibility for environmental protection and implementation of climate change strategies includes:

- Spatial planning and land management,
- Waste and water resources management,
- Implementation of energy efficiency measures, and
- Monitoring and adapting to climate change at the local level.

BiH is a signatory to and has ratified several international treaties and agreements in the segment of environmental protection and climate change, including:

- UNFCCC,
- Paris Agreement,
- Montreal Protocol,
- Kyoto Protocol,
- Convention on Biological Diversity (CBD),
- Aarhus Convention on Access to Information and Public Participation in Environmental Matters,
- Convention on the Protection and Use of Transboundary Watercourses and International Lakes, and
- Convention on Long-Range Transboundary Air Pollution (CLRTAP).

International obligations require BiH to develop and implement policies to reduce GHG emissions, adapt to climate change, and protect natural resources. However, their implementation depends on entity and cantonal authorities.

At the state level, the legal framework is limited to coordination and regulatory aspects and participation in policy-making related to international obligations. The main laws include:

- BiH Law on Freedom of Access to Information – enables public access to environmental information, in accordance with the Aarhus Convention,
- BiH Law on Electricity – defines the regulation of the electric power sector, including OiE and
- Decision on the quality of liquid petroleum fuels – prescribes the requirement for the quality of liquid fuels for the protection of human health and the environment.

The entities are responsible for detailed regulation in the field of environment and climate change. The FBiH has several key laws that regulate this area:



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- FBiH Law on Environmental Protection[1],
- Law on Waters of FBiH,
- FBiH Law on Waste Management,
- FBiH Law on the Use of OiE and Efficient Cogeneration,
- FBiH Law on Energy Efficienc, and
- FBiH Law on Air Protection.

Given the cantonal division, each canton may enact additional regulations, which may lead to uneven application of laws in different parts of the FBiH.

RS has a more centralised legal framework in the field of environmental protection. Key laws include:

- RS Law on Environmental Protection,[2]
- Law on Waters of the RS,
- RS Law on Forests,
- RS Law on Waste Management,
- RS Law on OiE,
- RS Law on Energy Efficiency, and
- RS Law on Air Protection.

BD BiH has its own legal framework that includes:

- Law on Environmental Protection of BD BiH,
- Law on Waters of BD BiH, and
- Law on Waste Management of BD BiH.
- Law on Nature Protection of the Brčko District
- Law on Air Protection
- Law on Energy Efficiency
- Law on Renewable Energy Sources
- Law on Forests of the Brčko District

These laws are aligned with Entity laws, but allow for specific solutions tailored to the local needs of the District.

## 2.2 2030 Agenda for Sustainable Development– Sustainable Development Goals

The Sustainable Development Goals (SDGs) (Global Goals) are an upgrade of the Millennium Development Goals (MDGs). The Millennium Goals, adopted in 2000, cover a wide range of issues, including the fight against poverty, hunger, disease, gender inequality, and the provision of water and sanitation. The achievement of the Millennium Goals has been a huge success, which shows the importance of having a comprehensive program based on the SDGs.

The Global Goals and the broader sustainability agenda go much further than the Millennium Goals and address the root causes of poverty and the universal need for development for the benefit of all people. Climate Action (Goal 13) is one of the 17 Global Goals that make up the 2030 Agenda for Sustainable Development. Achieving this goal, through an integrated approach, will require significant progress in the sphere of policy measures and investment of resources within the BiH climate change segment.

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[1] *Law on Environmental Protection (FBiH Official Gazette No. 15/21)*
[2] *Law on Environmental Protection (RS Official Gazette No. 71/12)*

In 2021, the UN-BiH Cooperation Framework for Sustainable Development was signed with the Council of Ministers. The Cooperation Framework should ensure the continuation of partnership and work towards a more sustainable, resilient, inclusive society, which will help all people in BiH to have longer, healthier, more prosperous and safer lives, while also helping to achieve the SDGs and the 2030 Agenda.

The signed document was approved by the RS, FBiH, BD BiH, as well as the business community and the non-governmental sector. A document has been created that should provide the basis for development and instruments for measuring the achievements, and which is dedicated to the implementation of the 2030 Agenda for Sustainable Development, the EU accession process, then joint socio-economic reforms, regional cooperation and a better life for the citizens of BiH.

These goals have been jointly developed, based on thorough analyses and extensive consultations with people and partners across BiH. The new Cooperation Framework renews the commitment to continue working with citizens and communities to build a society where no one is left behind, protect and promote human rights, advance gender equality and women's empowerment, and increase community resilience.

## 2.3 Gender Equality in Climate Change Policy and Decision-Making

Gender equality is one of the key principles of sustainable development, and its observance in the field of climate change is increasingly recognised as a necessity, not just an added value. Although at first glance it may seem that climate change affects all residents equally, practical examples from the world and research show that their consequences manifest differently on women and men, with those social groups that otherwise face certain forms of discrimination or limited access to resources being particularly vulnerable. The reason for this lies in the existing gender inequalities, social roles and socio-economic barriers that often hinder women and girls in decision-making, resource management, access to finance, and opportunities for professional development or professional advancement.

As a country that has ratified the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) and signed the Paris Agreement, BiH has a legal obligation to ensure integration of gender equality in all sectors of development, including climate policies. Applying a gender-responsive approach in this segment of social and economic policy not only contributes to global efforts to reduce GHG emissions and adapt to climate change, but also empowers women, ensures a fairer distribution of resources, and significantly accelerates progress towards SDGs (2030 Agenda). Furthermore, while BiH has ratified several international climate agreements, and developed strategic documents such as the Environmental Strategy and Action Plans (ESAPs), numerous Sustainable Energy and Climate Action Plans (SECAPs) for municipalities, as well as the NAP BiH, there is no comprehensive strategic framework that could integrate gender-sensitive aspects into climate and climate change topics. Also, the lack of gender-disaggregated data further affects the effective implementation of public policies. Nevertheless, BiH already has certain legal and institutional capacities that support gender equality, such as the Law on Gender Equality in BiH[3], the BiH Gender Action Plan (GAP BiH), and the activities of the BiH Agency for Gender Equality and gender centres in both entities. However, their real impact on climate and energy policies, as well as on accompanying strategic documents, still needs to be further strengthened.

[3] *BiH Official Gazette Nos. 16/03, 102/09 and 32/10*

One of the main challenges in creating gender-responsive climate policies is the lack of accurate and regularly collected gender-disaggregated data. In the energy, agriculture, forestry or waste management sectors, which are the primary sources of GHG emissions, the specific needs, resources and capacities of women and men are rarely taken into account. For example, women in rural areas, who often play a key role in family farming activities, may face the consequences of drought or floods in a way that puts additional strain on their work, health and safety. At the same time, they rarely have access to financial mechanisms or innovations to mitigate the effects of climate disasters. Without quality and gender-differentiated information on these challenges, it is difficult to plan adaptation measures that will truly respond to the needs of both genders and strengthen the resilience of communities as a whole.

Another important aspect is the participation of women in decision-making processes. Both at the local level and at the entity and BiH level, women often remain underrepresented in working bodies or commissions that develop sectoral strategies and action plans, including those dedicated to climate measures. According to analyses by UN Women and the BiH Agency for Gender Equality, gender representation in public policy-making bodies in the field of environment and energy significantly deviates from the equal ratio. This misses the opportunity to include different perspectives and experiences and to create policies that would better reflect the needs and priorities of the entire population. Given that women often deal with the consequences of climate change in households and communities, their active involvement in the creation and implementation of measures is crucial for finding effective and long-term sustainable solutions.

In this context, the BTR1 report for BiH provides a unique opportunity to systematically address the gender aspects of climate measures and policies, both through an overview of the current situation and through recommendations for the improvement and harmonisation of strategic documents. The idea is to recognise the gender perspective as a horizontal priority – not only as a component of social equality, but also as a factor that can strengthen the overall resilience of the country to climate change and contribute to a faster transition to low-carbon development. Empirical research[4] increasingly confirms that countries and communities that equally include women and men in decision-making processes have more efficient and tailored policies, achieve better results in the field of education and health, and produce economic benefits for the entire society.

In addition, it is important to point out that international frameworks that regulate the field of climate change – primarily the UNFCCC and the Paris Agreement – strongly advocate gender equality as an indispensable element of climate policies. The adopted Global Action Plan for Gender Equality (Gender Action Plan) defines concrete steps for signatory countries, pointing to the need to collect gender-differentiated data, provide adequate financial and technical support for projects aimed at women empowerment, and create inclusive mechanisms for women's participation in decision-making. The inclusion of these principles in national reports, such as BTR1, is one of the ways for BiH to meet its international obligations, but also to ensure more comprehensive and effective measures to reduce emissions, adapt and build resilience to climate change.

Ultimately, gender equality in the context of climate change can no longer be seen solely as a social issue, it has a direct impact on economic and environmental progress, the health and well-being of

[4] *UNFCCC, 2019, UN Women, 2021*

the population, and the overall resilience of society to climate risks. It is crucial to recognise the role of women as active actors in decision-making related to climate change, to provide them with equal opportunities for participation and decision-making, and to ensure that climate action responds to their needs, but also to value their knowledge and experience.

### 2.3.1 Strategic and Legal Framework for Gender Equality

The Law on Gender Equality in BiH (Official Gazette of BiH, Nos. 16/03, 102/09 and 32/10), is a key regulation for the promotion and protection of equal treatment of all genders in the public and private areas. It prohibits direct and indirect discrimination based on gender and sexual orientation, and covers a wide range of sectors, including education, employment, social and health care, sports, culture, public life and media. Although it addresses harassment, sexual harassment and gender-based violence, this law does not address the specific link between gender issues and climate change. In addition to state-level regulation, regulations on gender equality also exist at the entity levels.

Although the FBiH does not have a specific law that exclusively regulates gender equality issues, the Law on the Rights, Obligations and Responsibilities of Civil Servants in the FBiH (Official Gazette of FBiH, Nos. 49/05, 23/06, 63/11, 45/22) contains provisions that prohibit discrimination on the basis of gender and promote equality in public administration. Gender equality is additionally addressed through bylaws and implementation mechanisms within entity gender institutions (Gender Centre of FBiH). However, none of the applicable sectoral laws in the FBiH, such as the Law on Environmental Protection, the Law on Waters, the Law on Energy or the Law on Spatial Planning, contains specific provisions that would address the issue of gender equality in the context of climate change.

There is no separate entity law in the RS that comprehensively regulates the issues of gender equality, but this area is primarily regulated through the Law on Gender Equality in BiH. Provisions on the prohibition of discrimination on the basis of gender are also present in certain systemic regulations of the RS, including the RS Labor Law (RS Official Gazette Nos. 1/2016, 66/2018, 91/2021), which prohibits direct and indirect discrimination, including discrimination based on gender in the process of employment, duration of employment and termination of employment contract. In addition, provisions on equal treatment and non-discrimination are contained in the regulations governing the status of employees in the RS public administration, including the RS Law on Civil Servants (RS Official Gazette Nos. 118/2008, 117/2011, 37/2012 and 57/2016), which emphasises the importance of respecting the principles of equal opportunities and diversity and fair and equitable treatment in personnel policy, regardless of age, disability, gender, religious and national affiliation and political affiliation. The RS Centre for Gender Equality operates in the RS, which functions as an expert institution of the RS Government. Its competencies include monitoring the implementation of the gender equality policy, drafting proposals for measures, as well as coordinating implementation of strategic documents in this area.

### 2.3.2 BiH Gender Action Plan for 2023 - 2027 (GAP BiH)

GAP BiH is a key strategic document for the implementation of the Law on Gender Equality in BiH (Official Gazette of BiH, No. 32/10) and other international and domestic regulations that ensure equal participation of women and men in all spheres of social life. The latest GAP BiH defines measures and activities for the improvement of gender equality in the period 2023-2027, and was developed in coordination with the Agency for Gender Equality of BiH, Ministry of Human Rights and Refugees of



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BiH (ARS BiH MLJPI), in cooperation with entity gender centres and other sectoral institutions. GAP BiH represents the main lever for harmonising national legislation and policies with international obligations arising from CEDAW, the Beijing Declaration and the Platform for Action, and the goals defined by the 2030 Agenda for Sustainable Development. Accordingly, the current GAP BiH pays special attention to horizontal issues in which gender equality plays a crucial role, and one of them is environmental protection and adaptation to climate change. The measures defined in the following table represent priorities for the integration of gender and climate issues for six strategic areas.

*Table 2: Priorities for the integration of gender and climate issues for six strategic areas in BiH*

| Strategic Area | Measure |
|---|---|
| Legal and strategic framework | **I.1.42.** Identification of priority laws and implementation of gender analysis, strategies, action plans, programs and other documents in the field of environmental management with the aim of introducing and applying international and domestic standards for gender equality in this area and identifying shortcomings, advantages, real needs and opportunities from the aspect of gender equality. |
| Data collection and research | **I.1.43.** Improve the system for collecting gender-sensitive data and define a set of gender-sensitive quantitative and qualitative indicators in the field of environmental management.<br>**I.1.44.** Identify gender issues for research, especially in terms of gender-sensitive impacts on human health and exposure to natural disasters. |
| Raising awareness and capacity building | **I.1.45.** To raise awareness of the different types of new technologies in the field of environmental management and non-technical innovations that save time and energy and are adapted to the different needs of women and men.<br>**I.1.46.** Carry out educational activities on the application of gender mainstreaming and special measures and instruments in the context of environmental management, include information on the interventions of the NGO sector to raise awareness of environmental protection. |
| Finance and budgeting | **I.1.47.** Encourage financial allocations for specifically targeted interventions to promote social equality and gender equality, for the economic empowerment of vulnerable social groups, especially women, in the field of so-called green entrepreneurship, reuse of recycled waste, etc. |
| Monitoring and evaluation | **I.1.48.** Establish an adequate and consistent monitoring system. |
| Knowledge management and communication | **I.1.49.** Establish an electronic platform on the values of integrating the gender component in the field of environmental protection and preservation. |

Taking into account all of the above, it can be concluded that the existing laws and strategic documents in BiH represent the basis for regulating the field of environmental protection, energy and climate change, but do not sufficiently address gender equality and the specific needs of women and men in these sectors. Although the Law on Gender Equality in BiH and GAP BiH provide guidelines for the integration of the gender perspective in all segments of society, most sectoral regulations and plans (at the BiH and entity level) do not contain clear mechanisms for its implementation. This misses the opportunity to create comprehensive, gender-sensitive climate policies that, while improving energy efficiency and environmental protection, would ensure equal participation and benefits for both genders.

### 2.3.3 Gender-disaggregated Data

Gender-disaggregated data is a way of measuring differences between men and women in economic and social terms, and is key to understanding gender dynamics in all sectors relevant to climate change, especially when it comes to energy, agriculture, forestry, transport, waste management and water resources. Without this data, monitoring and assessing the impact of climate policies on women and men is difficult, as well as planning adaptation and mitigation measures in a way that responds to the real needs of both genders. According to UN Women's analysis, the most successful initiatives to reduce the risk of natural disasters are based on gender-disaggregated data, which can be obtained through the collection of secondary data, the analysis of socio-economic data, or the collection of data during implementation of processes relevant to disaster risk reduction. Such data contribute to measuring the direct and indirect impacts of natural disasters, such as differences in damage and human losses after natural disasters. However, many countries still do not collect gender-disaggregated data, even in exceptional cases such as natural disasters and disasters, which is directly related to the lack of capacity of state and local levels of government to collect data.

Also, while the need for climate action to be equitable and inclusive is increasingly discussed in BiH, the collection and use of gender-disaggregated data on this topic remains under-represented. Without a clear understanding of gender gaps in capacities, resources and needs, the formulation and implementation of relevant policies remain partially limited, which can slow down the transition towards climate-resilient and sustainable development. This makes it difficult to clearly see how climate and development measures affect women, men and other vulnerable groups, especially in areas such as energy, agriculture or water resource management. However, the BiH Agency for Statistics and entity statistics bureaus continuously produce the publication "Women and Men in BiH", which shows the contrast between the position of women and men in the segments of education, employment, social protection, political and private life (marriage, childbirth, etc.), according to the available gender-disaggregated data. Progress is also visible due to the obligation to report on SDGs and collect data for the needs of the Gender Equality Index, but BiH has in certain cases replaced or adapted global SDG indicators to omit the gender component, which is why some reports do not include elaboration by gender or other categories, such as 5.3.1 - Proportion of women aged 20 to 24 who were married or in a community before the age of 15 and before the age of 18. SDG reports do not include all relevant gender-disaggregated data, such as 1.1.1. Proportion of the population living below the international poverty line by gender, age, disability and urban/rural divide[5] On the other hand, many relevant indicators adapted for gender segregation of data, nor are such data systematically collected, and according to the UNDP Report on Mapping the Gender Component in Data and Legislation in the area of Climate Change, Environment and Biodiversity (2022), the collected national data often mask gender inequalities, and in BiH at the state level, many data were not collected in a gender-disaggregated form. As a result, certain indicators are completely omitted, e.g. there are no indicators on women's participation in climate processes or on the gender distribution of benefits from climate projects because these data are not found in existing statistics.

These shortcomings make it difficult to meet important international commitments and recommendations, including the UNFCCC, which through the Lima Gender Programme and the Gender Action Plan called on countries to integrate gender equality into climate policies and reporting. Also, the Paris Agreement (Article 7.5) emphasizes that "Parties affirm that adaptation action should follow a country-driven, gender-sensitive, participatory and fully transparent approach, taking into account vulnerable groups, communities and ecosystems. Such action should be based on and guided by the best available science and, where appropriate, traditional, indigenous knowledge and local knowledge systems, with the aim of integrating adaptation into appropriate socio-economic and environmental policies and measures, where appropriate."

[5] *USAID MEASURE, 2024.*

If BiH, as a signatory to the Paris Agreement, does not collect and display gender-disaggregated data, it is difficult to prove that its adaptation measures are truly gender-sensitive. For example, in the absence of data, it is more difficult to show how adaptation programmes specifically help vulnerable groups such as women or how women are involved in decision-making.

## 2.4 Overview of Flexibilities applied in the Preparation of BTR1

In accordance with the MPGs, developing countries are allowed to apply flexibility in the scope, frequency and detail of reporting, and in the scope of verification, if their capacity to prepare BTRs is limited. BiH, as a developing country, has made use of several flexibility provisions, according to paragraphs 35, 48, 57, 58, 85, 92, 95 and 102.

The key flexibilities applied are listed below.

- **Estimates of expected emission reductions by measures (MPG paragraph 85)** – BTR1 does not contain a quantitative estimate of the emission reductions of implemented measures from previous NDCs, due to the lack of models, data and analytical capacities. Through the preparation of BTR1 and the update of the NDC, the planned emission reduction effects for each measure are predicted.
- **Emission projections (MPG paragraphs 92, 95, 102)** – A projection of emission reductions resulting from the aggregate effect of implementation of all measures until 2030 and 2050 has been submitted, without elaboration of scenarios for each measure.
- **Displaying data from 1990 (MPG paragraph 57) –** The starting year is 2014, i.e. the base year for NDC.
- **Delays in forming inventories (MPG Paragraph 58)** – The last inventory year is 2022, with the preparation and submission of BTR1 in 2025, which is outside the standard N-2 requirement.
- **Limited gas coverage (MPG paragraph 48)** – The inventory covers $CO_2$, $CH_4$ and $N_2O$, while HFCs and PFCs are partially covered or not covered at all (depending on the year).
- **QA/QC plan (MPG paragraphs 34, 35)** – There is no formal quality assurance and control plan used to produce the said report.

In the coming period, it is necessary to perform planned activities aimed at gradually abolishing the use of flexibility. The key prerequisite for this is the establishment and strengthening of the legal and procedural framework, with the strengthening of institutional capacities, especially in the segment of preparation of strategic documents and regular collection of relevant data. By strengthening capacities and establishing a system for monitoring, reporting and verification (MRV), it would be possible to monitor the achieved emission reductions by individual measures, as well as to assess their future effects. This would also create the possibility of producing up-to-date, complete and timely reports, with a wider coverage of sectors and gases. In addition, it is recommended to carry out a comprehensive recalculation of data from 1990 until preparation of the next Greenhouse Gas Inventory Report (NIR) and the Biennial Transparency Report under the Paris Agreement (BTR), in order to improve the consistency of time series and ensure their reliable presentation. In this way, BiH would be able to meet its MPG obligations, without using flexibilities, with significantly improved accuracy and transparency.

# 3 GHG Inventory

## 3.1 Information on GHG Inventories and Climate Change

A GHG inventory is a systematic set of data on GHG emissions and sinks from various sources and sectors in a single country. These inventories are essential for tracking emissions, identifying trends, and formulating policies to reduce GHG emissions.

The international framework for the development of GHG inventories is defined by the UNFCCC and the Paris Agreement, which require countries to regularly submit data on GHG emissions. The methodologies for the development of GHG inventories are based on the guidelines of the Intergovernmental Panel on Climate Change (IPCC), which enable comparability of data at the global level. The Ministry of Spatial Planning, Construction and Ecology of BiH is responsible for creating policies and coordinating activities in international relations concerning the environment. However, specific environmental issues are the responsibility of the entity governments. The Ministry of Spatial Planning, Construction and Ecology acts as the focal point of BiH towards the UNFCCC. BiH, as a Non-Annex I Party to the Convention, in accordance with its capacities and principles of sustainable development, strives to contribute to the achievement of the primary goals of the Convention.

BiH is a signatory to and has ratified several key international agreements that require regular monitoring and reporting on GHG emissions:

- **UNFCCC** – BiH, as a developing country, is obliged to prepare National Communications on Climate Change (NC) and Biennial Transparency Reports (BTR), which include an inventory of GHG emissions,
- **Paris Agreement (2016)** – BiH has committed to define the goal of reducing GHG emissions through the development of NDCs, with the level of ambition being voluntary, i.e. no mandatory percentage reduction is prescribed. It has also committed to increasing transparency in reporting through the Enhanced Transparency Framework (ETF) and
- **Energy Community** – BiH, as a member of the Energy Community, is obliged to align its reporting on GHG emissions with the EU acquis, including the obligation to prepare inventories and reports in accordance with the requirements of the Regulation on the Governance of the Energy Union and Climate Action.

To date, BiH has prepared and submitted several key reports within its international obligations:

- First National Communication (INC) – 2009
- Second National Communication (SNC) – 2013
- Third National Communication (TNC) – 2017
- Fourth National Communication (FNC) – 2021
- First Biennial Update Report (FBUR) – 2014
- Second Biennial Update Report (SBUR) – 2017
- Third Biennial Update Report (TBUR) – 2022
- Intended Nationally Determined Contribution for Bosnia and Herzegovina (INDC) – 2015
- Nationally Determined Contribution for Bosnia and Herzegovina (NDC) – 2021
- National Adaptation Plan on climate change for Bosnia and Herzegovina (NAP) – 2022
- Climate Change Adaptation and Low-Carbon Development Strategy – 2020

These documents include data on GHG emissions, sectoral trends, and emission reduction measures.

By adopting the enhanced transparency framework under the Paris Agreement, signatory countries have an obligation to report regularly to the UNFCCC via:

- Climate Change Reports for Bosnia and Herzegovina, submitted every four years.
- Biennial transparency reports, which have replaced the previous BUR and are submitted every two years.

With this reporting, countries are fulfilling transparency obligations and strengthening trust in the global response to climate change.

Within the CBIT (Capacity Building Initiative for Transparency) project, BiH has improved the methodology for collecting and analysing data on GHG emissions. The project has enabled capacity building of relevant institutions, including trainings on the application of the IPCC methodology and the use of specialised software for calculating emissions.

According to the requirements of the UNFCCC, the GHG inventory covers:

- Five emission sectors: energy, industrial processes, agriculture, forestry and land use, and waste
- Seven direct GHGs: carbon dioxide ($CO_2$), methane ($CH_4$), nitrogen dioxide ($N_2O$), fluorocarbons (HFCs, PFCs), sulfur hexafluoride (SF6), nitrogen trifluoride (NF3).
- Four indirect GHGs: sulfur dioxide (SO2), carbon monoxide (CO), non-methane volatile organic compounds (NMVOCs), nitrogen oxides (NOX).
- Years, starting in 1990, which should be the base year for the assessment and reporting of emissions.

The calculation of emissions and sinks was made in accordance with the methodology set out in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, including relevant amendments from 2019 (Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories). The calculation used IPCC Inventory Software, v 2.95.

**Global Warming Potential (GWP)**

In this inventory, the GWP values defined in the Fifth Report of the Intergovernmental Panel on Climate Change (IPCC AR5) were applied, in accordance with the requirements of the UNFCCC and MPGs (Modalities, Procedures and Guidelines) of Decision 18/CMA.1. The values used are shown in the following table.

*Table 3: Global Warming Potential (GWP) according to AR5, 100-year horizon*

| Gas | GWP (AR5, 100-year horizon) |
|---|---|
| **$CO_2$** | 1 |
| **$CH_4$** | 28 |
| **$N_2O$** | 265 |
| **HFC-134a** | 1,300 |
| **HFC-125** | 3,170 |
| **HFC-143a** | 4,800 |
| **HFC-152a** | 138 |
| **HFC-23** | 12,400 |



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| | |
|---|---|
| **SF6** | 23,500 |
| **NF3** | 16,100 |
| **PFC-14 (CF4)** | 6,630 |
| **PFC-116 (C2F6)** | 11,100 |

## 3.2 Trends in Emissions

In the context of GHG inventory, monitoring emission trends is a key tool for analysing changes in emissions over time, identifying the main sources of emissions, and evaluating the effectiveness of emission reduction measures, prescribed through strategic documents. By analysing emission data from different sectors and categories, it is possible to monitor the impact of specific measures on GHG emissions, and understand the main factors that contribute to increasing or decreasing emissions. This trend overview includes relevant greenhouse gases ($CO_2$, $CH_4$, $N_2O$, HFCs, PFCs) and all sectors: energy, industrial processes and product use (IPPU), agriculture, forestry and land use (AFOLU), waste, as well as all emission precursors (NOx, CO, NMVOC, SO2). In the last reporting period, the emissions of all these gases were analysed, with a detailed presentation of their changes compared to previous years, and the determination of the main factors that influenced these changes. Through the analysis of emissions at the level of sectors and categories, and by type of gas, a specific pattern was observed that indicates the key sources of emissions and areas that require special attention in the future planning of emission reduction policies, which will be presented in the next chapter.

The following chart shows the trend of GHG emissions in the period 1990-2022, with and without sinks. Observed throughout the period 1990-2022, emissions without sinks show a significant decline in the early nineties, mainly due to the decrease in industrial activity and changes in the energy sector during the war and post-war period. Since the mid-nineties, there has been a gradual increase in emissions, which stabilises in the period 2000-2005. After 2005, emissions show an oscillating trend, but are increasing compared to the period of the early 2000s. Total GHG emissions without sinks in the period 2014–2022 ranged from 26,676.38 Gg $CO_2$ - eq in 2014 to a maximum of 30,376.09 Gg $CO_2$-eq in 2017. After 2017, a slight decline was recorded, with the exception of 2021 when emissions rose again to 29,237.61 Gg $CO_2$ - eq.

In 2022, emissions without sinks amounted to 28,031.44 Gg $CO_2$ - eq, which is an increase of 5.08% compared to 2014, and a decrease of 17.66% compared to 1990. Emissions from sinks in 2022 amounted to 21,102.73 Gg $CO_2$-eq, which represents an increase of 4.91% compared to 2014, or a decrease of 20.72% compared to 1990.

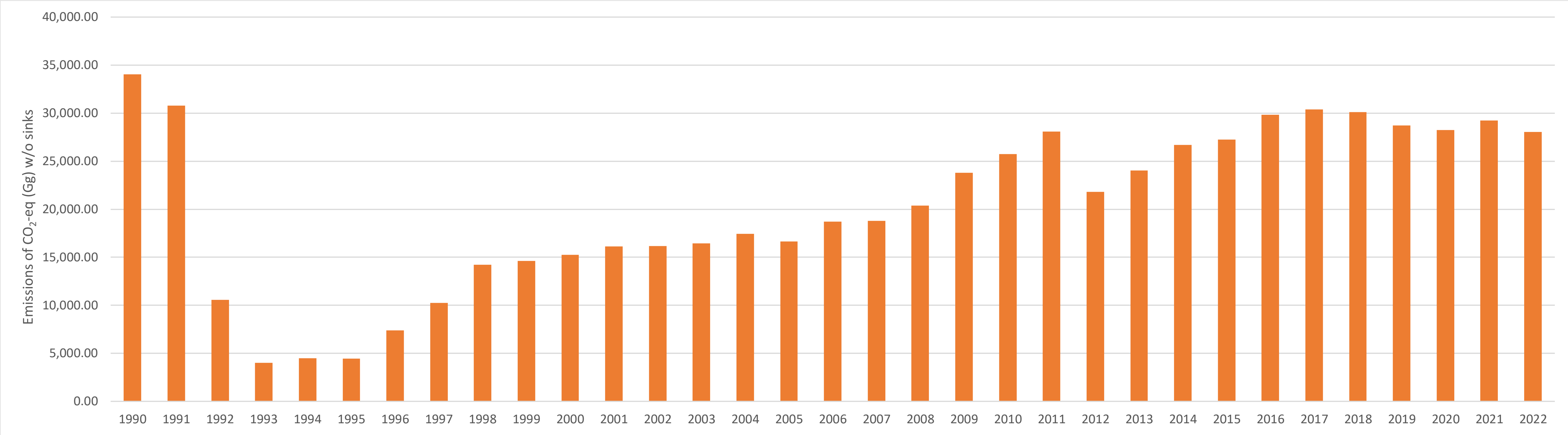


*Chart 1: $CO_2$ emission trends – eq without sinks in the period 1990 - 2022*

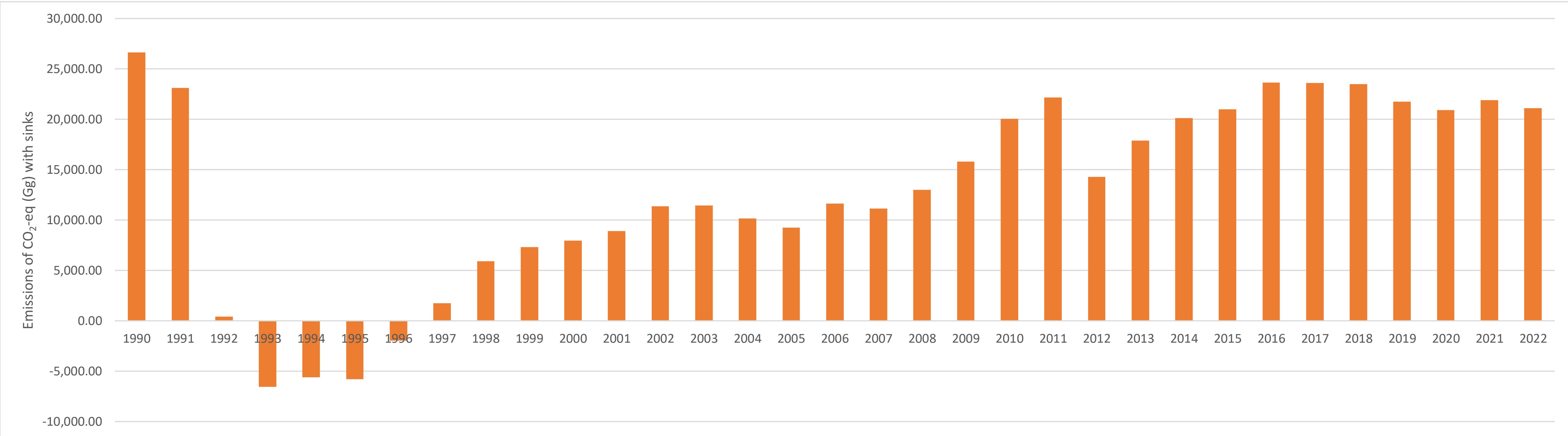


*Chart 2: $CO_2$ emission trends – eq with sinks in the period 1990 - 2022*



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The following chart presents the trends in $CO_2$-eq emissions by sectors without sinks in the period 2014 – 2022. In 2014, the energy sector accounted for 72% of total emissions, which is the highest percentage of all sectors. It is followed by the industrial processes and product use sector with 15%, the agriculture, forestry and other land use sector with 8% and waste with 5%. In 2022, a similar distribution of emissions by sectors was recorded as in 2014. The energy sector occupied 73%, the industrial processes and product use sector 16%, the agriculture, forestry and other land use sector 6% and waste 5%.

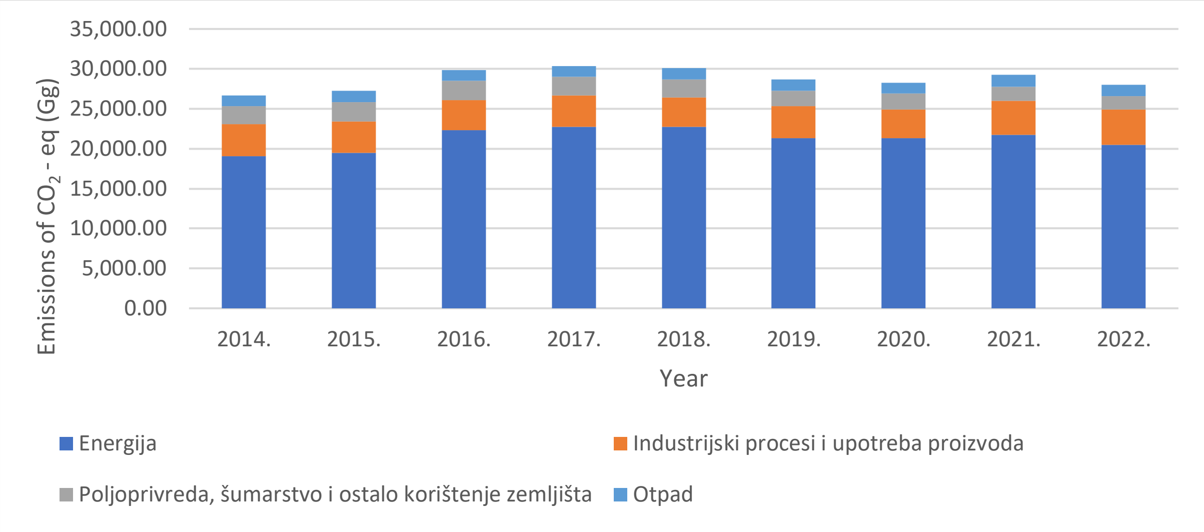


*Chart 3: $CO_2$-eq emission trends by sink-free sectors 2014-2022*

(Legend: Energija – Energy; Industrijski procesi I upotreba proizvoda – Industrial processes and product use; Poljoprivreda, šumarstvo I ostalo korištenje zemljišta – agriculture, forestry and other land use.)

### 3.2.1 Emissions Trends by Sectors

Total GHG emissions in BiH, including the land use, land-use change and forestry (LULUCF) sector, have shown some changes in recent years, which is the result of various factors such as changes in energy consumption, industrial production, agriculture and forest management. The trend of emissions by sectors for the period 2014-2022 is analysed below, with emissions presented in $CO_2$-eq amount (with and without sinks).

*Table 4: Overview of emissions trends with sinks by sectors for the period 2014-2022 (Gg $CO_2$-eq)*

| Sector | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|
| **Energy** | 19,080.37 | 19,517.47 | 22,289.45 | 22,750.94 | 22,718.31 | 21,355.36 | 21,284.91 | 21,714.00 | 20,504.47 |
| **Industrial Processes and Product Use** | 4,006.62 | 3,908.25 | 3,808.94 | 3,933.79 | 3,694.90 | 3,984.39 | 3,588.89 | 4,290.30 | 4,406.31 |
| **Agriculture** | 2,205.47 | 2,385.20 | 2,389.67 | 2,302.55 | 2,265.27 | 1,944.56 | 2,014.01 | 1,767.71 | 1,673.97 |
| **LULUCF** | -6,560.84 | -6,23825 | -6,178.34 | -6,760.72 | -6,593.76 | -6,975.76 | -7,322.79 | -7,332.42 | -6,928.71 |
| **Waste** | 1,383.92 | 1,436.95 | 1,347.42 | 1,388.81 | 1,415.54 | 1,422.55 | 1,366.82 | 1,465.61 | 1,446.69 |
| **Total** | 20,115.54 | 21,009.62 | 23,657.16 | 23,615.37 | 23,500.26 | 21,731.10 | 20,931.83 | 21,905.19 | 21,102.73 |

Total emissions with sinks, shown in the table above, in 2014 amounted to 20,115.54 Gg $CO_2$-eq. In 2022, GHG emissions with sinks amounted to 21,102.73 Gg $CO_2$-eq, which indicates an increase in emissions by 4%. In 2016, the percentage change indicates an increase in emissions by 15%, and a similar trend appears in 2017 where the percentage change indicates an increase in emissions by also



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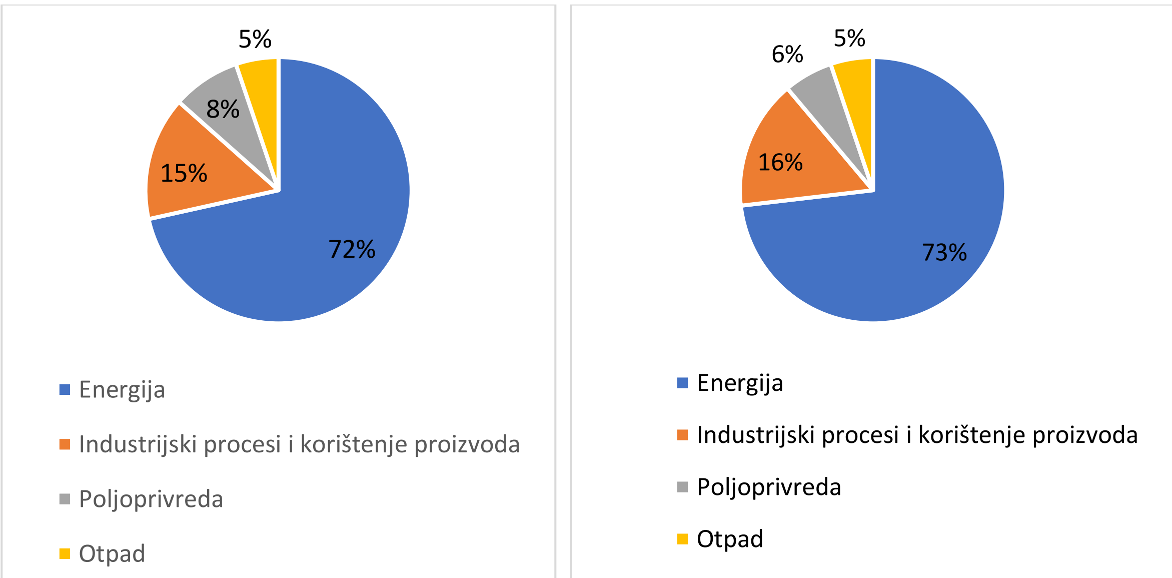
15%. In 2016, the percentage change, in addition to indicating the largest increase in emissions for this period, has the highest absolute value compared to other years.

*Table 5: Overview of emission trends w/o sinks by sectosr for the period 2014-2022. (Gg $CO_2$-eq)*

| Sector | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|
| **Energy** | 19,080.37 | 19,517.47 | 22,289.45 | 22,750.94 | 22,718.31 | 21,355.36 | 21,284.91 | 21,714.00 | 20,504.47 |
| **Industrial Processes and Product Usage** | 4,006.62 | 3,908.25 | 3,808.94 | 3,933.79 | 3,694.90 | 3,984.39 | 3,588.89 | 4,290.30 | 4,406.31 |
| **Agriculture** | 2,205.47 | 2,385.20 | 2,389.67 | 2,302.55 | 2,265.27 | 1,944.56 | 2,014.01 | 1,767.71 | 1,673.97 |
| **Waste** | 1,383.92 | 1,436.95 | 1,347.42 | 1,388.81 | 1,415.54 | 1,422.55 | 1,366.82 | 1,465.61 | 1,446.69 |
| **Total** | 26,676.38 | 27,247.87 | 29,835.49 | 30,376.09 | 30,094.02 | 28,706.86 | 28,254.62 | 29,237.61 | 28,031.44 |

When sinks are excluded from the trend overview, total emissions for 2014 amount to 26,676.38 Gg $CO_2$-eq. In 2022, GHG emissions without sinks amounted to 28,031.44 Gg $CO_2$-eq, which is 5% higher than in 2014. The years 2016, 2017 and 2018 have the highest percentages of change, which are 10%, 12% and 11% respectively. In these years, the largest increase in emissions is recorded.

Below is a comparison of the share of individual sectors in total emissions (without sinks) for 2014 and 2022.




*(Legend: Energija – Energy; Industrijski procesi I korištenje proizvoda – Industrial processes and product use; Poljoprivreda – agriculture; Otpad - waste)*

*Chart 4: Comparison of the share of individual sectors in total emissions (without sinks) for 2014 and 2022*

From the previous comparison, it is evident that in both observed years, the energy sector dominates total emissions (72% in 2014 and 73% in 2022), while the share of industrial processes and the use of products increased from 15% to 16%. The share of agriculture decreased slightly (from 8% to 6%), while the share of waste remained stable at 5%.

In accordance with the MPGs requirement (paragraph 91), an overview of emissions in the last reporting year (2022) is provided below.

*Table 6: Summary overview of GHG emissions for 2022*

| Categories | Emissions(gg) | | | $CO_2$-eq emissions (Gg) | | | | Total(gg) |
|---|---|---|---|---|---|---|---|---|
| | Net $CO_2$ (1)(2) | $CH_4$ | $N_2O$ | HFCs | PFCs | SF6 | NF3 | $CO_2$ - eq |
| **Total emissions and sinks** | 16,116.53 | 118.14 | 3.15 | 427.7 | 414.8 | 1.34 | 0.00 | 21,102.73 |
| **1 - Energy** | 19,471.90 | 32.60 | 0.45 | | | | | **20,504.47** |
| **1A – Fuel combustion activities** | 19,419.85 | 1.80 | 0.45 | | | | | **19,589.81** |
| 1.A.1 – Energy industries | 12,189.78 | 0.25 | 0.18 | | | | | 12,243.94 |
| 1.A.2 – Manufacturing industries and construction | 2,350.98 | 0.21 | 0.03 | | | | | 2,365.24 |
| 1.A.3 - Transport | 4,028.82 | 0.50 | 0.23 | | | | | 4,104.83 |
| 1.A.4 - Other sectors | 850.28 | 0.83 | 0.01 | | | | | 875.81 |
| 1.A.5 - Unspecified | NO | NO | NO | | | | | NO |
| **1B – Fugitive emissions from fuels** | 52.05 | 30.81 | 0.00 | | | | | **914.66** |
| 1.B.1 — Solid fuels | 52.05 | 30.71 | 0.00 | | | | | 911.93 |
| 1.B.2 – Oil and natural gas | 2.73 | NO | NO | | | | | 2.73 |
| 1.B.3 – Other emissions from energy production | NO | NO | NO | | | | | NO |
| **1.C – $CO_2$ transport and storage** | NO | | | | | | | NO |
| 1.C.1 – $CO_2$ transport | NO | | | | | | | NO |
| 1.C.2 — Injection and storage | NO | | | | | | | NO |
| 1.C.3 - Other | NO | | | | | | | NO |
| **2 – Industrial processes and product use** | 3,560.20 | 0.08 | NO | 427.7 | 414.8 | 1.34 | NO | **4,406.31** |
| 2.A - Mineral industry | 1,075.69 | | | | | | | **1,075.69** |
| 2.B – Chemical industry | 78.96 | NO | NO | NO | | | | **78.96** |
| 2.C – Metal industry | 2,392.15 | 0.08 | NO | | 414.8 | NO | NO | **2,809.22** |
| 2D – Non-energy products from fuels and use of solvents | 13.40 | | | | | | | **13.40** |
| 2.E – Electronics industry | | | | NO | NO | NO | NO | NO |
| 2.F – Use of products as a substitute for substances that deplete the ozone layer | NO | NO | NO | 427.7 | NO | 1.34 | | **429.04** |
| 2G – Other production and use of the product | NO | NO | NO | NO | NO | NO | NO | NO |
| 2.H - Other | NO | NO | NO | NO | NO | NO | NO | NO |
| **3 - Agriculture, forestry and other land use** | -6,915.56 | 36.66 | 2.39 | | | | | **-5,254.74** |
| 3.A - Livestock breeding | NO | 34.47 | 0.23 | | | | | 1,025.98 |
| 3.B - Land | -6,449.62 | NO | NO | NO | NO | NO | NO | -6,449.62 |
| 3C – Aggregate and non-$CO_2$ emission sources of land | 13.15 | 2.19 | 2,16 | | | | | 647.99 |
| 3.D - Other | -479.09 | NO | NO | | | | | -479.09 |
| **4 - Waste** | NO | 48.79 | 0,30 | | | | | **1,446.69** |
| 4A – Disposal of solid waste | | 30.49 | | | | | | 853.75 |
| 4B – Biological treatment of solid waste | | NO | NO | | | | | NO |
| 4C – Incineration and open burning of waste | NO | NO | NO | | | | | NO |
| 4D – Wastewater treatment and discharge | | 18.30 | 0.30 | | | | | 592.94 |
| 4E - Other (please specify) | NO | NO | NO | | | | | |
| **5 - Other** | NO | NO | NO | NO | NO | NO | NO | NO |
| | | | | | | | | |
| **Memo Items (5)** | | | | | | | | |
| **International bunkers** | 91.88 | NO | NO | | | | | 91,88 |



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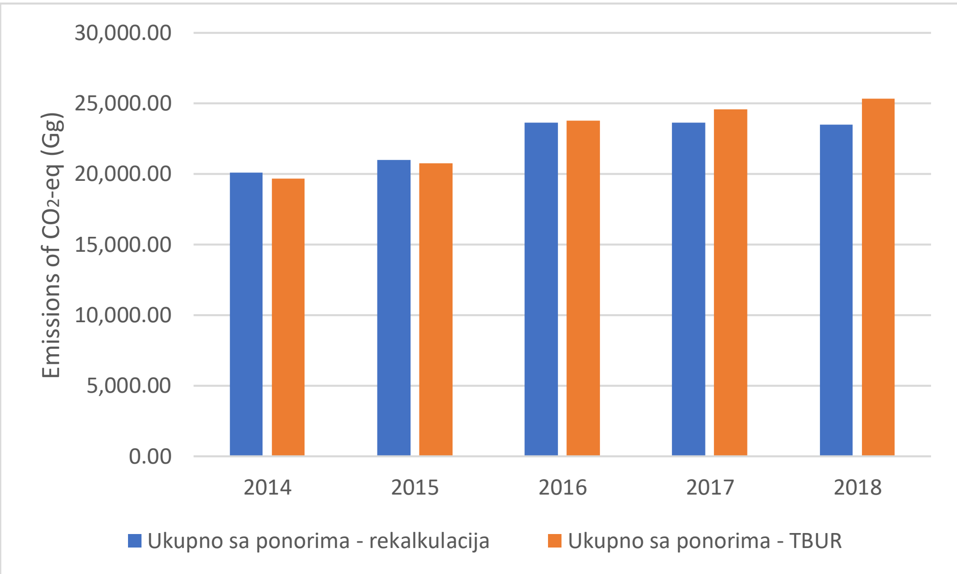
## 3.3 Recalculation of Emissions for 2014 – 2018

As part of the preparation of the inventory of greenhouse gases for the period 2019–2022, a recalculation of emissions for the earlier period 2014–2018 was also performed. This recalculation was performed in accordance with the IPCC guidelines from 2006 and their amendments from 2019 (*2019 Refinement*).

Other reasons for conducting a recalculation include:

- **Applying updated values of global warming potential** in line with *IPCC AR5,* ensuring greater consistency with international commitments (e.g. Paris Agreement, ETF requirements);
- **Inclusion of self-producers** in the energy sector, which has improved data on fuel consumption and related emissions;
- **Revision of coke consumption in the industrial process and product use sector (IPPU)** in line with the 2019 Refinement recommendations related to more precise mapping of coke inputs,
- **Use of nationally specific data on the thermal outputs of lignite**, which allows for more accurate calculations of emissions from combustion,
- **Use of new data from the research** of the Agency for Statistics of BiH, the Statistics Office of Republika Srpska and the Bureau of Statistics of the Federation of Bosnia and Herzegovina in agriculture.

This recalculation resulted in differences in total emissions for the years 2014–2018 compared to the previously reported values in the TBUR. The chart below shows the differences between the previously reported and recalculated values (with sinks).




(LEGEND: Ukupno sa ponorima-rekalkulacija – Total with sinks-recalculation; Ukupno sa ponorima-TBUR – Total with sinks-TBUR)

*Chart 5 - Emissions with sinks before and after recalculation (CO2-eq/year)*

The chart shows the differences in total emissions with sinks before and after the recalculation for the period 2014–2018. It is observed that the recalculated values are higher for 2014 and 2015 (up to 2%), while in the following years they are lower, with a particularly pronounced decrease in 2017 and 2018 (−4% and −7%). These differences are the result of the application of improved methodological approaches and updated input data.

## 3.4 Analysis of Key Categories

The analysis of key categories of GHG emissions in BiH was conducted in accordance with IPCC Approach 1, in order to identify the main sources of emissions expressed in $CO_2$ equivalent ($CO_2$ - eq). This analysis included both Level Assessment and Trend Assessment analyses and was conducted for 2022 in relation to the base year of the NDC (2014) and not in relation to 1990, which is in line with the flexibilities that developing countries have under the MPGs guidelines. Level assessment and Trend assessment were conducted with and without sinks, for clarity in the identification of sectoral priorities. The analysis of key categories was conducted in IPCC Inventory Software, version 2.95.

### 3.4.1 Level Assessment

The Level Assessment identifies the emission sources that make up the largest part of the total emissions in a given year, i.e. it categorizes the sources that together account for 95% of the total emissions. This analysis focuses on a static overview of emissions, regardless of how emissions change over time. Key categories are determined based on their share in total emissions, and the goal is to identify the largest emission sources based on data for that year. As already stated, the Level Assessment was done according to Approach 1, for the base years 2014 and 2022, with and without sinks.

Below is an overview of key categories (Level Assessment), without sinks for 2022:

- 1.A.1 Energy/energy industries — Solid fuels ($CO_2$)
- 1.A.3.b Road transport — liquid fuels ($CO_2$)
- 2.C.1. Iron and steel production ($CO_2$)
- 1.A.2 Industry and construction — Solid fuels ($CO_2$)
- 1.B.1.a Coal Mining and Handling ($CH_4$)
- 3.A.1 Enteric fermentation ($CH_4$)
- 4.A Disposal of solid waste ($CH_4$)
- 2.A.2 Production of limestone ($CO_2$)
- 4.D Wastewater treatment and discharge ($CH_4$)
- 2.A.1. Cement production ($CO_2$)
- 2.F.1 Refrigeration and air conditioning (HFCs, PFCs)
- 2.C.3. Aluminium production (PFCs)
- 1.A.4 Other sectors — Solid fuels ($CO_2$)
- 3.C.4 Direct $N_2O$ emissions from soil ($N_2O$)
- 1.A.2 Industry and construction — Liquid fuels ($CO_2$)
- 1.A.4 Other sectors — Liquid fuels ($CO_2$)
- 2.C.3. Aluminium production ($CO_2$)
- 1.A.2 Industry and construction — gaseous fuels ($CO_2$)

In 2014, the coverage of key categories was almost the same as in 2022, but their relative importance has partially changed, the share of road transport and refrigeration and air conditioning has increased, while the contribution of iron and steel production has decreased.

### 3.4.2 Trend Assessment

The Trend Assessment, on the other hand, focuses on changes in emissions over time, not just their current value. This analysis identifies categories whose emissions trend is significantly different from the general trend of emissions in inventory, which may not be recognised through the Level Assessment. Thus, Trend Assessment takes into account changes in emissions over time and can detect emission sources that have an increasing or decreasing trend, which could not be observed by analyzing by emission levels alone.

The key categories identified by the Trend Assessment for the period 2014-2022, without sinks, are:

- 1.A.3.b Road transport — liquid fuels ($CO_2$)
- 2.C.1. Iron and steel production ($CO_2$)
- 2.F.1 Refrigeration and air conditioning (HFCs, PFCs)
- 1.A.1 Energy/energy industries — Liquid fuels ($CO_2$)
- 2.A.2 Production of limestone ($CO_2$)
- 1.A.4 Other sectors — Solid fuels ($CO_2$)
- 3.A.1 Enteric fermentation ($CH_4$)
- 1.A.2 Industry and construction — Solid fuels ($CO_2$)
- 3.C.4 Direct $N_2O$ emissions from soil ($N_2O$)
- 1.A.4 Other sectors — Liquid fuels ($CO_2$)
- 4.A Disposal of solid waste ($CH_4$)
- 2.A.1. Cement production ($CO_2$)
- 1.A.2 Industry and construction — Liquid fuels ($CO_2$)
- 4.D Wastewater treatment and discharge ($N_2O$)
- 3.C.5 Indirect $N_2O$ emissions from soil ($N_2O$)
- 3.C.1 Fires ($CH_4$)
- 4.D Wastewater treatment and discharge ($CH_4$)
- 1.A.4 Other sectors — gaseous fuels ($CO_2$)
- 1.A.1 Energy/energy industries — Solid fuels ($CO_2$)
- 3.A.2. Fertiliser management (CH4)

## 3.5 Performed Inventory Upgrades

In the process of creating the GHG inventory for the period 2019 – 2022, with recalculation for the period 2014 – 2018, certain improvements were made to ensure compliance with international standards and improve the accuracy of reporting.

- The structure of the **Reporting and Monitoring Guidelines** (MPGs) adopted at the **United Nations Climate Change Conference - Paris Agreement in 2018 (CMA 2018)** was monitored, which enabled consistency in the development and reporting of global guidelines. These guidelines represent a key framework for monitoring, reporting and verification of GHG emissions, ensuring compliance with the requirements of international standards, thus improving the transparency and reliability of data.
- A single database has been prepared in IPCC software v 2.95, with data for the period 2014 (reference year in the NDC) to 2022. This step is crucial for the long-term consistency of



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reporting and ensuring compliance with the requirements of the Paris Agreement, as well as for future revision and updating of the inventory based on new data and requirements.

- Archiving all relevant information, by submitting QA/QC questionnaires, databases of used data, as well as software databases to UNDP.
- The sectoral and reference approaches are clearly presented to ensure the accuracy of sector-specific data, taking into account the specific characteristics and needs of each sector for the calculation of emissions according to the IPCC methodology. In this way, accurate monitoring of emissions is enabled, taking into account all relevant changes and specifics by sectors.
- The document includes reporting on indirect emissions (NMVOC, CO, NOx, SO2). Also, the reporting of **PFC** emissions from aluminum production has been improved.
- The engagement of an external quality assurance (QA) expert enabled additional check and verification of data, which improved the accuracy and reliability of all reports.
- For the **agriculture** sector, emissions for the period from 2010 to 2018 were recalculated, which improved the accuracy of data for this sector, taking into account new approaches in the methodology.
- Calculation of the inventory from the agricultural sector according to the last categorization in accordance with the IPCC 2006 methodology and amendments from 2019, after which a recalculation was made until 2010.
- Implementation of updated input data on the annual amount of applied mineral fertilizer taken from the FAO database. In this part, due to changes in the input data of the animal population and methodology, a recalculation was made for the period 2010-2022.
- Calculation of $CO_2$ emissions from urea resulting from N in the application of mineral fertilizers,
- Calculation of HFCs was performed.

## 3.6 Necessary Improvements of the Inventory Preparation Process

Proposals for improving the inventory preparation process were defined based on the following:

- Review and identification of the main challenges that BiH faces in the process of creating inventory,
- Preparation of proposals for the improvement of the inventory making process and
- Collecting opinions, suggestions and proposals of institutions responsible for environmental and energy protection and
- Conducted meetings, interviews and surveys with the FBiH and RS Hydrometeorological Institutes.

BiH, as a Non-Annex I country, faces a number of challenges in the process of preparing GHG inventory:

- Preparation of the GHG inventory is performed within the project financed by international financial institutions, with a noted lack of experts in authorised institutions for the preparation of inventory,
- Institutional arrangements and coordination of institutions in the process of collecting, processing and submitting data,
- Lack of a standardised methodology for data collection, incomplete or inconsistent data, and limited access to relevant data;
- Lack of harmonised databases with data in both entities and BDs on activities, emission factors and emissions for the period since 1990,



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- Inconsistency between existing data and data necessary for calculation according to the IPCC methodology,
- Lack of legislation on the type and scope of data collected in BiH.

The lack of a standardised methodology for data collection, incomplete or inconsistent data, and limited access to relevant data are problems that significantly hamper the accuracy and consistency of inventories. These challenges can lead to inaccurate estimates of emissions and make it difficult to produce reliable reports. Also, lack of harmonised databases, which would include data on emissions, activities and emission factors for the period since 1990, represents a significant aggravating circumstance for showing a complete and consistent trend in emissions.

In order to overcome these challenges, it is necessary to introduce standardised data collection methodologies that will enable consistency and harmonisation with international practices. In addition, it is necessary to continuously work on harmonising the data collected, analyzed and presented in statistical reports (at the BiH and entity levels), with the data needed for the calculation of the GHG inventory according to the guidelines of the 2006 Intergovernmental Panel on Climate Change, taking into account the improvements from 2019 (Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories). It is necessary to improve the legislative framework and oblige entity and cantonal ministries to submit data in accordance with relevant laws and ordinances.

Also, it is necessary to develop harmonised databases between entities with the aim of enabling the simpler possible consolidation of data on emissions in BiH, which would enable easier analysis and reporting. Improving institutional arrangements and coordination among relevant institutions is also crucial for efficient data collection and exchange, and it is especially important to harmonise with legislation that would define the type and scope of data collected in BiH.

In accordance with the RS Law on Air Protection, the RS Hydrometeorological Institue is in charge of preparing the greenhouse gas inventory for the RS territory, while, in accordance with the FBiH Law on Air Protection of September 2024, the FBiH Hydrometeorological Institute is in charge of preparing the greenhouse gas inventory for the territory of the FBiH. In this regard, it is necessary to ensure the existence of a joint body in BiH, for the consolidation of entity inventories into an inventory for BiH, which will include emissions from both entities, with the addition of emissions for the territory of BD BiH. In addition, it is important to strengthen the capacities of institutions (hydrometeorological institutes) through additional training and employment of experts, in order to ensure sustainability and quality of the inventory at the long-term level. In order to improve the quality of inventory production, it is recommended to participate in trainings and projects such as, among other things, RIPAP and CBIT projects. Some of the topics that should be included in the training are data collection and analysis, improvement of inter-institutional cooperation and use of software tools for calculating emissions.

With the aim of defining the initial state and improving the consistency and completeness of the time series, it is necessary, through recalculation until 1990, to determine the zero/initial state according to the latest methodology. In this inventory, the flexibility of presenting data from 2014 as the base year in the NDC was used, and a recalculation was made for the period 2014 – 2018. For all sectors, especially for the LULUCF sector, additional methods of data collection should be introduced, as well as implementation of expert analyses that will improve data used for the creation of inventory, hence new methods of data collection should be found.

Introduction of mandatory regular meetings between institutions, strengthening the capacities of institutions through trainings and additional resources, and forming a Technical Working Group composed of representatives of the competent hydrometeorological institutes of the RS and the FBiH, as well as representatives of the BD BiH responsible for the preparation of inventory, which will oversee reporting, could improve coordination between the institutions participating in the preparation of the inventory. It is also necessary to appoint persons on behalf of the institutions who will perform the submission and verification of data, which is defined by the RS Law on Air Protection (Article 50, RS Official Gazette Nos. 124/11, 46/17) and the FBiH Law on Air Protection (Article 44, FBiH Official Gazette No. 72/24). In addition, it is necessary to strengthen the awareness of institutions about the importance of inventory and use of inventory data for NDCs as well as about the importance of providing data in manner required by those creating the inventory.

For the successful preparation of the GHG inventory, it is necessary to improve the process of its development by strengthening the capacity of institutions, including financial and human resources. Key problems related to the financing of this process are the lack of budget for research and data analysis. The best way to ensure stable financing is to increase the budget for this area. Applying for international projects and funds and introducing mandatory contributions from the high-emission sector has helped to ensure stable financing.

Better digitisation and standardisation of data and greater participation of academic and research institutions would improve the quality and availability of data.

Greater investment in education and awareness raising on climate change could improve emission reduction policies and measures. Stricter regulations and controls for polluters and incentives for the transition to OiE would also have an impact on reducing emissions.

# 4 Information necessary to monitor progress in implementation and achievement of the Nationally Determined Contributions (NDCs) under Article 4 of the Paris Agreement

## 4.1 Circumstances and Institutional Framework in Bosnia and Herzegovina

BiH faces a number of institutional, legislative and technical constraints in the areas of climate policy, energy transition and reporting, which require targeted international support to achieve emission reduction targets and ensure transparency in line with the Paris Agreement.

Creation of the GHG inventory is prescribed by the entity laws on air protection, without a clearly established MRV system. This process needs to be aligned with the provisions of Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action (which replaced the former MMR – Monitoring Mechanism Regulation).

Through the development and submission of the Climate Change Report, biennial reports on GHG emissions and through participation in CDM projects, BiH has established key elements of the international MRV within the UNFCCC for developing countries. It is necessary to work on further development of the domestic MRV that 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 the credibility of measures to reduce GHG emissions by ensuring consistency, completeness, accuracy and transparency.

Below is an overview of the situation and needs of BiH in terms of monitoring and reporting on emissions, in accordance with the "Annual Implementation Report for 2024", published by the Energy Community Secretariat.

In terms of monitoring and reporting on GHG emissions, a system for monitoring policies, measures and emission projections has not yet been established in BiH. The legal framework for these processes has not yet been transposed, and reporting through the Reportnet platform has not been formally initiated. Also, institutional mechanisms for reporting on revenues from emission prices or climate change adaptation strategies have not been developed.

Regarding the system for monitoring, reporting, verification and accreditation of emissions at the plant level, the Regulation on Monitoring and Reporting, as well as the Regulation on Verification and Accreditation, have not yet been transposed in BiH. This means that a system for approving monitoring plans and submitting annual emission reports has not yet been established.

In the OiE sector, the legislative framework in the entities and BD BiH recognises the concept of self-consumption and energy communities, but the implementation of secondary regulation is still ongoing and cooperation mechanisms (statistical transfers, joint projects and schemes) have not yet been established. The sustainability and emission reduction criteria for biofuels, bioliquids and biomass have not been transposed, which is non-compliant with the Directive (EU) 2018/2001 (RED II).

Regarding energy efficiency, although the FBiH has adopted the Strategy for Long-Term Renovation of Buildings, such strategies have not been adopted in the RS and BD BiH, and there is a lack of a unified system for monitoring measures and energy consumption, especially in the heating and cooling sector. The laws recognise energy service companies (ESCO models), but there are no accompanying bylaws and standard contracts, which limits their application.

The BiH Strategy for Climate Change Adaptation and Low-Emission Development for 2020-2030 was adopted in 2023, but it does not contain the goal of climate neutrality by 2050, but the goal of reducing emissions by 80% compared to 1990. The targets for 2030, contained in the draft NECP, are partially aligned with the objectives of the Energy Community, but require further clarification in terms of investment needs, progress indicators and quantitative effects of measures.

### 4.1.1 Population Profile

According to the results of the census in BiH, which was done in 2013, the total number of inhabitants was 3,791,622[6]. Compared to the last census in 1991, the number of inhabitants decreased by 585,411 (number of inhabitants in 1991 was 4,377,33). The reason for the decrease in population are war conflicts, migrations and decline in the birth rate. Preliminary results indicate that in 2013 1,326,991 (35%) were enumerated in the RS[7], 2,371,603[8] (63%) in the FBiH and 93,028 (2%) in the BD BiH[9] .

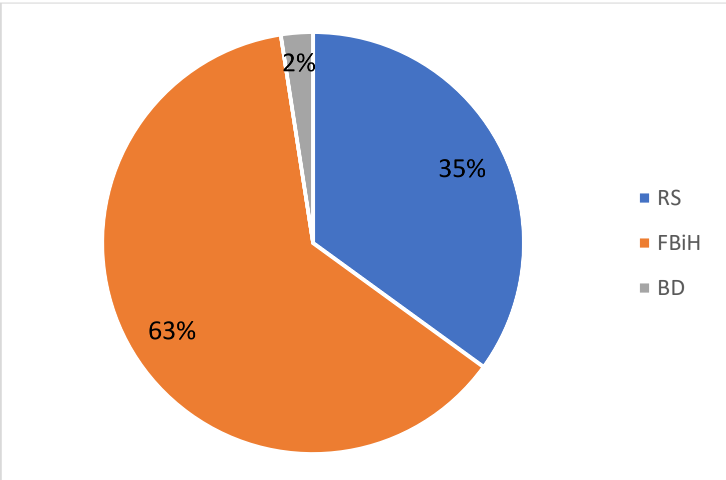


*Chart 6: Overview of the distribution of population in BiH by entities and BD BiH (Results of the 2013 census)[10]*

According to the data of the Agency for Statistics of BiH, there has been a trend of negative natural increase in BiH in recent years. During 2022, 25,311 live births were registered in BiH, which compared to 2021 shows a decrease in the number of live births by 2.16%, and 39,665 people died, which compared to 2021 shows a decrease in the number of deaths by 18.22%. During 2022, 16,788 marriages were concluded in BiH, which shows a decrease of 2.81% compared to 2021. During 2022, 1,999 marriages were divorced, which is a decrease of 4.95% compared to 2021.[11]

The following table shows the natural trend in population of BiH in the period 2016 - 2022

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[6] *BiH Agency for Statistics, 2013*
[7] *RS Statistics Bureau, 2013*
[8] *FBiH Statistics Bureau, 2013*
[9] *BiH Agency for Statistics, 2013.*
[10] *BiH Agency for Statistics*
[11] *https://bhas.gov.ba/data/Publikacije/Saopstenja/2023/DEM_01_2022_Q4_1_BS.pdf*

*Table 7: Natural trend in population in BiH in the period 2016-2022[12].*

| Year | Total number of inhabitants | Livebirths | | | Deaths | | | |
|---|---|---|---|---|---|---|---|---|
| | | Men | Women | Total | Men | Women | Total | Natural increase |
| **2016** | 3,511,000 | 15,716 | 14,357 | 30,073 | 18,542 | 18,029 | 36,571 | -6,198 |
| **2017** | 3,504,000 | 15,674 | 14,423 | 30,097 | 19,186 | 18,793 | 37,979 | -7,882 |
| **2018** | 3,496,000 | 15,268 | 14,199 | 29,379 | 19,007 | 18,737 | 37,744 | -8,365 |
| **2019** | 3,491,000 | 14,806 | 13,472 | 28,278 | 19,787 | 19,042 | 38,829 | -10,551 |
| **2020** | 3,475,000 | 14,166 | 13,021 | 27,187 | 23,040 | 21,387 | 44,427 | -17,240 |
| **2021** | 3,453,000 | 13,896 | 13,162 | 27,058 | 25,923 | 24,410 | 50,333 | -23,275 |
| **2022** | 3,434,000 | 13,690 | 12,902 | 26,592 | 21,148 | 20,148 | 41,296 | -14,704 |

### 4.1.2 Geographical Features

BiH has an area of 51,209.2 km2, (51,197 km2 of land area and 12.2 km2 of sea surface). FBiH covers about 51% of the territory of BiH, RS about 49%, while BD BiH occupies about 1% of the total area. The structure of land areas is as follows: 5% lowlands, 24% hills, 42% mountains and 29% karst areas. The Balkan geographical position determines BiH's affiliation to the Adriatic and Black Sea basins.

BiH borders with the Republic of Croatia (931 km), the Republika Srpska (375 km) and the Republic of Montenegro (249 km). The border on the Adriatic Sea is 23.5 km. The relief is predominantly hilly to mountainous, with an average altitude of 500 meters. Surface waters flow in seven river basins (Una, Vrbas, Bosna, Drina, Sava, Neretva with Trebišnjica and Cetina), of which 75.5% belong to the Black Sea basin and 24.3% to the Adriatic Sea basin. The country is also characterised by a wealth of thermal, mineral and thermo-mineral waters.

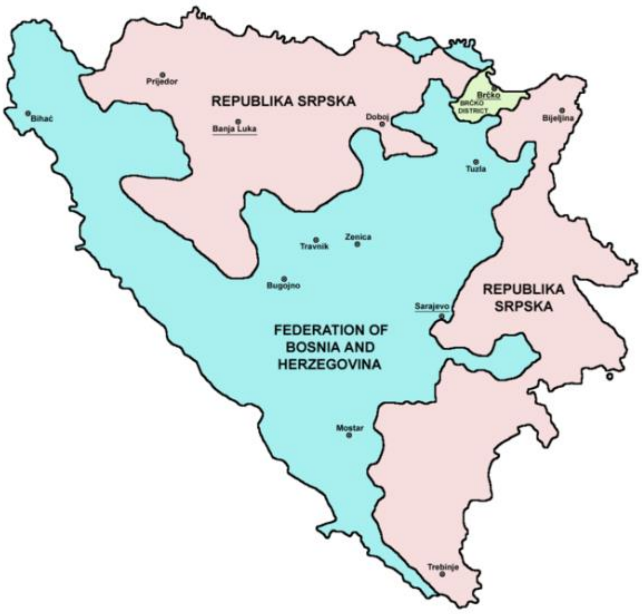


*Figure 1: Geographical map of Bosnia and Herzegovina*

[12] *BiH Agency for Statistics, https://bhas.gov.ba/data/Publikacije/Bilteni/2023/DEM_00_2022_TB_1_BS.pdf*

### 4.1.3 Economic Characteristics

BiH is an upper-middle income country with a nominal GDP of BAM 45.6 billion in 2022 and a GDP per capita of BAM 13,284, which represents only about 28% of the EU average when measured in standard purchasing power. The economic structure is predominantly service-oriented – services account for 66% of GDP, industry and construction for 26%, while agriculture accounts for less than 5%. Although GDP grew by 4% in 2022, high inflation of 14% neutralised the positive effect of growth. Inflation decreased to 6.2% in 2023 and the expected stabilisation for 2024 is 3.2%.

### 4.1.4 Climate characteristics

The climate of Bosnia and Herzegovina is dominantly determined by its geographic position, circulation of air masses, relief and geological base. The thermal regime and climate characteristics of Bosnia and Herzegovina are dominantly influenced by two action centers of the atmosphere: the Azores anticyclone, which causes stable and warm weather in summer, and the Icelandic cyclone, which brings precipitation. In winter, the influence of the Siberian anticyclone is occasionally registered, which is accompanied by cold and mostly dry weather, while in the summer, the influence of an anticyclone is also present, which has a Saharan or Mediterranean origin, which causes extremely hot and dry weather[13].

In Bosnia and Herzegovina, there are continental, moderate-continental, mountain-basin, modified Adriatic and Adriatic climate types[14].

The continental climate is represented in the northern and northeastern part of BiH. The approximate transitional border towards the moderate-continental climate is an altitude of 500 m. The average annual temperature in the continental type is over 11°C (for the period 1961 – 2020). Summers are usually very warm and hot, and absolute air temperatures are recorded up to 41.7°C (Banja Luka). The warmest month is July with average temperatures over 21°C. Winters are moderately cold, and the coldest month is January with average temperatures from 0.1 to 0.3°C. The primary maximum precipitation is most often in May. During the last two decades, there has been less and less snow and snow retention, which is related to climate change.

Moderate-continental climate is represented on the peripannonian perimeter and in the eastern part of Bosnia and Herzegovina. The approximate limit according to the mountain climate is an altitude of 1,200 m. The average annual temperature ranges from 7 to 11 °C (for the period 1961 – 2020). It is characterised by moderately warm summers and cold winters (Sokolac). The warmest month is July with an average temperature of 17 to 21 °C. The coldest month is January with average temperatures in the range of –4 to 0 °C. Compared to the continental climate, the territory where the moderate-continental climate is present receives more precipitation (up to 1,500 mm).

The mountain climate is represented in the territory over 1,200 m above sea level. Average annual temperatures range up to 7°C. The warmest month of July has an average temperature of 14 to 17°C, and the coldest, January, lower than –3°C. Precipitation is in form of rain and snow, which stays much longer compared to the lower areas. Average January temperatures are from –3°C (Čemerno) to –6.5°C (Bjelašnica), and July temperatures from 10°C (Bjelašnica) to 17°C (Čemerno – 15.6°C). The amount of precipitation is up to 1,800 l/m² (Čemerno). Typical representatives of the mountain climate type are: Čemerno, Bjelašnica, Kupres, Jahorina and Makljen.

[13] *Trbić, 2010*
[14] *Trbić, 2023*

The changed Adriatic and Adriatic climate affects the areas in the Adriatic hinterland, where the influences of the sea and the coastal belt (Neum-Klek) reach. This type of climate is represented in the area of Neum, and in the valley of the lower course of the Neretva, Popovo polje as well as the area of low Herzegovina. The limestone interior warms up faster during the summer than the coastal area, but cools faster during the winter, which affects the temperature regime. In the area of the changed Adriatic climate, temperature extremes are more pronounced, i.e. summers are warmer, and winters are colder compared to the coastal area of the Adriatic (Neum). Maximum temperatures during summer can reach up to 45°C (Trebinje and Mostar). The warmest month of July has an average temperature of over 23°C, while the coldest is January with temperatures above 5°C. The summer period, with temperatures over 20°C, lasts four months. In terms of the amount and annual distribution of precipitation, there are no significant differences compared to the Adriatic coast. It is characterised by mild and rainy winters, dry and warm summers. Average annual temperatures are over 14°C. Typical representatives of the changed Adriatic climate are Mostar, Trebinje, Stolac and Ljubinje.

### 4.1.5 Sector Details

#### 4.1.5.1 Economy

Data from the Agency for Statistics of BiH for 2022 show that the value of GDP amounted to BAM 45.6 billion, while GDP per capita amounted to BAM 13,284 or EUR 6,792. Production activities (agriculture, forestry and fishing, mining and quarrying, manufacturing, production and supply of electricity, water supply and construction) generate 35.11% of value added, and 64.89% in service activities. The largest share in GDP is the value added created in trade (14.74%), manufacturing (14.37%), public administration (6.88%), as well as in agriculture, forestry and fishing (4.83%).

*Table 8: Basic economic indicators of BiH, period 2016 - 2022*[15]

| Indicators | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|
| **Nominal GDP (in BAM billion)** | 30.3 | 31.8 | 33.9 | 35.8 | 34.7 | 39.1 | 45.6 |
| **Nominal GDP (in EUR billion)** | 15.5 | 16.3 | 17.4 | 18.3 | 17.6 | 20.1 | 23.3 |
| **Gross domestic product per capita in EUR** | 4,407 | 4,641 | 4,964 | 5,241 | 5,110 | 5,796 | 6,792 |
| **The real rate of GDP growth (%)** | 3.2 | 3.2 | 3.7 | 2.8 | -3.2 | 7.5 | 4.0 |
| **Average net salary (EUR)** | 428 | 435 | 449 | 471 | 489 | 510 | 573 |
| **Annual inflation rate (%)** | -1.1 | 1.2 | 1.4 | 0.6 | -1.0 | 2.0 | 14.0 |
| **Annual unemployment rate (in %)** | 25.4 | 20.5 | 18.4 | 15.7 | 15.9 | 17.4 | 15.4 |
| **Retail deposits in banks (in EUR million)** | 5,451 | 5,761 | 6,210 | 6,770 | 7,036 | 7,514 | 7,452 |

*Table 9: Entity's share in the GDP in BiH*[16]

| Indicators | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|
| RS (in BAM billion) | 9.63 | 10,07 | 10,68 | 11,3 | 11,13 | 12,50 | 14,53 |

[15] http://www.bhas.ba/saopstenja/GDP_Proizvodni_sr.pdf
[16] https://www.irbrs.net/statistika/UporedniPrikaz.aspx?tab=3&lang=lat



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30.04.2026, Sarajevo Log No. 63/26
Staša Elezović, Certified Court Translator for English Language

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| RS (in %) | 32.8% | 31.7% | 31.9% | 31.8% | 32% | 32% | 33% |
| FBiH (in BAM billion) | 19.53 | 20.54 | 21.94 | 23.13 | 22.25 | 25.22 | 29.68 |
| FBiH (in %) | 66.6% | 64.6% | 65.6% | 65% | 64% | 65% | 66% |
| BD BiH (in BAM billion) | 0.16 | 1.15 | 0.9 | 0.8 | 0.9 | 0.9 | 1.0 |
| BD BiH (in %) | 0.6 | 2.7% | 2% | 2 | 2% | 2% | 2% |
| BiH (in BAM billion) | 29.32 | 31.76 | 33.40 | 35.23 | 34.25 | 38.63 | 43.99 |
| BiH (in %) | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

GDP per capita in BiH, expressed in SKM (standard purchasing power) for 2012 is 28% of the EU-27 average, while consumption per capita in SKM in the same year amounted to 36% of the EU-27 average. In the period 2008 – 2010, GDP per capita in BiH, expressed in SKM, increased from 30% to 31% of the EU-27 average. The general price level in BiH in 2010 was 50% of the EU-27 average. In the period 2008 – 2010, the general price level in BiH increased from 49% to 50% of the EU-27 average. Based on the average movement of the consumer price index in BiH in 2012 compared to the average of 2011, there was an increase in inflation by 2.10%. Price increases were recorded in all categories except clothing and footwear, and the health and education sectors. Annual inflation in 2011 was 3.70%, while in 2012 it was 2.10%.

Monetary policy settings have remained unchanged since May 2009, after minimum reserve requirements had been reduced several times since October 2008 to increase the liquidity of the banking sector in times of financial fluctuations. The economic crisis in 2009 showed the vulnerability of BiH's growth model, which relies on foreign-financed consumption, thus creating a large foreign imbalance. Sustainability of macroeconomic policies has been weak due to structural weaknesses in public finances, although external imbalances have improved and financial and monetary stability has been preserved.

#### 4.1.5.2 Energy

15,035.96 GWh of electricity was produced in BiH in 2022, which is 2,019 GWh, or 11.8% less than in the previous year. Unlike in 2021, when hydrological conditions were favorable, in 2022 the hydrological situation was significantly worse, especially in the second half of the year, and production in hydro power plants decreased by 1,855 GWh or 29.4% and amounted to 4,459 GWh. Total production in thermal power plants decreased by 192 GWh or 2.0%, and amounted to 9,629 GWh. While the Stanari thermal power plant recorded the highest annual production since entering operation in 2016 in the amount of 2,128 GWh, the other four thermal power plants had lower production than in the previous year, and the largest decrease was recorded in the thermal power plants Ugljevik (8.7%) and Tuzla (8.5%). Wind farms connected to the transmission system produced 390 GWh, which is 2.2% more than in the previous year. At the same time, production in the Podveležje and Jelovača wind farms was slightly higher, and in the Mesihovina wind farm 5.1% lower than in 2021. Production from smaller renewable energy sources amounted to 536.89 GWh, which is 3.5% more than in 2021. Unfavorable hydrological conditions were also reflected in production in this category, in which small hydro power plants have a dominant share with 406.75 GWh (433.41 GWh in 2021). The production of solar (photovoltaic) power plants recorded a significant percentage increase (58.4%) of still relatively small amounts – in 2022, 117.05 GWh was produced, and in 2021 73.89 GWh. A dynamic growth in the production of solar power plants is noticeable, although certain part of the capacity (according to estimates of 23 MW) and the quantities of energy produced from these sources cannot be recorded, due to the specific status of electricity production for own needs. A total of 13.06

GWh was produced in the four existing biomass and biogas power plants (11.34 GWh in 2021).[17] Electricity production in wind farms connected to the distribution system in 2022, as in the previous year, amounted to 0.03 GWh. 20.70 GWh was produced in power plants of industrial producers. Total electricity consumption in BiH amounted to 12,058 GWh and decreased by 112 GWh, or 0.9% compared to the previous year. Consumption of customers connected to the transmission system (HV customers) decreased by 3.9% and amounted to 1,124 GWh.

The difference between total production and consumption in BiH, i.e. the balance surplus in 2022 amounted to 2,978 GWh, which ranks BiH, along with Bulgaria (surplus of 12,200 GWh), among the countries that are the only countries in Southeast Europe to have a surplus in the electricity balance.

Total production of heat energy (for district heating) in BiH in 2022 amounted to 5,728 TJ, of which 3,243 TJ or 56.62% was produced in heating plants, 1,887 TJ or 32.94% in thermal power plants, and 598 TJ or 10.44% in industrial power plants. In the final consumption of heat energy in 2022, households have the largest share with 74.87%, while industry and other consumers participate with 25.13%.[18]

According to available data, there are currently 32 active district heating systems in BiH, of which 22 are located in the FBiH and 10 in the RS. In addition, three systems are in bankruptcy proceedings and are not included in further analyses. Most systems date back to the 1980s and 1990s, with an average age of 29 years for boiler plants and 21 years for distribution networks. Most systems use fossil fuels, primarily coal and natural gas, while heat is in some cases supplied from thermal power plants and industrial plants (e.g. Tuzla, Zenica, Lukavac). In the RS, systems predominantly rely on their own boiler rooms that use biomass, heating oil, coal or natural gas. Although certain systems have been modernised (e.g. Sarajevo, Banja Luka, Prijedor, Gradiška, Gračanica), most systems still operate with high heat losses, outdated infrastructure and limited billing options. The model of flat-rate calculation of heating per square meter prevails, with only about 20% of users paying according to actual consumption, which reduces energy efficiency and user motivation to save. At the same time, an increasingly pronounced trend is the transition to renewable sources, especially biomass, in municipalities with significant forest potential such as Gračanica and Nemila. Biomass is used primarily in the form of wood chips, and in the last ten years new capacities have been developed with private investments. However, the development of the biomass market is hampered by complex public procurement procedures in public systems, while private operators have greater flexibility in supply. Despite positive examples, insufficient system size, seasonal use (solely for space heating), poor billing and a complicated regulatory framework remain serious challenges for the long-term sustainability of the district heating sector.

There is no official and systematically collected data for the cooling sector in BiH. This sector covers a wide range of applications, from households, commercial and industrial facilities, through healthcare facilities, to transport and agriculture, and represents a significant source of HFC emissions. The infrastructure is mostly underdeveloped, outdated and energy inefficient, while the cooling units management system is fragmented and lacks adequate regulatory oversight.

In the building and service sectors, air conditioning equipment that runs almost solely on HFC refrigerants with a relatively high GWP, such as HFC-134a, R404A and R410A, is increasingly used. The

[17] *Work Report of the State Electricity Regulatory Commission in 2022*
[18] *Electricity and Heat in 2022, BiH Agency for Statistics*

import and use of these substances grew until 2019, when HFC-134a peaked at almost 775 tons, after which a decline was recorded, only to rise again to over 272 tons in 2022. HFC emissions in 2022 amounted to 427.70 Gg $CO_2$ eq.

In the commercial sector, especially in the trade, hospitality and food industries, there are many outdated cooling systems with a high degree of leakage and high electricity consumption. The lack of regular servicing, proper dismantling and treatment of equipment further increases emissions during and at the end of the life of the equipment. In the food industry and processing, cold stores and warehouses often use outdated systems, and in rural areas such capacities are often lacking, which increases food losses and indirectly contributes to methane emissions.

The urban and transportation cooling segment also contributes significantly to HFC emissions. Most cities do not have developed district cooling infrastructure, so they rely on decentralised units that use HFC cooling units. In transportation, cooling systems in vehicles, especially refrigerated trucks and trailers, often use high-emission technologies with no leak control mechanisms. In healthcare, hospitals and laboratories rely on HFC devices to store drugs and vaccines.

Data on the import of HFC gases were collected from the competent entity institutions – the RS Ministry of Spatial Planning, Construction and Ecology and the FBiH Ministry of Environment and Tourism. In the period 2019–2022, large fluctuations in the import of fluorinated gases were recorded. The highest imports were recorded by HFC-134a, while R404A showed continuous growth, and R407C and R410A have oscillations with a significant decrease in imports by 2022. Gases such as R600a, R1234yf, HFC-152A and R125 are present only sporadically, which indicates their limited use. The overall data show the dominance of cooling units with high GWP, but also the emergence of substitute technologies, which requires further analysis and harmonisation with the Kigali Amendment and the EU F-gas regulation.

HFC emissions almost doubled between 2019 and 2022 – from 213.74 Gg $CO_2$ eq in 2019 to 427.70 Gg $CO_2$ eq in 2022. This trend indicates an accelerated expansion in the use of HFC-based refrigeration and air conditioning devices/units, which highlights the need to strengthen the regulatory framework, better monitoring and measures to reduce emissions in the coming period.

#### 4.1.5.3 Traffic

According to available data, the total length of the road network in BiH is 22,740.20 km, of which 72.60 km are highways, 3,786.00 km are main roads, 4,681.60 km are regional, and about 14,200.00 km are local roads. Below are the data on the volume of passenger transport in BiH (in thousands of passengers) and transport of goods in BiH (in thousands of tons).

*Table 10: Passenger transport in BiH (in thousands of passengers)*

| Type of traffic | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| **Road** | 14,053 | 6,542 | 8,211 | 9,170 |
| **City-suburban** | 122,004 | 81,145 | 90,809 | 81,675 |
| **Railway** | 657 | 181 | 250 | 436 |
| **Airline** | 1,920 | 524 | 1,215 | 2,205 |

All modes of passenger transport recorded a decline during 2020 and a gradual recovery by 2022, with the highest number of passengers recorded in urban-suburban transport in 2019 (122,004), and the lowest number of passengers recorded in rail transport during 2020 (181).

*Table 11 - Transport of goods to BiH (in thousands of tons)*

| Type of traffic | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| **Road** | 9,266 | 8,869 | 9,442 | 10,348 |
| **Railway** | 13,538 | 11,414 | 12,305 | 12,685 |

Freight transport shows steady growth after a decline in 2020, with the highest volume of goods transported by rail in 2022 (12,685) and the lowest by road in 2020 (8,869).

In 2022, a total of 1,184,763 road motor vehicles were registered. Out of the total number of registered passenger motor vehicles in 2022, 85% refers to passenger vehicles (1,006,142), 7% to freight vehicles, and 8% to all other categories of vehicles. Out of the total number of registered motor vehicles, 4.2% refers to first-time registered passenger vehicles in 2022.

The volume of passenger transport in BiH is represented by two indicators: transport of goods and transport of passengers. According to both indicators, the volume of transport had an increase. More detailed indicators on the volume of traffic according to individual structure are presented in the table.

*Table 12: Passenger transport in public road transport (in 1000)*[19]

| Parameter | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| **Vehicle mileage** | 95,774 | 44,713 | 55,269 | 69,975 |
| **Passengers transported** | 14,053 | 6,542 | 8,211 | 9,170 |
| **Passenger kilometres** | 1,732,480 | 718,750 | 965,481 | 1,306,032 |

Passenger transport in public road transport recorded a marked decline in all indicators during 2020 due to the pandemic, followed by a gradual recovery. The number of vehicle kilometers traveled decreased from 95,774 in 2019 to 44,713 in 2020, and in 2022 it reached 69,975 kilometers, which represents a difference of 53.3% between the maximum and minimum values. A similar trend is recorded by transported passengers – from 14,053 in 2019, the value decreases to 6,542 in 2020, and then rises to 9,170 in 2022, with a total difference of 53.5%. Passenger kilometers, as an indicator of the intensity of use, fell from 1,732,480 to a minimum of 718,750 in 2020, and then rose to 1,306,032 in 2022. Although there is a continuous recovery, the 2019 level has not yet been fully reached.

Below is the presentation of the transport of goods in public road transport in the period 2019 – 2022.

*Table 13: Transport of goods in public road transport (in 1000)*[20]

| Parameter | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| **Kilometers traveled** | 597,076 | 546,178 | 603,940 | 621,756 |
| **Goods transported (t)** | 9,266 | 8,869 | 9,442 | 10,348 |
| **Tonne-kilometres** | 4,380,071 | 3,901,256 | 4,447,226 | 4,645,109 |

When it comes to the transport of goods in public road transport, there was also a visible decline during 2020, but the recovery is faster and more stable compared to passenger traffic. The number of kilometers traveled decreased from 597,076 (2019) to 546,178 (2020), and then increased to 621,756 in 2022, which is a difference of 13.9% compared to 2020. The amount of goods transported fell from 9,266 tons to 8,869, and reached 10,348 tons in 2022, with a difference of 16.7% compared to 2020. Tonne-kilometres, as a combination of transport volume and distance, rose from a low of 3,901,256

[19] https://bhas.gov.ba/data/Publikacije/Bilteni/2024/TRA_00_2023_TB_1_BS.pdf
[20] https://bhas.gov.ba/data/Publikacije/Bilteni/2024/TRA_00_2023_TB_1_BS.pdf

in 2020 to 4,645,109 in 2022, surpassing the 2019 level, with an overall difference of 19%. These indicators point to a more resilient nature of freight transport, which has recovered faster and has already exceeded pre-pandemic values.

The BiH railway network consists of 1,018 km of railway lines, of which 417 km are located in the RS and 561 km in the FBiH. The density of railway traffic in BiH, with indicators of the amount of transport of goods and passengers per kilometer, is far below the European average. The current state of the railway infrastructure is such that normal traffic is impossible without major investments, and the existing amount of transport is insufficient to generate enough revenue to cover the costs.

The volume of rail traffic in BiH is represented by two indicators: transport of goods and transport of passengers.

*Table 14: Volume of railway traffic in BiH*

| Parameter | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| **Traction mileage (1000)** | 4,469 | 3,538 | 4,095 | 5,085 |
| **Train-kilometres** | 3,351 | 2,306 | 3,317 | 3,689 |
| **Tonne-kilometres (in mil t)** | 2,508 | 1,951 | 2,242 | 2,371 |

Unlike passengers, the volume of rail transport in the field of passenger transport had a decrease compared to 2019 by about 9%. This indicator best illustrates the existing trends, but also the possibilities of mitigation in the field of transport in BiH.

Out of the 27 officially registered airports in BiH, only four (Sarajevo, Banja Luka, Mostar and Tuzla) are registered for international traffic[21]. The annual number of air passengers for 2022 is about 1,920,000. There is no domestic air traffic in BiH and all data refer to international traffic.

BiH has a very short coastline in Neum and does not have regulated adequate access to international waters, and therefore, does not have a regulated seaport. The international port that is most important for the economy of BiH is the port of Ploče in Croatia.

In BiH, the Sava River is the main navigable river in the length of 333 km. Water transport along the Sava is connected to the Danube, which is considered the Trans-European Transport Corridor VII. The main characteristics of the situation in river transport in BiH are: neglected waterways, lack of a technologically modern fleet (towing instead of pushing), technical and technological obsolescence, as well as the devastation of ports and the lack of shipyards with slipways. As a positive fact, it should be noted that river navigation has an institutionally equal status as other modes of transport.

#### 4.1.5.4 Agriculture

The share of the agriculture, hunting and related service sectors in the structure of GDP for 2022 was 4.83%. Out of the total area of BiH, about 2,572 million ha or 50.3% are suitable for agriculture, of which only 0.65% is irrigated. Of these, arable land occupies 1,009,000 ha or 20.0% of the total land, of which 478,000 ha or 47% is currently uncultivated. Per capita there is about 0.56 ha of agricultural land, of which 0.36 ha are arable land and gardens.

[21] *Ministry of Communication and Transport of BiH, 2005.*

45% of agricultural land is hilly (300 to 700 m above sea level), of medium quality and suitable for semi-intensive livestock farming. Mountainous areas (over 700 m above sea level) make up a further 35% of agricultural land. However, the high altitude, slope as well as infertility of the soil limit the use of this land for grazing livestock only in the spring and summer period. Less than 20% of agricultural land (half of the total arable land) is suitable for intensive agriculture, and is mainly located in lowland areas in the north of the country, river valleys. Natural water resources are abundant, with many unpolluted rivers and groundwater available. Despite the abundance of water, water supply is a limiting factor for production in many areas. About 10,000 ha (0.1 percent of arable land) was irrigated before the war. The area that is irrigated today is significantly less than stated.

In the structure of sown areas in 2022, grains account for 92.73% (81,169 ha), fodder plants with 2.80% (2,183 ha), vegetables with 1.98% (1,737 ha) and industrial plants with 2.49% (2,447 ha).[22] In the sown areas in autumn sowing in 2022, wheat (49,289 ha) dominates, followed by barley (17,708 ha), oats (6,516 ha) and triticale (5,298 ha).

In BiH, in 2022, the most sown was corn (116,000 ha), followed by wheat (51,000 ha), barley (21,000 ha) and potatoes (19,000 ha). In the same year, the yield of corn per hectare was 6.7 t, wheat 4.8 t, barley 3.9 t and potatoes 15.1 t[23].

Prices of agricultural products in 2022 were higher by 48.7% compared to the 2015 price average. In 2022, compared to 2015 prices, crop production prices increased by 58.7% and livestock production prices increased by 38.7%. Prices of goods and services for current consumption in agricultural production (Input I) in 2022 were higher by 39.3% compared to the 2015 price average[24].

#### 4.1.5.5 Forestry

BiH has a rich biodiversity. BiH is one of the countries in Europe with the greatest diversity of plants and animals. The flora of BiH consists of about 4,696 plants, or 4,182 higher plants, 514 lower plants, 514 algae and 552 species of fungi. Currently, there are about 250 species of forest trees and shrubs. There are over 12,000 species of fauna in the nature of BiH[25]. The total endemic flora of BiH is about 450 species or about 10%. [26]Fauna censuses indicate that the animal kingdom is rich and diverse, especially compared to other countries in the Balkans and Europe, but this rich biodiversity is endangered. It is important to note that only about 1.96% of the territory of BiH is under protected area (four national parks and seven nature parks), with about 3% of the area under protection in the RS, and less than 1% in the FBiH, which is quite small considering the richness of biodiversity and the potential of natural resources[27].

The total area of forests and forest lands in BiH is 3,231,500 ha or 63.08% of the total area of BiH. Almost 52% of the forest area is located in the RS, and almost 48% in the FBiH. According to the II Forest Inventory in BiH, the area of available forests of production character is 2,172,700 ha or 42.5%

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[22] *https://bhas.gov.ba/data/Publikacije/Saopstenja/2024/AGR_10_2022_Y1_2_BS.pdf*
[23] *file:///D:/NUM_00_2023_TB_1_BS%20(1).pdf*
[24] *https://bhas.gov.ba/data/Publikacije/Saopstenja/2023/AGR_23_2022_Y1_1_BS.pdf*
[25] *Strategy and Action Plan for Protection of Biological Diversity in Bosnia and Herzegovina (2015 – 2020), 2016*
[26] *Bosnia And Herzegovina —Land of Diversity, First National Report of Bosnia And Herzegovina for the Convention on Biological Diversity, FBiH Ministry oEnvironment and Tourism, 2009*
[27] *Strategy and Action Plan for Protection of Biological Diversity in Bosnia and Herzegovina (2015 – 2020), 2016*

of the total area of BiH. The mass volume is 170 $m^3$/ha of all forests with an annual volume increment of 4.39 $m^3$/ha. The total area of all high forests in BiH is 1,652,400 ha with an average stock of 267.4 m3/ha and an increment of 3.93 m3/ha. The area of all coppice forests in BiH occupies 1,252,200 ha, with an increase in the stock of large wood of about 2.54 $m^3$/ha. Based on this increase, about 7 million m3/year was cut in BiH before the war and this potential should be the basis for the strategic development of the wood processing industry. The legal and institutional framework covering forestry is structured across two entities.

The total production of forest assortments in BiH in 2022 amounted to 3,810,387 m3 and is higher by 1.96% compared to the same period of 2021. The production of assortments of coniferous tree species increased by 1.86%, and the production of assortments of deciduous species increased by 2.07%. The production of coniferous logs increased by 3.04% and the production of deciduous logs recorded an increase of 0.66%. Production growth compared to 2021 was recorded for the following forest assortments: other long coniferous wood by 6.45%, spatial wood (deciduous) by 8.61%, pit wood (coniferous) by 3.05%, other long hardwood by 13.79% and firewood by 2.33%. A decrease in production was recorded in case of deciduous pit wood of 43.01%, in the spatial wood of conifers by 2.4%. In the production of other roughly processed wood and firewood of conifers, these are small quantities of assortments, the variation of which in the produced quantities does not affect changes in the total production of forest assortments[28].

Table 15. Total areas under forests in the Republika Srpska29 and the Federation of BiH30 (in ha)

| Year | Republika Srpska | Federation of Bosnia and Herzegovina |
|---|---|---|
| **2018** | 1 094 834 | 1 512 851 |
| **2019** | 1 097 001 | 1 511 386 |
| **2020** | 1 100 268 | 1 510 938 |
| **2021** | 1 095 891 | 1 518 466 |
| **2022** | 1 093 326 | Data not available |

[28] https://bhas.gov.ba/data/Publikacije/Saopstenja/2023/FOR_03_2022_Y1_1_BS.pdf

29 https://www.rzs.rs.ba/static/uploads/bilteni/sumarstvo/Bilten_Sumarstva_2023_WEB.pdf

30 https://fzs.ba/index.php/publikacije/godisnji-bilteni/sumarstvo/

#### 4.1.5.6 Waste management

According to the data of the Agency for Statistics of BiH, in 2022, 1.1 million tons of municipal waste were collected (382,341 t of waste in RS, 612,083 t of waste in FBiH, and the rest in BD BiH), which is 3.6% less than in 2021. On average, a resident of BiH produced 345 kg of municipal waste in 2022. In 2022, 929,141 tons of municipal waste was collected by public collection, which is 1.9% more compared to 2021[31]. Data indicating the origin of the generation of collected municipal waste show that the largest increase was registered in the collection of waste from households, as much as 81.3% of the total collected waste.

In 2022, 971 thousand tons of waste were disposed of in landfills. Thereof, 99.03% of waste was permanently disposed of, as a disposal option. The municipal waste disposal rate decreased by 0.2% in 2022 compared to the previous year 2021. The current trend indicates that more needs to be done to prevent waste generation, as well as to significantly increase the recycling rate in the coming years. In 2022, 388 thousand tons of waste were produced in the Republika Srpska, of which 366 thousand tons were permanently disposed of, and 2,276 tons were handed over for processing. In the Federation of BiH in the same year, 573 thousand tons of waste were permanently disposed of, while 4,088 tons were handed over for processing. The current trend indicates that more needs to be done to prevent waste generation as well as to significantly increase the recycling rate in the coming years.

Table 16 Produced, collected and treated municipal waste in the Republika Srpska (in tonnes)32

| Republika Srpska | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|
| **Waste produced** | 395 737 | 399 826 | 390 246 | 392 000 | 382 341 |
| **Collected waste** | 269 803 | 275 858 | 278 457 | 287 986 | 289 281 |
| **Permanently disposed of waste** | 294 666 | 321 178 | 334 713 | 356 548 | 366 309 |
| **Waste handed over for processing** | 2 767 | 2 929 | 1 999 | 2 189 | 2 276 |

Table 17. Produced, collected and treated municipal waste in the Federation of BiH (in tonnes)33

| Federation of BiH | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|
| **Collected waste** | 624 658 | 637 597 | 611 854 | 612 373 | 612 073 |
| **Household waste** | 491 970 | 507 984 | 493 647 | 500 002 | 504 686 |
| **Permanently disposed of waste** | 581 281 | 644 689 | 565 651 | 578 554 | 573 094 |
| **Processed waste** | 898 | 3 927 | 6 777 | 4 301 | 4 088 |

[31] https://bhas.gov.ba/data/Publikacije/Saopstenja/2023/ENV_01_2022_Y1_1_BS.pdf

32 https://www.rzs.rs.ba/static/uploads/bilteni/zivotna_sredina/Bilten_Zivotna_Sredina_2023_WEB.pdf

33 https://docs.google.com/gview?url=http://fzs.ba/wp-content/uploads/2023/08/20.5.1.pdf

#### 4.1.5.7 Water Resources Management

The territory of Bosnia and Herzegovina covers two main river basins: the Sava River Basin (38,719 km or 75.7% of the total area) and the Adriatic Sea Basin (12,410 km or 24.3% of the total area). The average annual runoff from the Sava River Basin is 722 m3/s or 62.5%, while the runoff from the Adriatic Sea Basin is 433 m3/s or 37.5%. Unfavorable spatial and temporal distribution of water runoff requires the construction of water management plants of considerable size and complexity, in order to enable rational water exploitation, protection of water quality and quantity, and protection from adverse effects of water.

In the Republika Srpska, the competent institution for the management of water resources is the Public Institution "Vode Srpske" Bijeljina (established by the Decision of the Republika Srpska Government No. 04/1-012-2-5/13 of January 11, 2013), and its activity and competence are prescribed by the Law on Waters, which defines it as a public institution responsible for the integrated management of waters of the Republika Srpska in accordance with the aforementioned law, other regulations and decisions of the competent authorities of the Republika Srpska[34].

In the FBiH, according to the Law on Waters, water resources are managed by the Sava River Basin Agency (AVPS) and the Adriatic Sea River Basin Agency (AVPJM), seated in Sarajevo and Mostar. The Law also prescribes the establishment of regional offices, in order to perform tasks more efficiently and promote the principle of approaching water users. The Sava River Basin Agency currently has three regional offices: in Zenica, Jajce and Bihać, while the Adriatic Sea Basin Agency has two regional offices in Livno and Konjic[35].

According to the World Bank (WB) data, in 2021 there were about 300,000,000 m3 of total abstracted and collected amounts of water[36]. Of the total amount of water abstracted, 46.7% was abstracted from underground springs, 36.1% from springs, 14.7% from watercourses, 0.8% from reservoirs, 1.7% from lakes.

#### 4.1.5.8 Education

The education system in BiH includes: preschool education, nine-year primary education that is compulsory and free for all children from the age of six to fifteen - secondary education and higher education. Competence for education in BiH is vested in entity and cantonal ministries, as well as a department in the Government of BD BiH. Each entity, canton, and BD BiH as a separate organisational unit in BiH, has its own law that covers all levels of education. There are more than thirty laws at different levels that regulate this area.

In the school year 2022/2023, 260,337 students were enrolled in BiH, which is 4,465 students or 1.7% less than in the previous school year. The share of the number of female students in the total number of students is 48.7%. In the school year 2022/2023, 28,253 students were enrolled in the first grades, which is 0.9% more than in the previous school year[37].

[34] http://www.voders.org/o-nama/pravni-status/
[35] https://fmpvs.gov.ba/wp-content/uploads/2024/02/07-federalna-strategija-upravljanja-vodama-2022-2032.pdf
[36] https://databank.worldbank.org/reports.aspx?source=2&series=ER.H2O.FWTL.K3&country=BIH#
[37] https://bhas.gov.ba/data/Publikacije/Saopstenja/2023/EDU_03_2022_Y2_1_BS.pdf

In the same school year, 2022/2023, 107,936 students were enrolled in 312 secondary schools in BiH, which is 321 students or 0.3% less than in the previous school year. In the school year 2022/2023, 13,068 teachers were involved in the teaching process, of which 8,242 were women or 63.1%. The largest number of students attend technical schools (57.8%), followed by grammar schools (20.5%), while 18.3% of students attend vocational schools[38].

In the first cycle of higher education studies, in the school year 2022/2023, including the short cycle and integrated studies, 73,250 students were enrolled in the winter semester, of which 64,064 students were enrolled in all years of study, and 9,186 were graduates. In 2022, 11,312 students graduated/completed their studies, which is 8.2% less than in 2021. Of the total number of graduated students, 62.1% are female students[39]. Over the last ten years, there has been an evident decline in the number of students.
According to the data of the Agency for Development of Higher Education and Quality Assurance in BiH, 8 public (6 in FBiH and 2 in RS) and 16 private universities (9 in FBiH, 7 in RS and 2 in BD), two public (both in RS) and 11 private universities (5 in RS, 5 in FBiH and one in BD) are accredited[40].

In the RS, the Ministry of Science, Technology and Higher Education in the RS Government is responsible for higher education and the science sector. In the FBiH, public universities are established by the cantons, while the FBiH Ministry of Education and Science performs administrative, professional and other tasks at the entity level, including the protection of copyrights and intellectual property rights, as well as the coordination of scientific and research activities. Cantonal ministries in the FBiH regulate the education and science policy for their cantons. The BD BiH, as a separate administrative unit, has the authority for educational and scientific policy.

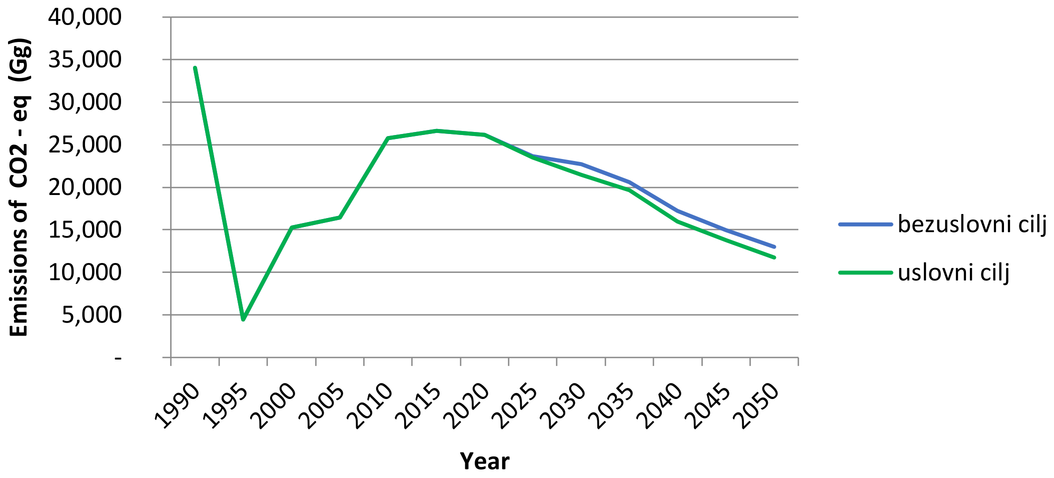
## 4.2 Description of BiH's Determined Contribution under Article 4 of the Paris Agreement, including updates

BiH, as a signatory to the Paris Agreement, has so far submitted two nationally determined contributions: the first NDC from 2017, based on the INDC document from 2015, and the second NDC from 2021, which for the first time defined the aggregate target for reducing greenhouse gas emissions.
In the 2021 NDC, BiH defined the goal of reducing total GHG emissions by 2030 and by 2050 compared to 2014:

- BiH has a goal to reduce greenhouse gas emissions by 2030 in the sectors of electricity, district heating, buildings, transport, industry, agriculture and waste by a total of 12.8% compared to 2014 (unconditional target), and 17.5% compared to 2014 (conditional target – with more intensive international assistance). In addition, measures to increase greenhouse gas sinks in forestry were analysed.
- On the other hand, adaptation to climate change in BiH, as a country where the negative consequences of climate change are already visible, is also one of the priorities.

The conditional option of the emissions reduction target implies more intensive international assistance on decarbonisation, with an additional focus on assistance for a just transition of mining areas. The following chart shows GHG emissions from 1990 to 2050 according to the previously described targets.

[38] https://bhas.gov.ba/data/Publikacije/Saopstenja/2023/EDU_04_2022_Y2_1_BS.pdf
[39] https://bhas.gov.ba/data/Publikacije/Saopstenja/2023/EDU_05_2022_Y2_1_BS.pdf
[40] https://hea.gov.ba/Content/Read/lista-akreditiranih-vsu




(LEGEND: bezuslovn icilj – unconditional target; uslovni cilj – conditional target.)

*Chart 7: GHG emissions in BiH by 2050 according to emission reduction targets (NDC, 2021)*

The following table shows the GHG emission reduction targets for BiH according to the NDC in 2021 compared to emissions from 2014 and 1990 (excluding sinks).

*Table 15: GHG emission reduction targets for BiH (compared to 2014 emissions) (NDC, 2021)*

| Target/year | 2025 | 203 | 2050. |
|---|---|---|---|
| **Unconditional** | 9.1% | 12.8% | 50.0% |
| **Conditional** | 9.8% | 17.5% | 55.0% |

*Table 16: GHG emission reduction targets for BiH (compared to 1990 emissions) (NDC, 2021)*

| Target/year | 2025 | 2030 | 2050 |
|---|---|---|---|
| **Unconditional** | 30.4% | 33.2% | 61.7% |
| **Conditional** | 30.9% | 36.8% | 65.6% |

The targets expressed in the NDC have been assessed as satisfactory by the UNFCCC Secretariat. However, these goals are insufficient when it comes to the ambitions of an Energy Community member state and with this level of ambition for emission reduction, no significant international assistance on decarbonisation can be expected. In addition, the 2021 NDC did not take into account the achievement of climate neutrality by 2050. Therefore, the emission reduction target for 2030 needs to be significantly more ambitious in order to achieve climate neutrality by 2050.

The Draft integrated National Energy and Climate Plan of BiH (NECP) defines the target value of greenhouse gas emission reduction in 2030. This value was obtained as a result of planning the development of the entire energy sector, on the basis of decarbonisation of the sector and compliance with the criteria defined in order to achieve carbon neutrality in 2050. In this regard, theatarget presented in Table 17 has been defined.

*Table 17: Greenhouse gas emission reduction target in 2030 according to the Draft NECP*

| | |
|---|---|
| Total $CO_2$-eq emissions by sinks in 2030 | 15.65 $MtCO_2$ |



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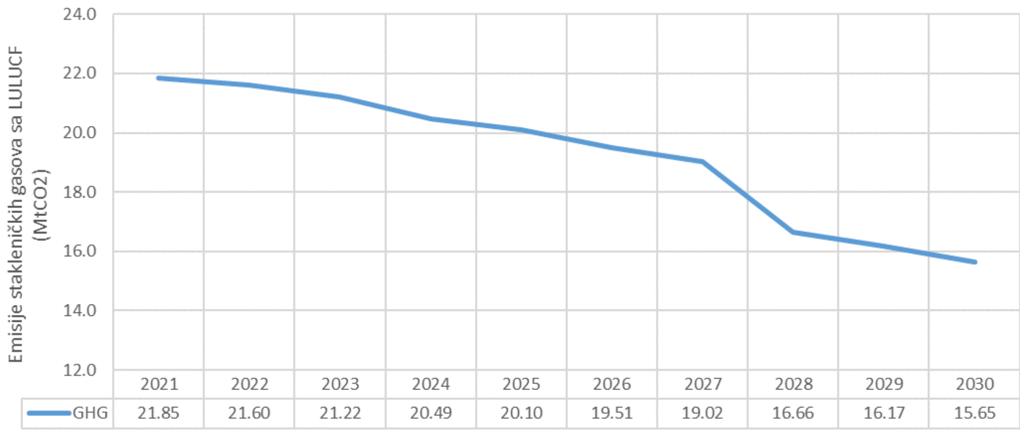
| | |
|---|---|
| Total $CO_2$-eq emissions excluding sinks in 2030 | 22.15 $MtCO_2$ |
| Total $CO_2$-eq emissions with sinks in 1990. | 26.62 $MtCO_2$ |
| Emission reduction in 2030 compared to 1990 (with sinks) | 41.21% |

The target implies a gradual reduction of GHG emissions in the period 2022-2030 according to the trend shown in the following diagram.




(LEGEND: Emisije stakleničkih gasova sa LULUCF – GHG emissions with LULUCF)

*Chart 8: Trajectory for the reduction of net GHG emissions in Bosnia and Herzegovina (draft NECP, 2024)*

Taking into account GHG emissions in 2014 and the conditional target, the targeted gross emissions in 2030 amount to 21.50 million tons of $CO_2$-eq. The amount of sinks in 2018, according to the values from the GHG inventory available in the period of making the 2021 NDC, was 5.83 million tons of $CO_2$-eq. Thus, when the amount of the sink is subtracted from emissions, according to the 2021 NDC, the targeted net emissions in 2030 amount to 15.67 million tons of $CO_2$-eq. Compared to the NECP target, the difference is only 0.13% or about 20,000 tons of $CO_2$-eq. The conclusion is that the NDC and NECP are aligned in terms of the greenhouse gas emission reduction targets. The two documents are not aligned when it comes to the 2050 target, given that the 2021 NDC was developed before the signing of the Sofia Declaration.

## 4.3 Assessment and quantification of the contribution of the Nationally Determined Contribution to Climate Change Mitigation to the implementation of the Sustainable Development Goals

At the Sustainable Development Summit held on 25 September 2015, UN Member States adopted the 2030 Agenda for Sustainable Development, which contains 17 Sustainable Development Goals (SDGs) aimed at eradicating poverty, combating inequality and injustice, and addressing climate change by 2030.

The Global Goals and the broader sustainability agenda go much further than the Millennium Goals and address the root causes of poverty and the universal need for development for the benefit of all people.

Mitigating the effects of climate change (Goal 13) is one of the 17 global goals that make up the 2030 Agenda for Sustainable Development. An integrated approach is crucial for progress towards multiple goals at the same time. Achieving this goal, within the integrated approach, will require significant changes in the sphere of policy measures and investment of resources within the climate change segment of BiH.

On the way to achieving the Sustainable Development Goals in 2018, BiH is ranked 71st out of 156 countries included in the analysis, with a total of 67.3 points (BiH Voluntary Report on Implementation of the 2030 Agenda and Sustainable Development Goals, 2019). The value of the SDG index indicates a country's place between the worst (0) and the best or target (100) outcome. BiH ranks lower on the

SDG index ranking than other countries in the region: Slovenia (8th place/80.0 points), Croatia (21st/76.5 points), Serbia (40th place/72.1 points) and just below the index values for the Republic of North Macedonia (61st place/69.0 points), Albania (62nd place/68.9 points) and Montenegro (69th place/67.6 points). The highest ranked country according to this index is Sweden, with a total index value of 85 points (the country has on average got to 85% on its way to achieving the best outcome for all 17 SDGs).

According to the 2018 Sustainable Development Goals Index Report, most countries in Eastern Europe and Central Asia have performed well in addressing poverty, improving health and education outcomes, and ensuring access to critical infrastructure. However, trend data suggest a regression by some countries regarding the central dimensions of human development. The report also emphasises that all countries in the region need to make greater efforts to decouple economic growth from negative environmental impacts. The value of the SDG index for BiH, as well as the assessment of national progress towards meeting the SDGs, are shown in the following figure.

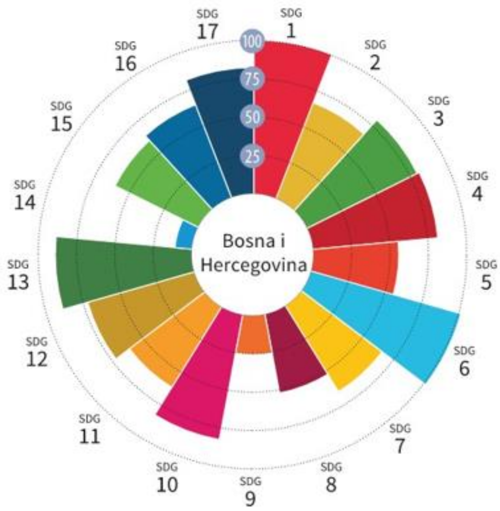



*Figure 2: Value of the SDG index for BiH, from worst (0) to best or target outcome (100)[41]*

[41] *Voluntary report of BiH on implementation of the Agende 2030 andSustainable Developmenmt Goals, 2019.*



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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 World without poverty → | 2 World without hunger → | 3 Health and wellbeing ↗ | 4 Quality education ** | 5 Gender equality → | 6 Clean water nd sanitation ** | 7 Affordable and clean energy → | 8 *Decent work* and economic growth ↓ | 9. Industry, innovations and infrastructure ↑ |
| 10 Reduced inequalities ** | 11 Sustainable cities and ccommunities ↓ | 12 Responsible consumption and production ** | 13 Climate action ↓ | 14 Water world preservation ↓ | 15 Preservation of life on land → | 16 Peace, justice and strong institutions → | 17 Partnership for the goals ** | |

| | | | | |
|---|---|---|---|---|
| ↓ **Decreasing** – Value is decreasing, country is going in wrong direction | → **Stagnating** – Value is stagnating or increasing at the rate of less than 50% required growth dynamics to achieve the goal until 2030 | ↗ **In moderate increase** – Value is increasing at the rate of over 50% of required growth dynamics, but it is still not sufficient to achieve the goal until 2030 | ↑ **On the right course** – Value is increasing at the required growth dynamics to achieve the goal by 2030 | → **Maintaining achieved result** – value and trends have been achieved or exceed the target values for 2030 |

*Figure 3: Assessment of BiH's National Progress towards Meeting the Sustainable Development Goals* [42]

In 2015, leaders of UN member states agreed on goals related to changing the economy and society towards sustainable and decarbonised development through adoption of the 2030 Agenda on the Sustainable Development Goals and the Paris Agreement to mitigate climate change to well below 2°C by 2100.

The interdependence of the goals of these agreements can be seen as an opportunity to move away from the discourse of two different plans that are often seen as in competition; and instead continue to implement them in a way that maximises mutual benefits.

In this context, the SDG Climate Action Nexus tool (hereinafter: the SCAN tool) has been developed. The SCAN tool aims to be user-friendly and practical and is intended to support policymakers in different sectors at different levels of governance, to achieve greater policy coherence, to enable the achievability of multiple goals and to improve the effectiveness of implementation by providing them with an initial indication of which climate actions may impact - positively or negatively - the specific SDGs.

Generally, across all sectors, emission reduction measures are grouped into three categories of climate change mitigation. These are "Activity Change" (actions that reduce the baseline demand for an emission-intensive activity), "Emission Intensity Reduction" (actions that reduce emissions produced per unit of activity) and "Energy Efficiency Increase" (actions to reduce the amount of energy required per unit of activity).

In this part, the assessment of measures in NDC on the Sustainable Development Goals (SDGs) has been performed. One of the most significant measures to reduce emissions is the installation of solar power plants. The following figure shows an assessment of the impact of this measure on the Sustainable Development Goal (SDG) related to poverty reduction.

[42] *ibid*



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| Category | Effect | Mitigation measure | |
|---|---|---|---|
| **Electricity and thernal energy** | **Carbon intensity reduction** | **Renewable enrgy sources, solar power plants** | **SDG 1-4- 1.Poverty reduction** |
| Potentially negative | Reduction of access to land and resources for dependant communities since installations require large land surfaces | | Goal 1.4:<br>Until 2030, ensure that all men and women, especially poor and vulnerable groups, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of ownership, heritage, natural resources, appropriate to new technologies and financial services, including microfinance. |

*Figure 4: Analysis of the impact of mitigation measures – installation of solar power plants on the Sustainable Development Goal – poverty reduction*

Although solar power plants play a significant role in the decarbonisation of the energy sector, it is necessary to consider in parallel the technical and systemic challenges that accompany their wider implementation (including the impact on stability of the electricity system, reduction of inertia of rotating machinery and risks of disruptions in electricity supply). Construction of solar power plants in terms of poverty reduction can have a negative impact due to the reduction of access to land and resources for dependent communities, as the installations require large areas of land. In order for this measure to be on track to achieve this SDG, it is necessary to ensure that all men and women, especially the poor and vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control of land and other forms of ownership, heritage, natural resources, appropriate to new technologies and financial services, including microfinance.

## 4.4 Information necessary to monitor progress made in implementing and achieving its Determined Contribution under Article 4 of the Paris Agreement

Monitoring, reporting and verification (MRV) of the system for implementation of NDC in BiH is a key mechanism for ensuring transparency, reliability and consistent monitoring of progress in meeting climate goals, as well as to provide a basis for informed policymaking and access to international support. The MRV system enables timely collection, processing and verification of data on GHG emissions, sinks, implementation of sectoral measures, mobilisation and spending of funds, and implementation of policies and regulations relevant to the transition to a low-carbon economy and adaptation to climate change. The MRV system is aligned with principles of the Decision 18/CMA.1 and follows the structure of sectoral policies. It uses, as a basis, the proposed structures and standard operating procedures for MRV defined in the NAP BiH.

The basis for the development of the MRV framework are:

a) Regarding climate change mitigation:

    a. GHG inventories, and
    b. Evaluation of the impact/effectiveness of individual and combined mitigation measures.
b) Regarding climate change adaptation:
    a. Vulnerability and climate risk assessment, and
    b. Evaluation of the impact/effectiveness of individual and combined adaptation measures.

The MRV system in BiH aims to provide the authorities with a tool to quantify progress, demonstrate the effectiveness of measures, and identify any failures or needs to adapt the approach. In accordance with the NAP, the system should include two key dimensions:

- Horizontal – across sectors and thematic areas, with a focus on priorities identified in strategies, national communications to the UNFCCC and sectoral evaluations.
- Vertical – through different levels of governance (state, entity, cantonal, local), including data from operational stakeholders, regulatory bodies, academia, local self-government units and local projects.

Both dimensions are necessary for the establishment of a functional and comprehensive MRV system for climate change mitigation and adaptation. Given the institutional and technical context of BiH, it is expected that in the initial phase, the greatest focus will be on monitoring and reporting, while evaluation and verification will gradually take on a stronger role as capacities develop. This approach is in line with the practice of other countries that have started implementing similar processes.

The aim of the MRV system for NDCs is to monitor the progress in implementation of measures envisaged by the strategies (Strategy for Adaptation to Climate Change and Low-Emission Development of BiH for the period 2020-20230, NDC, Draft NECP of BiH, Framework Energy Strategy of BiH until 2035, Climate Change Adaptation Plan of BiH), action plans and sectoral documents. The system must be able to:

a) With regard to climate change mitigation:
- Quantify the reduction of GHG emissions, by sector and year,
- Provide a link between policy implementation and emission trends in GHG inventories,
- Support establishment of market-based instruments (e.g. ETS) and climate finance, and
- Provide the basis for reporting under the BTR, NDC and NECP.

b) With regard to climate change adaptation:
- Quantify progress based on indicators and clearly defined goals,
- Provide data to update vulnerability and climate risk assessments, and
- Inform the decision-making and planning processes regarding future actions.

In line with the UNFCCC obligations, the MRV system will be developed in phases, integrated with the Climate Change Reports and the Biennial Transparency Reports for BiH (BTRs), and adapted in accordance with scientific knowledge and available capacities. This will ensure that BiH reports on progress towards resilience and achievement of NDC goals in a systematic and measurable manner. Below is a proposal for the MRV Framework for Climate Change and NDC in BiH. The final structure of the scheme must be agreed by the competent institutions in accordance with the constitutional competencies.



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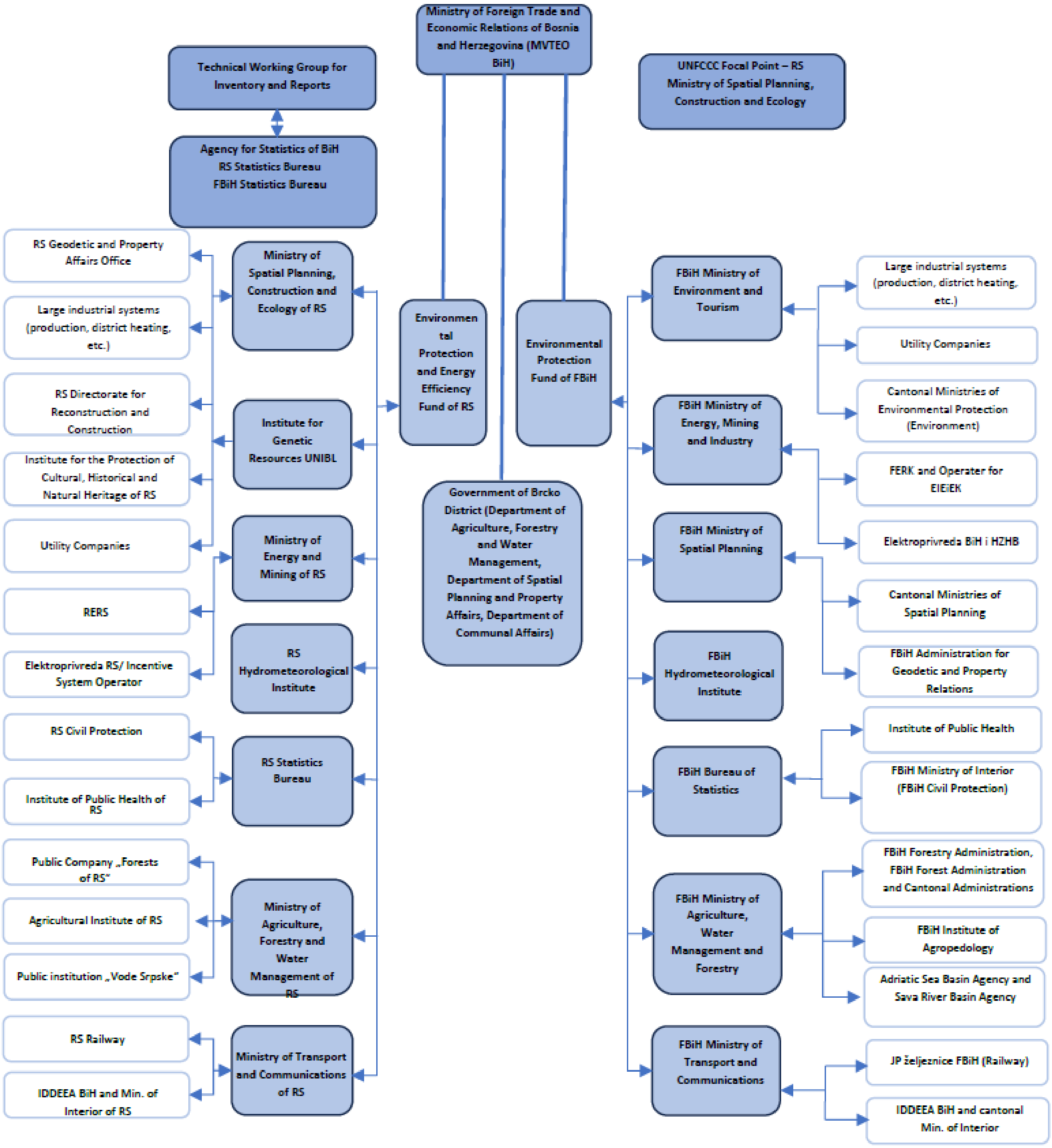


*Chart 9: Scheme of the MRV Framework for Climate Change and NDC in BiH[43]*

The institutional structure shown in the diagram above provides the basis for the establishment of a functional and integrated MRV system for both dimensions (climate change adaptation and mitigation), which includes vertical and horizontal coordination between state, entity and cantonal institutions, as well as BD BiH institutions:

- Horizontal coordination by sectors - Data are collected from sectoral institutions that are organised by entities, cantons and BD BiH. Key institutions include:

[43] *MRV developed and adjusted to climate change adaptation in NAP.*

- Hydrometeorological Institutes (FBiH Hydrometeorological Institute and RS Hydrometeorological Institute) – for climatology data, extreme weather events and vulnerability indicators (e.g. SPI, aridity, precipitation, temperature), effects of adaptation measures, as well as for GHG inventories at the entity level and indicators for monitoring emission reductions (total $CO_2$ - eq and $CO_2$ - eq by sector).
- Ministries of Energy, Transport, Environment, Industry and Spatial Planning at the entity and cantonal levels, and departments in BD BiH – for implementation of mitigation and adaptation measures in relevant sectors,
- Ministries of Agriculture, Forestry and Water Management (FBiH, RS and BD BiH Department) – for data on agricultural practices, irrigation, drought resilience, forestry policy and land use relevant for both components,
- Public health institutions (FBiH, RS and Department of BD BiH) – for data on the impact of climate change on health and on health aspects of adaptation,
- Agencies and public companies (e.g. electric utilities, system operators, funds, forestry and utility companies) – to provide technical and operational data on the status and performance of adaptation and mitigation measures, including investments, energy efficiency, emission savings and infrastructure resilience;
- Statistical Institutes (state, FBiH and RS) – for processing, harmonisation and distribution of data, and calculation of indicators and trends regarding the effect of measures,
- Environmental Protection Funds (FBiH and RS) – for monitoring financial flows and reporting on adaptation and mitigation projects.

- Vertical integration
    - Cantonal and municipal authorities, including cantonal ministries of environment, forestry and spatial planning and municipal local self-government units, shall submit data on implementation of climate change adaptation and mitigation measures, including the construction of protective infrastructure, afforestation, adaptation of water infrastructure, projects in buildings, transport and waste management, as well as accompanying financial flows,
    - BD BiH participates through its sectoral departments, including the Department of Agriculture, Forestry and Water Management, the Department of Spatial Planning and Property Affairs and the Department of Utility Services, which coordinate and report to the central institutions of BiH on the implementation of adaptation and mitigation measures.

The flow of information within the MRV system takes place through clearly defined phases:

1. Collection of data at the level of sectoral institutions

It is based on regular collection and reporting of sectoral data at all levels of administration, in accordance with the defined institutional scheme. Data are collected through standardised templates (which need to be developed in the coming period based onthe List of Selected Indicators for the Environment in BiH developed as part of the UNEP/GEF project "Capacity Development for the Integration of Global Environmental Obligations into State Policies and the Development of Decision-Making Processes", which enables uniform recording of the effects of measures, financial flows and indicators of vulnerability and emissions, and transparent monitoring of progress.

2. For climate change adaptation, data on climate change impacts and sectoral vulnerabilities are collected, including the agriculture, forestry, health, water management and infrastructure sectors. Implemented adaptation measures such as the construction of protective infrastructure, adaptation of water infrastructure, afforestation and health interventions, along with the costs and financial flows related to their implementation, are recorded. For climate change mitigation, data on GHG emissions and energy indicators, including energy consumption, emissions from the transport, industry and waste sectors, are collected. Implemented mitigation measures, such as installed OiE capacities, energy renovation of buildings, introduction of electric vehicles and increase in energy efficiency, are monitored, along with the invested funds and achieved emission savings. Data consolidation and analysis

Data analysis and integration is performed using tools such as LEAP, GHG Inventory Software and similar models to assess the impact of measures and link them to emission inventories. Entity and BiH statistical institutions, with the support of hydrometeorological institutes, consolidate data and develop thematic and sectoral indicators in accordance with applicable strategic documents and climate goals.

3. Verification through QA/QC mechanisms and independent evaluations

Data verification is ensured by technical working groups formed by the competent institutions by applying the adopted SOPs from strategic documents (such as the NAP) and the internal quality control system (QA/QC) in the preparation of the GHG inventory. The process includes verification of methodologies, independent verification of key data by expert bodies, and transparent publication of reports to the public and the UNFCCC system.

4. Final reporting and submission of report to the UNFCCC

Reporting is coordinated by MVTEO BiH in cooperation with key institutions, in accordance with the formats from the Decision 18/CMA.1 and the BTR Guidelines, while the Ministry of Spatial Planning, Construction and Ecology of the Republika Srpska ensures the formal transmission of reports towards UNFCCC. Reporting is realised through the development of the GHG inventory (in accordance with the IPCC 2006 Guidelines and 2019 Refinement), the report on implementation of measures and progress made in implementation of the NDCs, the report on received and required international support (finance, technologies, capacities), the BTR and the Climate Change Report.

Technical teams and external experts support the reporting process, and UNDP is a key partner in providing technical assistance. The development of a digital database compatible with EU systems (e.g. Reportnet 3.0), which enables data storage, processing and sharing, is also envisaged. In addition to the above, the MRVA system is an integral part of the wider MRV system and is used for plants covered by the ETS, in accordance with the obligations from the process of accession to the Energy Community and harmonisation with the EU ETS regulation. Monitoring of emissions from large stationary sources includes the obligation of plant operators to monitor and report on annual emissions according to accredited methods, with independent verification of reports in accordance with standards such as ISO 14065. This data will be integrated into the MRV system and will contribute to better and standardised reporting on implementation of NDCs.

It is planned that the MRV system will be dynamic and adaptable, with the possibility of updating methodologies, including new sectors and activities, and gradually integrating the requirements of the EU energy and climate reporting system. Continuous training programs for state and entity officials on implementation of IPCC guidelines, use of software tools (e.g. GHG Inventory Software, LEAP) and international obligations will further strengthen the system's capacities.

Indicators for monitoring progress in implementation of measures from the NDC are shown in the following table.

*Table 18: MRV framework for the implementation of NDCs*

| Indicator | Unit | Indicator type | Follow-up period |
|---|---|---|---|
| **Total GHG emissions** | Gg CO2 -eq | Emissions | Biennial |
| **Net increase or maintenance of CO2 sinks in the LULUCF sector** | Gg CO2 -eq | Emissions | Biennial |
| **Degree of implementation of planned NDC measures** | % | Technical | Biennial |
| **Area of land, infrastructure or settlements protected or restored through implemented adaptation measures** | ha | Technical | Biennial |
| **Total funds spent for the implementation of NDC measures** | BAM mil. | Financial | Biennial |
| **Total funds mobilised from international and domestic sources for the implementation of NDCs** | BAM mil. | Financial | Biennial |
| **Number of laws and policies adopted that enable implementation of NDCs** | Number | Strategic / Regulatory | Biennial |

The primary indicator for monitoring progress in meeting the NDC targets by 2030 in BiH is **the Total GHG emissions** (CO2 eq), based on which the monitoring of GHG emission reductions is performed compared to the base year 2014. The year 2014 was chosen as the reference year, with the aim of maintaining consistency in monitoring and reporting, since it was previously used as the base year in the NDC. In addition, 2014 represents the first year for which official and verified data are available, including detailed recalculated GHG emissions in accordance with the global warming potential of the IPCC Fifth Report (AR5). The indicator includes total emissions of all non-sink GHG gases expressed as CO2 eq from the energy, industrial processes and product use (IPPU), agriculture, forestry and land-use change (AFOLU) and waste sectors using 100-year global warming potential (GWP). Data on total GHG emissions will be taken from Bosnia and Herzegovina's official GHG inventory and GHG inventory reports, which are updated in accordance with IPCC guidelines and ETF requirements.

## 4.5 Progress in meeting the objectives of the 2021 BiH Nationally Determined Contribution

The 2021 BiH NDC defines emission reduction targets for 2030 and identifies measures to achieve them. However, no indicators have been adopted for the prescribed measures to monitor their implementation, which makes it difficult to quantify progress in meeting the 2021 NDC targets.

The 2021 NDC included a set of priority measures in the energy, buildings, district heating, industry, transport, waste, agriculture, and forestry sectors. Some of the key measures included increasing the share of OiE, improving energy efficiency in the residential sector, modernising industrial plants, and improving waste management systems. Nevertheless, the analysis of implementation of these measures shows limited implementation.

According to available data, most of the measures envisaged by the 2021 NDC have not yet been implemented. In the electricity sector, none of the planned new coal-fired thermal power plants (1,050 MW, conditionally 750 MW) have been built, and the project of the new unit "Tuzla 7" (750 MW) was officially canceled at the end of 2023, and other projects (e.g. Gacko 2) are still in the



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preparation phase. OiE is growing slower than targets: installed wind energy reached only 135 MW by the end of 2023 (out of the planned 550 MW), while photovoltaic plants exceeded the target of 100 MW, reaching about 101.56 MW at the end of 2022. Several larger solar power plants are announced.) Biomass and small hydropower plants have practically not been realised (in the FBiH, issuance of new permits for small hydropower plants is prohibited). Large hydro projects (e.g. 35 MW and a number of planned ones on the Drina) are in the planning or construction phases.

Limited changes have been made to district heating systems. The installation of heat meters and the modernisation of networks are taking place gradually within individual projects, but there are no consolidated progress reports. The most attention has been drawn to plans in Sarajevo to install large heat pumps in district heating systems (projects of 20 MW each that would use waste and drinking water). If implemented, they would significantly increase the share of heat pumps and reduce natural gas consumption. Coal continues to dominate some local district heating systems (especially in smaller towns), and the cessation of their use has not yet been achieved.

In the building sector, progress is also modest. Although a building renovation strategy has been adopted (e.g. in the FBiH by 2050), implementation is low. Through the NDC 2021, the goal is to renovate 10% of the housing and 10% of the public-business stock by 2030, but current renovations cover only a fraction of that. *Solar heat systems* and *heat pumps* are also poorly spread in the building sector, with no concrete statistics to confirm this.

In the 2021 NDC, the industrial sector is covered through defined goals related to increasing energy efficiency and own energy production by up to 5%. However, due to the lack of publicly available and systematic data, progress in meeting these goals is difficult to monitor. Industrial entities mostly implement projects independently, without the obligation to report to central institutions, which further complicates the assessment of effects achieved. A positive example of implementation of measures to reduce energy consumption in industry is the UNDP project from 2022, which supported the preparation of decarbonisation projects for 20 small and medium-sized enterprises from energy-intensive industry in BiH.

According to data from the Agency for Statistics of BiH, rail passenger transport in BiH in 2022 (31.4 million passenger km) returned to about 91% of the 2015 level (34.3 million passenger km), far from the required 50% increase. Rail freight transport (about 1.25 billion tkm in 2022) was only at the level of 2015 (1.29 billion) https://bhas.gov.ba/data/Publikacije/Bilteni/2024/TRA_00_2023_TB_1_HR.pdfhttps://bhas.gov.ba/data/Publikacije/Bilteni/2024/TRA_00_2023_TB_1_HR.pdf), instead of the planned +20%. Only 1,306 billion passenger km were transported by city and suburban buses in 2022, down from 1,690 billion in 2015 (the target was +20% since 2015).

In the forestry sector, available indicators show that afforestation is far below plan. There are no complete statistics, but local examples illustrate a wider problem. For example, in the forest area, the High-level Plan envisages afforestation of 60 ha/year, but in the period 2019-2021 only 25 ha was afforested (plan 180 ha in three years). Given these results, the target of 2,500 ha/year (25,000 ha by 2030) for BiH has not been achieved. Data for the whole of BiH is not available. The same applies to plantations and areas at risk of erosion: there are no reports on the achieved afforestation volumes for them either.

According to the reports of the Agency for Statistics of BiH and the entity bureaus of statistics, 99.03% of collected municipal waste in 2022 ended up in landfills. There is no information on the collection of $CH_4$ from landfills (mostly not used), nor on the use of biodegradable waste.

The NDC, within the multidisciplinary sector, envisaged the development of a plan and inventory of cooling units, which has not been started, but is certainly necessary in order for these gases with a lower degree of uncertainty to be included in emission inventories.

## 4.6 Mitigation policies and measures, actions and plans related to implementation of the Nationally Determined Contribution under Article 4 of the Paris Agreement

In accordance with the planned absolute emissions for 2030, determined by the revised NDC of April 2021 and the draft NECP, a harmonised target of reducing GHG emissions by 16.97% by 2030 compared to 2014 is defined, without sinks. This goal is planned to be achieved by implementing measures to mitigate climate change and reduce emissions in the sectors shown in the table below, through defined absolute values and percentage reductions compared to the reference year.

The year 2014 was chosen as the reference year, with the aim of maintaining consistency in monitoring and reporting, as it was previously used as the base year in the NDC. In addition, 2014 represents the first year for which official and verified data are available, including detailed reconstructed GHG emissions in accordance with the global warming potential of the IPCC Fifth Report (AR5).

*Table 19: Overview of GHG emission reduction targets in key sectors*

| Sector | Absolute emissions in 2014, Gg $CO_2$ - eq | Absolute amount of emissions in 2030, Gg $CO_2$-eq | Percentage decrease compared to 2014 |
|---|---|---|---|
| **Electricity** | 10,880.91 | 9,283.42 | 14.68% |
| **District heating** | 232.66 | 161.33 | 30.66% |
| **Building** | 1,205.20 | 627.43 | 47.94% |
| **Transport** | 3,064.77 | 3,541.47 | -15.54% |
| **Industry**[44] | 5,482.44 | 4,063.10 | 25.89% |
| **Waste** | 1,383.92 | 1,082.88 | 21.75% |
| **Agriculture** | 2,202.79 | 1,763.04 | 19.96% |
| **LULUCF** | -6,560.84 | -6,928.71 | 5.61% (increase) |

In the following subchapters, a description of the current situation, emission trends, key challenges and needs in the coming period is given for each key sector, and a table overview of the set of measures in all sectors to achieve the above goals in 2030. A detailed overview is given in Attachment III of measures and necessary policies and interventions as prerequisites for the implementation of measures within each sector.

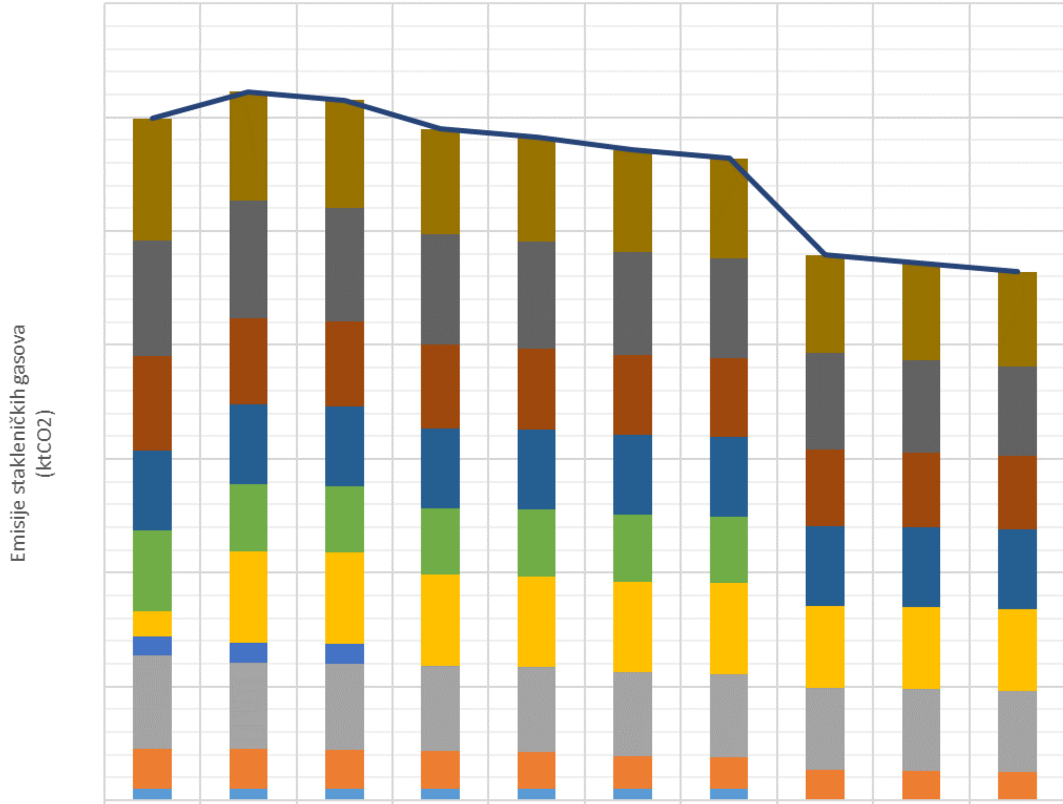
### 4.6.1 Electricity

Although BiH has significant potential for OiE, their use has not yet reached full capacity, and institutional and regulatory frameworks remain fragmented between the entities and BD BiH. Market

[44] *Note: The amounts of emissions and targets for industry do not include PFCs and HFCs, in order to align the targets and make it easier to monitor implementation of the NDC with the draft NECP.*

constraints are also present – the absence of an organised wholesale market, poor integration of OiE, low flexibility of the system and absence of mechanisms for market valuation of emissions.

In order to achieve the 2030 targets, regulatory reforms are necessary towards alignment with the EU acquis (including RED II and ETS directives), and establishment of a functioning internal electricity market. Key priorities include: establishment of mechanisms to support OiE (auctions, guaranteed buy-backs), stimulation of prosumer and shared energy models, elimination of coal subsidies and redirection of public funds towards the green transition. In addition to legislative reforms, the modernisation of network infrastructure and digitalisation of management systems, including smart metering, SCADA systems and improvement of transmission capacities, are necessary. Also, the gradual replacement of outdated thermal power plants with high-efficiency, low-carbon capacities is envisaged, thus contributing to the reduction of emissions, improvement of air quality and strengthening of energy independence. The transformation of BiH's electricity sector is not only a climate imperative but also an economic opportunity – for creation of new green jobs, development of domestic industry and access to international funds. Successful implementation requires coordination of all levels of government, transparent investment policies and strong involvement of citizens and the private sector in the transition.




| | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| Stanari 300 MW | 2,154.29 | 1,917.14 | 1,886.14 | 1,855.14 | 1,824.15 | 1,793.15 | 1,762.15 | 1,731.16 | 1,700.16 | 1,669.16 |
| Ugljevik 300 MW | 2,026.67 | 2,060.30 | 1,999.05 | 1,937.79 | 1,876.54 | 1,815.29 | 1,754.03 | 1,692.78 | 1,631.52 | 1,570.27 |
| Gacko 300 MW | 1,653.88 | 1,528.27 | 1,497.41 | 1,466.56 | 1,435.70 | 1,404.85 | 1,373.99 | 1,343.13 | 1,312.28 | 1,281.42 |
| TZ6 215 MW | 1,402.97 | 1,402.96 | 1,402.96 | 1,402.96 | 1,402.96 | 1,402.96 | 1,402.96 | 1,402.96 | 1,402.96 | 1,402.96 |
| TZ5 200 MW | 1,422.71 | 1,168.02 | 1,168.02 | 1,168.02 | 1,168.02 | 1,168.02 | 1,168.02 | - | - | - |
| TZ 4 200 MW | 442.72 | 1,599.87 | 1,599.31 | 1,598.76 | 1,598.21 | 1,597.65 | 1,597.10 | 1,436.89 | 1,436.39 | 1,435.90 |
| TZ3 100 MW | 329.94 | 351.31 | 351.31 | | | | | | | |
| KK7 230 MW | 1,641.26 | 1,529.03 | 1,515.82 | 1,502.61 | 1,489.40 | 1,476.19 | 1,462.99 | 1,449.78 | 1,436.57 | 1,423.36 |
| KK6 110 MW | 695.14 | 685.19 | 669.03 | 652.87 | 636.72 | 558.51 | 543.96 | 529.42 | 514.88 | 500.34 |
| KK5 110 MW | 212.11 | 212.11 | 212.11 | 212.11 | 212.11 | 212.11 | 212.11 | - | - | - |
| Total | 11,981.69 | 12,454.20 | 12,301.18 | 11,796.84 | 11,643.81 | 11,428.73 | 11,277.32 | 9,586.12 | 9,434.77 | 9,283.42 |

*Chart 10: Target greenhouse gas emissions from electricity production in BiH in the period 2021-2030 (draft NECP, 2024)*

(LEGEND: Emisije stakleničkih gasova – GHG emissions)

There are currently five thermal power plants in operation in BiH: two in the FBiH entity (TPP Tuzla and TPP Kakanj) and three in the RS entity (TPP Gacko, TPP Ugljevik and TPP Stanari), which use lignite and brown coal as fuel. When it comes to emissions from the electricity sector, from 2014 to 2022, there was a 5% increase, with emissions increasing from 10,880.91 Gg $CO_2$-eq in 2014 to 11,453.2 Gg $CO_2$-eq in 2022. In accordance with the climate policies of BiH, a target of 9,283.42 Gg $CO_2$-eq for 2030 has been set, i.e. a 14.68% decrease compared to 2014 and 18.94% compared to the values in 2022. This target is fully aligned with the defined target for the electricity sector in the draft NECP. The previous chart shows the modeled trend of decline in emissions from 2021 to 2030 from electricity production from the draft NECP.

### 4.6.2 District Heating

According to available data, there are currently 32 active district heating systems in BiH, of which 22 are located in the FBiH and 10 in the RS. In addition, three systems are in bankruptcy proceedings and are not included in further analysis. Most systems date back to the 1980s and 1990s, with an average age of 29 years for boiler plants and 21 years for distribution networks. Most systems use fossil fuels, primarily coal and natural gas, while heat is in some cases supplied from thermal power plants and industrial plants (e.g. Tuzla, Zenica, Lukavac). In the RS, systems rely predominantly on their own boiler rooms that use biomass, heating oil, coal or natural gas. Although certain systems have been modernised (e.g. Sarajevo, Banja Luka, Prijedor, Gradiška, Gračanica), most systems still operate with high heat losses, outdated infrastructure and limited billing options. The flat-rate heating model per square meter prevails, with only about 20% of users paying according to actual consumption, which reduces energy efficiency and user motivation to save.

At the same time, an increasingly pronounced trend is the transition to renewable energy sources, especially biomass, in municipalities with significant forest potential such as Gračanica and Nemila. Biomass is used primarily in the form of wood chips, with new capacities developed with private investments in the last ten years. However, development of the biomass market is hampered by complex public procurement procedures in public systems, while private operators have greater flexibility in supply. Despite positive examples, insufficient system size, seasonal use (solely for space heating), poor billing and a complicated regulatory framework remain serious challenges for the long-term sustainability of the district heating sector.

In addition to technical and economic challenges, in many urban areas, the absence of developed district heating systems contributes to serious air pollution during the winter months, due to the use of individual coal and wood fireplaces. Due to a combination of energy, environmental and health reasons, the transition to low-carbon, sustainable and efficient district heating systems is becoming an increasingly urgent priority for local communities, with a growing interest in *greenfield* investments based on renewable energy sources and the use of waste heat from industry.

In accordance with the priority and urgency of the transition to more efficient and low-carbon district heating systems, the goal of reducing emissions to 161.33 Gg $CO_2$-eq in 2030 has been defined, i.e. reduction in absolute amount of 71.33 Gg $CO_2$-eq or 30.66% compared to emission levels in 2014, and reduction compared to 2022 in the amount of 41.94 Gg $CO_2$-eq or 20.63%. This target is fully aligned with the planned amount of emissions from district heating in the draft NECP.

### 4.6.3 Building Sector

The building sector in BiH shows a significant trend of reducing $CO_2$ emissions in the last decade, which is the result of a significant implementation of energy efficiency measures and increased use of renewable energy, due to the allocation of available local and international funds. According to the latest inventory, emissions from this sector were reduced from 1,205.20 Gg $CO_2$-eq in 2014 to 727.06 Gg $CO_2$-eq in 2022, which represents a decrease of 39.67% compared to the previous year. This trend is expected to continue in the next planning period. Projections under the draft NECP predict that emissions from the sector will be further reduced to 627.43 Gg $CO_2$-eq by 2030, which is a further reduction of 13.7% compared to 2022. The same target is set in this document. Overall, between 2014 and 2030, the sector will experience a decrease in emissions of 577.77 Gg $CO_2$-eq, or 47.94%. This decline is the result of the gradual introduction of energy renovation measures for residential and non-residential buildings, through implementation of the Long-Term Building Renovation Strategy. A particular contribution also comes from targeted measures to complete the construction of unfinished single-family houses used as housing solutions for refugees and internally displaced persons, which also contributes to the social dimension of climate action. The 2030 target reflects not only technical progress, but also a broader transition towards a climate-resilient and low-carbon building sector, aligned with the goals of the Paris Agreement, the European Green Deal and the Green Agenda for the Western Balkans.

### 4.6.4 Transport

The transport sector in BiH in the last decade has been characterised by continuous growth, both in the number of vehicles and in energy consumption and greenhouse gas emissions. This sector plays a key role in the daily functioning of the economy and the mobility of the population, but at the same time represents a significant source of emissions and energy consumption, and is therefore recognised as a priority area for decarbonisation within national climate policies. The number of registered vehicles in BiH shows a clear upward trend. From 2019 to 2022, the number of motor vehicles increased from 1,063,115 to 1,138,394, which represents an increase of 7.08% in just three years. In parallel with the increase in the number of vehicles, fuel consumption has also increased. From 2014 to 2022, total fuel consumption in the transport sector increased from 951,457 tons to 1,273,420 tons, or by 33.83%. The largest absolute increase was achieved in diesel, which increased from 727,125 tons to 1,067,724 tons, while liquefied petroleum gas achieved the largest relative growth of 47.67%. In contrast, the consumption of unleaded motor gasoline recorded a decrease of 19.01%. Such dynamics was directly reflected in greenhouse gas emissions. Total emissions from the transport sector increased from 3,064.77 Gg $CO_2$ - eq in 2014 to 4,104.52 Gg $CO_2$ - eq in 2022, which represents an increase of about 34%, including $CH_4$ and nitrous oxide emissions. Overall, the transport sector in BiH is characterised by strong growth in mobility, dominant use of fossil fuels and growth in emissions, which indicates the urgent need for strategic measures that will enable the transition to more sustainable, efficient and climate-friendly forms of transport.

In accordance with climate policies, a target of 3,541.47 Gg $CO_2$ - eq emissions from the transport sector in BiH for 2030 has been set, which is aligned with the target of the draft NECP (excluding planned aviation emissions that are excluded from the national total emissions). Compared to 2022, the planned reduction is approximately 13.73%, which represents a significant step towards the decarbonisation of the sector. However, when this value is compared to 2014 emissions, it is observed that emissions in 2030 would still be about 476.7 Gg $CO_2$ - eq, or 15.54% above the 2014 reference level. Compared to 1990, when emissions amounted to 2,357.7 Gg $CO_2$ - eq, emissions in 2030 would be higher by as much as 1,183.77 Gg $CO_2$ - eq, which represents an increase of 50.21%. The main reason why planned emissions in 2030 are still above the level of 2014 and especially in 1990 is the decades-long increase in the number of vehicles and the more intensive use of fossil fuels in road transport. Increasing population mobility, urbanisation, logistics flows and an obsolete vehicle fleet have all contributed to the growth of emissions over the past decades, resulting in significantly higher emissions in recent years compared to earlier periods.

Despite the fact that total emissions in 2030 do not reach the 2014 and 1990 levels, the target represents a realistic balance between economic development, increased demand for mobility and the need for climate transition. Efforts to modernise the vehicle fleet, switch to alternative fuels and strengthen public transport remain key to further reducing emissions after 2030.

### 4.6.5 Industry

The industrial sector of BiH represents one of the largest sources of GHG emissions, including emissions from energy consumption in industry and emissions from industrial processes and product use. The structure of industry in both entities is characterised by the presence of energy-intensive production processes. In 2014, total emissions from these categories amounted to 5,482.44 Gg $CO_2$-eq, of which 1,867.56 Gg $CO_2$-eq was from energy consumption, while emissions from industrial processes, predominantly from the production of cement, lime and metals, amounted to 3,614.87 Gg $CO_2$-eq. By 2022, emissions increased further, and amounted to a total of 5,927.68 Gg $CO_2$-eq. The increase compared to 2014 is 445.24 Gg $CO_2$-eq. The main causes of this trend lie in limited modernisation of equipment, growth of industrial activity without the proportional development of emission reduction measures, as well as retention of a high share of fossil fuels in the energy mix of the industry. Industrial systems in BiH continue to operate on technological solutions that are energy and emission intensive, and energy efficiency measures have not yet been widely accepted in practice. In accordance with the draft NECP, this document plans that by 2030 emissions from the industrial sector will be reduced to 4,063.10 Gg $CO_2$-eq, of which 1,318.77 Gg $CO_2$-eq would be from energy consumption and 2,744.33 Gg $CO_2$ from industrial processes. This would achieve a total reduction of emissions of 1,419.34 Gg $CO_2$-eq compared to 2014, which represents a relative reduction of 25.89%. When looking at the period from 2022 to 2030, a reduction of 1,864.58 Gg $CO_2$- eq is predicted, which is a decrease of 31.46%. With this objective and the current situation, the emissions of PFCs and HFCs, which occur in certain niches of industrial production, are not taken into account, but only the emissions of $CO_2$, CH4 and nitrogen oxides.

The industrial sector in BiH faces a number of challenges, such as outdated production infrastructure, high energy intensity, limited access to finance for technological modernisation, weak institutional support for the deployment of energy management systems, low utilisation of potential for recycling and reuse of materials, as well as underdeveloped markets for secondary raw materials. The high emissions that currently characterise this sector are the result of a combination of technical constraints, structural dependence on fossil fuels and lack of regulatory and economic incentives for decarbonisation. The ambitious goals set for 2030 can only be achieved through strong, systemic and coordinated interventions that link energy efficiency, circular economy, digitalisation and substitution of high-carbon technologies.

### 4.6.6 Measures to Reduce PFC and HFC Emissions

In the period from 2019 to 2022, the production of raw aluminum in BiH, realised using Soderberg technology, shows an oscillating trend that reflects economic and operational challenges in the sector. During 2019, a total of 67,690 tons of raw aluminum was produced, while in 2020 production was completely suspended, which is related to financial problems and the temporary shutdown of the production capacities of the company "Aluminij d.d. Mostar". In 2021, production was restarted, with 90,038 tons recorded, while in 2022 a further increase in production was recorded, reaching 138,969 tons. This increase indicates a partial stabilisation of the sector and renewal of capacity, but at the same time increased GHG emissions, given that aluminum in BiH is produced through electrolysis using Soderberg technology, known for its high perfluorocarbon (PFC) emissions, especially during the occurrence of anode effects. In the period from 2014 to 2022, PFC emissions grew from 391.74 Gg $CO_2$ - eq to 414.88 Gg eq $CO_2$ - eq. By 2030, by applying measures of technical and operational optimisation of the electrolytic process of aluminum production, it is planned to reduce PFC emissions by 166 Gg $CO_2$ - eq, or 40% compared to the amount of emissions in 2022.

There is no domestic production of HFC gases in BiH, and all market needs are met solely through imports. Accordingly, for the first time, the GHG inventory includes data on imported quantities of fluorinated gases (F-gases), which is an important step towards establishing a more complete reporting system in accordance with the requirements of Article 13 of the Paris Agreement and the guidelines from the IPCC methodology. Data on the import of HFC gases were collected on the basis of information submitted by the competent entity institutions – the Ministry of Spatial Planning, Construction and Ecology of the RS and the FBiH Ministry of Environment and Tourism. During the period 2019–2022, significant fluctuations in the import of fluorinated gases in BiH were recorded. The largest imports are consistently related to HFC-134a, which reached almost 775 tons in 2019, then fell to 45 tons in 2021, and rose again to over 272 tons in 2022. R404A shows continuous growth, while gases such as R407C and R410A have oscillated, with a significant decrease in imports by 2022. R600a, R1234yf, HFC-152A and R125 are present only in trace amounts or in certain years, indicating limited use. SF6 imports have stabilised at 312 kg per year since 2021. The overall data indicate the dominance of high-GWP gases, but also the beginning of implementation of substitute technologies, which requires further analysis and harmonisation with the Kigali Amendment and the EU F-gas regulation. HFC emissions in 2022 amounted to 427.70 Gg $CO_2$ - eq. By applying the measure of phasing out HFC gases with high GWP and switching to environmentally friendly cooling technologies, it is planned to reduce these emissions by 29.3% or to an absolute amount of 302.36 Gg $CO_2$ - eq in 2030, whereby BiH would fulfil its obligations under the Kigali Amendment.

### 4.6.7 Waste

Waste management in BiH is organised at the level of entities and BD BiH. The waste sector in BiH has a growing importance in the context of climate policy and sustainable resource management, given its contribution to GHG emissions and potential for the transition to a circular economy. According to the latest GHG inventory, total emissions from the waste sector in 2022 amounted to 1,446.69 Gg $CO_2$ - eq. The largest part of these emissions comes from the solid waste disposal category (853.75 Gg $CO_2$), where CH4, as a result of anaerobic decomposition of biodegradable waste, is the dominant gas. A significant share of emissions also comes from wastewater treatment and discharge, i.e. 592.94 Gg $CO_2$, especially in urban areas without and with outdated or insufficient treatment plants. The Strategic Framework in BiH recognises the waste sector as a priority area for intervention, where a significant reduction in the amount of landfilled waste, an increase in recycling and composting, and introduction of a landfill gas energy recovery system are envisaged. In addition, the strategic documents envisage alignment with key EU directives, including the Landfill Directive (1999/31/EC) and the Waste Directive (2008/98/EC), which set targets such as a maximum of 10% of municipal waste disposal and a minimum of 60% recycling by 2035.

### 4.6.8 Agriculture

Agricultural production in BiH takes place within the jurisdiction of the FBiH, RS and BD BiH, with differences in the structure of production and the intensity of agricultural activities. In the period from 2014 to 2022, emission categories in agriculture related to livestock breeding and use of nitrogen substances show pronounced negative changes conditioned by the decline in production and the increase in input prices. Emissions from enteric fermentation ($CH_4$) and fertilizer management ($CH_4$



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and $N_2O$) are directly related to the number of livestock heads and the manner of fertilizer management, while emissions from the use of urea and nitrogen compounds from the soil additionally reflect the intensity of plant production and the management of mineral fertilizers. In the category of enteric fermentation, which refers to fermentation processes in the digestive system of ruminants, the decline in the number of cattle, dairy cows and goats in BiH results in a decrease in the total emission potential. Fertilizer management, as the second main category, includes storage, treatment and use of fertilizers. In this segment, in addition to the quantitative decline in the number of livestock heads, the dominant management mode also plays a significant role – where open, disorderly systems without emission control still prevail. On the other hand, emissions from urea application, as well as direct and indirect $N_2O$ emissions from soil and fertilizer management, depend on the use of mineral nitrogen fertilizers and practices in crop production. In BiH, a decrease in the use of urea and other nitrogen compounds has been observed in years with high prices of raw materials, and in regions affected by rural depopulation and weakening of planting activities. However, in more intensive areas of cereal and vegetable cultivation, this practice is still maintained, often without precise control of dosage and timing of the crop's needs.

Overall, the emissions trend reflects the general situation in the agricultural sector: a combination of declining livestock production, uneven application of agrotechnical measures and the need to improve organic and mineral nitrogen management practices. In the coming years, the sector will be under pressure not only due to market and demographic factors, but also due to commitments (e.g. the Nitrate Directive) to reduce emissions of nitrogen compounds in line with climate goals and initiatives such as the Global Methane Pledge. If reforms are implemented, which include establishment of closed fertilizer management systems, rational use of urea, monitoring of soil emissions and broader education of farmers, it is possible to mitigate the existing negative trends and contribute to the development of more sustainable and efficient agriculture in BiH by 2030.

Although there are no concrete numerical projections of the growth of the number of livestock heads by 2030, strategic documents such as the NAP imply the need to increase livestock production in BiH. This increase should be aligned with the goals of sustainable development and climate adaptation, with implementation of measures that enable the growth of livestock farming without a proportional increase in GHG emissions. To define the goal and measures, an assumption of growth of about 10% of the number of livestock, an increase of 0.3% of the number of poultry, and an increase in crop production and fertilization practices of about 32% by 2030 was taken, and a target amount of emissions in 2030 of 1,763.04 Gg $CO_2$ - eq was defined, in accordance with the draft NECP, i.e. a reduction of 19.96% or 439.75 Gg $CO_2$ - eq compared to 2014. This target implies an increase in emissions by 8.53% or 150.42 Gg $CO_2$ - eq in 2022 as the last year of the GHG inventory, which indicates that future measures are aimed at curbing the growth of emissions due to the increase in agricultural and livestock activity in the period from 2022 to 2030.

### 4.6.9 Forestry as part of LULUCF

Forest resources in BiH are distributed on the territory of the FBiH, RS and BD BiH, in such a way that almost 52% of the forest area is located in the RS and almost 48% in the FBiH, and the remaining part (less than 1%) in the BD BiH. BiH is one of the most forested countries in Southern Europe, with high biodiversity and significant ecological potential for carbon sequestration. Forest ecosystems in BiH cover over 60% of the territory and have a stable sinkhole capacity thanks to the structure of forest communities, natural succession potential and the predominantly natural character of forests.

According to the data from the GHG inventory, the LULUCF sector, and especially the forest land category, continuously records high net $CO_2$ sinks – in 2022, total sinks amounted to −6,928.71 Gg $CO_2$, of which −6,443.57 Gg $CO_2$ came from forest land, -479.09 Gg $CO_2$ came from wood products from felling, and −6.05 Gg from cultivated land. An analysis of trends from 2014 to 2022 shows a gradual increase in sinks from forest land, which grew from − 6,560.84 Gg $CO_2$ in 2014 to −6,928.71 Gg $CO_2$ in 2022. These dynamics are the result of natural forest regeneration, stable management and limited changes in land use. While forest ecosystems in BiH are currently contributing to a positive climate balance, they are also highly vulnerable to the impacts of climate change – including displacement of forest communities, pest growth, fires, erosion and productivity decline. Climate change projections for BiH by the end of the century indicate an increase in temperature of 2.5–5°C and a decrease in precipitation of up to 20%, which will significantly affect the structure and resilience of forest ecosystems.

Due to the aforementioned sensitivity and biological inertia in forest growth, it has been estimated that measures in the forestry sector, which are mostly focused on adaptive management and preservation of existing capacities, will not result in an additional increase in sinks in the short and medium term. Therefore, for purpose of estimating emission targets until 2030, it is justified to assume a stable level of $CO_2$ sinks from the forestand cultivated land, at the level of 2022, without further changes. Maintaining this level implies a focus on preventing degradation, controlling fires and pests, preserving genetic diversity and functional ecosystems, and not necessarily quantitatively increasing sinks. This approach is in line with the recommendations of national climate strategies, which recognise forestry as a key measure to mitigate climate change through preservation of existing sinks, but also as a vulnerable sector that requires continuous investment to maintain $CO_2$ absorption capacity. In this sense, the agriculture sector in BiH by 2030 has the task of maintaining the current sinkhole capacity of the LULUCF sector, which represents a strategic contribution to the country's overall climate goal. Below is a summary table with measures to achieve the described goals in each of the sectors.

*Table 20: Planned set of measures to achieve the emission reduction target in 2030*

| Measure | Description | Specific objectives | Responsible authorities | Expected effects | Benefits of implementation |
|---|---|---|---|---|---|
| | | **Electricity** | | | |
| **Construction of new photovoltaic prosumer systems and energy communities** | In 2024, BiH did not have a single prosumer and energy community in the network, but due to the development of the regulatory framework and a favorable investment environment, significant growth and interest of citizens, public and private sectors is expected. By 2030, the integration of the following capacities of prosumers and energy communities is planned:<br>• 92 MW of PV in the industry, and<br>• 500 MW PV in the housing and public sectors.<br>The measure also includes the promotion of prosumers and energy communities, and the establishment of a support system through subsidies, tax breaks and special benefits for prosumers and energy communities, especially in households and the public sector. | • Increasing the share of renewable energy sources in the energy mix<br>• Reduction of specific CO2 emissions<br>• Empowering end users to actively participate in the energy transition through the production of electricity from renewable energy sources for their own needs and delivery to the grid | Ministry of Energy and Mining of the Republika Srpska, FBiH Ministry of Energy, Mining and Industry, Ministry of Spatial Planning, Construction and Ecology of the Republika Srpska, FBiH Ministry of Environment and Tourism, Department in BD BiH, Public and Private Electric Power Companies, MVTEO BiH, Cantons and Municipalities | Reduction of emissions by approx. 586 Gg $CO_2$ - eq per year | • Reducing the total consumption of coal<br>• Significant improvement of air quality, especially in industrial zones, and reduction of cross-border transport of acid gases<br>• Mitigating the socio-economic consequences of the transition in the mining and electricity sectors by preserving existing and creating new jobs<br>• Diversifying the energy mix and increasing energy security<br>• Activation of local resources and valorisation of biomass, agricultural and forest waste, thus ensuring sustainability of local enterprises and strengthening the rural economy<br>• Transfer of advanced technologies and practices, increasing technical capacities and creating space for research and innovation<br>• Development of infrastructure in rural areas through construction of new energy and ancillary facilities, including opportunities for the development of tourism and new services<br>• Strengthening the resilience of the power system and preparing for an increased share of variable energy sources through more flexible production capacities<br>• Empowering citizens and businesses to actively participate in the energy transition through the role of prosumers and local energy communities<br>• Reducing health costs by improving air quality, which contributes in particular to the health of children, the elderly and the chronically ill<br>• Reducing energy poverty through local energy production, participation of households as prosumers and stabilisation of electricity prices<br>• Supporting a just transition through measures that balance decarbonisation with preserving employment and developing new sources of income |
| **Construction of new capacities of commercial photovoltaic power plants** | According to the latest available DERK report for 2024, BiH had 607.64 MW of installed photovoltaic capacity. Through this measure, the construction of additional 292.36 MW is planned, with the aim that the total installed capacity will reach 900 MW by 2030, in accordance with the priority projects defined in the Indicative Generation Development Plan 2023-2032 (NOS BiH, 2022). | • Increasing the share of renewable energy sources in the energy mix<br>• Reduction of specific CO2 emissions<br>• Diversification of electricity production and exploitation of available natural resources | Ministry of Energy and Mining of the Republika Srpska, FBiH Ministry of Energy, Mining and Industry, Ministry of Spatial Planning, Construction and Ecology of the Republika Srpska, FBiH Ministry of Environment and Tourism, Department in BD BiH, Public and Private Electric Power Companies, MVTEO BiH | Reduction of emissions by approx. 898 Gg $CO_2$ - eq in 2030 | |
| **Construction of new wind farm capacities** | According to the latest available DERK report for 2024, BiH had 219 MW of installed wind power plant capacity. Through this measure, the construction of an additional 381 MW is planned, based on priority projects from the Indicative Generation Development Plan 2023–2032 (NOS BiH, 2022), with the aim of bringing the total installed capacity to 600 MW by 2030. | • Increasing the share of renewable energy sources in the energy mix<br>• Reduction of specific CO2 emissions<br>• Diversification of electricity production and exploitation of available natural resources | Ministry of Energy and Mining of the Republika Srpska, FBiH Ministry of Energy, Mining and Industry, Ministry of Spatial Planning, Construction and Ecology of the Republika Srpska, FBiH Ministry of Environment and Tourism, Public and Private Electric Power Companies, MVTEO BiH | Reduction of emissions by approx. 920 Gg $CO_2$ - eq in 2030 | |
| **Decommissioning of thermal power plant units** | This measure includes decommissioning of a total of 410 MW of thermal power plant capacity, of which 310 MW refers to coal-fired power plants that will be shut down in the coming period until 2030, specifically TPP Kakanj 5 (110 MW) and TPP Tuzla 5 (200 MW). It is important to note that TPP Tuzla 3 (100 MW) unit has already been decommissioned during 2024. | • Reducing dependence on coal<br>• Decarbonising the energy sector<br>• Reducing air pollutant emissions and CO2 emissions | FBiH Ministry of Energy, Mining and Industry, FBiH Ministry of Environment and Tourism, Elektroprivreda BiH, MVTEO BiH | Reduction of emissions by approx. 2583 Gg $CO_2$ - eq in 2030 | |
| **Construction of new biomass CHP plant capacities** | According to the latest available DERK report for 2024, BiH had 2.71 MWe of biomass capacity installed. Through this measure, it is planned to build an additional 25 MW of electricity from biomass as a replacement for coal-fired thermal power plants, with the aim of bringing the total installed capacity to 30 MWe by 2030. | • Increasing resource efficiency and promoting circular economy<br>• Increasing the share of renewable energy sources in the energy mix<br>• Reduction of specific CO2 emissions | Ministry of Energy and Mining of the Republika Srpska, FBiH Ministry of Energy, Mining and Industry, Ministry of Spatial Planning, Construction and Ecology of the Republika Srpska, FBiH Ministry of Environment and Tourism, Public and Private Companies, Municipalities and Cities, MVTEO BiH | Reduction of emissions by approx. 424 Gg $CO_2$ - eq in 2030 | |
| **Construction of new capacities of small and large hydro power plants** | According to the latest available DERK report for 2024, BiH had 2,297.6 MW of hydropower capacity installed. By 2030, it is planned to increase the total capacity to 2,526.8 MW, including 1,900 MW of large hydro power plants, 420 MW of pumped storage facilities and 206.8 MW of small hydro power plants. For this purpose, the construction of an additional 190.04 MW of large hydro power plants is planned, based on priority projects from the Indicative Generation Development Plan 2023-2032 (NOS BiH, 2022), as well as 38.26 MW of small hydro power plants, taking into account the strong | • Increasing the share of renewable energy sources in the energy mix<br>• Strengthening flexibility and stability of the power grid<br>• Improving climate resilience and creating socio-economic benefits through the sustainable use of water resources and | Ministry of Energy and Mining of the Republika Srpska, FBiH Ministry of Energy, Mining and Industry, Ministry of Spatial Planning, Construction and Ecology of the Republika Srpska, FBiH Ministry of Environment and Tourism, Public and Private Companies, Municipalities and Cities, MVTEO BiH | Reduction of emissions by approx. 980 Gg $CO_2$ - eq in 2030 | |

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| | resistance of local communities and the civil sector to their construction. | increasing the income of local communities from fees and development contributions | | | |
| | | **District heating** | | | |
| **Implementation of projects for replacement of fossil fuels with renewable energy sources and construction of new district heating systems** | The measure implies continuous implementation of projects aimed at decarbonising the district heating sector through replacement of fossil fuels with renewable energy sources and the construction of new systems. It includes introduction of biomass in existing district heating systems that use coal and heating oil, construction of new biomass systems, use of geothermal and solar energy for preparation of domestic hot water, as well as installation of high-efficiency renewable cogeneration plants. | • Reducing greenhouse gas emissions by replacing coal and heating oil with renewable energy sources in district heating systems<br>• Increasing energy efficiency and utilisation of locally available resources<br>• Ensuring long-term sustainability and resilience of heating systems by building new low-carbon and efficient systems that contribute to the 2050 climate goals. | Ministry of Energy and Mining of the Republika Srpska, FBiH Ministry of Energy, Mining and Industry and Department of BD BiH, Cantonal, City and Municipal Authorities, District Heating Companies | Reduction of emissions by approx. 35.7 Gg $CO_2$ - eq in 2030, of which CH4 emissions are reduced by 0.0095 Gg $CO_2$ - eq and N2O by 0.0095 Gg $CO^2$ - eq | • Reducing $CO_2$ emissions, other pollutants and improving air quality, with a direct contribution to climate and environmental objectives<br>• Reducing BiH's energy dependence on imported fuels through greater use of locally available renewable sources<br>• Creating new jobs in the biomass, system maintenance and infrastructure works sectors<br>• Increasing the resilience of communities to energy crises and the consequences of climate change<br>• Long-term reduction of the cost of heat energy for end users through more efficient systems and lower losses<br>• Improving operations of district heating companies thanks to reduced operating costs and more efficient management<br>• Greater reliability and stability of heat delivery, while reducing the risk of interruptions and failures<br>• Long-term preservation and modernisation of infrastructure, which reduces the need for emergency interventions<br>• Reduction of heat energy consumption as a result of increased user awareness and consumption control<br>• A fairer billing system based on actual consumption, which increases customer satisfaction<br>• Established basis for introduction of smart energy management systems and advanced tariff models |
| **Implementation of fossil fuel replacement projects and construction of new district heating systems using renewable energy heat pumps** | The measure implies continuous implementation of projects aimed at decarbonising the district heating sector through replacement of existing fossil fuel systems (coal, heating oil and natural gas) with high-efficiency systems that use renewable energy sources through heat pumps. It includes installation of heat pumps in existing district heating networks, construction of new heating systems based on geothermal sources, groundwater, waste heat or ambient air, as well as modernisation of heat distribution in order to increase overall energy efficiency. | • Reducing greenhouse gas emissions by replacing fossil fuels with heat pumps that use renewable energy sources<br>• Increasing energy efficiency and modernisation of district heating systems<br>• Reducing dependence on fossil fuels and strengthening resilience to energy and market crises | Ministry of Energy and Mining of the Republika Srpska, FBiH Ministry of Energy, Mining and Industry and Department of BD BiH, Cantonal, City and Municipal Authorities, District Heating Companies | Reduction of emissions by approx. 12.5 Gg $CO_2$ - eq in 2030, of which CH4 emissions are reduced by 0.0034 Gg $CO_2$ - eq and N2O by 0.0034 Gg $CO_2$ - eq | |
| **Reconstruction and modernisation of the district heating network and heating substations** | The measure includes reconstruction and modernisation of the district heating network and heat substations with the aim of increasing energy efficiency and reliability of the system. Activities include replacement of worn-out pipelines, improvement of thermal insulation, installation of modern SCADA control and monitoring systems, and reduction of technical losses in heat distribution. The measure is planned to be implemented continuously until 2050, as a key element of the transition to sustainable and efficient district heating systems. The modernisation of the network and substations also enables more precise control of consumption, greater safety in heat delivery and lower operating costs. | • Increasing the overall energy efficiency of the district heating system by reducing technical losses in the network and optimising heat delivery<br>• Reduction of $CO_2$ and other pollutant emissions due to lower energy consumption due to more efficient heat transfer<br>• Increasing reliability and safety of heating systems through modernisation of substations and introduction of digital tools for management and control (SCADA systems) | Ministry of Energy and Mining of the Republika Srpska, FBiH Ministry of Energy, Mining and Industry, Cantonal, City and Municipal Authorities, District Heating Companies | Reduction of emissions by approx. 8.4 Gg $CO_2$ - eq in 2030, of which CH4 emissions are reduced by 0.0029 Gg $CO_2$ - eq and N2O by 0.0029 Gg $CO_2$ - eq | |
| **Installation of measuring devices for monitoring heat energy consumption in facilities connected to SDG** | The measure involves installation of cumulative and individual measuring devices for monitoring heat energy consumption in all facilities connected to the district heating system. The meters enable more transparent billing, reduce irrational consumption and create the basis for introduction of advanced tariff models. The implementation of the measure is planned continuously until 2050 with intensive implementation in the initial period until 2030, as one of the key steps towards modernisation of the system and strengthening control over energy consumption. | • Reduction of $CO_2$ and other pollutant emissions due to reduction of irrational energy consumption and optimisation of heating systems<br>• Enabling accurate and fair calculation of heat energy consumption through installation of measuring devices in all buildings connected to the district heating system<br>• Increasing energy efficiency and encouraging the rational use of energy by end users | Ministry of Energy and Mining of the Republika Srpska, FBiH Ministry of Energy, Mining and Industry, Cantonal, City and Municipal Authorities, District Heating Companies | Reduction of emissions by approx. 15.2 Gg $CO_2$ - eq in 2030, of which CH4 emissions are reduced by 0.0052 Gg CO2 - eq and N2O by 0.0052 Gg $CO_2$ - eq | |
| | | **Building sector** | | | |
| **Energy renovation of buildings in the housing sector** | The measure implies improvement of thermal characteristics of residential buildings through insulation of facades, roofs and basement ceilings, replacement of worn-out joinery and elimination of thermal bridges. It includes collective and individual residential buildings, and is implemented through national and local energy renovation programs, with the support of international financial mechanisms. The long-term building renovation strategy in BiH envisages renovation of the housing stock in the period | • Reduce final energy consumption in residential buildings by improving thermal characteristics<br>• Reduce CO2 emissions from the household sector by contributing to national decarbonisation targets by 2030 | Ministry of Spatial Planning, Construction and Ecology of the Republika Srpska, FBiH Ministry of Environment and Tourism and Department of the Municipality of Bosnia and Herzegovina, Environmental Protection Fund of the Federation of Bosnia and Herzegovina, Environmental Protection and Energy Efficiency Fund of the Republika Srpska, | Reduction of emissions by approx. 208 Gg $CO_2$ - eq in 2030 | • Reduction of final energy consumption and heating costs in households and public institutions<br>• Direct reduction of emissions from the building sector, contribution to fulfilment of climate goals and commitments<br>• Increasing the quality of housing, health and comfort, especially for socially disadvantaged categories |

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| | until 2030 according to the following parameters: annual renovated area is 1.32 million m², the annual renovation rate is 2.2%, and a total of 23.2% of the housing stock should be renovated by 2030, which would result in cumulative final energy savings of 183.35 ktoe. | • Increase the comfort and quality of living for citizens | cantonal ministries, municipalities and cities | | • Creating new jobs in the building sector, production and installation of energy-efficient materials and OiE equipment<br>• Activation of the construction market and incentive for local small and medium-sized contractors<br>• Reducing energy poverty through better insulation and more efficient heating systems<br>• Strengthening the resilience of buildings to climate extremes (cold and heat waves)<br>• Reducing the Budgetary Burden on Public Energy Institutions through Lower Operating Costs<br>• Accelerating the market transformation towards energy-efficient materials and smart solutions (e.g. BMS systems, solar DHW)<br>• Improving social cohesion and reintegration of displaced persons through the completion of neglected facilities<br>• Long-term increase in the value of real estate and revitalising urban and rural areas<br>• Increasing the safety and technical correctness of buildings that have so far been partially completed or inadequately insulated |
| **Replacement of heating and DHW preparation systems in the housing sector** | The measure involves replacement of outdated and inefficient domestic heating systems, including coal, oil and older wood-fired boilers, with energy-efficient solutions such as heat pumps, condensing boilers, biomass boilers and solar domestic hot water (DHW) systems. The measure can be combined with installation of photovoltaic systems for own consumption, especially in case of the use of heat pumps. | • Replace inefficient and outdated heating and DHW systems with modern technologies that use renewable energy sources<br>• Increase households' resilience to energy crises and price shocks by reducing dependence on fossil fuels<br>• Improve the quality of life of citizens through modernisation of heating systems that are safer, more efficient and more environmentally acceptable. | Cities, municipalities and cantons, Environmental Protection Fund of the Federation of BiH, Environmental Protection and Energy Efficiency Fund of the Republika Srpska | Reduction of emissions by approx. 111 Gg $CO_2$ - eq in 2030, of which CH4 emissions are reduced by 0.028 Gg $CO_2$ - eq and N2O by 0.027 Gg $CO_2$ - eq | |
| **Energy renovation of external building envelopes in the non-housing sector (public and commercial buildings)** | The measure applies to public (schools, hospitals, administrations) and commercial buildings (hotels, shopping malls) and includes improvement of façade and roof insulation, replacement of joinery and solving thermal bridges. Implementation is performed through public budgets, funds, ESCO models and with technical support. The renovation of the non-residential building stock in BiH by 2030 is planned to be performed according to the following parameters (in accordance with the Long-Term Building Renovation Strategy): the annual renovated area is 0.298 million m², with an annual renovation rate of 1.91–1.67%, which would cover a total of 18.4% of the non-residential building stock. By implementing these activities, it is planned to achieve cumulative final energy savings of 35.75 ktoe. | • Reduce energy consumption and operating costs in public and commercial buildings through more efficient use of energy<br>• Improve working conditions and provision of public services, in particular in schools, hospitals and administrative buildings, while reducing CO2 emissions.<br>• Contribute to the objectives of the public energy transition policy through the example of the public and business sectors in the use of energy efficiency measures | Ministry of Spatial Planning, Construction and Ecology of the Republika Srpska, FBiH Ministry of Environment and Tourism and Department of the Municipality of Bosnia and Herzegovina, Environmental Protection Fund of the Federation of Bosnia and Herzegovina, Environmental Protection and Energy Efficiency Fund of the Republika Srpska, cantonal ministries, municipalities and cities | Reduction of emissions by approx. 109 Gg $CO_2$ - eq in 2030 | |
| **Replacement of heating and DHW systems in the non-housing sector** | The measure involves replacing existing heating systems in public and commercial buildings, in particular fossil fuel boiler rooms, with more energy-efficient and environmentally friendly solutions. It includes installation of biomass boilers, heat pumps, solar thermal systems and hybrid combinations, with the integration of digital control such as building automation systems (BMS) and smart thermostats. | • Modernise heating and hot water systems in the facilities of public institutions and business users in accordance with the principles of low-carbon transition<br>• Increase the share of renewable energy sources in the service sector and public administration through the introduction of advanced heating technologies<br>• Establish more efficient and digitally controlled heating systems that contribute to a more rational use of energy and reduction of emissions | Ministry of Spatial Planning, Construction and Ecology of the Republika Srpska, FBiH Ministry of Environment and Tourism and Department of the Municipality of Bosnia and Herzegovina, Environmental Protection Fund of the Federation of Bosnia and Herzegovina, Environmental Protection and Energy Efficiency Fund of the Republika Srpska, cantonal ministries, cities and municipalities | Reduction of emissions by approx. 94 Gg $CO_2$ – eq in 2030, of which $CH_4$ emissions are reduced by 0.02 Gg $CO_2$ - eq and N2O by 0.01 Gg $CO_2$ - eq | |
| **Completion of construction of unfinished family housing for refugees and internally displaced persons** | The measure refers to supporting the completion of construction of unfinished family residential buildings that were originally built as housing solutions for refugees and internally displaced persons, and which have not been completed to date. According to the Long-Term Building Renovation Strategy, as many as 30% of residential buildings built in the period 1992-2014 do not have a completed façade, which has a significant impact on energy efficiency, quality of housing and the health of residents. The measure includes technical, financial and institutional support for the completion of buildings, including construction of facades, roofs, basic installations and EE heating and DHW systems – with priority use of OiE where possible. Implementation is planned in cooperation with relevant entity and local authorities, and with the support of international donors and social housing programs. | • Provide dignified and energy-efficient housing for refugees and internally displaced persons through completion of unfinished housing.<br>• Reduce the number of buildings without basic construction and energy characteristics, especially without façade and insulation, thus directly contributing to the reduction of energy poverty<br>• Increase social cohesion and territorial reintegration through completion of housing for vulnerable groups, with the introduction of measures that contribute to the objectives of the energy transition | Ministry of Spatial Planning, Construction and Ecology of the Republika Srpska, FBiH Ministry of Environment and Tourism and Department of BD BiH, competent ministries for refugees and displaced persons, and social protection, entity funds for environmental protection | Reduction of emissions by approx. 57 Gg $CO_2$ - eq in 2030 | |
| **Transport** | | | | | |

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| **Increasing the share of environmentally friendly vehicles** | The measure refers to the gradual replacement of conventional vehicles with lower-emission vehicles, including electric vehicles, compressed natural gas (CNG) vehicles and biodiesel. It includes electrification of the passenger and light commercial vehicle fleet, as well as the modernisation of public transport and replacement of some heavy-duty vehicles with alternative fuels. Priority is given to the replacement of obsolete vehicles and vehicles in public transport. The measure also includes promotion of cleaner fuels in the existing vehicle fleet and establishment of a support system through subsidies, tax breaks and special benefits for the use of environmentally friendly vehicles, with a focus on urban areas. | • Reducing greenhouse gas emissions in the transport sector<br>• Gradual decarbonisation of road transport by increasing the share of electric vehicles and alternative fuels in the vehicle fleet<br>• Reducing consumption of fossil fuels and improving energy efficiency in transport through transition to more environmentally friendly technologies | Ministry of Transport and Communications of Bosnia and Herzegovina, Ministry of Transport and Communications of the Republika Srpska, FBiH Ministry of Transport and Communications, Government of DB, Cantons, Cities and Municipalities | Reduction of emissions by approx. 524 Gg $CO_2$ - eq in 2030 | • Reducing greenhouse gas emissions in the transport sector<br>• Reducing air pollution and noise, especially in urban areas<br>• Reducing consumption of fossil fuels and energy dependence on imports<br>• Increasing the share of renewable energy sources in transport<br>• Increasing energy efficiency of the fleet and infrastructure<br>• Modernisation of public and private transport, including electric public transport<br>• Increasing the quality of service, comfort, safety and reliability of transport<br>• Better connectivity of regions and accessibility of mobility for the population<br>• Development of the market for electric and alternative vehicles and related services<br>• Improving railway infrastructure and shifting part of traffic from road to rail<br>• Strengthening logistics and transport corridors for alternative fuels<br>• Establishing a system for the management of waste batteries and parts in accordance with the circular economy<br>• Creating new jobs and encouraging development of the sustainable mobility sector |
| **Development of new and modernisation of existing public and private transport infrastructure** | The measure includes development of new and modernisation of existing transport infrastructure with the aim of supporting the transition to sustainable transport and reducing greenhouse gas emissions. It includes the construction and expansion of the network of charging stations for electric vehicles, including fast and standard stations in urban, suburban and transit zones. A special focus is on infrastructure for electric and hybrid public transport, including charging stations and service capacities for electric buses and minibuses, as well as adaptation of routes and terminals. The measure also includes establishment of a system for the disposal and recycling of batteries and spent components of electric vehicles, in line with the principles of the circular economy. It also includes adaptation of existing transport corridors for the use of alternative fuel vehicles, including CNG and biodiesel, and development of the logistics infrastructure necessary for their supply. Implementation of this measure contributes to the functionality and safety of traffic, reduction of emissions and strengthening of conditions for the wider use of environmentally friendly vehicles, both in private and public transport. | • Enable the widespread use of electric and other low-carbon vehicles through the development of affordable and reliable charging and maintenance infrastructure.<br>• Support modernisation of public transport through construction of infrastructure capacities for electric and hybrid buses and minibuses<br>• Reduce greenhouse gas emissions in the transport sector through infrastructure adaptations that enable the use of alternative fuels and decarbonisation of road transport | Ministry of Transport and Communications of BiH, Ministry of Transport and Communications of RS, FBiH Ministry of Transport and Communications, Government of BD BiH, cantons, cities and municipalities | This measure enables achievement of emission reductions from measure "1. Increasing the share of environmentally friendly vehicles". | |
| **Improving the level of utilisation and efficiency of rail transport** | The measure implies improvement of the level of use and efficiency of rail transport through investments in reconstruction and modernisation of key railway infrastructure. It includes reconstruction of tracks, bridges, tunnels, retaining and lining walls, modernisation of signalisation and level crossings, as well as introduction of modern information systems for traffic management. Implementation of this measure improves the speed, safety and comfort of rail transport, which increases attractiveness of this mode of transport for passengers and freight, reduces the burden on road transport and directly contributes to the reduction of greenhouse gas emissions through redirection of traffic to a more energy-efficient and environmentally friendly transport modality. | • Increase efficiency, safety and reliability of rail transport through modernisation of infrastructure and management systems<br>• Increase the share of rail transport in the total transport system by shifting passengers and freight from road to more energy-efficient rail transport<br>• Reduce greenhouse gas emissions and environmental impacts of the transport sector by strengthening rail as a sustainable alternative | Ministry of Transport and Communications of Bosnia and Herzegovina, Ministry of Transport and Communications of Republika Srpska, FBiH Ministry of Transport and Communications, Government of the Federation of Bosnia and Herzegovina, JP Railways of the Federation of Bosnia and Herzegovina, Public Railways of the Republika Srpska | Reduction of emissions by approx. 40 Gg $CO_2$ - eq in 2030 | |
| **Industry** | | | | | |
| **Reducing the energy intensity of industry through implementation of energy efficiency measures, optimisation of production processes and replacement of heating systems** | The measure includes implementation of EE measures and replacement of heating systems in industrial plants throughout BiH, with a focus on the metal processing sector, food industry, wood processing sector and production of building materials. Within this measure, a detailed energy audit will be performed in each of the affected plants based on which priority technical measures to increase efficiency will be defined, including modernisation and automation of production systems, optimisation of combustion processes, replacement of obsolete equipment and improvement of thermal insulation. A special focus will be on replacing existing heating and process heating systems that use fossil fuels with more energy-efficient ones. The measure also includes establishment of an energy management system in accordance with the ISO 50001 standard, as well as technical and financial support through public funds and credit lines to ensure wide implementation of these solutions in practice. Through a combination of technical interventions and management solutions, | • Reduction of overall energy consumption in industrial plants<br>• Replacement of fossil fuels in heating and process heating systems in enterprises, which directly reduces $CO_2$ emissions and local pollution<br>• Creation of a technical and regulatory model for wider replication of the measure through development of standardised solutions for the industrial sector, including recommendations for minimum energy performance and co-financing procedures | FBiH Ministry of Energy, Mining and Industry, FBiH Ministry of Development, Entrepreneurship and Crafts, Ministry of Energy and Mining of RS, Ministry of Economy and Entrepreneurship of RS, Cantonal Ministries of Economy, Industry and Entrepreneurship, Department of Economic Development, Sports and Culture of BD BiH, entity funds for environmental protection and energy efficiency, Foreign Trade Chamber and Entity-level Chambers of Commerce, MVTEO BiH | Reduction of emissions by approx. 919 Gg $CO_2$ - eq in 2030, of which $CH_4$ emissions are reduced by 0.26 Gg $CO_2$ - eq and N2O by 10.36 Gg $CO_2$ - eq | • Strengthening competitiveness of the domestic industry by reducing operating costs and increasing energy efficiency<br>• Increasing resilience of companies to price shocks in the energy and raw materials market<br>• Creation of new jobs through engagement of domestic professional workforce in the sector of energy efficiency, waste management and industrial engineering<br>• Improving technical capacities and knowledge in industry, especially in SMEs, through introduction of modern technologies and management systems |

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| | a significant reduction in final energy consumption and $CO_2$ emissions per unit of industrial production is expected. | | | | • Supporting market development for local manufacturers of equipment, services and software solutions for energy efficiency and circular economy<br>• Reducing negative impact of industry on the environment, including air, soil and water<br>• Improving air quality in local communities by reducing emissions from outdated combustion systems<br>• Improving the health of workers and the population in industrial zones through better emission control and lower exposure to pollutants<br>• Support to the Sustainable Development Goals and BiH's integration into the EU climate transition policy<br>• Strengthening the role of local communities in creating and implementing solutions for sustainable industry and green economy |
| **Reduction of process emissions in the cement, lime and metal industries through optimisation of raw material composition and processes** | The measure includes technical and process interventions in key industries with the highest process $CO_2$ emissions – cement, lime and metal industries – with the aim of reducing emissions that occur during chemical transformations of raw materials. It is planned to be implemented in all major cement and lime producers in BiH, as well as in medium and large plants in the metal processing sector (steel, ferroalloys, aluminum). In the cement and lime industry, the focus of the measure is on reducing the content of clinker in finished cement products through increased use of additives such as fly ash, slaked slag and pozzolane, and on optimising the chemical composition of raw materials in calcination processes. In the metal industry, the measure refers to improvement of metal processing processes and the use of secondary raw materials, optimisation of combustion temperatures and reduction of emissions from chemical reactions by using alternative alloys and technological solutions. All interventions will be based on the analysis of existing emissions and raw material flows, and their implementation will be supported by technical guidelines and quality control systems. A significant reduction in emissions per ton of product is expected while preserving the quality of the final product and reducing production costs in long term. | • Reduction of clinker content in cement in major cement plants, which directly reduces CO2 emissions from calcination<br>• Optimisation of process emissions in metal production through the use of secondary raw materials and reduction of reaction intensity<br>• Introduction of standardised raw material and process protocols in the cement, lime and metals sectors with the aim of their wider implementation by 2030 | Ministry of Spatial Planning, Construction and Ecology of Republika Srpska, FBiH Ministry of Environment and Tourism and Department of BD BiH, FBiH Ministry of Energy, Mining and Industry, FBiH Ministry of Development, Entrepreneurship and Crafts, Ministry of Energy and Mining of Republika Srpska, Ministry of Economy and Entrepreneurship of Republika Srpska, Cantonal Ministries of Economy, Industry and Entrepreneurship, Department of Economic Development, Sports and Culture of BD BiH, Entity Funds for Environmental Protection and Energy Efficiency, Foreign Trade Chamber and Entity Chambers of Commerce, MVTEO BiH | Reduction of emissions by approx. 646Gg $CO_2$ - eq in 2030, of which a reduction in $CH_4$ emissions by 0.01 Gg $CO_2$ - eq | |
| **Introduction of circular practices in industrial production and use of waste materials** | The measure focuses on introduction of circular economy principles in the industrial sector of BiH, with the aim of reducing greenhouse gas emissions through better use of materials, reducing waste and increasing the share of secondary raw materials in production processes. Implementation of the measure will include companies from the metal, wood processing, food and textile industries, where there are significant flows of by-products and waste that are currently not valorised. Key activities include establishment of a system for the selective collection and reuse of production waste, replacement of primary raw materials with recycled materials, development of internal closed material streams, and installation of equipment for heat recovery and reuse of process water. In addition, the digitalisation of material and waste streams through industrial resource management and monitoring systems is envisaged. The measure will be supported by technical guidelines for the introduction of circular solutions, and access to favorable financial instruments for companies that introduce innovative approaches in materials management. The result of this measure will be a significant reduction in process emissions, lower energy consumption per unit of product and increased competitiveness of the domestic industry in a market that increasingly favors products with a reduced carbon footprint. | • Increasing the share of secondary raw materials and recycled materials in production processes, thereby reducing the need for primary resources and emissions associated with their extraction and processing<br>• Establishing a system for the internal use of waste and by-products in production in the woodworking, metal and food sectors, including heat and water recovery, with the aim of reducing the overall consumption of energy and raw materials<br>• Digitalisation of material and energy flow management, through introduction of monitoring, reporting and optimisation tools, which enables long-term measurement and reporting of emission reductions per unit of product | Ministry of Spatial Planning, Construction and Ecology of the Republika Srpska, FBiH Ministry of Environment and Tourism and Department of BD BiH, FBiH Ministry of Energy, Mining and Industry, FBiH Ministry of Development, Entrepreneurship and Crafts, Ministry of Energy and Mining of Republika Srpska, Ministry of Economy and Entrepreneurship of Republika Srpska, Cantonal Ministries of Economy, Industry and Entrepreneurship, Department of Economic Development, Sports and Culture of BD BiH, Entity Funds for Environmental Protection and Energy Efficiency, Foreign Trade Chamber and Entity Chambers of Commerce, MVTEO BiH | Reduction of emissions by approx. 300 Gg $CO_2$ - eq in 2030, of which a reduction in $CH_4$ emissions by 0.007 Gg $CO_2$ - eq | |
| **Measures to reduce PFCs and HFCs** | | | | | |
| **Reducing PFC gas emissions from aluminium production** | The measure implies technical and operational optimisation of the electrolytic process of aluminum production in order to reduce emissions of perfluorocarbons (PFC gases), which occur during anode effects when the concentration of aluminum oxide in the electrolyte falls below the optimal level. Emissions can be significantly reduced through introduction of advanced process control systems, modernisation of electrolytic cells and implementation of software solutions for monitoring and control of voltage and current in real time. Elements of implementation include automated systems for detection and interruption of anode effects, modernisation of cells by installing voltage, temperature and concentration sensors, software integration with a central monitoring system, development of standard operating procedures, training for operators and technicians, and establishment of a system for monitoring, reporting and verification of emissions according to the IPCC methodology. | • Reduce specific emissions of PFCs per tonne of aluminium produced<br>• Improve efficiency and stability of the electrolytic process<br>• Contribute to industrial decarbonisation and achievement of BiH's climate goals | FBiH Ministry of Environment and Tourism, FBiH Ministry of Energy, Mining and Industry, Industrial Operator, MVTEO BiH | Reduction of PFC emissions by approx. 166 Gg $CO_2$ – eq in 2030 | • Reducing the negative impact of climate change by reducing greenhouse gas emissions<br>• Increasing energy efficiency in refrigeration/cooling and air conditioning systems, leading to reduced operating costs<br>• Support for implementation and development of environmentally friendly technologies and cooling units<br>• Strengthening compliance with international agreements and regulatory requirements<br>• Reducing the risk of sanctions and increasing competitiveness in the international market |



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Staša Elezović, Certified Court Translator for English Language

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| **Phasing out high-GWP HFCs and switching to environmentally friendly cooling technologies** | The measure involves phasing out the use of refrigerant gases with a high global warming potential (GWP), primarily R404A, HFC-134a and R410A, through a combination of regulatory, technical and economic instruments. The focus is on prohibiting installation of devices with a GWP above 1500, replacing existing systems with low-GWP alternatives (such as R1234yf, R32, R448A), introducing mandatory records of HFC consumption and leakage, educating and certifying servicing staff, and establishing a system for collection and recycling of used gases. The measure also includes financial support for the replacement of equipment and the obligation of public institutions to use only environmentally friendly colling agents. The goal is to reduce fluorinated gas emissions and harmonise with the Kigali Amendment and the EU F-gas regulation. | • Reduce emissions of high-GWP fluorinated gases by phasing out the use of HFCs such as R404A, HFC-134a and R410A in accordance with the Kigali Amendment and the EU F-Gas Regulation<br>• Establish a regulatory and technical framework for equipment replacement that includes mandatory records, servicing staff training, import bans and a system for the disposal of used gases<br>• Encourage market transition to environmentally friendly technologies through financing mechanisms, public procurement and availability of low-carbon cooling agents | Ministry of Spatial Planning, Construction and Ecology of Republika Srpska, FBiH Ministry of Environment and Tourism, FBiH Ministry of Spatial Planning, Departments of Environmental Protection of BD BiH, Environmental Protection Fund of the Federation of Bosnia and Herzegovina, Environmental Protection and Energy Efficiency Fund of Republika Srpska, cantonal ministries | Reduction of HFC emissions by approx. 125 Gg $CO_2$ – eq in 2030 | • Improving air quality and protecting the health of the population by reducing pollutants<br>• Fostering innovation and employment in sectors that develop green technologies<br>• Reducing adaptation and repair costs caused by climate change<br>• Strengthening the capacity of local experts and companies to implement sustainable solutions<br>• Improving the image of companies and industry entities as responsible and environmentally conscious market actors<br>• Reducing the carbon footprint and contributing to meeting climate goals at national and international level<br>• Strengthening the competitiveness of enterprises through adoption of advanced technologies that use environmentally friendly cooling agents<br>• Reducing dependence on fossil fuels and highly globally warming gases in industrial processes<br>• Encouraging development and implementation of innovative technologies and systems with low warming potential (Low-GWP) technologies<br>• Improving air quality and protecting public health by reducing emissions of hazardous gases and toxins<br>• Creating new opportunities for employment and development of professional staff in the sectors of green technology and sustainable development<br>• Supporting the local economy through development of domestic manufacturers of environmentally friendly cooling units and equipment<br>• Preserving the Ozone layer and Ccntributing to global efforts to protect the atmosphere and environment |
| **Waste management** | | | | | |
| **Energy recovery of waste and landfill gas** | The measure focuses on installation of waste-to-energy systems, including municipal waste incineration plants in the form of RDF or SRF, as well as systems for the capture, treatment and use of landfill gas (biogas) for production of electricity and/or heat. It also includes the introduction of financial incentives for investments in infrastructure and equipment, and strengthening of capacities for the management and operation of plants through technical training. | • Reduce $CH_4$ emissions from the waste sector through capture and energy recovery of landfill gas<br>• Increase production of renewable or alternative energy from waste through development of RDF/SRF and biogas plants<br>• Encourage investment in infrastructure and provide training for operators in the efficient management of waste-to-energy technologies | Ministry of Spatial Planning, Construction and Ecology of Republika Srpska, FBiH Ministry of Environment and Tourism, FBiH Ministry of Spatial Planning, Departments of Environmental Protection of BD BiH, Environmental Protection Fund of the Federation of Bosnia and Herzegovina, Environmental Protection and Energy Efficiency Fund of Republika Srpska, municipal utility companies, local self-government units | Reduction of $CH_4$ emissions by approx. 117 Gg $CO_2$ – eq in 2030 | • Reducing emissions of methane and nitrous oxide, which have a high global warming potential (GWP)<br>• Improving air quality and reducing local pollution, especially in the vicinity of landfills and plants, which directly affects the health of the population<br>• Reducing the risk of contamination of groundwater and surface water through proper waste and wastewater management<br>• Production of renewable energy from landfill biogas, which contributes to the energy transition and reduces dependence on fossil fuels<br>• Creating new jobs in the recycling, composting and waste management sectors, especially at the local level<br>• Development of green infrastructure and markets for secondary raw materials and compost, fostering the circular economy and innovation |
| **Sanitary management of landfills and recultivation of unregulated landfills** | The measure includes systematic remediation of existing sanitary landfills, closure and recultivation of unregulated and illegal landfills, and introduction of technical standards for waste management. It includes activities to identify and prevent illegal landfills, regulate access to legal landfills, establish inspection supervision, as well as strengthen the capacity of operators through training. Adoption of regulations and mechanisms for the control and suppression of greenhouse gas emissions from uncontrolled landfills is envisaged. | • Prevent and recultivate unregulated and illegal landfills in order to eliminate uncontrolled sources of greenhouse gas emissions and reduce risks to human health and the environment. | Ministry of Spatial Planning, Construction and Ecology of Republika Srpska, FBiH Ministry of Environment and Tourism, FBiH Ministry of Physical Planning, Departments of Environmental Protection of BD BiH, FBiH Environmental Protection Fund, Environmental Protection and Energy Efficiency Fund of | Reduction of $CH_4$ emissions by approx. 46 Gg $CO_2$ – eq in 2030 | |



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| | | • Improve technical and regulatory standards for sustainable landfill management<br>• Ensure implementation of supervision and institutional capacities for waste management | Republika Srpska, municipal utility companies, local self-government units | | • Reducing the costs of long-term waste management and extending the lifetime of landfills by reducing the amount of landfilled waste<br>• Alignment with EU directives and strengthening institutional capacity for waste and emissions management, facilitating access to pre-accession and climate funds<br>• Increasing citizens' environmental awareness and behavioural change through campaigns, education and community involvement<br>• Improving the appearance and functionality of urban and rural areas, by removing illegal landfills and introducing modern separate waste collection systems. |
| **Development of circular infrastructure for recycling and biological treatment of waste** | The measure implies establishment and expansion of infrastructure for separate collection, sorting, recycling and biological treatment of waste, with the aim of reducing the amount of waste disposed of in landfills and increasing the use of resources in accordance with the principles of the circular economy. It includes construction and equipping of selection centers (MRFs), composting plants and biowaste processing centers in larger municipalities, as well as establishment of green islands, local recycling points and mobile units for the collection of specific waste streams. The measure includes standardszation of the system for separate waste collection, training of utility companies and local authorities, establishment of a system of economic and regulatory instruments, and implementation of continuous information and educational campaigns with the aim of changing the behavior of end users. | • Establish a functional network of infrastructure facilities for sorting, recycling and biological treatment of waste<br>• Increase the recycling and composting rate of municipal waste through improvement of separate waste collection and local management systems.<br>• Reduce the amount of biodegradable waste that is landfilled by developing a market for secondary raw materials and compost | Ministry of Spatial Planning, Construction and Ecology of Republika Srpska, FBiH Ministry of Environment and Tourism, FBiH Ministry of Spatial Planning, Departments of Environmental Protection of BD BiH, Environmental Protection Fund of the Federation of Bosnia and Herzegovina, Environmental Protection and Energy Efficiency Fund of Republika Srpska, municipal utility companies, local self-government units | Reduction of $CH_4$ emissions by approx. 173 Gg $CO_2$ – eq in 2030 | |
| **Improving urban wastewater treatment and emission control** | The measure includes modernisation and expansion of the urban wastewater treatment system with the aim of reducing CH4 and nitrogen oxide emissions from inadequately treated or untreated water and sludge. The focus is on introduction of secondary and tertiary treatment in urban centers where plants currently do not meet standards, and on installation of anaerobic digesters and biogas capture and incineration systems in larger plants. The measure also includes procurement of equipment for emission monitoring, standardisation of reporting and establishment of a database on emissions from water treatment plants. It is implemented in cooperation with local utility companies, with the support of the relevant ministries and environmental funds, and with mandatory operator training and strengthening of inspection supervision. | • Modernise existing wastewater treatment plants by introducing anaerobic and biogas control systems<br>• Increase the coverage of secondary and tertiary wastewater treatment to at least 65% of the total urban population by 2030.<br>• Establish a system of monitoring and reporting of emissions from municipal water treatment plants | Ministry of Spatial Planning, Construction and Ecology of Republika Srpska, FBiH Ministry of Environment and Tourism, FBiH Ministry of Physical Planning, Departments of Environmental Protection of BD BiH, Environmental Protection Fund of the Federation of Bosnia and Herzegovina, Environmental Protection and Energy Efficiency Fund of Republika Srpska, municipal utility companies, local self-government units | Reduction of emissions by approx. 27 Gg $CO_2$ - eq in 2030 (25.8 Gg $CO_2$ - eq for $CH_4$ and 1.2 Gg $CO_2$ - eq for N2O) | |
| | | **Agriculture** | | | |
| **Integrated optimisation of animal feed and fermentation** | The measure implies systematic implementation of activities aimed at reducing CH4 emissions from the livestock sector through increased feed quality, optimisation of nutrition and improvement of fermentation processes in ruminants. It includes introduction of dietary supplements (such as red algae Asparagopsis, oils and fats) that have been proven to reduce the production of CH4 in the rumen, as well as the modification of feeding regimes in order to improve the efficiency of feed conversion. The measure is implemented on farms of all sizes through technical support, farmer training and subsidised procurement of feed additives, in cooperation with veterinary and agricultural advisory services. In later stages, it is possible to integrate digital solutions for monitoring feeding regimes and fermentation parameters. This measure is expected to cover at least 50% of cattle and 20% of sheep by 2030, with the aim of significantly reducing $CH_4$ emissions from enteric fermentation and further contributing to the sustainability of livestock production. | • Reduce CH4 emissions from enteric fermentation in ruminants through the use of additives and adapted feeding regimens<br>• Increase the efficiency of feeding and feed conversion, resulting in less resource consumption per unit of product (milk or meat), while preserving animal productivity<br>• Cover at least 50% of cattle and 20% of sheep in BiH by 2030 through systematic implementation of technologies and professional support to farmers in rural areas | Ministry of Agriculture, Forestry and Water Management of Republika Srpska, FBiH Ministry of Agriculture, Water Management and Forestry, cantonal line ministries in charge of agriculture and the department in the BD BiH responsible for agriculture, in cooperation with the Veterinary Office of Bosnia and Herzegovina | Reduction of $CH_4$ emissions by approx. 160 Gg $CO_2$ - eq in 2030 | • Reducing greenhouse gas emissions while contributing to fulfilment of climate goals and international obligations of BiH<br>• Increasing resilience of agriculture to climate change, in particular droughts, floods and land degradation<br>• Improving productivity and yields in livestock and crop production, with more efficient use of resources<br>• Reducing dependence on imported mineral fertilizers, through replacement with digestate and locally available inputs<br>• Creation of new jobs and investment opportunities in the sector of biogas, advisory services and production of OiE<br>• Increasing energy independence of rural communities through production of electricity and heat from biogas<br>• Reduction of water and soil pollution due to better management of manure and mineral fertilizers<br>• Proper disposal of organic waste (manure) reduces the need to add mineral fertilizers |
| **Modernisation of manure management and implementation of technologies for energy utilisation of biogas** | The measure implies comprehensive modernisation of manure management in livestock production, through introduction of closed and watertight manure storage systems, as well as installation of anaerobic digestion plants for biogas production. Activities include construction of concrete pools with covers for the storage of solid and liquid manure, prevention of uncontrolled runoff and emissions of gases into the atmosphere, and construction of small and medium-sized biogas power plants on farms and in agricultural cooperatives as off-grid plants. By using digesters, manure and | • Reduce greenhouse gas emissions from manure through introduction of closed storage systems and the energy use of biomass<br>• Increase the capacity of off-grid biogas plants (electricity and heat) on farms and cooperatives by 2030<br>• Replace mineral fertilizers with digestate | Ministry of Agriculture, Forestry and Water Management of Republika Srpska, FBiH Ministry of Agriculture, Water Management and Forestry, cantonal line ministries in charge of agriculture and the department in BD BiH that is responsible for agriculture, in cooperation with the Ministry of Energy and Mining of the Republika Srpska, FBiH Ministry of Energy, | Reduction of emissions by approx. 118 Gg $CO_2$ – eq in 2030 (117.6 Gg $CO_2$ – eq for CH4 and 0.4 Gg $CO_2$ – eq for $N_2O$) | |

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| | other biodegradable waste are exploited in terms of energy for production of electricity and heat, while the by-product (digestate) is used as a high-quality organic fertilizer. The measure contributes to reduction of CH4 and nitrogen oxide emissions, improvement of nutrient management, reduction of the use of mineral fertilizers, and increase in the share of renewable energy sources in the overall energy mix of agriculture. | from biogas plants, further reducing soil emissions and crop production costs | Mining and Industry, Ministry of Spatial Planning, Construction and Ecology of the Republika Srpska, FBiH Ministry of Environment and Tourism and the cantonal line ministries in charge of energy and environment, Environmental Protection Fund of the Federation of BiH, Environmental Protection and Energy Efficiency Fund of Republika Srpska, all with the coordination of MVTEO BiH | | • Improving public health and reducing odours in populated areas around farms<br>• Strengthening advisory and educational capacities in rural areas, including knowledge and technology transfer<br>• Greater social inclusion and empowerment of small and medium-sized producers through access to support, subsidies and markets<br>• Creating preconditions for access to climate and green finance<br>• Positive effects on biodiversity and soil conservation thanks to crop rotation, cover crops and reduced tillage<br>• Connecting primary production with energy and circular economy through integrated value chains |
| **Precise management of mineral and organic fertilizers** | The measure includes introduction of precise agrotechnical practices for the management of mineral and organic fertilizers in order to reduce $N_2O$ emissions and increase the efficiency of nutrient use in crop production. Activities include implementation of slow-release and coated mineral fertilizers, use of nitrifying inhibitors, optimisation of the time and amount of fertilization based on soil analysis, as well as the use of GPS technology and sensors for precise dosing. In the segment of organic fertilizer management, the measure includes use of digestate from biogas plants as a substitute for part of mineral fertilizers, with proper application in accordance with agrochemical analyses, and timely application of organic fertilizers in the fields and ploughing in the colder part of the year. This simultaneously reduces $N_2O$ emissions from the soil and dependence on expensive imported mineral products. This measure is implemented through strengthening of the advisory network, digitalisation of farm management and co-financing of the procurement of precision machinery and fertilizers through public calls. A special focus is placed on intensive regions of farming, fruit and vegetable growing. | • Reduce $N_2O$ emissions from mineral and organic fertilizers through the widespread use of precision fertilization techniques and the replacement of urea with other forms of nitrogen<br>• Cover at least 30% of BiH's total arable land with precision fertilization practices by 2030, including digital tools and agrotechnical support.<br>• Replace part of urea and standard fertilizers with advanced products (slow-release, inhibitors and digestate), while preserving yields and reducing production costs | Ministry of Agriculture, Forestry and Water Management of Republika Srpska, FBiH Ministry of Agriculture, Water Management and Forestry, cantonal line ministries in charge of agriculture and the department in the BD BiH responsible for agriculture, in cooperation with the Administration of Bosnia and Herzegovina for the Protection of Plant Health | Reduction of N2O emissions by approx. 111 Gg $CO_2$ – eq in 2030 | |
| **Implementation of agrotechnical measures in crop production** | The measure involves implementation of a wide range of agrotechnical practices in crop production with the aim of reducing greenhouse gas emissions, improving soil quality and increasing resilience to climate change. Activities include introduction of cover crops, crop rotation, reduction of tillage intensity, as well as rational implementation of mineral and organic fertilizers based on agrochemical analyses. A special focus is on practices that prevent the loss of nitrogen and organic matter from the soil, and reduce direct and indirect $N_2O$ emissions. The measure also includes producer training, support through advisory services, as well as co-financing of sowing cover crops and the purchase of equipment for conservation tillage. Its implementation is especially important in areas of intensive crop production, but it can also be adapted to smaller producers through simple, low-cost interventions. | • Reduce $N_2O$ emissions and preserve soil organic matter content through adoption of conservation agrotechnical practices on arable land<br>• Introduce cover crops and crop rotation, which directly reduces soil emissions, improves water balance and increases drought resilience<br>• Ensure that at least 30% of producers have access to advisory services and incentive measures for implementation of sustainable agrotechnical practices by 2030 | Ministry of Agriculture, Forestry and Water Management of Republika Srpska, FBiH Ministry of Agriculture, Water Management and Forestry, the cantonal line ministries in charge of agriculture and the department in the BD BiH responsible for agriculture, in cooperation with the Administration of Bosnia and Herzegovina for the Protection of Plant Health | Reduction of N2O emissions by approx. 51.5 Gg $CO_2$ – eq in 2030 | |
| | **Forestry as part of LULUCF** | | | | |
| **Reforestation of barren, degraded and erosion-affected areas** | This measure combines activities of afforestation of barren, degraded thickets, burned and erosion areas using a combination of indigenous and adapted species, with the aim of environmental revitalisation and climate resilience. It includes afforestation of areas that have not been under forest in the last 50 years, with a special focus on land subject to erosion and degradation. It is planned to raise new forest stands on a total of 25,000 ha by 2030, with an average annual coverage of 2,500 ha.<br>The proposed measure must be aligned with the forest management bases of cantonal forestry companies, in order to ensure compatibility with local environmental conditions, soil types and long-term management plans. In addition to public areas, afforestation should also include private forest plots located within priority zones. Through introduction of a monitoring | • Increase the total forest area through planting to at least 25,000 ha by 2030 to conserve and expand CO2 sinks.<br>• Reduce the risk of erosion and improve the water regime on degraded and bare lands through biotechnical interventions<br>• Establish sustainable planting structures using indigenous species and raise the capacity of nursery production and forest regeneration | Ministry of Agriculture, Forestry and Water Management of Republika Srpska, FBiH Ministry of Agriculture, Water Management and Forestry, Public and Private Companies Managing Forests | Increase in $CO_2$ sink by approx. 375 Gg $CO_2$ - eq | • Conservation and enhancement of the $CO_2$ absorption capacity of forests, thereby contributing to national and global climate goals<br>• Reducing the risk of forest fires, erosion and land degradation, thereby protecting settlements, infrastructure and agricultural land<br>• Conservation and restoration of biodiversity through protection of indigenous species and natural habitats<br>• Creating new jobs in rural areas through planting, forest care, fire protection and protected area management activities |

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| | system after planting, the sustainability of plantings and the possibility of assessing the impact on carbon sequestration, erosion control, local hydrology and the enhancement of biodiversity will be ensured. | | | | • Increasing revenues for local communities through sustainable use of forest biomass, plantations and ecosystem services<br>• Strengthening institutional capacities and implementation of modern forestry technologies and digital systems for monitoring and management<br>• Improving air quality and protecting water resources by stabilising land and reducing pollution<br>• Reducing the exposure of the population to extreme weather conditions, landslides and floods through forest barriers and microclimate regulation<br>• Long-term stability of rural economies through linking forestry, agriculture and energy sector<br>• Education and engagement of local communities in nature protection, which strengthens social cohesion and a sense of responsibility towards the environment<br>• Preservation of cultural and natural values of forest areas that are part of the identity of local communities<br>• Promotion of the health of the population through preservation of the natural environment and development of forest spaces for recreation and outdoor activities |
| **Establishment of plantations of fast-growing species for energy and industrial use** | The measure includes cultivation of fast-growing native and introduced species on degraded lands with implementation of the principle of low emissions and high CO2 absorption. It is planned to form 1000 ha of plantations by 2030. The goal is to produce biomass for renewable energy sources and reduce pressure on natural forests, with an additional $CO_2$ sink and the recovery of neglected land. | • Use 1000 ha of degraded land to raise plantations of fast-growing species by 2030, contributing to land recovery and carbon sequestration<br>• Produce renewable biomass for energy needs and replace fossil fuels, thereby reducing GHG emissions<br>• To increase the interest of the private sector and local communities in investing in forest-biomass projects through standardised models of plantation cultivation | Ministry of Agriculture, Forestry and Water Management of Republika Srpska, FBiH Ministry of Agriculture, Water Management and Forestry, Public and Private Companies Managing Forests | Increase in $CO_2$ sink by approx. 100 Gg $CO^2$ - eq | |
| **Adaptive management of natural forests and transformation of degraded stands** | This measure implies improving the structure and composition of existing forests in order to increase resilience to climate stressors and preserve or increase the $CO_2$ sink capacity. Activities include conversion of low and coppice forests into a higher silvicultural form, directing succession towards more stable and diverse communities, and maintaining and enriching biological and genetic diversity. Special focus is placed on limiting the proportion of allochthonous species and promoting mixed native stands, thereby reducing the risk of monocultures and ensuring environmental stability.<br>The measure is implemented in forests that already function as sinkholes, but require active interventions for the long-term preservation of this function. In order to preserve soil fertility and sustainable management, mandatory soil analysis is prescribed before and after interventions, especially when using fast-growing species that can deplete nutrients. Also, it is recommended to prepare a sustainability study in order to assess the long-term economic and energy justification of such measures in relation to natural forest ecosystems. | • Increase the resilience of natural forests to climate change through structural and species diversification of existing stands<br>• Reduce emissions from forest degradation and increase long-term sinks by improving the management of coppice and selection forests<br>• Ensure permanent preservation of the capacity of $CO_2$ sinks through revitalisation of low-quality forests and transformation into more stable forest systems | Ministry of Agriculture, Forestry and Water Management of Republika Srpska, FBiH Ministry of Agriculture, Water Management and Forestry, Public and Private Companies Managing Forests | Increase in $CO_2$ sink by approx. 250 Gg $CO_2$ - eq | |
| **Establishment of a system for protection of forest ecosystems from fires and biological stressors** | The measure includes preventive and operational protection of forests from fires, diseases and pests, with the aim of preserving already stored carbon and preventing biomass loss due to climate stresses. Activities include construction and maintenance of firefighting infrastructure, implementation of modern technologies for monitoring and early detection of fires (e.g. sensor systems, drones), control of invasive species, biological protection of forests and removal of infected or damaged trees as a repressive measure.<br>The measure relies on existing good practices in the forestry profession, especially in the field of care and sanitary interventions, but its implementation is often limited by the lack of financial resources, equipment and personnel. Therefore, it is necessary to define sustainable sources of financing and technical support in order to implement the measures continuously and systematically. The measure directly contributes to the preservation of ecosystem functions and forest stability in the conditions of increasingly frequent climate stresses. | • Reduce the risk of forest biomass loss and emissions due to fires through construction, restoration and digitalisation of prevention and control systems.<br>• Establish monitoring of invasive and harmful organisms and develop protocols for their environmentally acceptable control<br>• Strengthen the capacity of managers and local communities to identify and manage climate-induced forest risks early | Ministry of Agriculture, Forestry and Water Management of Republika Srpska, FBiH Ministry of Agriculture, Water Management and Forestry, Public and Private Companies Managing Forests | Increase in $CO_2$ sink by approx. 500 Gg $CO_2$ - eq | |
| **Conservation and expansion of protected forest areas and conservation of genetic diversity** | This measure includes formal expansion of the boundaries of existing protected zones, establishment of new reserves for vulnerable and climate-sensitive species, the ex situ conservation of genetic resources and promotion of landscape connectivity through habitat corridors. The focus is on preserving ecosystems with high environmental value and ensuring the long-term stability of $CO_2$ sinks. | • Expand the network of protected forest zones with the aim of preserving biodiversity and sinks in natural and old-growth forest ecosystems<br>• Conserve and multiply the genetic resources of important indigenous forest species through in situ and ex situ programs<br>• Establish ecological corridors and connect fragments of forest habitats to strengthen | Ministry of Agriculture, Forestry and Water Management of Republika Srpska, FBiH Ministry of Agriculture, Water Management and Forestry, Public and Private Companies Managing Forests | Increase in $CO_2$ sink by approx. 75 Gg $CO_2$ - eq | |

| | | | | | |
|---|---|---|---|---|---|
| | | landscape resilience and adaptive capacity of forests | | | |



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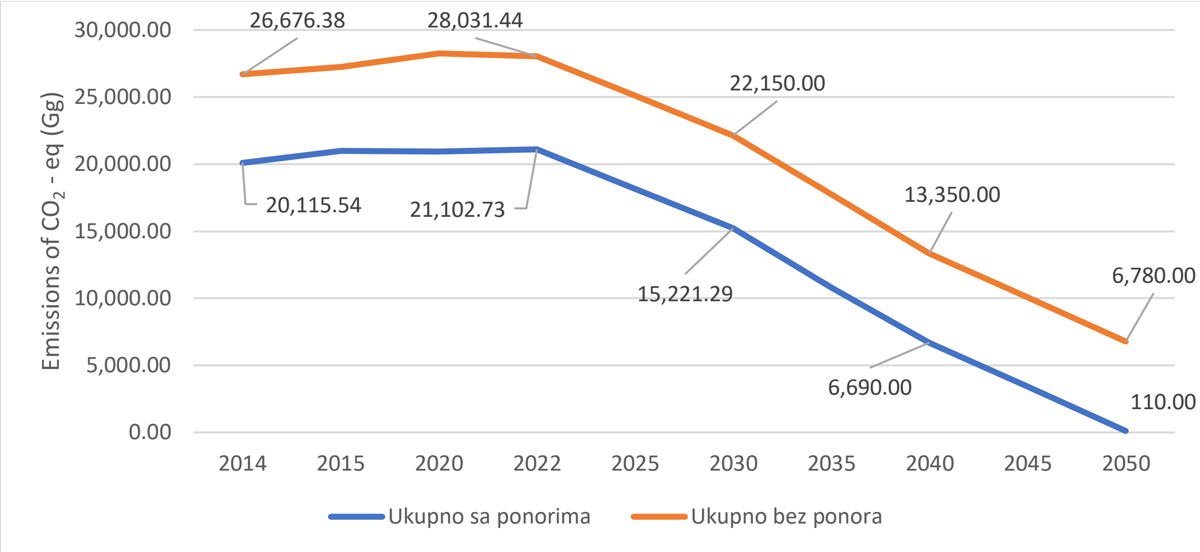
The planned trend of reducing GHG emissions with and without sinks from the last available inventory year to the target 2030 and 2050 is presented below.




(LEGEND: Ukupno sa ponorima – Total with sinks; Ukupno bez ponora – Total without sinks)

*Chart 11: Planned reduction of GHG emissions, Gg $CO_2$ -eq (with and without sinks in the period from 2022 to 2040 and 2050)*

## 4.7 Analysis of Alternative Scenarios for Reducing GHG Emissions in BiH by 2030 and 2050

To achieve the 2030 GHG emissions reduction target, three scenarios are being considered:

- One that is aligned with the "Policy" scenario in the draft NECP (Scenario 1), and
- Two alternative scenarios (Alternative Scenario 2 and Alternative Scenario 3) that achieve the same overall level of emission reductions by 2030 as the Policy scenario, but through different combinations of measures and sector contributions.

All three scenarios result in the same percentage reduction (~16.97% lower emissions by 2030 compared to 2014) and the same absolute reduction (to 22,150 Gg $CO_2$-eq annual emissions in 2030) without accounting for sinks. Given that the Policy scenario (Scenario 1) has been described in detail above, the characteristics of the alternative scenarios are described below, as well as the reason why Scenario 1 was rated as the best choice.

**Alternative scenario 2: Accelerated energy transition (focus on energy sources)**
Alternative scenario 2 achieves the same overall level of emission reductions by 2030 as Scenario 1, but relies primarily on the accelerated decarbonisation of the energy sector. In this alternative path, the greater burden of reductions is borne by the production of energy and fuels (electricity, heating systems), while measures on the consumption side and other sectors are less ambitious than in Scenario 1. The target total emissions in 2030 are achieved through more drastic reductions in emissions from energy sources, which are compensated by a lower contribution of individual demand sectors. This scenario implies a policy and investment focus on large-scale energy transition projects, with a somewhat slower progress in building efficiency and consumer behaviour compared to the selected Scenario 1.

Key features and measures in the Alternative Scenario 2:

- **Faster coal phase-out:** A more aggressive plan to shut down coal-fired power plants, potentially before 2030, additional units that were planned in Scenario 1 after 2030 are being shut down. The share of coal in electricity generation is declining sharply, with electricity emissions falling well below the sectoral target in the selected scenario. The reduction in coal-fired generation is compensated by accelerated introduction of renewable energy and introduction of transitional solutions (e.g. natural gas or electricity imports) to maintain system stability.
- **Intensive investment in OiE:** This scenario adds even greater incentives and investments in OiE to maximize emission reductions in the energy sector by 2030. The aim is for the electricity sector to contribute to higher absolute emission reductions, replacing slower progress in other sectors.
- **Transition to OiE in district heating:** District heating is rapidly converting to biomass, geothermal sources and heat pumps. In cities, most district heating systems are trying to switch from coal/fuel oil to biomass or waste heat by 2030. The expected outcome is a higher percentage reduction in district heating emissions compared to 2014, even approaching the complete decarbonisation of some systems.
- **Less ambitious building renovation:** Unlike Scenario 1, which envisages broader renovation of buildings, here the pace and scope of energy renovation of buildings is reduced. Investments are partially redirected towards energy production, so insulation and replacement programs of individual heating systems progress more slowly. Consequently, emissions from buildings are higher in this scenario than in the selected scenario (less in energy savings).
- **Limited measures in transport:** Electromobility and public transport are progressing at about the same level as in the selected Scenario 1, with no additional incentives. Due to less focus of resources on transport, transport emissions continue to grow until 2030 in a similar way to the selected scenario. In other words, this sector does not contribute to the reduction of emissions, but remains a net source of growth, which is accepted because the energy sector takes on the burden of reductions.
- **Industry and other sectors:** The industrial sector in this scenario achieves lower emission reductions than in the selected Scenario 1, relying mainly on the modest implementation of energy efficiency measures. The waste and agriculture sectors are also not targeted, and established practices and measures are implemented, without new initiatives.
- **Role of LULUCF:** Herewith, the contribution of sinks is not projected to be significantly higher than what has already been planned. The reforestation and conservation programs are running according to the Scenario 1 plan, but there are no additional large-scale afforestation campaigns to achieve the goal.

To sum up, Alternative Scenario 2 achieves the target mainly thanks to the energy sector – dramatically lower emissions from electricity and heat production – while the contribution of reductions from buildings, transport and other sectors remains more modest. This is an alternative path that requires strong political will to decarbonise the energy sector and major investments in OiE, with the risk that improvements on the energy consumption side and other sectors will be neglected.

**Alternative scenario 3: Increased energy efficiency and sinks**

Alternative Scenario 3 represents an alternative path where the same emission reduction target by 2030 is achieved primarily through maximum reduction of energy demand, increased efficiency and increased removal of emissions by sinks. Unlike Alternative Scenario 2, the burden of reduction is borne more by the end consumption sectors and the LULUCF sector, while the transition in energy is



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less abrupt. Through deep cuts in energy consumption in buildings and industry, changes in transport and a strong afforestation program, Alternative Scenario 3 achieves its 2030 emissions targets with less reliance on the exclusion of fossil sources than Alternative Scenario 2. This scenario implies a broad social mobilisation: from investments in energy efficiency at the micro level (households, businesses) to changes in consumer habits and agricultural practices.

Key features and measures in Alternative Scenario 3:

- **Maximum renovation and energy efficiency in buildings:** In this scenario, an intensive energy renovation wave is triggered, covering more of the residential and public sectors by 2030 than planned in the selected scenario. Additional financial resources are directed to the insulation and deep renovation of around 1.8 million m² of residential and 0.4 million m² of non-residential buildings per year, which corresponds to an average renovation rate of 3% of residential and 2.5% of non-residential stock, i.e. a total of 30% of residential and 24% of non-residential buildings by 2030. Most households are switching to high-efficiency heating systems (heat pumps, efficient and biomass stoves, solar collectors) with subsidies. As a result, building emissions are significantly reduced, which is why this sector contributes to a greater reduction through additional energy savings.
- **Decarbonisation of transport and modal transition:** Alternative scenario 3 aggressively promotes the electrification of transport and reduction of the use of fossil fuels in transport. The import and sale of electric vehicles (passenger and light freight) is accelerating, incentives and infrastructure (charging stations) are being introduced to make electric vehicles mainstream by the end of the decade. At the same time, public transport is being significantly improved – modernisation of bus fleets (electric/CNG), construction or expansionof tram/suburban lines, improvement of rail services –all of which stop the growth of emissions from transport. By 2030, emissions from the transport sector in this scenario are stabilised at 2014 levels or even lower. Such a shift also requires behavioural change (greater preference for public transport, ride-sharing, cycling) to reduce the overall mileage of fossil-powered vehicles.
- **Increased measures in waste and agriculture:** Alternative scenario 3 prioritises the reduction of $CH_4$ emissions. This includes making the most of landfill gas – all major landfills are equipped with $CH_4$ capture and energy production or flaring systems. In agriculture, almost all larger farms are introducing biodigesters for manure to produce biogas and prevent $CH_4$ emissions from open lagoons. In addition, education programs are being implemented for farmers on optimising livestock nutrition and fertilizer management. Due to these measures, emissions from waste and agriculture are declining rapidly and these sectors are thus making an important contribution to the overall goal.
- **Increasing $CO_2$ sinks (LULUCF):** In alternative scenario 3, forestry and land use become a key component of achieving the target. An ambitious afforestation program is launched: a significantly larger area of degraded land is afforested annually, including massive planting of trees in bare areas and erosion-affected areas. At the same time, stricter measures are being introduced to protect existing forests from fires, illegal logging and pests, in order to preserve the existing sink. By 2030, this results in significantly higher $CO_2$ removals. In this way, sinks offset a larger part of emissions and make it easier to reach the target.
- **Slowed energy transition:** As in this scenario the demand for energy and fossil fuels is significantly reduced by efficiency measures, the energy sector contributes to the reduction of emissions without significant interventions. The electricity sector and industry reduce

emissions primarily due to less energy use, and not solely due to capacity replacement. This means that the transition to renewable energy is taking place at a slower pace, as lower demand makes it easier to achieve the planned reductions and with slightly smaller installed capacities. In other words, the risk to energy security and pressure on large infrastructure projects is lower in this scenario, since part of the results is achieved through "negative demand" and sinks.

Therefore, Alternative scenario 3 achieves the same cumulative effect of reducing emissions by 2030 as the others – but the path to the goal is different, focusing on efficiency, savings, and greater removal of $CO_2$ from the atmosphere through sinks, while slightly less directly decarbonising primary energy production than in the Alternative scenario 2. This approach can be challenging because it requires broad participation from the population and the private sector, strong coordination of subsidies for energy efficiency and changing habits, but it also brings wider benefits, cleaner air in cities, better waste management, sustainable agriculture and new forest areas.

**Conclusion**

Although all three considered approaches lead to the same percentage and absolute emission reductions by 2030, Scenario 1 stands out as the best and most feasible path for BiH. The key reasons are listed below:

- **Balance and lower risk:** Scenario 1 spreads efforts widely across all sectors, thus avoiding over-reliance on one area. Unlike alternative scenarios, where success depends on extreme shifts in a particular sector, a balanced approach reduces risk – if one sector lags behind, others can partially compensate. This structure is more resilient to uncertainties and changes in circumstances.
- **Implementability and capacities:** The proposed Scenario 1 is realistically based on the country's existing policies and capacities. The measures are set in line with what BiH can currently implement institutionally and economically by 2030. Scenario 1 takes into account constraints (financial, technological, administrative) and predicts a gradual intensification of efforts, rather than sudden shocks. This makes it more likely that the plan will be fully implemented. In contrast, Scenario 2 would require extremely fast and expensive energy projects and the shutdown of thermal power plants with potential socio-economic shocks, while Scenario 3 calls for a high degree of social mobilisation and investment in efficiency that can be difficult to achieve in the short term.
- **Just transition:** As Scenario 1 requires a moderate contribution from each sector, the burden of transition is distributed more fairly. This allows, for example, the decarbonisation of the electricity sector to take place gradually with just transition planning for workers in the coal sector, while at the same time improving other sectors. No sector is exposed to a disproportionate shock – which facilitates social acceptance of climate action. Alternative scenarios could generate resistance (e.g., abrupt closure of mines in Alternative Scenario 2 without adequate job replacement or imposing strict energy conservation in Alternative Scenario 3, which could meet with resistance if not gradual).
- **Alignment with strategies and support**: Scenario 1 is fully aligned with the draft NECP, which provides a detailed operational framework for implementation of measures. This compliance means that the scenario already has institutional and analytical support. In other words,

Scenario 1 is not only a theoretical goal, but is embedded in the state planning process, with clear responsibilitiesand monitoring mechanisms, which increases the chance of successful implementation.

- **Cost-effectiveness and efficiency:** The balanced mix of measures is cost-optimal. The combination of investments in OiE, efficiency and other sectors is the result of a detailed cost-benefit analysis as part of the drafting of the NECP and NDC. This implies that the objectives are achieved at the lowest possible total cost to society, as the "lowest hanging fruits" of emission reductions in each sector are exploited. Conversely, alternative scenarios may require disproportionately costly measures in one sector (e.g. accelerated construction of a large amount of spare capacity or a massive subsidy for one technology) to compensate for the lack of action elsewhere, which is neither cost efficient nor sustainable.

All of the above is in favor of Scenario 1 (balanced scenario) representing the best compromise between ambition and achievability of goals. It ensures that BiH meets its international commitment to reduce emissions by 2030 at a sustainable pace of transition. The scenario is designed to maximise the existing potentials in all sectors, minimise risks and costs, and embed climate action in a broader development context. Therefore, this scenario is the most reliable path to decarbonisation of the BiH economy by 2030.

**Alternative Scenario 2 by 2050: An Accelerated Energy Transition to Climate Neutrality**

Alternative scenario 2 continues beyond 2030 to primarily rely on deep decarbonisation of the energy sector in order for BiH to achieve climate (carbon) neutrality by 2050. This scenario maintains the focus on energy sources as the main drivers of emission reductions, and predicts that by mid-century, the country's energy system will almost completely eliminate fossil fuels and replace them with renewable sources with the support of new technologies. At the same time, although energy efficiency and demand reduction measures continue, they are still less emphasised than in Scenario 3, which means that part of the sector is achieving reductions at a slower pace by 2050. The main burden of achieving the climate neutrality goal lies on energy projects and technical solutions, while the remaining emissions are sought to be neutralised through sinks.

**Key features and measures for the period 2030-2050 for the Alternative Scenario 2:**

- **Complete phase-out of fossil fuels in the electricity sector:** After 2030, the shutdown of the remaining coal-fired thermal power plants will accelerate and the gradual phase-out of the use of natural gas in the energy sector will begin. By around 2040, all remaining coal-fired thermal power plants have been shut down or converted to alternative fuels, while natural gas is still used only as a transitional solution in certain sectors with plans to completely abandon it by 2050. By mid-century, the electricity sector will reach almost zero direct emissions – electricity production relies predominantly on OiE (solar, wind, hydropower), with the possible use of energy storage technologies (batteries, hydro accumulations) to balance the system.

- **Decarbonisation of heating and industrial processes:** In this scenario, the almost complete exclusion of fossil fuels from heating systems and industry is also achieved by 2050. District heating systems, which have predominantly switched to biomass and geothermal energy by 2030, will be further improved by the 2040s to use only OiE or waste heat. Individual storage facilities in households are massively electrified (heat pumps) or switched to sustainable fuels (such as pellets, etc.), so that the building sector has minimal residual emissions by 2050. Industrial processes, especially energy-intensive industries, are undergoing modernisation: the use of hydrogen and electricity instead of coal and oil is introduced wherever possible, and where there are unavoidable emissions (e.g. in the cement industry), carbon capture and storage (CCS) technologies are used to neutralise them.

- **Transformation of transport to climate neutrality:** Although this scenario by 2030 did not place special emphasis on transport, the period until 2050 naturally leads to a major transition in the transport sector as well. Global technological developments and market trends are leading to electric vehicles and vehicles running on alternative fuels (hydrogen, biogas) becoming the standard. Around 2040, most passenger vehicles in BiH have been replaced by electric ones, with the development of charging station infrastructure. Heavy freight transport is switching to hydrogen or electric trucks, while public transport is expanding and modernising to reduce the use of private vehicles. As a result, transport emissions gradually decline after 2030 and are reduced to very low levels by 2050, with the remaining minimal emissions (e.g. aviation or some heavy equipment) offset by sinks.

- **Continued investments in OiE and new technologies:** Scenario 2 requires continued large investments in energy infrastructure throughout the 2030s and 2040s. In addition to the massive construction of renewable energy sources (onshore wind farms, solar farms on buildings and areas, potentially exploiting more hydropower where it is sustainable), advanced technologies are also being introduced to stabilise the grid and decarbonise carbon-intensive sectors. This includes battery storage systems, smart grids, as well as the production of green hydrogen using excess OiE for industry and transport needs. By 2050, BiH may also have a certain amount of installed negative emission facilities (e.g. bioenergy with carbon capture – BECCS or direct $CO_2$ capture from the air) in this scenario to compensate for the remaining emissions from sectors that are difficult to completely eliminate.

- **Moderate progress in energy efficiency in consumption:** While the focus remains on energy production, by 2050 this scenario also sees significant improvements in energy efficiency as technologies naturally improve and standards become more stringent. After slower progress by 2030, the following decades will nevertheless see a wider renovation of buildings and the introduction of efficient systems (especially when fossil fuel equipment becomes obsolete and is replaced). Also, in industry, competitiveness requires more efficient processes, so the energy intensity of production is reduced. Total final energy consumption in 2050 is significantly lower than in 2020 thanks to efficiency, but not as dramatically as in Scenario 3.

- **Reliance on sinks to neutralise residual emissions:** By 2050, Alternative scenario 2 calculates that certain residual emissions (primarily from the agricultural sector, a smaller proportion of residual transport, industrial processes, or gas leaks) will be offset by increased sinks or technological removal of $CO_2$. Although Scenario 2 does not give a specific focus to the LULUCF sector by 2030, efforts to refine and protect the forests are intensified in the period thereafter, in order to significantly increase the absorption of $CO_2$ from the atmosphere by 2050. In addition to existing forest sinks, additional reforestation of degraded areas and better forest management help to compensate for those emissions that cannot be completely removed at source. The end result is that BiH will achieve net-zero GHG emissions in 2050 – all remaining emissions will be offset by investing in sinks or capturing carbon.

**Alternative scenario 3 by 2050: Pronounced energy efficiency and sinks towards climate neutrality**

Alternative scenario 3 by 2050 continues on the path of maximising energy demand reduction and increasing sinks, in order to achieve climate neutrality by mid-century. After achieving a significant decrease in emissions by 2030 through savings, efficiency and afforestation, this scenario from 2030 to 2050 seeks to deepen these trends even further. The focus is on minimising the use of fossil fuels in all sectors by 2050 through reduced demand and substitution with clean alternatives, and maximising the capacity of natural $CO_2$ sinks. The energy transition in terms of capacity replacement is taking place gradually, as lower demand allows for an easier phase-out of fossil sources without sudden interventions. Scenario 3 basically assumes a high degree of social transformation: sustainable habits, technologies and practices are widely accepted by citizens, communities and the economy, leading to a more sustainable and climate-neutral society in long run.

**Key characteristics and measures for the period 2030-2050 for the Alternative Scenario 3:**

- **Deep energy renovation and passive house standard:** After an intensive wave of building renovation by 2030, the renovation of the residential and commercial stock is accelerating even more in the coming decades to make almost all existing and building stock highly energy efficient by 2050. Renovation rates remain high (3%+ y/yfor residential, ~2.5% for non-residential buildings) until mid-century, using advanced construction standards (passive house, low-energy buildings). By 2050, over 80% of buildings are thermally insulated and modernised, which drastically reduces the need for heating and cooling. Most households use highly efficient heating systems (heat pumps, solar thermal systems, efficient biomass stoves), so the immediate consumption of fossil fuels in buildings is almost eliminated.
- **100% clean transport sector:** Scenario 3 by 2050 strives towards full decarbonisation of transport. Building on the stabilisation of emissions by 2030, the next period will bring mass electrification of all modes of transport. By the 2040s, electric and hybrid vehicles make up the dominant part of the vehicle fleet in BiH, supported by an extensive charging station infrastructure and incentives for the replacement of old vehicles. Public transport is experiencing a renaissance: cities are introducing electric buses, tram and rail systems where possible, and urban planning is encouraging greater use of bicycles and walking. At the same time, zero-emission fuels are being introduced for specific purposes (e.g. green hydrogen or e-fuels for aviation and heavy transport). As a result, by 2050, emissions from transport have been reduced to negligible levels, with anything that may be left over (such as a small number of fossil vehicles or airplanes) being neutralised by sinks or offsets.
- **Sustainable industry and agriculture:** In the industrial sector, Scenario 3 between 2030 and 2050 achieves major energy savings and emission reductions through process modernisation and introduction of clean technologies. Factories are massively switching to electricity and hydrogen instead of coal, oil and gas, especially in heating and process steam processes. Where possible, circular principles are implemented to reduce raw material and energy consumption (e.g. material recycling). Agriculture is also undergoing a transformation to reduce emissions: precision agriculture that optimizes the use of fertilizers (less $N_2O$ emissions) is promoted, feed additives are introduced to reduce methane in ruminants, and

agroforestry practices that increase soil carbon absorption are encouraged. Waste management by 2050 is reaching a higher level: almost all biodegradable waste is diverted to biodigesters or composting instead of landfills, and existing landfills are equipped with complete gas capture systems or remediated.

- **Gradual but complete energy transition:** Although Scenario 3 does not force abrupt changes in the energy mix in the early years, by 2050 it still leads to an almost complete decarbonisation of the energy sector. As energy demand decreases and becomes more efficient, older fossil capacities are being withdrawn mainly due to economic uncompetitiveness and the end of their working lives, and are being replaced by OiE. In the mid-2040s, a significant proportion of coal-fired power plants and fossil fuel thermal power plants were phased out, partly due to emissions taxation policies that make fossil energy unprofitable. Through a planned increase in OiE capacity (especially decentralised ones, such as rooftop solar panels and small hydropower plants with strict environmental standards), energy is produced almost exclusively from low-carbon sources by 2050. The remaining emissions of the energy sector, if any, are fully neutralised by carbon capture or sinks.

- **Maximising $CO_2$ sinks:** The LULUCF sector in post-2030 Scenario 3 becomes an even more important pillar of achieving neutrality. Climate change programs continue intensively throughout the 2030s and 2040s, expanding BiH's urban coverage and increasing $CO_2$ absorption every year. The new forests are planted on barren land, abandoned agricultural land and areas affected by erosion, while respecting biodiversity. At the same time, sustainable forest management ensures that existing sinks remain intact or increase (e.g. longer and cycle times, enhanced fire and pest protection). By 2050, thanks to these efforts, the LULUCF sector in BiH absorbs significant amounts of $CO_2$ per year, which makes it possible to neutralise those emissions that are technologically or economically unfeasible to eliminate completely. Combined with minimised emissions from all other sectors, this means that BiH achieves the goal of net-zero emissions in 2050.

**Conclusion**

Although all three approaches (Scenario 1, Alternative Scenario 2 and Alternative Scenario 3) enable the achievement of the goal of climate neutrality by 2050, the differences in the approach and trajectory of decarbonisation are significant. Below are the characteristics and explanation of the optimality of the selected scenario:

- **Balance and flexibility**: Scenario 1 ensures an even distribution of efforts across sectors and time phases, with a gradual intensification of measures as we approach 2050. This structure allows for adaptation to technological change and economic circumstances, while Alternative scenario 2 accelerates the transformation of the energy sector, and Alternative scenario 3 strongly reduces consumption and relies on the widening of the gap, which may be more sensitive to changes in social acceptance.
- **Feasibility and institutional readiness**: Scenario 1 is fully integrated into the strategic framework of the draft NECP, with clear sectors, action holders and monitoring mechanisms until 2050. This makes its implementation more realistic compared to alternative scenarios that would require either a very rapid construction of large OiE capacities and the shutdown of thermal power plants (Scenario 2) or very intensive social mobilisation and massive investments in efficiency and natural sinks (Scenario 3).
- **Just transition**: Scenario 1 distributes the burden of the transition more fairly, allowing the energy transition and sink widening to take place in parallel with the protection of socio-economic interests. In Alternative scenario 2, there is a risk of socio-economic shocks due to

the abrupt closure of mines and thermal power plants, while Scenario 3 may cause resistance due to restrictive energy consumption measures if they are not phased in.

- **Compliance with national and EU targets**: Scenario 1 is designed to ensure full alignment with EU climate policy objectives and ETS requirements by 2050, while alternative scenarios offer potentially faster technical or efficient shifts, but with greater challenges in terms of integration into the existing regulatory framework.
- **Cost-optimality**: Scenario 1 applies a combination of measures that allow the objectives to be achieved at the lowest overall cost, using the 'lowest hanging fruits' in each sector and gradually introducing more expensive measures as technologies mature. Alternative scenarios may generate disproportionately high costs in some sectors to compensate for the lack of activity in others.

All of the above indicates that Scenario 1, as a balanced and institutionally supported approach, provides the most reliable trajectory for BiH towards climate neutrality by 2050, minimising risks and costs and ensuring the social and political sustainability of the process.

## 4.8 Technological Needs for Implementation of NDC

Achieving the goals defined in the NDC BiH requires accelerated development and wide implementation of modern technologies in all sectors that contribute to reducing GHG emissions and increasing resilience to climate change. Technological needs are multi-layered, encompassing energy production and consumption, industrial processes, buildings, transport, waste management, agriculture and land use, as well as the development of circular economy and digital tools that support a comprehensive approach to decarbonisation.

#### 4.8.1.1 Energy Sector

In the energy production sector, BiH faces the necessity of a complete technological transformation in order to meet decarbonisation goals. The technological needs of this sector are primarily related to the replacement of outdated and emission-intensive electricity production from coal-fired power plants with cleaner and more efficient solutions. This includes the construction of new production capacities based on OiE, especially solar and wind power plants, with the expansion of hydropower potential where technically and environmentally acceptable. At the same time, it is necessary to introduce high-efficiency cogeneration plants and modern gas turbines in the combined cycle as transitional solutions that enable the stability of the system until a sufficient share of OiE is ensured.

There is also a significant need for the development of energy storage infrastructure, primarily through high-capacity battery systems, which are key to balancing production from variable sources such as solar and wind. Also, it is necessary to improve the transmission and distribution network through digitalisation, introduction of smart grids and predictive energy management systems that enable efficient integration of a large number of producers, including prosumers. Technological progress must also be accompanied by introduction of modern systems for monitoring, verification and reporting of GHG emissions, which will enable harmonisation with the requirements of the European ETS and upcoming mechanisms such as CBAM.

In the long term, the energy production sector in BiH needs to develop capacities to use carbon capture and storage (CCS) technologies, especially for plants that will continue to use fossil fuels, to mitigate residual climate impacts. These technological needs require strong international support, both financial and technical, as well as the development of educational and reskilling programs that will ensure availability of skilled workers capable of implementing and managing these complex systems. Without investments in new technologies, digital infrastructure and knowledge, it is not possible to achieve a sustainable transition of the energy sector and achieve the goals of climate neutrality by 2050.

#### 4.8.1.2 District Heating

The district heating sector in BiH faces pronounced technological challenges arising from outdated infrastructure, low energy efficiency and high share of fossil fuels in the production of thermal energy. The technological needs for its transformation imply a complete modernisation of the heat production, distribution and consumption system, in order to achieve the goals defined in the draft NECP.

The first priority is to replace existing heat sources that use coal, heating oil and natural gas with more sustainable solutions, including biomass boiler rooms, geothermal sources, solar-thermal systems, integration of high-efficiency heat pumps, and the use of waste heat from industrial processes. This replacement requires the design and installation of new plants with modern combustion control systems and automatic regulation of energy consumption, which includes construction of the necessary logistics infrastructure for the procurement and storage of fuels such as biomass.

District heating distribution systems, especially in urban centers such as Sarajevo, Tuzla, Zenica and Banja Luka, require a technical retrofit through the replacement of worn-out pipelines, reduction of heat losses and installation of a system for digital management and real-time performance monitoring. Introduction of smart metering systems that enable calculation according to actual consumption and optimisation of heat flows in the network is crucial. It is also necessary to apply advanced software solutions for hydraulic balancing and consumption planning in different temperature regimes, including low-temperature systems.

Finally, the transition of district heating requires strengthening of the technological capacities of local operators through education and technical training, especially in terms of OiE management in heating systems, consumption management, reading and interpretation of data from smart devices, and optimisation of systems based on weather and seasonal conditions. This technological transformation can significantly reduce GHG emissions from the heating sector, enable the lowering of temperature levels in networks in accordance with the concept of fourth generation district heating, ensure greater energy security and contribute to better accessibility of heating for end users. However, its implementation requires international technical and financial support, including investments in infrastructure, technologies and knowledge.

#### 4.8.1.3 Building Sector

Building sector in BiH represents one of the most important sectors in terms of energy consumption and GHG emissions, especially due to the predominantly old and energy-inefficient building stock. The technological needs for implementation of measures in this sector focus on comprehensive energy renovation of existing facilities and establishment of standards for the construction of new nearly zero-energy facilities (nZEB).

It is necessary to apply modern technologies for thermal insulation of the outer envelopes of buildings, including facades, roofs, floors and basement ceilings, as well as the installation of energy-efficient carpentry with multi-layer glass and advanced sealing systems. At the same time, it must be possible to install mechanical ventilation systems with heat recovery, which enable a high degree of energy savings and improve the air quality in the interior.

In order to reduce the use of fossil fuels for heating and cooling, it is necessary to enable a wider implementation of technologies for the use of OiE at the building level, including solar thermal collectors for hot water preparation, heat pumps of various types (air-to-water, water-to-water, geothermal), as well as photovoltaic systems for electricity generation in residential and public buildings.

Technological modernisation also implies the digitalisation of energy consumption management systems through implementation of smart meters, sensor systems and software solutions for energy management in buildings, which enable real-time monitoring and optimisation of consumption. An important segment is also the installation of systems for automating the control of lighting, heating and air conditioning, as well as use of energy-efficient household appliances that contribute to energy efficiency without compromising user comfort.

For public buildings, especially schools, health and administrative institutions, additional technical measures are needed, which include replacement of obsolete equipment, improvement of heating and cooling systems, and integration of energy-efficient lighting. All these measures require specific competencies in the design and performance of works, which implies the need for technical training and certification of contractors, supervising engineers and energy auditors.

Due to the large volume of necessary interventions, the building sector depends on availability of long-term financing and support for the development of technical standards, standardised solutions and digital tools that can accelerate energy renovation and facilitate access to financial mechanisms. Without a strong reliance on new technologies, digital services and education of professional staff, achieving the goal in the building sector will not be possible.

#### 4.8.1.4 Transport

The transport sector in BiH has a high energy intensity and a significant share in total GHG emissions, with road transport dominating. The technological needs for decarbonisation of this sector within the draft NECP focus on vehicle electrification, fleet modernisation, development of alternative fuels infrastructure, and use of these fuels and the digitalisation of mobility management.

A key technological need is the electrification of public transport as an initial and priority phase, including city buses, trams, trolleybuses and other public transport vehicles. In parallel, electric vehicles need to be introduced in all other transport categories, from passenger cars to delivery vans, with the development of an extensive network of charging stations, including fast chargers on major roads and standard chargers in urban, business and residential areas. As a transitional measure to reduce emissions from internal combustion vehicles, hybrid and plug-in hybrid solutions should be introduced.

Biodiesel represents a significant opportunity for rapid emission reduction in transport segments where full electrification or transition to hydrogen is still not technically or economically viable. Its implementation is possible in existing diesel engines with minimal technical adjustments, which allows for rapid integration into the vehicle fleet. It is necessary to develop domestic capacities for the production of biodiesel from sustainable sources, including waste vegetable oils and oilseeds from domestic agriculture, and to establish logistics infrastructure for the distribution and quality control of fuels in accordance with European standards.

For freight transport, solutions based on heavy-duty vehicles powered by electricity, compressed natural gas (CNG), biomethane or hydrogen, with appropriate filling infrastructure and filling tanks, are needed. A particular challenge is represented by rail transport, where investments are needed in electrification of tracks, procurement of electric locomotives and modernisation of signaling and control systems.

In urban and intercity transport, technological needs include procurement of electric buses, trolleybuses and trams, along with modernisation of depots and service facilities. An important segment is also development of software solutions for planning and management of public transport, including intelligent transport systems (ITS), applications for integrated travel and digitalisation of ticketing.

For cycling and pedestrian traffic, infrastructure solutions such as smart lighting, traffic management sensors and smart security systems are necessary. In addition, it is necessary to develop digital platforms that enable optimisation of the use of public and private transport, monitoring of emissions along the route and support for multimodal transport.

Given the emission requirements adopted by EU regulations, including the future coverage of the transport sector through ETS 2, and the potential impact of CBAM, the technological priority is introduction of a system for measuring and verifying emissions from the fleet, as well as fleet management through digital tools to optimise fuel consumption and logistics.

Decarbonisation of the transport sector also requires significant investment in education and training of professional staff – from electric vehicle mechanics to sustainable mobility planners and intelligent systems operators. Without implementation of these technological solutions, the transport sector in BiH will not be able to reduce emissions in line with the draft NECP or achieve functional integration with European transport and energy systems.

##### 4.8.1.5 Industry

The industrial sector in BiH represents a significant source of GHG emissions, especially in the areas of metallurgy, cement production, chemical industry and food processing. The technological needs for its decarbonisation within the draft NECP imply a deep transformation of production processes through implementation of energy-efficient technologies, transition to OiE and introduction of low-carbon industrial solutions.

The first and foremost important technological requirement refers to the replacement of obsolete equipment and plants with modern machines that have lower specific energy consumption and the possibility of electrification of production processes. This includes high-efficiency engines, heat recovery systems, automation and optimisation of production lines, as well as introduction of cogeneration plants where applicable. Special focus should be placed on decarbonisation of the so-called hard sectors, where it is necessary to introduce technologies of reduced emissions in the production of steel, aluminum and cement, including direct reduced iron, plasma furnaces, and use of alternative raw materials and fuels.

Given the upcoming introduction of the EU CBAM mechanism, the industrial sector must develop capacities to monitor, verify and report emissions through sophisticated MRV systems, as well as the use of digital tools for carbon balancing and calculating the emission footprint of products. For export companies, this is a prerequisite for maintaining competitiveness in the EU market.

In the segment of energy sources, the industry must switch from coal and fuel oil to electricity and natural gas as transitional energy sources, and develop internal production capacities based on solar photovoltaic systems and biomass. In the long term, development of infrastructure for the use of green hydrogen in energy-intensive industries is also needed, and possible implementation of CCS in plants where process emissions are unavoidable.

Technological needs also include digital transformation through introduction of energy management systems (EMS), industrial Internet of Things (IIoT), and simulation tools for resource optimisation. Given the presence of small and medium-sized enterprises (SMEs), it is crucial to develop standardised, modular and affordable technologies for energy auditing, consumption analysis and implementation of effective measures. In addition to technical infrastructure, the sector must invest in the development of human resources, training of engineers and technical staff to manage modern technologies, conduct emission reporting and plan energy efficiency measures.

Without introduction of these technological solutions, the industrial sector will not be able to respond to the challenges of the EU's climate policy, nor achieve the goals of reducing emissions, increasing energy efficiency and preserving competitiveness in the transition to a low-carbon economy.

#### 4.8.1.6 Waste Sector

The waste sector in BiH represents a significant source of GHG emissions, especially $CH_4$ from municipal waste landfills. The technological needs for implementation of the draft NECP in this sector are focused on establishment of modern waste management systems, closure and remediation of non-sanitary landfills, control of gas emissions from landfills and establishment of facilities for energy valorisation of biodegradable waste.

The key need is the construction of regional sanitary landfills with appropriate systems for the collection, purification and energy utilisation of landfill gas, which implies installation of horizontal and vertical gas extraction systems, burners for its controlled incineration or cogeneration units for the production of electricity and heat. Such systems must be equipped with sensors for measuring the amount and composition of gas and automation of the work process.

In parallel, it is necessary to introduce technology-based systems for sorting, recycling and mechanical-biological treatment of waste (MBT), including lines for dry fraction separation, fermentation of organic waste and stabilisation of residue. For biodegradable waste, composting and anaerobic digestion technologies are key, which enable the conversion of waste into energy and useful material for agriculture, while significantly reducing $CH_4$ emissions.

In wastewater treatment, improvements to existing plants are needed through the installation of secondary and tertiary treatment, control of emissions from sludge and improvements in aeration efficiency, where technologies are used to optimize the oxygen regime and reduce emissions of nitrogen compounds. It is also necessary to install a system for capturing and measuring gases from digesters and sludge pools.

The digital component includes establishment of databases on the types, quantities and origin of waste, GIS records of landfills and infrastructure facilities, as well as development of digital tools for waste management planning and monitoring of emissions by location. All these technologies must be integrated into local and entity waste management plans, and their implementation requires building of technical capacities in utility companies, waste management centers and competent institutions.

Without implementation of these modern technologies, the waste sector will not be able to significantly contribute to the emission reduction goals defined in this document, nor harmonise waste management with the requirements of the EU acquis in the field of circular economy and environmental protection.

#### 4.8.1.7 Agriculture and Forestry

The agriculture and forestry sector in BiH has a specific emission profile, with agriculture contributing to $CH_4$ and nitrous oxide emissions through livestock farming, manure management and use of mineral fertilisers, while forestry acts as a net carbon sink but is under pressure from illegal logging and land degradation. The technological needs for implementation of draft NECP in these sectors are focused on modernising production practices, increasing resource efficiency and preserving the function of forests as GHG sinks.

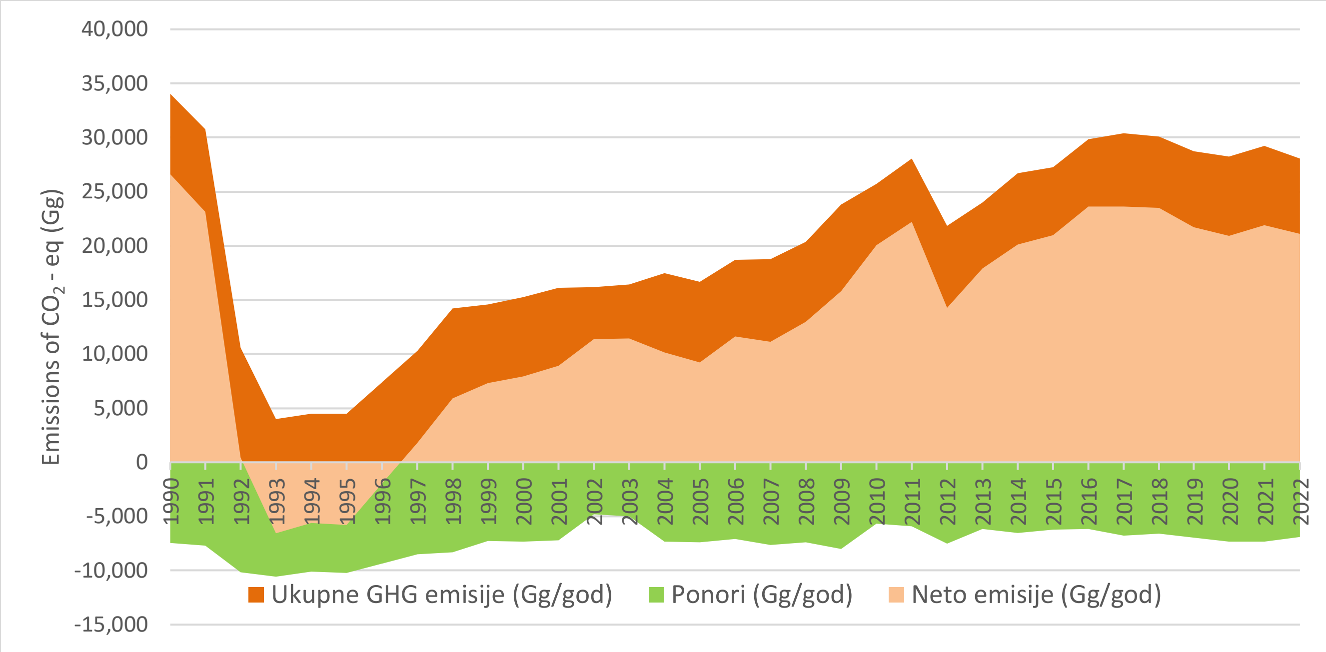
The agricultural sector requires implementation of precise and conservation agricultural technologies that allow optimisation of nitrogen input, reduction of $N_2O$ emissions and increase of yields with lower resource consumption. This includes introduction of systems for precise dosing of mineral and organic fertilizers, modernisation of mechanisation and use of satellite and sensor tools to monitor the condition of soil and plants. In livestock production, manure management technologies, including anaerobic digestion, covered lagoons and solid-liquid separation, are crucial, which significantly reduce $CH_4$ emissions and enable the production of energy from waste.

It is necessary to establish low-emission farms that use controlled animal nutrition, ventilation systems with heat recovery and digital monitoring of productivity and emissions. In addition, laboratory and analytical capacities are needed to measure emissions and develop emission factors specific to the agro-ecological conditions of BiH. An important component is the development of infrastructure for collecting and processing data from farms for accurate reporting in accordance with the IPCC methodology.

In forestry, technological needs are focused on strengthening systems for monitoring land use and forest resources through the use of remote detection, GIS tools and digital databases. It is necessary to develop and apply modern methods for mapping degraded areas, planning afforestation and monitoring changes in coverage. To preserve and increase $CO_2$ sinks from the LULUCF sector, it is necessary to apply sustainable forest management methods, mechanisation for selective felling, planting and care of young trees, as well as forest restoration through biodiversity-adapted species.
In addition, introduction of a system for the verification of emissions and sinks from the LULUCF sector requires development of a data collection and processing system, aligned with IPCC standards. Without implementation of these technologies, the agriculture and forestry sectors will not be able to make their full contribution to the realisation of the goals, nor ensure the role of BiH as a state that simultaneously reduces emissions and increases resilience to climate change through preservation of its natural resources.

## 4.9 GHG emissions of BiH

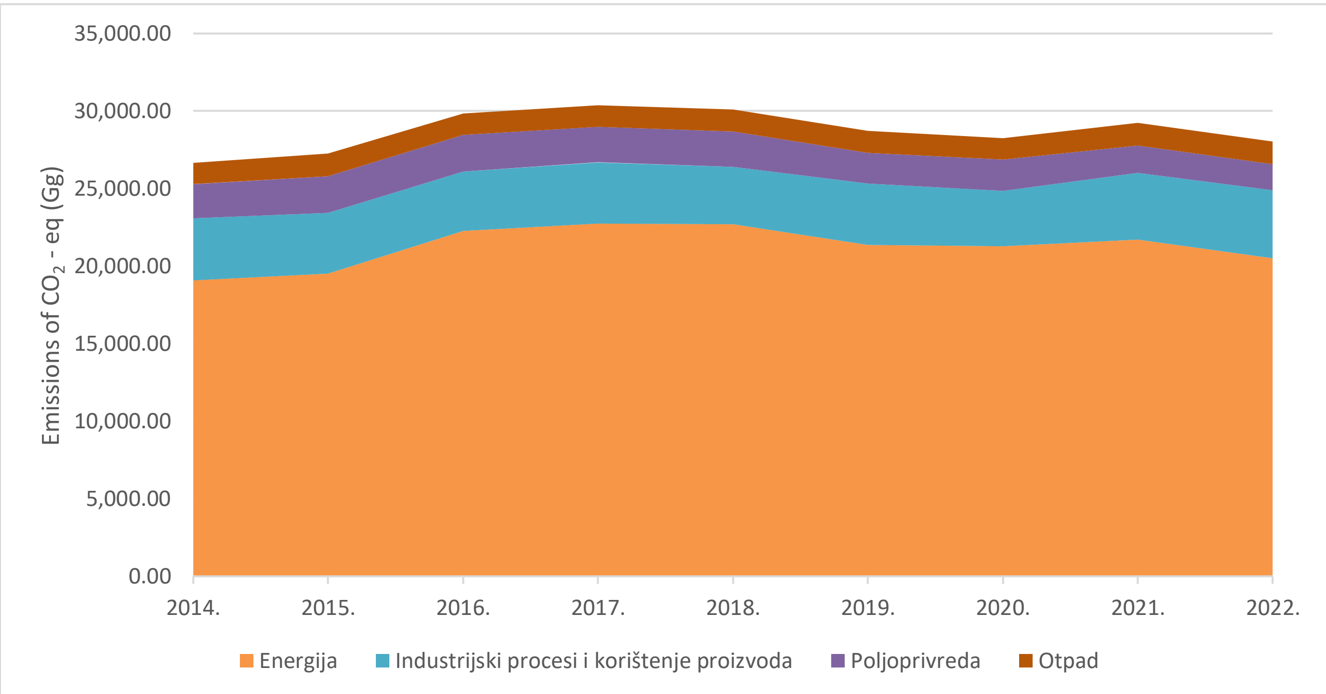
Through preparation of the GHG inventory within the development of BTR1, the calculation was performed for GHG emissions for the period 2019–2022, with the recalculation of data from 2014.




(LEGEND: Ukupne GHG emisije (Gg/god) – Total GHG emissions (Gg/year); Ponori (Gg/god) – Sinks (Gg/year); Neto emisije (Gg/god) – Net emissions (Gg/year).)

*Figure 5: GHG emissions in BiH (2014-2022)*

From the previous chart, it is evident that, after a significant drop in emissions in the early 1990s, caused by the events of war and economic collapse, there was a gradual increase and then stabilisation of emissions in the last decade. Compared to 2014, when total emissions amounted to 26,676 Gg $CO_2$-eq, in 2022 there was a slight increase to 28,031 Gg $CO_2$-eq. Nevertheless, according to larger sinks (-6,561 Gg in 2014 and -6,929 Gg in 2022), net emissions remained relatively stable, with values of 20,116 Gg in 2014 and 21,103 Gg in 2022, respectively.




(LEGEND: Energija – Energy; Industrijski procesi I korištenje proizvoda – Industrial processes and produc use; Poljoprivreda – Agriculture; Otpad – Waste.)

*Figure 6: Share of sectors in total GHG emissions in BiH*

As can be seen from the charts, the largest share in total GHG emissions in BiH is occupied by the energy sector. The smallest share in total emissions is occupied by the waste sector.



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# 5 Information relating to climate change impacts and adaptation under Article 7 of the Paris Agreement

## 5.1 Circumstances, Institutional and Legal Frameworks in BiH

BiH, as a signatory to the Paris Agreement, has an obligation to develop and implement climate change adaptation measures in accordance with Article 7 of the Agreement. It underlines the importance of resilience, vulnerability reduction and integration of adaptation into development processes. BiH's circumstances are determined by its geographic diversity, complex political and administrative structure and high vulnerability to the impacts of climate change. Given the increasing climate risks and limited institutional and financial capacities, climate change adaptation is a priority issue for the country's sustainable development.

Climate trends in BiH show a clear increase in average annual temperatures, especially in the summer months, with a simultaneous decrease in total precipitation and more pronounced seasonal fluctuations. Forecasts point to a temperature increase of 1.4°C by 2030, with a possible increase of up to 4.8°C by the end of the century in a high-emission scenario. The consequences are increasingly pronounced heat waves, droughts, floods and forest fires, which significantly increases the risks to natural resources, infrastructure, population health and overall national security.

BiH is highly vulnerable to these changes, especially in the sectors of agriculture, water resources, health, forestry and biodiversity. Climate impacts are already leading to reduced agricultural yields, land degradation, problems with water availability and quality, and disruption of the ecological balance. In this context, NAP represents a crucial step towards institutionalising the response to climate challenges. NAP defines concrete measures for short, medium and long-term action, through capacity building, better coordination between levels of government and involvement of local communities.

The assessment of loss and damage caused by climate extremes, such as the 2014 floods that caused damages of more than €2 billion, confirms the urgency of a systemic approach. An analysis of the contact points in the most vulnerable sectors emphasises the need to develop effective early warning systems, more resilient infrastructure and introduction of financial mechanisms for recovery and damage prevention. Introduction of a process for monitoring and assessing loss and damage is also key to supporting international negotiations under the Thematic Dialogue on Loss and Damage.

The fragmentation of competences on climate governance in BiH requires strong mechanisms of inter-institutional cooperation, as well as standardisation of procedures, databases and adaptation plans. Establishment of a functional system that connects all levels of government and sectors is a prerequisite for effective implementation of Article 7 of the Paris Agreement.
Competencies for adaptation to climate change in Bosnia and Herzegovina are divided between institutions at the level of Bosnia and Herzegovina, Republika Srpska, Federation of Bosnia and Herzegovina, Brčko District of BiH and cantonal and local levels of government, with a coordinating role of the competent ministries for environment and spatial planning, and sectoral institutions in the areas of water, agriculture, health and forestry. At the BiH level, MVTEO BiH coordinates international obligations and reporting in accordance with the UNFCCC, while entity ministries play a key role in the

planning and implementation of measures. Existing laws on environmental protection, water, forests, health and spatial planning include provisions that allow for the integration of adaptation measures, but further harmonisation and clarification of institutional responsibilities is needed, in order to avoid overlapping competencies and ensure effective implementation.

The legal framework for adaptation to climate change in BiH consists of entity laws on environmental protection, water, air, forests and nature, as well as strategic documents such as NDC and NAP. However, there is a need for further harmonisation of legal solutions and strengthening implementation through allocation of financial resources, establishment of clear competencies and strengthening of control mechanisms.

A particularly important component of the new approach to adaptation is the introduction of the so-called Nexus approach – integrated management of forests, water and biodiversity. BiH, as a country with rich biological and forest resources, recognises the importance of ecosystem-based solutions for improving resilience. The Nexus approach enables integrated planning and decision-making that takes into account interdependencies between natural resources, contributes to the preservation of ecosystem services, strengthens resilience of communities and contributes to the Sustainable Development Goals.

Conservation and restoration of forests, protection of rivers, wetlands and mountain habitats, and establishment of green corridors have multiple benefits: from reducing climate risks and mitigating GHG emissions, to strengthening the local economy and protecting biodiversity. Through introduction of this approach, BiH is demonstrating its readiness to modernise its legal, institutional and development framework in line with contemporary international practices.

BiH recognises climate change as a multi-sectoral challenge that requires the synergy of institutions, policies and society as a whole. While obstacles exist, especially in terms of institutional coordination, available resources and technical capacities, the foundations laid through the NAP, NDC and other strategic documents represent an important step towards creating a resilient society that is able to adapt to a changing climate in accordance with the spirit and provisions of the Paris Agreement.

## 5.2 Vulnerability and Adaptation Assessment

### 5.2.1 Agriculture

Climate change has a very pronounced impact on the agricultural sector in BiH. These impacts have been particularly emphasised in the past two decades, and are reflected in the increase in air temperature, long-lasting heat waves, uneven distribution of precipitation, occurrence of drought, increase in the number of days with intense precipitation, appearance of hail clouds and hail excretion, decrease in precipitation during the summer period, reduction in the number of days with snow and retention of snow cover. Climate extremes also have a negative impact in the form of strong and stormy winds (impact on fruit and crop growing) and intense precipitation in the form of heavy rainfall (floods, erosion, etc.). The consequences of climate change in the agricultural sector are predominantly negative and significantly affect the decrease in yields[45]. Due to the extreme spatial and time unevenness in the distribution of precipitation, during summer dry periods, when water needs are the highest, an increase in the need for irrigation of agricultural crops in BiH is expected. Irrigation planning must respect environmentally acceptable flows on rivers. According to the sixth IPCC report[46], it can be expected that spring crops will be more endangered due to high temperatures

[45] *Žurovec, J, Čadro, S, 2011*

[46] *AR6, IPCC, WGII 2022, https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_FullReport.pdf*

and water shortages during the summer months. A decrease in yield and quality of grazing, forage (especially spring crops) and degradation of pastures are also expected. According to the same report, by the end of the 21st century, accelerated processes of soil erosion can be expected, mainly through increased soil erodibility after prolonged dry periods, increased precipitation intensity and changes in land use.

It should be expected that climate change will have a positive effect on the yields and quality of winter crops due to the extended vegetation period. An increase in temperatures and the vegetation period can cause the expansion of the segment of fruit and vine cultivation[47]. However, one of the very important elements, but also being a consequence of climate change, is the frequency and date of occurrence of frost days. Therefore, an extension of the vegetation period can be expected, which will directly cause a decrease in the number of days with frost in BiH. A decrease in the number of days with frost may cause an increase in the area for some crops. In addition, a decrease in the number of days with frost, along with an unstable atmosphere, usually causes the occurrence of late spring frosts, which have an extremely negative impact on the fruit growing sector. Changes in the frequency and distribution of frost occurrence are one of the consequences of the warming of the climate system. Although the annual number of frosty days has been reduced, frost in the future may have a greater negative impact on plants due to changed climatic conditions.

Numerous studies have shown that the increase in air temperature has resulted in changes in plant phenology. In regions where there is a warming trend, changes in plant phenology were mainly manifested in the earlier occurrence of spring phenophases (e.g. budding, leafing and flowering) and in the later occurrence of autumn phenophases (e.g. leaf discoloration and leaf fall). The risk of late spring frosts is expected to increase, as well as the negative impact on fruit growing in BiH.

In the observed period 1961–2022, there is a negative trend in the annual number of frosty days on the territory of BiH, which is statistically significant in almost all areas. The determined values of the negative trend range from 3.6 (Bijeljina) to 6.3 days per decade in Banja Luka. The observed trend is most pronounced in the northwestern part of the territory (especially in Banja Luka), followed by Bugojno, Zenica and at the highest station, Bjelašnica. In general, the years with the lowest number of frosty days were recorded after 2000, when the warming trend becomes more pronounced. An extremely small number of frosty days has been recorded during the last decade. On the other hand, in the period 1961-2022, statistically significant positive trends in the duration of heat waves and warm days were determined throughout the territory of BiH. In the same period, the trend of tropical nights has also increased significantly, while the number of days with precipitation is increasing. It is clear that such trends cause more frequent and more intense occurrence of drought, which has a negative impact on the agricultural sector in BiH.

Due to the frequent occurrence of drought, irrigation in changed climatic conditions in BiH is becoming an urgent need. Vegetable crops and modern orchards will increasingly require implementation of irrigation, i.e. crops such as potatoes, beans, onions, as well as plantations of apples, pears, peaches, berries, especially those raised on shallow to medium-deep soils, in order to ensure regular fertility and quality of yield.
There is a total of 2,557,415 hectares of agricultural land in BiH, but not all of this area is suitable for irrigation. Only 46% of the land is under arable land and gardens. Even the largest part of these areas

[47] *Trbić et al, 2020*



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is not suitable for irrigation. According to the NAP BiH, only 158,000 hectares in the territory of the RS is the area of land suitable for irrigation, which is only 23.5% of the area, and in the territory of the FBiH 80,800 hectares or 17.8%.

In the Integrated Water Management Strategies in RS[48] and FBiH[49], which also considered the possible impacts of climate change, the development of drainage on 158,000 hectares of land of the highest quality classes is planned. Drainage systems may prove to be particularly important if there is an increase in short-term episodes with intense precipitation in future climatic conditions, as indicated by future climate scenarios. Analyses indicate that the climate will be warmer and drier on average, but that drainage problems will continue to occur in the colder part of the year (autumn-winter, early spring), so drainage channels should be maintained for the above reasons. Even in conditions of a drier climate, more intense precipitation can be expected, with an increased risk of flooding. In the coming period, it is necessary to review the drainage criteria, primarily three-day surpluses of water in the vegetation period (spring) for many years, as well as the ways of managing drainage systems, in selected localities (e.g. Semberija, where the trend of increasing precipitation has been observed, Tuzla, central Posavina, Herzegovinian karst fields).

Agroclimatic zoning was performed in NAP BiH, according to the climate scenario RCP8.5 until 2100, in order to determine the possible impacts of climate change. Four agro-ecological areas were singled out:

- Area of low Herzegovina (including the upper course of the Neretva river and karst fields),
- Area of high karst with karst fields,
- Central hilly and mountainous area with river valleys and
- Lowland hilly area (including serpentine and flysch zones).

**Low-Herzegovina area (including the upper course of the Neretva river and karst fields)** – According to the climate scenario RCP8.5, a more intense increase in temperature and a higher demand for water are expected during the summer period of the year. If the results of this climate scenario are observed, a greater increase in temperatures and a decrease in precipitation are expected, especially in the second half of the 21st century. In addition, intense precipitation may pose threats, which are expected to increase for the period 2016-2035, and especially for the period 2081-2100. In addition to the above, climate scenarios also indicate an increase in the number of days with hail and warmer winters with a decrease in snow cover. Based on all of the above, it is clear that more intense climate change can be expected, and especially climate extremes in the territory of the agroecological region of Low Herzegovina. Consequently, it is necessary to adapt more adequately to the new climatic conditions and their impact on the agricultural sector.

**High karst area with karst fields** – According to the RCP8.5 climate scenario, this agroecological region is particularly exposed to a greater impact of more intense rainfall and, consequently, greater erosion. In addition, forest fires are expected to occur more frequently in this region. As this is a mountainous region, if the forecasted climate changes are realised, by the end of the 21st century, it is possible to expect a more significant impact on forest communities and the shift of their ranges to higher zones.

**Central mountainous area with river valleys** – Compared to others, this agroecological region is the least threatened by climate change. The greatest pressure can be caused by intense precipitation, which can cause the occurrence of intense erosion and torrential floods, especially in the higher parts

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*[48] Strategy of Integrated Water Management of the Republika Srpska until 2024 (Draft – first iteration), Ministry of Agriculture, Forestry and Water Management, Sava River Basin Water Agency, Trebišnjica River Basin Water Agency, Bijeljina, July 2012*

*[49] FBiH Water Management Strategy 2010. – 2022., Sarajevo, March 2012*

of this region. In the area of the basins, higher temperatures, milder winters and reduced precipitation can be expected, which will also cause the occurrence of droughts, especially according to the climate scenario RCP8.5 by 2100.

**Lowland hilly area, including serpentine and flysch zones** – This agroecological region is significantly affected by climate change. The pressures refer to the increase in intense precipitation, which can cause occurrence of floods and various degrees of excessive wetting, from overmoistening to browning of lowland arable land, then an increase in the intensity and frequency of heat waves, drought, stormy winds and hail. All of the above already has a negative impact on the planned development of agriculture. Warm winters also have an extremely negative impact, which conditions atypical fruit flowering in the winter and, consequently, a worse yield, both in terms of quantity and quality of fruit produced in the following year. Late spring frosts are also a serious problem, which partially or completely destroy blossoming fruits, and especially fruit species and varieties that bloom a little earlier, due to the increase in the vegetation period. According to the RCP8.5 climate scenario, by the end of the XXI century (2100) these climatic extremes will be increasingly represented.

### 5.2.2 Water Resources

According to NAP, BiH is one of the countries that have good availability of water resources with a dense river network in the Sava River basin and a less developed network in the Adriatic Sea basin, and with significant underground courses. One of the basic characteristics of the BiH river network is that a large number of watercourses belong to the category of international watercourses: the northern border of BiH along its entire length is the Sava River, the Una River makes up a significant part of the border in the west, and the Drina River most of the border in the east. In BiH, the total annual resources of water from precipitation amount to 63.9 km3. According to the assessment of BiH's vulnerability to natural or other disasters, the average annual runoff from the Sava River basin[50] is 722 m3/s or 62.5%, while the runoff from the Adriatic Sea basin is 433 m3/s or 37.5%, therefore the value of the average annual runoff coefficient is about 0.57. An extremely high runoff coefficient indicates that the runoff regimes of even larger rivers are torrential in character with very fast flow concentrations. In addition, a special feature of the natural hydrological regime is the extremely unfavorable distribution of water in the time and area of BiH.

In the last two decades, BiH has been hit by several extreme floods. In mid-May 2014, extreme floods occurred that affected BiH and the wider region. The floods followed several days of rainfall (the highest precipitation recorded since the beginning of organised measurement, i.e. in the last 120 years) that coincided with the melting of snow, which contributed to an extreme increase in water levels in an extremely short period of time, especially on the rivers Bosna, Sava and Drina and their tributaries. Thus, in the period from 17 to 18 May 2014, embankments were broken in several places along the Sava River and its main tributaries, which caused floods and great material damage in the area of Central Posavina, Odžak Posavina and Semberija. Additional damage in the basin was caused by the occurrence of a large number of landslides, some of which completely reshaped the environment. Flooding, erosion, torrents and landslides marked the year 2014. After the floods in May, already in July, August and September 2014, precipitation caused new flooding problems in areas that were devastated by previous floods. In addition to these major flood events, in the past two decades there have been many situations when rivers have overflowed their beds in places, flooding

[50] *BiH Vulnerability Assessment from Natural or Other Disasters, Council of Ministers of BiH, Sarajevo, March 2011*

settlements and roads near the banks. Namely, due to the relatively fast reaction of the catchment area and to lower intensity precipitation, with a short travel time of high water waves, there often coincidence flood waves of the Sava River tributaries and tributaries of the lower order, as well as high waters of the Sava.

After the catastrophic floods in 2014, the Action Plan for Flood Protection and River Management in BiH 2014-2017 was prepared and adopted. Flood Hazard Maps have been prepared, and the Flood Risk Management Plan is being drafted. The first Regional River Basin Management Plans for the Sava and Trebišnjica River Basins were adopted in 2017. The Regional River Basin Management Plan (District) of the Sava River RS (2018-2021)[51] and the Regional River Basin Management Plan (District) of the RS River ([52]2018-2021) were adopted by the Government of the RS in 2018 (RS Official Gazette No. 14/18). In 2022. The Water Management Plan for the Sava River Basin was adopted in the FBiH[53].

Water systems are expected to be exposed to impacts related to climate change, and that projected changes in precipitation and air temperature will have a negative impact on the current water resource management system in BiH.

### 5.2.3 Impact on Water Supply

Due to the variation of flow, with longer low-water periods, increasing problems can be expected at numerous water supply sources, both in terms of the amount of water and its quality. Periods of reductions in water supply systems are getting longer in low-water periods throughout BiH.

In the FBiH, groundwater accounts for 85% of the total amount of water abstracted for water supply. Groundwater from fissure-karst environments, which are particularly sensitive to pollution input, accounts for 52%. Systematic observations of groundwater quality are not performed, and conclusions about the quality of this water resource can be made based on data on quality of water that is captured for the needs of water supply of the population, which show that the quality of groundwater resources is still mostly good. According to the Water Management Strategy of FBiH, about 60% of the population is covered by public water supply systems (in urban areas, the coverage is 94% of the total population, while in rural areas the coverage is much smaller and is around 20%).

According to the RS Integrated Water Management Strategy for the period 2015-2024, about 48% is connected to the water supply systems of municipal centers, about 12% is connected to the water supply systems of local communities, and about 40% of the population is supplied with water from individual wells or sources. Therefore, about 60% of the RS population is supplied with water in an organised manner. The ratio of abstracted water for water supply in the RS is such that 31% of the total amount of water is provided through water abstraction at sources, 46% through water abstraction through wells, and 23% of the total amount of water abstracted from rivers, lakes and reservoirs. The quality of springs in river alluvion is endangered in low-water periods, and in some cases in the situation of floods (the case of Doboj).

Water supply in rural areas is very vulnerable under the influence of climate change due to the increased risk of deterioration of water quality and quantity in prolonged drought and flood periods.

[51] *Sava River District Management Plan (2017-2021), Public Institution "Vode Srpske", November 2017.*
[52] *Trebišnica River District Management Plan (2017-2021), Public Institution "Vode Srpske", November 2017*
[53] *Water Management Plan for the Sava River Basin District in the Federation of BiH (2022 – 2027)*

Worsening of the problem in water supply of the industry in BiH can be expected in the future in terms of reducing the amount of available water, which will depend on the growth of industrial production.

The average water losses in water supply systems in the RS are about 48%. According to the data for the Sava River Basin in the FBiH, losses amount to an average of 57% of the total affected quantities, while in some water supply systems in the FBiH, losses amount up to 80% of the total amounts of affected water. Based on the above presented data on water losses in water supply systems in the FBiH and RS, it is evident that the increasing demand for water in the future is in conflict with the reduction of available amounts of water under the influence of climate change.

Providing additional water by expanding the capacity of existing water sources or creating new sources does not represent a sustainable solution to water supply problems. At the same time, the current state of water supply is characterised by inefficiencies in terms of large losses in systems, non-economic water prices and poor organisation of public companies in charge of water supply.

### 5.2.4 Impact of Climate Change on the Housing Sector

The impact of climate change on the housing sector in BiH manifests itself in two ways:

- Direct (construction and use – exploitation) and
- Indirectly (indirect effects of natural disasters).

The direct impact of climate change on the housing sector in BiH is present in the construction of residential buildings, and especially in the use – exploitation of housing units. Higher temperatures and higher amounts of precipitation during the construction season (May–November) can complicate conditions and extend the construction deadlines of residential buildings. An increased number of days with precipitation above 20 mm may cause a greater possibility of filling the foundation pit of a residential building under construction with rainwater and an increased risk of collapse of the foundation pit. A higher frequency of extreme weather phenomena (stormy wind, hail, thunderstorms) can cause various damages to residential buildings under construction (primarily roof structure) and equipment on construction sites.

Another form of direct impact of climate change on the housing sector refers to the use and exploitation of housing units. The increased frequency of weather disasters can lead to direct damage to constructed residential buildings (primarily roof structure and exterior joinery). However, during the exploitation of the building, changed climatic conditions expressed in higher temperatures in the summer period can lead to increased cooling of residential buildings, i.e. increased electricity consumption. On the other hand, higher temperatures in the winter period cause reduced consumption of energy sources (wood, coal, gas, fuel oil, electricity, etc.) used for heating residential buildings. The indirect impact of climate change on the housing sector in BiH is primarily related to the indirect impact of natural disasters, which results from changes in climatic elements, especially the increased frequency of extreme weather phenomena – weather disasters. Intense precipitation, which is increasingly present, results in two types of natural disasters in particular – floods and landslides. The occurrence of floods and landslides in May 2014 was simultaneously triggered by heavy rainfall due to cyclone Tamara, but the massive landslide was additionally caused by cumulative precipitation. Therefore, the main causal factor of all landslides is extreme cumulative precipitation during May and April 2014, with the main trigger being extremely heavy precipitation (over 50 mm/day). Even after 2014, several climatic extremes occurred in the form of intense precipitation that caused fluvial, urban and torrential floods. At the beginning of October 2024, very extreme intense precipitation occurred (about 320 mm during 8 hours), which triggered landslides and flash floods in Jablanica, Fojnica, Kreševo and Konjic, which destroyed numerous households and in which 27 residents have died. It is evident that due to the increase in the intensity and frequency of intense precipitation, it is necessary to revise the erosion and landslide risk maps in BiH.

### 5.2.5 Forestry and Biodiversity

Changes in climate through increasing average temperatures and changing rainfall regimes can affect the structure, distribution and forest cover in BiH. Fir forests in BiH can show a high response to climate change, given that they have a very narrow ecological niche and may face decline or loss. Due to their growth mainly in mixed forests with beech, which has a wider ecological niche and greater adaptability, stable beeches have a greater chance of replacing fir due to changes in humidity and temperature. Species with narrow niches are likely to face decline and losses[54] and may, in case of BiH, begin to shift the boundaries of their habitats, which then reflect in a change in vegetation due to climate change, thereby making other species more dominant (and potentially causing a decline in the economic value of these forests).

In the area of sub-Mediterranean forests of BiH, there is a threat of land structure changes. This could cause a decrease in pH values and lead to increased acidity, which will not be acceptable for existing species. We also emphasise the vulnerability in the canyon parts of relict-refuge landscapes, where most often shallow soils are formed, subject to wind and water erosion. By drying trees in canyons, soils can be exposed to even greater erosion, which would lead to stronger temperature extremes. This can cause even greater drying of trees, i.e. prevent the recovery of refuge forest communities. It is to be expected that some endemic species that are currently found in forest ecosystems will also disappear. Mountain forests and high mountain ecosystems are indeed very endangered due to temperature changes. The greatest threat will be for specific species of oaks (pedunculate oak and sessile oak), which mostly grow at lower altitudes. Threats can undoubtedly cause species migrations. The high genetic diversity of individual species, and thus the potentials in diversity of tolerance to climate change, distinguish certain species that have priority in terms of adaptive capacity. However, it is necessary to assess the response of different species and their provenances to climate extremes and to identify appropriate populations or ecotypes that are better adapted to the projected climate change[55].

The assumed climate changes can lead to changes in the spatial distribution of forest vegetation (manifested in the abundance of existing forest types), possible deterioration of existing or the emergence of new communities, changes in the number of individual populations of tree species, forest ecosystem productivity, ecological stability and health status of forests, as well as in changes in the overall productivity and generally beneficial functions of forests.

Climate changes are causing the ranges of many tree species to shift towards higher altitudes. Species with narrow ecological niches, such as fir (*Abies alba*), are particularly vulnerable to these changes. Models predict significant increases in temperatures and changes in precipitation by 2080. Species

such as beech (Fagus sylvatica) and fir (Abies alba) are expected to be particularly affected[56].

[54] *Kirschbaum, 2000*
[55] *Mataruga, 2015*
[56] *Vukelić et al. 2012*

According to the models of spatial distribution of ecological niches and their projections according to the CGCM2 global climate change model for 2080[57], some species show a spatial redistribution of ecological niches (pedunculate deer, downy oak, holm oak, black pine and white pine), while others show a significant change in the vertical stratification of them (beech, fir, spruce, curve pine). The projection of the ecological niche of sessile trees (Quercus petraea) according to the climate change model shows horizontal redistribution with vertical stratification of the ecological niche. Changes in temperature and precipitation regime cause the range of many woody species to shift towards higher altitudes, while at the same time their horizontal distribution decreases. Prediction models indicate that species such as fir (Abies alba) and beech (Fagus sylvatica) will be particularly vulnerable to these changes, leading to habitat fragmentation and loss of genetic diversity

Climate change affects the structure, distribution and forest cover in BiH, especially beech-fir forests that have a narrow ecological niche and high sensitivity to changes in humidity and temperature. Beech (Fagus sylvatica), which has a wider ecological niche, can replace fir from mixed beech and fir forests. Species with narrow niches, such as e.g. Picea osmrika, face population decline and habitat changes. Models show that climatically suitable habitats for beech and fir will shift towards the northeast and higher altitudes, leading to a reduction in their ranges in BiH.

Relict-refuge landscapes in canyons are particularly vulnerable to erosion and drying of trees, which can lead to the loss of endemic species. Mountain forests and high-mountain ecosystems are also threatened by rising temperatures, which will cause species to migrate and change the composition of forest communities.

The climate scenario RCP 8.5 indicates a pronounced further increase in air temperature and a decrease in the amount of precipitation, which will have an impact on forest ecosystems. Thematic research of the impact of climate changes and individual communities and tree species is necessary.

An ecological niche is defined as the n-dimensional space of ecological factors in which a particular species can survive. Climate factors such as temperature and precipitation play a key role in the distribution of tree species. Consequently, any changes in these factors can significantly affect forestry practices, management, as well as expected yields.

Also, the increased frequency of extreme climate events (e.g. droughts, heatwaves) puts additional strain on forest ecosystems, making them more susceptible to invasive species, pests and diseases. In the long term, this can lead to a decrease in forest productivity and changes in the functional structure of ecosystems.

Spatial distribution of an ecological niche according to selected climatic factors with average values for the period 1950-2000 and projection according to the global climate change model CGCM2 for 2080. Purple represents a higher (closer to 1) probability of prediction, while light green represents a lower (closer to 0), white represents an area outside the ecological niche for certain tree species[58].

*[57] Karta x. – Vukelić et al. 2012*
*[58] Vukelić et al. 2012*

### 5.2.6 Impact of Climate Change on Mountain Ecosystems

Over the past decades, mountain ecosystems in BiH have been more exposed to the risk of climate change. This risk is predominantly manifested through: increased temperatures, heat waves, intense precipitation, stormy winds, which cause an increased risk of fires, erosion and flash floods. According to the RCP climate scenarios, climate risks are expected to intensify in the future[59].

Although there have been no studies on the monitoring of the reaction of vegetation cover to changes in climatic conditions on the territory of Bosnia and Herzegovina, based on numerous global, European and regional research, it is clear that modern climate change has strongly influenced and is affecting changes in the plant world[60].

Modern climate change has led to major changes in physiology, phenology, distribution (range) of plant species, and to significant changes in the composition of plant communities, as well as interactions between community members, and ultimately changes in the structure and dynamics of ecosystems[61].

The distribution of many plants is currently changing in latitude and altitude in response to shifting climate conditions. The shift of the tree boundary upwards towards the mountain tops and towards the poles represents a well-established pattern of changes in the distribution of plant species. Through a meta-analysis of global data, Rubenstein et al. (2023) found that species ranges shifted towards higher altitudes at a mean rate of 9 m per decade and towards higher latitudes at a mean rate of 11.8 km per decade, and similar results were obtained from the global analysis performed by Chen et al. (2011) – species ranges shifted by an average of 11.0 m per decade upwards and 16.9 km per decade towards the poles. At least three different types of change in the distribution of species with increasing altitude (similar to the increase in latitude) have been determined: (1) upward displacement of the entire range (parallel displacement of both the central part of the range where the species is most abundant and the extreme boundaries of the species' range), (2) shift of the central center of gravity of the species distribution towards higher altitudes (shifting the optimal altitude of the species upwards), while the absolute boundaries of the existing range remain unchanged, and (3) change of the range due to widespread mortality within the existing range of the species[62].
Xerotremization of habitats, which leads to an increase in the number of species adapted to warmer conditions (emergence of thermophilic species), is the dominant trend in forest vegetation in BiH. Beech and fir, key species in the Dinaric forests, are sensitive to drought and high temperatures, which will lead to a decrease in their ranges. Black pine (Pinus nigra), although drought tolerant, shows sensitivity to extreme weather conditions, especially in the southwestern parts of Europe. There will be a shift of thermophilic sub-Mediterranean species that will spread from the south of the country more into the interior of the continent, e.g. holm oak (Qurecus ilex) or downy oak (Q. pubescens).

The displacement of species ranges occurs as a result of population expansion. Rapid warming, especially in the Northern hemisphere, has led to the creation of spaces with a more favorable climate for species that require warmer conditions, which has allowed them to expand their ranges northward or higher altitudes. Gottfried et al. (2012), for example, identified a consistent process of

[59] *Trbic, 2024*
[60] *Popov, 2023*
[61] *Kappelle et al., 1999, Hughes, 2000, Walther et al., 2002, Root et al., 2003, Rosenzweig et al., 2007*
[62] *Breshears et al., 2008*

"thermophilization" in high mountain vegetation (abundance of species more adapted to cold declines and the number of species that are more adapted to heat increases.

If the southern boundary of the range of plant species of the temperate zone in the Northern hemisphere recedes faster than the species expands its range to the north, its range is reduced, and the species may eventually become locally extinct in some areas (Adams, 2010). The mountain ranges of Bosnia and Herzegovina are recognised as highly vulnerable to climate change due to the limited migration capacity of flora and fauna.

The situation with the displacement of ranges under the conditions of climate change is further complicated in the case of border areas (e.g. as is the case with the Sutjeska National Park), because for some species, migration will require crossing international borders if suitable climate conditions are located outside their country of origin. This type of cross-border migration poses additional challenges for organisms due to differences in the manner and intensity of land use, conservation priorities, laws and policies between different countries, etc. Therefore, international cooperation will be necessary in order to effectively preserve biodiversity.

In addition to the direct impact on physiology, phenology and plant ranges, climate change has also affected plant life indirectly, through changes in ecosystems. The synergy of rapid changes in climatic conditions and other "non-climatic" pressures in the ecosystem (especially fragmentation, degradation and destruction of habitats) can lead to disruption (asynchronicity) of interactions between species in the community at the same or adjacent trophic levels within the ecosystem, i.e. to the modification or interruption of existing or the creation of new interactions (for example, phenological asynchronicity between plants and their pollinators, predators and prey, pests and hosts, species related by mutualism, etc., as well as disturbances in trophic interactions, i.e. mismatch of timing, needs and availability of food in food chains) (Gilman et al., 2010, Walther, 2010, Bellard et al., 2012) or to the creation of a new composition of species in the community, because species, in accordance with their ecological needs and physiological possibilities, react differently to these external pressures and changes in the environment (loss and/or acquisition of new species, emigration and/or immigration of species, thermophilization, spread of invasive species, spread of allochthonous pests and pathogens).[63]

Projections show that by the end of the 21st century, there will be significant changes in the composition of species in forests in Europe. Temperate forests will undergo major changes caused by climate change, the negative effects are mainly related to increasingly frequent and intense extreme events such as heat waves and droughts, which, combined with the emergence and spread of pathogens, cause greater vulnerability of tree trunks, and thus increased mortality.
The negative effects of climate change are likely to be felt in Europe by the widespread common beech. In Central and Southeastern Europe, beech can be found in the altitude range from less than 100 m to approximately 1700 m above sea level, in areas with an average annual temperature higher than 4.5 °C and an average annual precipitation of more than 600 mm[64]. In the part of the range at lower altitudes, high air temperatures and reduced amounts of precipitation in the vegetation period (especially in the summer months of June and July) have a negative effect on the width of the rings of beech trees[65]. Beech is also sensitive to drought[66], especially in the part of the range that is closer to

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[63] *Root et al., 2003, Reid, 2006, Rosenzweig et al., 2007, Walther, 2010*
[64] *Klopčić et al., 2022*
[65] *Stjepanović, 2019*
[66] *Kasper et al., 2021, Rukh et al., 2023*

the limit caused by lack of precipitation. It is likely to be affected to an even greater extent in the near future, as drought events are predicted to become more frequent and intense[67]. Thus, the dieback of beech stands occurs due to an increase in mean and maximum air temperatures, increased intensity of evapotranspiration, reduced precipitation and longer duration of insolation.

The decrease in productivity of beech forests will be most pronounced towards the southern limit of their distribution, in regions where drought intensity is expected to increase. Models predict that the climatically suitable habitat for beech will shift towards the northeast and upwards, as higher temperatures and higher precipitation at the northern edges of the range increase survival in new areas, while lower precipitation and higher winter temperatures at the southern edges of the range increase drought mortality and prevent bud dormancy during the winter[68]. In Slovenia, a significant shift of beech upwards and towards colder habitats has already been observed[69]. Applied models suggest that there could be a significant upward shift in altitude during the first half of this century, after 2071, beech stands at altitudes below 500 m will occupy a smaller area, however, at the highest altitudes of the range, there is no expected further upward movement of the species[70].

The analysis of the impact of climate change on the area of the Dinaric beech and fir forest in BiH shows that the area of their range will be significantly reduced[71]. It is predicted that the fir range will move towards higher altitudes and towards the north. Research in the region has determined that the distribution of fir could be significantly reduced by the end of the 21st century in Serbia, Slovenia and Montenegro[72].

Given the above, the vegetation of fir is also strongly influenced by climate change, which is reflected in a significant increase in air temperature and a decrease in the amount of precipitation in the summer season, as well as in the increasingly frequent heat waves and droughts[73]. According to projections for Serbia, a decrease in the distribution of fir, spruce and black and white pine is expected[74]. Buras & Menzel (2019) state that there will be a retreat of spruce from Central and Southeastern Europe to the higher elevations of the Alps and Carpathians, as well as to northern Europe. Vukelić et al. 2012 state a similar situation for the Western Balkans.
Black pine forests have been greatly affected by climate change. Black pine stands usually occur in steep, karst habitats or on inaccessible terraces in forests normally dominated by typical mixed mountain species, mainly beech and fir, and shows relatively good tolerance to a wide range of environmental conditions, including cold, heat and drought-induced stress. Black pine is mainly sensitive to meteorological parameters related to water availability, with ecological conditions in winter and early spring playing a primary role in the annual growth of trees[75]. Black pine in the Dinaric region is vulnerable to drought-induced stress, high air temperatures, intense summer droughts and natural fires. The results of the research on Northern Velebit in Croatia showed a significant positive impact of precipitation and a significant negative impact of air temperature on the radial growth of black pine in that area[76]. The results of the research on Mount Rudnik in Serbia showed that black pine is very sensitive to the amount of precipitation in the summer months (higher amounts of precipitation

[67] *Klopčić et al., 2022*
[68] *Saltré et al., 2015*
[69] *Klopčić et al., 2022*
[70] *Pavlović et al., 2019*
[71] *Radusin et al., 2013*
[72] *Ficko et al., 2011, Stojanović et al., 2021, Tanovski et al., 2022*
[73] *Trbić et al., 2017, Popov et al., 2018, 2019, Popov, 2020*
[74] *Stojanović et al., 2021, Miletić et al., 2021*
[75] *Proutsos & Tigkas, 2020*
[76] *Miklić et al., 2021*

in the summer season cause a statistically significantly higher increment), and a slight negative impact of higher July temperatures on the size of the increment was also registered[77]. High summer temperatures and drought have also negatively affected the radial growth of black pine in southwestern Turkey[78]. Research from Greece shows that although black pine appears to be drought tolerant, there are indications that perennial droughts may have prolonged effects on tree growth, which can last approximately three years after the drought ends[79].

In the conditions of modern climate change, it is necessary to reconsider both the adequacy and efficiency of existing networks of protected areas to preserve and protect biodiversity. The boundaries of protected areas are static, and the plant (and animal) organisms they protect will have to move their ranges in response to the warming of the climate system and the increasingly frequent occurrence of extreme events. Research has shown that about half of protected areas in temperate and northern high-latitude biomes will face new climatic conditions by the end of the 21st century, which will result in formation of new habitats and disappearance of existing ones[80]. By creating new habitats in protected areas, invasive species can migrate to protected areas, and with the loss of their existing habitats, the species that have inhabited them so far are likely to migrate from protected areas to unprotected environments. In both cases, communities within protected areas will be modified with unknown consequences for ecosystem functioning. By the end of the century, almost 60% of plant and vertebrate species will have lost suitable climatic conditions in Europe's protected areas, however, it is predicted that protected areas will still retain greater climate benefits for species than unprotected areas[81].

However, although the effectiveness of the conventional static network of protected areas for the protection of species in the conditions of climate change may be questioned, there is a large body of evidence confirming the ability of protected areas to preserve biodiversity in conditions of global warming[82]. It has been shown that protected areas facilitate the expansion of the distribution of species, especially when they are effectively managed, but also that they mitigate the retreat of species ranges on the "final" edges. They are also able to protect endangered species, which are already under the disproportionately large adverse effects of climate change.

### 5.2.7 Climate Changes and Fauna

Climate changes, which have been more pronounced over the last two decades, can have a negative impact on the fauna in BiH. In interaction with non-climate factors, especially changes in habitats caused by human activity, they represent the main force driving the decline and extinction of species today. As the climate scenarios of the projection of the future climate have shown an increase in air temperature and a decrease in precipitation (below -30%), many scientific papers indicate that these changes negatively affect the majority of wildlife, it is very important to continuously monitor these changes and the behavior of wild animals.

Climate change negatively affects the brown bear in several ways: increased temperatures cause dry periods, and thus a decrease in availability of natural food, increasingly frequent fires reduce the

[77] *Stajić & Kazimirović, 2018*
[78] *Doğan & Köse, 2019*
[79] *Proutsos & Tigkas, 2020*
[80] *Hoffmann et al., 2019*
[81] *Araújo et al., 2011*
[82] *Lehikoinen et al., 2021*

quality and size of the habitat[83], increased temperatures reduce the hibernation time[84], which extends the time of activity of individual animals. These processes condition bears to change their habitat or to adapt, and to look for food in other places, such as domestic animals, agricultural crops and apiaries. It is clear that such behavior of bears is sanctioned by man, and this increases the negative circumstances on the species.

It is unlikely that climate change will have a direct negative impact on gray wolves, but an indirect impact (impact on the habitat and on its prey, Lovari et al. 2020) will have negative effects. These negative impacts can manifest themselves through the early maturation of green plants at altitudes even up to 2000 m, and herbivores cannot keep up with these phenomena with their reproductive cycles (because of this, they could leave habitats in search of higher altitudes where the effects of climate change are not felt). The existence of the wolf depends on the quality of the habitat and the availability of prey. In suitable habitats, such as wild forested hilly and mountainous areas in BiH, where there is enough space for hiding, peace and enough natural prey, the species can absorb anthropogenic impact to certain limits[85].

Climate change can also have a negative impact on the population of the Balkan chamois, as well as on other herbivores in the habitat, i.e. due to incompatibility of the birth of young with the early greening of vegetation, it can force individuals to leave the habitat. In combination with anthropogenic pressure, the population can disappear very quickly.

Studies, which were done in North America, have shown that golden eagles have an adaptation mechanism and show some resistance to climate change. Namely, golden eagles that migrate through northwestern North America adapt to changes in the weather and duration of Arctic winters, arriving at breeding sites earlier each spring, probably to prolong their breeding and rearing phases of chicks[86]. Given that golden eagles are nesting birds in BiH, increases in air temperature could force the species to move towards colder parts of Europe.

### 5.2.8 Impact of Climate Changes on High Mountain Lakes

A pilot study on the impact of climate changes on mountain lakes in BiH was conducted within the FNC. In the research of high-altitude lakes, it was pointed out that there have been certain changes in water quality parameters, which can lead to the process of eutrophication and change in habitat conditions, and these changes can be partly caused by climate change.

A comparison of some earlier research of these lakes with our research shows that certain changes have occurred in these aquatic ecosystems. Recently, in some lakes of Zelengora, a significant amount of submerged and emersion macrophytes has developed, the decomposition of which forms a layer of silt at the bottom and leads to an increase in the organic production of the lakes themselves.

In the process of eutrophication of the lake, the wind plays a significant role, which brings dust and fine sand particles, landslides due to the effects of waves and rain, as well as rivers and streams that flow into the lake. The washing away of organic matter and inorganic salts from the surrounding land

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[83] *Su et al. 2018*
[84] *Johnson et al. 2017*
[85] *Trbojević, 2016*
[86] *LaPoint et al. 2017*

of the basin leads to an increase in the amount of nitrogen, phosphorus and other biogenic elements in the water, which leads to increased growth of algae and aquatic plants, i.e. to increased primary production. Algae and aquatic plants die in autumn and fall to the bottom, which gradually reduces the depth of the lake, thus creating conditions for the development of macrophytes.

Although the aging process of lake ecosystems takes place naturally, it should be pointed out that some parameters promote eutrophication and lead to faster overgrowth of lakes.

In the conducted research of these lakes, a different degree of eutrophication has been stated, so Lake Gornje Bare in Zelengora can be cited as an example. Lake Gornje Bare is relatively shallow and is more exposed to eutrophication processes. The parameters of the oxygen regime and the pH value correspond to the III class of waters, i.e. Gornje Bare classified as moderately eutrophic lakes. Since the values of all other physico-chemical parameters are within the I class of quality, and the sanitary-microbiological parameters within the II class, and that the III class is indicated solely by factors related to the intensive development of phytoplankton during the sampling period, the condition of this aquatic ecosystem is still not alarming. The self-sufficiency index itself, calculated on the basis of the qualitative and quantitative composition of phytoplankton, indicates β-mesosaprobable water. However, intensive development of phytoplankton leads to the accumulation of dead organic matter at the bottom, which accelerates the aging process of the lake, so it is necessary to perform continuous monitoring in order to be able to implement appropriate protective measures in time.

Also, certain degree of eutrophication can be seen at the Black Lake on Zelengora, where the data show that this lake has water of satisfactory quality. All physico-chemical parameters indicated high quality water, while microbiological parameters indicated that the lake does not have continuous contact with waste fecal matter.

The abundance of aerobic psychrophilic and mesophilic heterotrophic bacteria indicates the presence of organic matter in water, which, along with the relatively low diversity and low abundance of phytoplankton, indicates the conclusion that organic matter reaches the water mainly by washing away the surrounding soil after precipitation and decomposition of macrophytes. The decomposition of aquatic plants gradually creates a layer of silt that is a suitable substrate for the development of immersion plants, which accelerates the aging process of this sensitive aquatic ecosystem[87].

Research on Kotlanica Lake in Zelengora shows that it is a water that has a high ecological status and weak signs of the eutrophication process. The measured values of all monitored physicochemical parameters corresponded to waters of the first quality class, except for hypersaturation with oxygen. The high concentration of oxygen in the water is a consequence of developed underwater meadows consisting of macrophytes. The total number of bacteria in the surface layer corresponded to the second class of surface waters only at site A. An increased number of bacteria in the layer above the bottom is expected because sludge is deposited at the bottom due to the death of hydrobionts, which contains a higher number of bacteria compared to free water. The values of the saprobic index, obtained on the basis of the qualitative and quantitative composition of phytoplankton, indicate oligosaprobable water.

[87] *Dekić and associates, 2016*

### 5.2.9 Human Health

Climate change has become a reality in BiH and has an increasingly intense impact on human health. This impact is predominantly manifested through sudden changes in extreme weather conditions. These changes are closely related to the problems of fluctuations in blood pressure, cardiovascular and neurological problems, especially in vulnerable population groups (chronically ill, elderly, etc.). In addition, extreme events such as floods can contribute to the spread of water- and food-borne diseases. The negative health effects of climate change are likely to become more intense in the future, especially in poor countries, where the ability to adapt is limited by resources and technologies. Therefore, there is an urgent need to identify approaches and new methods, and to develop new tools to improve the health of the population in relation to the risks posed by climate change. If the current trend of climate change continues, as indicated by climate models and scenarios, we can expect unforeseen climate conditions that will bring with them diverse and devastating phenomena. The health of the population is directly related to the environment and the environment. Climate change directly affects the living conditions of people through economic development, food production, water quality, agriculture, etc. [88]. The deterioration of some of these conditions will have a detrimental effect on the health of the population.

In BiH, very little research has been done on the impact of climate change on human health, mostly at the local level. There are no regular data on health statistics on the impact of climate change on the health of the population, nor are there results based on many years of scientific research in the country. Although it is not possible to determine the connection 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, it can be said with certainty that climate change has a significant impact on human health. It is undeniable that there is a great concern of society about the general state of health, but nevertheless the involvement of the public in these problems is crucial in finding effective responses to adaptation to extreme climate change. A well-informed and educated public, which is also familiar with the dangers of extreme climate situations, can reduce their negative consequences with appropriate measures.

Extreme climate conditions can lead to more frequent changes and deterioration of the health situation, especially in the most serious patients (cardiac patients, hypertensive patients, kidney and lung patients), but also in other vulnerable groups (children, pregnant women, the elderly, people prone to allergies, etc.). Of all extreme meteorological events, heat waves are most associated with the disease of the population, but also with a high mortality rate, and represent an important and global public health problem. Due to the intense impact of heat waves, heat stroke can occur, as a more serious disorder. Heat waves have a detrimental effect on heart patients, but young and healthy people can also feel the effects of extreme heat. In addition to the above, other health problems can also occur, such as diseases caused by contaminated water and food, diseases transmitted by mosquitoes, ticks, rodents and birds (vector-borne diseases). In Bosnia and Herzegovina, there is still no legal regulation regarding outdoor work due to high temperatures and heat waves.

The interaction between climate change and human health affects the general socio-economic situation and standard of living of BiH residents, especially those with lower incomes. The most difficult situation is in less developed and smaller towns that do not have adequately organised health

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[88] *Vujković and Trbić, 2023, Menne and ebi 2005, Smith et al. 2014*

centers. Although there are no precise indicators on the impact of climate change on the health of the population, it can be assumed that any investments in adaptation to climate change are economically, but above all from the human side, justified and profitable. It is necessary to direct many more funds to measures of protection against heat stroke, education and information of the population, and monitoring accompanied by scientific research. At a later stage, it is necessary to make detailed cost-benefit analyses in this area as well, because it is indisputable that human lives are worth the most, and if mortality for certain diseases in extreme climatic situations is reduced by only 10%, investments in adaptation measures will pay off many times over.

The impact of climate change on human health is not well understood. There are studies that indicate that during climate extremes, the incidence of cardiovascular disease increases. The Third National Communication has found that there was an increase in the number of strokes by type of bleeding in the population in some municipalities in July and August. It is probably a population that is engaged in agricultural work and exposed to the direct action of the sun. Based on this result, recommendations can be made for this population. However, there are no results based on scientific research that would show the connection between other diseases and climate extremes.

Future studies should examine the association of climate extremes with heart attack, chronic obstructive pulmonary disease and respiratory diseases in BiH. In this sense, it is necessary to conduct a population-based scientific research through which data on the movement of the rate of general and specific morbidity and mortality during climate extremes would be collected. By analysing the collected data, it would be possible to estimate which disease has the highest increase in these indicators in our environment. As a result of this research, we would obtain conclusions that would allow us to make effective recommendations for the adaptation of the population to climate extremes. These adaptation measures would also be targeted at specific population groups (e.g. patients with chronic obstructive pulmonary disease or workers performing outdoor work). The adopted recommendations would also be the basis for the adoption of legal regulations that would regulate working hours and work obligations in the days of climate extremes. Research in the region indicates that climate change will lead to a change in the distribution and increase in the incidence of vector-borne infectious diseases (malaria, dengue fever, West Nile virus, Zika virus, etc.), as well as the spread of water-borne infectious diseases. According to research and reports conducted by the Veterinary Institute "Vaso Butozan" from Banja Luka, in the summer of 2015, the presence of the Asian tiger mosquito Aedes albopictus was determined at five locations in the RS, namely: Laktaši, Bijeljina, Brod, Gradiška and Banja Luka. It is known that this species of mosquito plays an important role as a vector of microorganisms that cause viral transmissible infectious diseases such as dengue, chikungunya, West Nile fever. This species of mosquito has previously been detected in some neighboring European countries. In the RS and FBiH, some other species and geners of mosquitoes have been detected, which are important for human health. A larger population of these mosquitoes has been determined in the area of Gradiška, Brod, Srbac and Kozarska Dubica. It is known that climate change is already having a measurable impact on weather conditions in Europe in the form of an increase in average values and changes in the amount of precipitation, and increasingly frequent heat waves, droughts and floods are expected. One of the consequences of climate change is its impact on the occurrence, prevalence and seasonal variation of infectious diseases in humans. This, in fact, implies the emergence and spread of already existing infectious diseases in areas where they did not exist before, but also the emergence of new infectious diseases.

Climate change has the greatest impact on vector-borne infectious diseases. These are diseases whose causative agent spends some time in the vector (mosquitoes, ticks and various other types of insects) before it enters the body of its host. Vectors are organisms that do not have mechanisms to maintain body temperature, so they are directly dependent on the outside temperature. Appropriate temperature and humidity are the basic prerequisite for the development of eggs and larvae of insects into adults, so in conditions of high temperature and high humidity their number can increase several times. It is estimated that every 0.1 degree Celsius increase in air temperature expands the mosquito's habitat up to 150 kilometers in the direction of the northern latitude of the globe. When it comes to vector-borne infectious diseases, predominantly cases of Lyme disease and a few cases of imported malaria per year are registered in the territory of BiH, but in 2014 there were also 10 probable cases of West Nile fever. Greater synergy is needed between institutions dealing with the early warning system (hydrometeorological institutes) and public health (institutes of public health and medical institutions) during extreme climate events that are becoming more frequent (extreme temperatures, floods, polluted air, etc.).

One of key problems is unavailability of data and lack of research in certain branches of medicine in which a significant impact of climate change is expected (cardiology, pulmonology, etc.). It is necessary to constantly inform the public about the possible impact of climate change on human health, especially in extreme weather and climate conditions. In the immediate future, it is necessary to functionally adapt public health in BiH to climate change. It involves improving prevention, efficiency of the health system and response to increasingly rapid and extreme climate events. Priority interventions include better management of the environmental determinants of health (such as water supply and sanitation), monitoring existing and emerging infectious diseases, and increasing the resilience of health systems to extreme weather and climate events. Also, poverty reduction and socio-economic development are a necessary prerequisite for successful adaptation. Climate models and scenarios suggest that the constraints on health adaptation will become increasingly complex. For example, projections of warming and temperature increase are expected under all climate scenarios by the end of the 21st century. This increase indicates that temperatures may occur that exceed physiological limits during the period of the year, making it impossible to work or perform other physical activities outdoors. In addition, with the increase in temperature, pressure on water resources is expected, which in the long run may put pressure on availability and quality of drinking water. It is necessary to continue further research, but also to permanently inform the public about the possible impacts of climate change on human health.

#### 5.2.10 Tourism

Climate change, which is reflected in the increasingly intense increase in air temperatures, reduced amounts of precipitation in form of snow and extreme weather conditions in the atmosphere, have an increasing (negative) impact on the development of tourism. The phenomenon of insufficient snowfall and the number of snow days was registered in the late 1980s in the Alps. It was accompanied by problems related to reduced revenues from winter tourism, increased investment activities, increase in employment in tourism, etc.[89] For these reasons, "in the early 1990s, along with climate studies on global warming, sectoral and regional studies on the impact of climate change on winter tourism appeared, covering almost all mountain tourist areas."[90] Various studies have shown that "the reliability of snow in tourist destinations is directly proportional to the increase in altitude, whereby

[89] *Elsasser & Messerli, 2001*
[90] *Budović, Mimić, Ratkaj, 2015*

climate change, through the increase in average air temperatures, will create a trend of decreasing the number of tourist places with reliable snowfall. Burki et al. (2003) believe that, by 2030/2050, winter tourist destinations, located below 1500 m above sea level, will not be able to rely on snowfall and that this limit, by the end of this century, could rise to 1800 m above sea level.

In the tourist offer in BiH, climate is a significant factor of development, especially taking into account the fact that most tourist activities are realized outdoors, tourists count on clear and sunny weather during the holidays, and enough snowfall during the winter season in the mountains. Attractive destinations are also protected natural areas, which are associated with outdoor tourist activities. In this regard, domestic tourist destinations are vulnerable to climate change, especially in terms of temperatures and precipitation. On the basis of previous research, the character of global climate change has been determined, and practice has shown a direct interdependence between climate and tourism. Winter tourism is in the greatest and increasing danger, as a result of the reduced amount of snowfall and the reduced number of days with snow in a year. The consequences of such a trend are reflected in a shorter winter tourist season, a reduced number of visitors in winter tourist centers and reduced financial effects of tourist traffic.

In accordance with the general, i.e. global, trends of climate change, certain studies have shown the coincidence of changes in climate elements at the regional level. Thus, regional climate models and scenarios for the area of BiH show a continuous increase in temperature, of varying intensity in certain periods. The current increase in air temperature in BiH is taking place much faster than the existing climate predictions indicate[91]. According to the RCP8.5 climate scenario, the expected temperature increase of 2.5 °C has already been achieved in some urban centers (Banja Luka, Mostar).[92] The impact of climate change in the tourism sector may also have wider implications for the entire economy of the RS and FBiH. The reduced number of tourists in mountain resorts due to insufficient snowfall during the winter tourist season will initially be felt the most by hotels, catering facilities and owners of private holiday facilities, which will have a negative impact on the local and then domestic economy. The negative impact of climate change in other sectors also has implications for tourism. For example, weaker yields and losses in the agricultural sector and higher food prices also have a negative impact on the price of tourism services. However, some of the impacts of climate change, such as the extension of the tourist season and the development of new tourism products, can be subsumed as positive.

In order to solve the problem of vulnerability in the tourism sector, it is necessary to invest in scientific research and develop a system of informing all participants in tourism about climate change and its impact. The efforts and cooperation of the entity authorities of the RS and the FBiH in formulating strategies and measures to facilitate adaptation to climate change in the tourism sector are crucial.

In recent years, the entities, and therefore BiH, have recorded a significant increase in the number of tourists, and therefore the tourism sector has been generating increasing revenues and providing new jobs. Given the fact that BiH is a predominantly hilly and mountainous country, winter mountain tourist destinations have a particularly important place in the tourism sector, which will have their function during the summer. In addition to mountain tourism, which is dominated by the winter tourist season.

[91] *Trbić, 2024*
[92] *Trbić et al., 2022*

A significant part of the tourist offer consists of urban and religious tourism destinations, followed by tourist activities related to rivers and lakes in the summer and tourism in protected natural areas.

According to the Bureau of Statistics of BiH, in 2024[93] tourists made 1,935,745 visits, which is 10.3% more than in the same period in 2023. Domestic tourists made 0.5% more visits compared to the same period of 2023, while foreign tourists made 14.8% more visits compared to the same period last year. In the period January – December 2024, tourists made 4,002,561 overnight stays, which is 8.5% more than in the same period of 2023. Domestic tourists achieved 1.1% more visits compared to the same period of 2023, while the number of overnight stays of foreign tourists increased by 11.9% compared to the same period last year. In the total number of overnight stays, the share of domestic tourists is 29.5%, while the share of foreign tourists is 70.5%. In the structure of overnight stays of foreign tourists, the most overnight stays were recorded by tourists from Croatia (13.9%), Serbia (11.6%), Turkey (9.8%), Saudi Arabia (7.6%), Slovenia (6.0%), Germany (4.3%), USA and China with (3.4% each), Italy (2.9%), Poland (2.6%), and Austria and Montenegro (2.5% each) overnight stays, which represents 70.5% of the total number of overnight stays. Tourists from other countries accounted for 29.5% of overnight stays. According to the type of accommodation facility, the largest number of overnight stays was realised within the activity Hotels and similar accommodation with a share of 94.2%.

However, similar to other economic sectors, climate change is becoming one of the key issues affecting the development and management of the tourism sector in BiH. In this regard, winter mountain tourism is directly exposed to the consequences of climate change, given the relatively low altitudes at which domestic ski centers are located, and the distinct dominance of the winter tourist season. A decrease in snowfall and milder winters cause a decrease in the number of tourists during the winter tourist season, which results in poor financial performance of our mountain centers. In addition to the negative implications for the winter tourist season in mountain centers, due to higher daily temperatures on the Mediterranean coast, mountain centers can affirm themselves as new destinations during the summer tourist season.

## 5.3 Climate Change Adaptation Priorities, Barriers and Measures

Climate change adaptation priorities and measures are defined based on the adopted strategic documents of BiH on climate change. The key document is the NAP BiH. Other documents include: Strategy for Adaptation of BiH to Climate Change, Fourth National Communication of BiH on Climate Change according to the UNFCCC and the Environmental Protection Strategies of the RS, FBiH and BD BiH. The strategic framework for adaptation to climate change is quite broad and provides opportunities for cooperation between stakeholders at the state, entity, cantonal and local levels, including public institutions, academia and the non-governmental sector.

Some of the key priorities are to disseminate knowledge and raise awareness of the need to adapt to climate change, as well as to strengthen scientific research and assessments of the impact of climate change on the most vulnerable sectors and the development of early warning systems. The most important priorities related to infrastructure are activities related to water resources management related to water supply, irrigation, stormwater regulation and flood defence.

The key challenges and barriers are the high speed of present and the uncertainty of future climate change, which requires updating and redefining climate change adaptation measures. Adequate

[93] *Press release, Business statistics, Tourism, cumulative, Period January – December 2024, Agency for Statistics of BiH, Sarajevo, February 3035.*

adaptation usually requires cross-sectoral engagement and a planned approach. In practice, there is an overlap between the competencies of certain departments and institutions. Also, insufficient financial resources for the implementation of adaptation measures are one of the important challenges.

*Table 21: Proposal of proposed climate change adaptation measures by sectors*

| Sector/Area | Measure |
|---|---|
| **Multi-sectoral** | 1. Improving the early warning system and increasing availability of information and strengthening information and education of the public in order to increase preparedness of citizens for growing climate hazards,<br>2. Updating methodologies for disaster risk assessment with the integration of information on climate change, in particular on increasing climate hazards;<br>3. Development and implementation of climate change monitoring systems, implementation and effectiveness of adaptation measures and recording of losses and damages from climate change,<br>4. Advancing scientific research on climate change and developing sectoral impact assessments.<br>5. Improving the NEXUS approach,<br>6. Integration of climate change into planning and strategic documents, |
| **Agriculture** | 7. Raising awareness, educating and organising workshops on the need to adapt to climate change,<br>8. Development of regional climate change adaptation programs (in the RS by agro-regions, and in the FBiH by cantons),<br>9. Integrating climate change into the budget's incentive programs.<br>10. Development and improvement of agrotechnical measures (irrigation, drainage, water accumulations, antifrost systems, hail protection, etc.),<br>11. Development of research on varieties and species more resistant to climate change,<br>12. Improvement of cultivation technology and conservation of land, |
| **Water resources** | 13. Construction of multi-purpose reservoirs,<br>14. Improvement of water management (capturing of springs, arrangement of river beds, cleaning of drainage channels, preparation of studies, etc.),<br>15. Updating flood risk management plans,<br>16. Updating flood risk and hazard maps,<br>17. Improving the hydrological forecasting system,<br>18. Preparation of studies (assessment of availability of water for irrigation, new technical solutions of flood protection based on natural solutions (NbS) erosion reduction, water supply,..), |
| **Public Health** | 19. Development of methodology and development of climate change impact assessment and monitoring of vulnerability for the health sector, especially for vulnerable groups (children, sick, persons with disabilities, the elderly, outdoor workers), with proposed climate change adaptation measures,<br>20. Strengthening the capacity of the health sector in responding to climate change (emergency services, strengthening prevention, protocols, disseminating knowledge and good practices, etc.),<br>21. Development of a study on new diseases caused by climate change in BiH,<br>22. Research on bioclimatic effects on human health,<br>23. Research on the impact of allergens on human health (ragweed pollen...), |

| | |
|---|---|
| **Biodiversity** | 24. Preparation of an assessment of the vulnerability of species, habitats and ecosystems, with proposed measures of adaptation to climate change,<br>25. Development of a system and methodology for monitoring the impact of climate change on biodiversity,<br>26. Integrating adaptation to climate change into nature conservation programs.<br>27. Research on the impact of climate change on endemic fauna, |
| **Forestry** | 28. Mapping of forest areas in GIS,<br>29. Reforestation with native and fast-growing species,<br>30. Sanitary inspection and replacement of trees in urban zones,<br>31. Preparation of a study on forest fires (risks, mapping of burned areas, early detection of fires, etc.), |
| **Tourism** | 32. Promoting ecotourism,<br>33. Improving tourism on rivers and lakes,<br>34. Promoting summer tourism in the mountains,<br>35. Snowmaking of ski slopes, |
| **Transport infrastructure** | 36. Preparation of an assessment of vulnerability and risk of climate extremes on road infrastructure in BiH. |

## 5.4 Current and Future (Projected) Cimate Trends and Hazards

### 5.4.1 Climate Trends in BiH until 2022

Climate change has been the driver of the biggest risks and disasters in BiH in the past two decades. Below are the climate trends for key climate elements and indices for the period 1961-2022 and their impact on the sectors most vulnerable to climate change. Research indicates that the temperature increase in the largest urban centers in BiH has exceeded the threshold of 2°C on an annual basis, and that the pluviometric regime has been changed to a large extent. There are clear trends in the increase in dry days (without precipitation), but also days with intense precipitation on an annual basis. Such trends have triggered the occurrence of extreme droughts, as well as floods during the same years. The most vulnerable sectors from climate change in BiH are: agriculture, water management, forestry, human health, tourism, biodiversity and fragile ecosystems, and the housing sector, while the greatest risks are from floods, droughts, heat waves, forest fires, late spring frosts, hail and stormy winds. Climate models and projections by the end of the 21st century indicate a rapid increase in air temperature, a large change in the precipitation regime with an increase in intense precipitation, which causes fluvial, urban and torrential floods, as well as the number of days without precipitation that affect the occurrence of droughts and forest fires. Possible pathways of adaptation to climate change must follow contemporary climate trends, as well as climate projections until the end of the 21st century.

#### 5.4.1.1 Air Temperature

In the second half of the 20th and at the beginning of the 21st century, a statistically significant positive trend of annual average air temperature was present in all parts of BiH. The largest increase in air temperature is recorded in urban areas in Banja Luka, Sarajevo and Mostar (Fig. 12). In the analysed period 1961-2022, the growth trend in most parts of BiH was 0.3-0.5 °C per decade. The growth rate is most pronounced in the summer season, while in the autumn season there is only a slight and mostly insignificant increase in air temperature (Trbić et al. 2017). In the summer season, statistically significant trends in air temperature were determined throughout the territory (statistical significance at the level of 99%), which ranged from 0.3 °C per decade in Ivan Sedlo to 0.6 °C per decade in Banja Luka, Prijedor, Bijeljina and Bugojno.

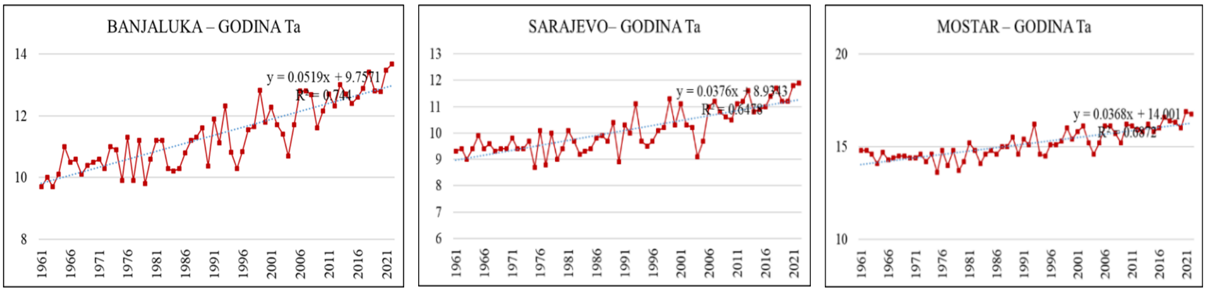



*Figure 7: Trend of annual mean air temperatures in the period 1961-2022 (in °C)*

A statistically significant increase in air temperature is also present in the winter and spring seasons in most of BiH, except at the stations in higher areas: Bjelašnica, Bileća and Ivan Sedlo (in spring) where a slight increase in air temperature of 0.0-0.3 °C per decade and 0.1-0.2 °C per decade was determined, respectively, which was not statistically significant. At other stations, the temperature in the winter and spring seasons increased significantly, and the increase ranged from 0.2 to 0.5 °C per decade and 0.2 to 0.4 °C per decade. The smallest trends were recorded in the fall. A significant upward trend in the range of 0.2-0.3 °C per decade was found in only a few areas – Banja Luka, Prijedor, Bugojno, Sokolac and Livno. Since 1990, when the warming trend has become more pronounced, only a few years have been recorded at individual stations with annual mean air temperatures lower than the average of the reference period 1961-1990 - usually1991, 1996 or 2005. Out of ten years with the highest values of annual mean air temperatures in the period 1961-2022 at most stations, all have been recorded since the beginning of the 21st century. Among the hottest years are 2022, 2019, 2018 and 2014.

This trend in air temperature has also caused an increase in other temperature climatic indices, and a more frequent and intense occurrence of drought, which has a particularly negative impact on the agricultural and water management sectors.

#### 5.4.1.2 Frost days (FD0)

The number of frost days (FD0) represents the number of days in a year when the daily minimum temperature (TN) is ≤0ºC. In the analysed period 1961-2022, a statistically significant negative trend was found in the annual number of frosty days throughout the territory of BiH. The number of frost days in most areas in the north decreased along a trend line of 3.6 days per decade in Bijeljina to 6.3 days per decade in Banja Luka. The number of frost days in Sokolac decreased by 3.6 days. The decrease in the lower parts of Herzegovina is significantly smaller due to their rare frequency of occurrence in that area.

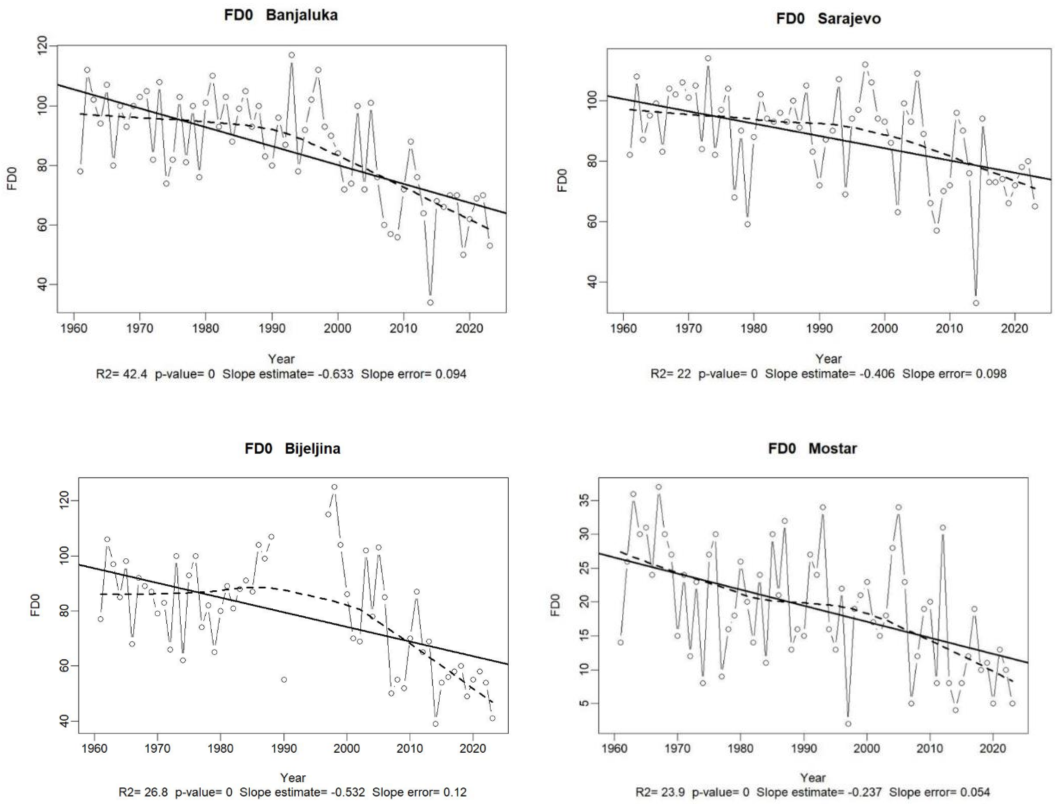



*Figure 9: Trend of the annual number of frost days in the period 1961-2022 (in days)*

The analysis of the deviation of the annual number of frost days from the average of the reference period 1961-1990 shows a decrease in the frequency of their occurrence since the 1990s, and especially since the beginning of the 21st century. In this period, only a few years with an above-average frequency of frost days were recorded at all analysed stations. The percentile analysis shows that after 1990, as many as 18 years were in the < category of the 25th percentile (including the last 10 years of the analysed period), and only 2-4years in the category > the 75th percentile. Of the ten years with the lowest values of the annual number of frost days in the period 1961-2022, almost all have been recorded since the beginning of the 21st century. The lowest number of frosty days was recorded in 2014. This trend has caused a very rare occurrence of early autumn frosts, which has had a positive impact on the vegetable sector. However, despite the decrease in the number of frost days, the frequent occurrence of late spring frosts in April is evident, which causes a great negative effect on fruit growing in BiH.

#### 5.4.1.3 Summer days (SU25)

The increase in air temperature has caused an increase in the number of summer days (SU25 - the number of days in a year when the daily maximum temperature (TX) is ≥25ºC). In the analysed period 1961-2022, a statistically significant positive trend in the annual number of summer days was established throughout the territory of BiH. The number of summer days in most areas increased along the trend line by 5-7 days per decade. The largest increase was recorded in Banja Luka (8 days per decade), and the lowest in Čemerno (4 days per decade).

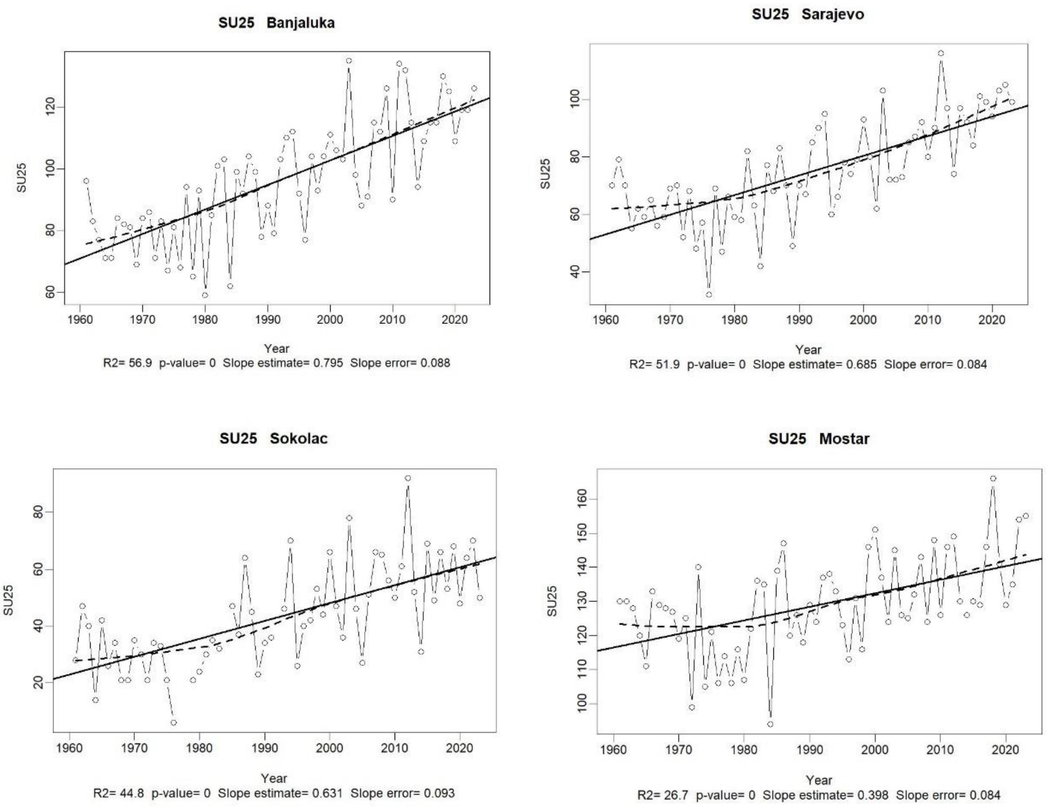



*Figure 10: Trend of the annual number of summer days in the period 1961-2022 (in days)*

An analysis of the deviation of the annual number of summer days from the average of the reference period 1961-1990 shows an increase in the frequency of their occurrence since the 1990s, and especially since the beginning of the 21st century. In this period, only a few years were recorded at all analysed stations with the appearance of summer days below the project - in Banja Luka, Sarajevo and Mostar only in 1996, in Bijeljina in 2002, 2005 and 2010, in Sokolac and Gacko in 1995 (i.e. 1997), 2005 and 2014, etc. The increase in the number of summer days can have a positive effect on tourism in Bosnia and Herzegovina.

#### 5.4.1.4 Tropical days (SU30)

The intense increase in air temperature has caused an increase in the number of tropical days (SU30 - the number of days in a year when TX≥30ºC), as well as heat waves. In the analysed period 1961-2022, a statistically significant positive trend was found in the annual number of tropical days in the entire territory of BiH. The number of tropical days increased in the higher regions by about 3-4 days per decade, in the lower regions in the north by 5-7 days per decade, and in the south in Mostar and Trebinje by almost 8 days per decade.

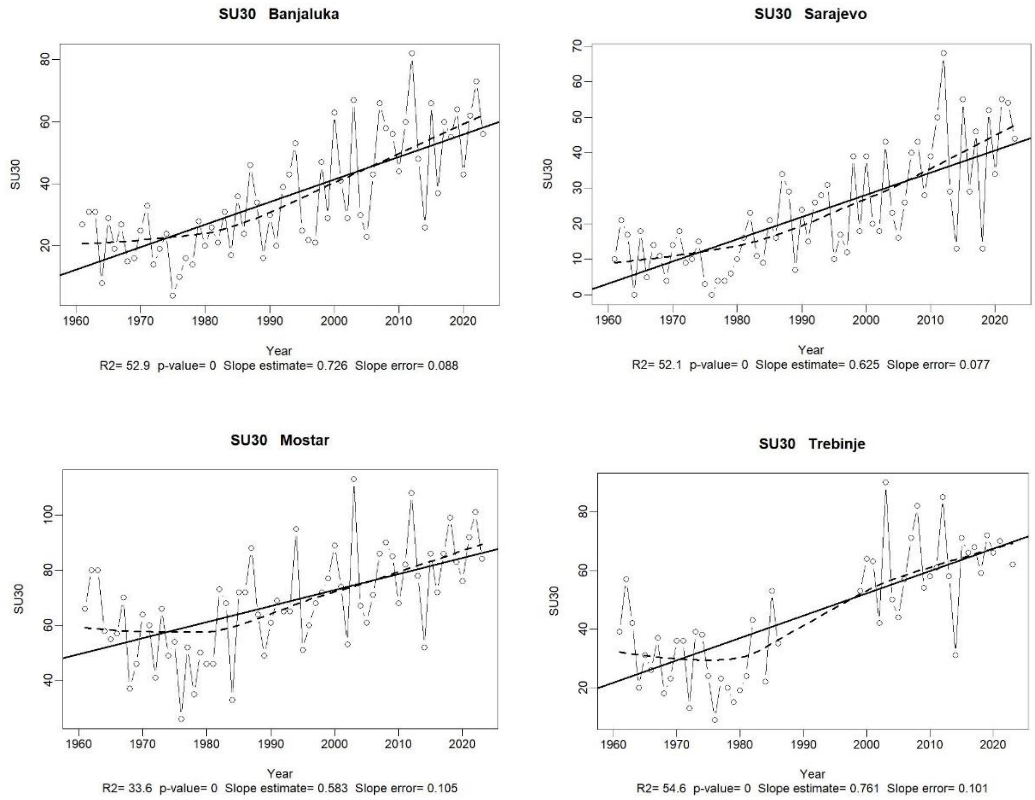



*Figure 11: Trend of the annual number of tropical days in the period 1961-2022 (in days)*

Among the ten years with the highest values for the annual number of tropical days in the period 1961-2012, almost all years are from the 21st century. There is also an increase in episodes with series of more than five tropical days.

#### 5.4.1.5 Tropical nights (TN20)

One of the elements of the change in the thermal regime is the increase in the number of tropical nights (TR 20 - the number of days in a year when the daily minimum temperature TN ≥ 20 ºC). In the period 1961-1990, tropical nights occurred several times a year in the northern lower regions of Bosnia and Herzegovina. In the same period, the occurrence of tropical nights was not recorded in the high-mountain regions. Tropical nights have a higher frequency of occurrence in the south, in low Herzegovina. In the period 1961-2022, a statistically significant positive trend in the number of tropical nights was recorded in Trebinje and Mostar (7 days per decade). The analysis of the deviation of the annual number of tropical nights in Trebinje from the average of the reference period 1961-1990 shows that after 1990 a below-average number of tropical nights was not recorded in any year. No year was in the < 25th percentile category. On the other hand, 13 years is to be found in the > category of the 75th percentile.

In recent years, tropical nights have become more frequent in the lower areas in the north of Bosnia and Herzegovina. For example, in Banja Luka, during the period 1961-1990, only 5 tropical nights were recorded, while as many as 113 were recorded after 1990. The highest number of tropical nights was recorded in 2012 (10), 2022 (8), 2010 (8), 2019 (8), 2017 (7), 2007 (6) and 2018 (6). The number of tropical nights in the period 1961-2022 increased in Banja Luka at a statistically significant rate of 1.1 days per decade. Also, since the beginning of the 21st century, tropical nights have been recorded in parts of BiH where they had not occurred before. For example, in Sokolac, no occurrence of tropical nights was recorded in the period 1961-1990, one tropical night was recordedin 2000, 2003 and 2007. Among the years with the highest number of tropical nights, the years after 1990 are dominant, and especially since the beginning of the 21st century.

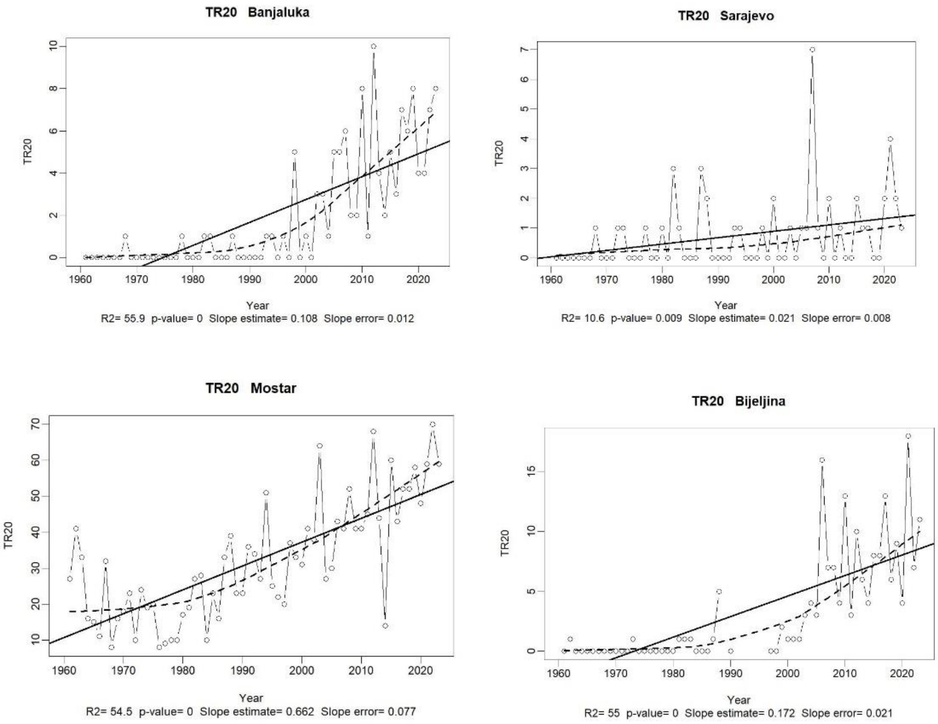
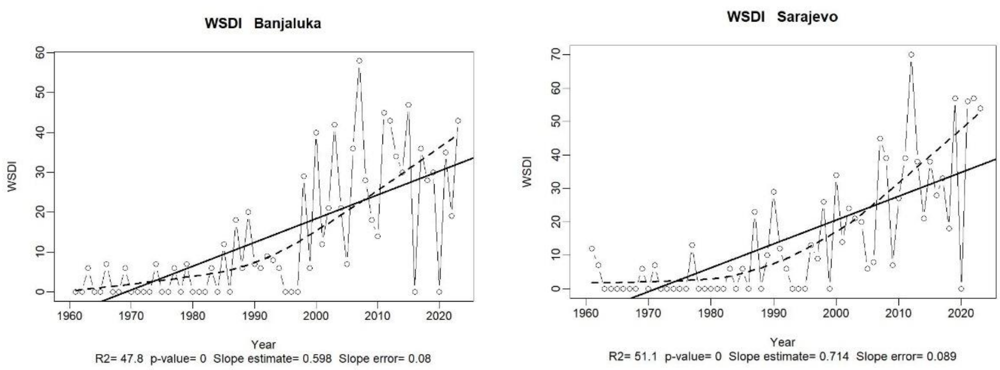



*Figure 12: Trend of the annual number of tropical nights in the period 1961-2022 (in days)*

#### 5.4.1.6 Warm Spell Duration

The Warm Spell Duration Index ( WSDI) is defined as the annual sum of the number of days that make up groups of at least six consecutive days with a maximum daily air temperature higher than the daily 90th percentile calculated for the period 1961-1990. The duration of warm days is increasing throughout BiH. In the period 1961-2022, statistically significant positive trends in the duration of warm days were found throughout the researched territory, which ranged from 4.2 days per decade in Bijeljina to 6.5 days per decade in Sokolac (6.0 days per decade in Banja Luka, 5.8 days per decade in Sarajevo, 5.7 days per decade in Mostar).



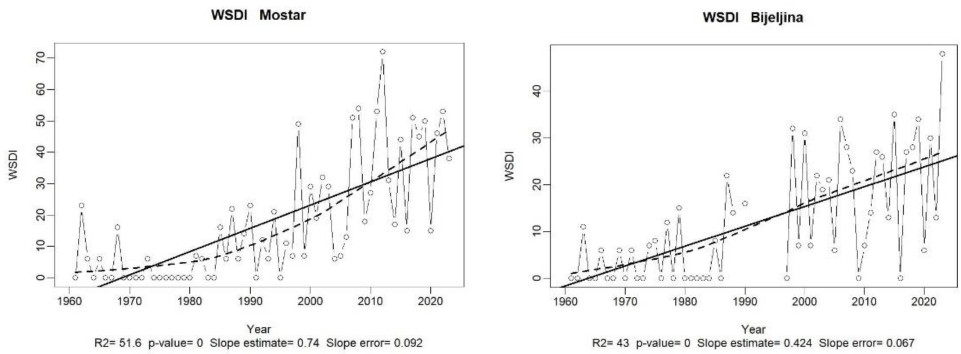



*Figure 13: Trend of annual duration of warm days (WSDI) in the period 1961-2022 (in days)*

The analysis of the deviation of the duration of warm days from the average of the reference period 1961-1990 shows that after 1990 the annual number of WSDI increased many times (as much as 4 to 7 times), which indicates more intense warming and an increase in the frequency of extremely high air temperatures. In this period, only a few years were recorded with WSDI values lower than the average of the reference period - mainly 2005, 2009, 2014, 2016 or 2020. These years are the only ones in the < 25th percentile category. On the other hand, after 1990, on average, every second year is in the category > the 75th percentile – for example, 16 years in Banja Luka (as many as 7 in the category > the 90th percentile). None of the years 1961-1990 were in this category.

#### 5.4.1.7 Mean value of precipitation (R)

Precipitation trends in the period 1961-2022 are regionally highly variable. A statistically significant positive trend of the average annual precipitation of 31.3 mm per decade was registered only in the area of Sokolac. Throughout Herzegovina, there is a non-significant decrease in annual precipitation - for example, in Bileća by 7.8 mm per decade and Trebinje by 30 mm per decade.

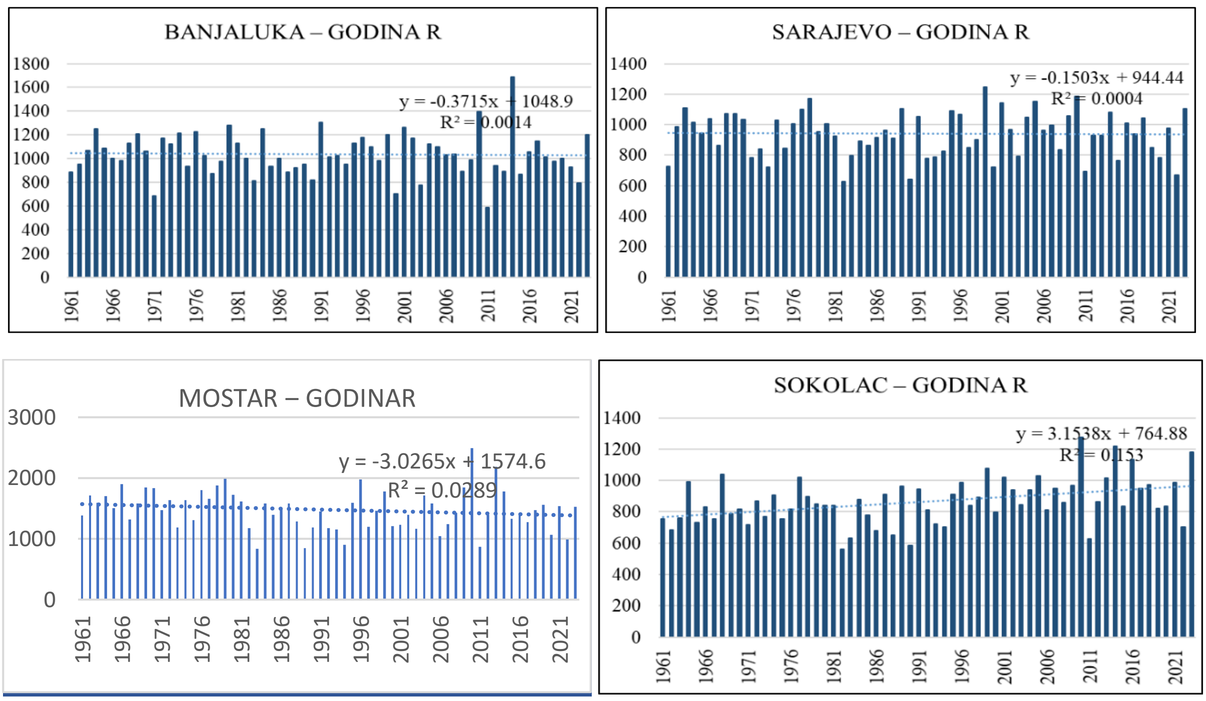


*Figure 14: Trend of mean annual precipitation in the period 1961-2022 (in mm)*

The analysis of the deviation of the average annual precipitation from the average in the standard climatological period (1961-1990) in the period 1961-2022 indicates an increase in interannual precipitation variability and an increase in the frequency of years with extreme precipitation, because the alternation of very wet years with intense floods is becoming more frequent and very dry years with the occurrence of drought: 1990/1991, 2000/2001, 2010/2011, 2013/2014/2015, 2020, 2021, 2022.

#### 5.4.1.8 Maximum one-day precipitation (RX1day)

Maximum one-day precipitation (RX1day) is the maximum daily amount of precipitation in a year. The maximum daily precipitation recorded at the analysed stations is 212 mm, and it was measured in Bileća on September 25, 1984. Maximum daily precipitation in the northern part of the territory was measured in Banja Luka on 24 July 1976 (156.5 mm) and Bijeljina on 23 July 1977 (101.2 mm). In Sokolac, the maximum was measured in October 2003 and November 2021 (114.2 mm). In the period 1961-2022, there was an insignificant positive trend of maximum daily precipitation in most areas (except in Trebinje and Čemerno, where slight negative rates were recorded).

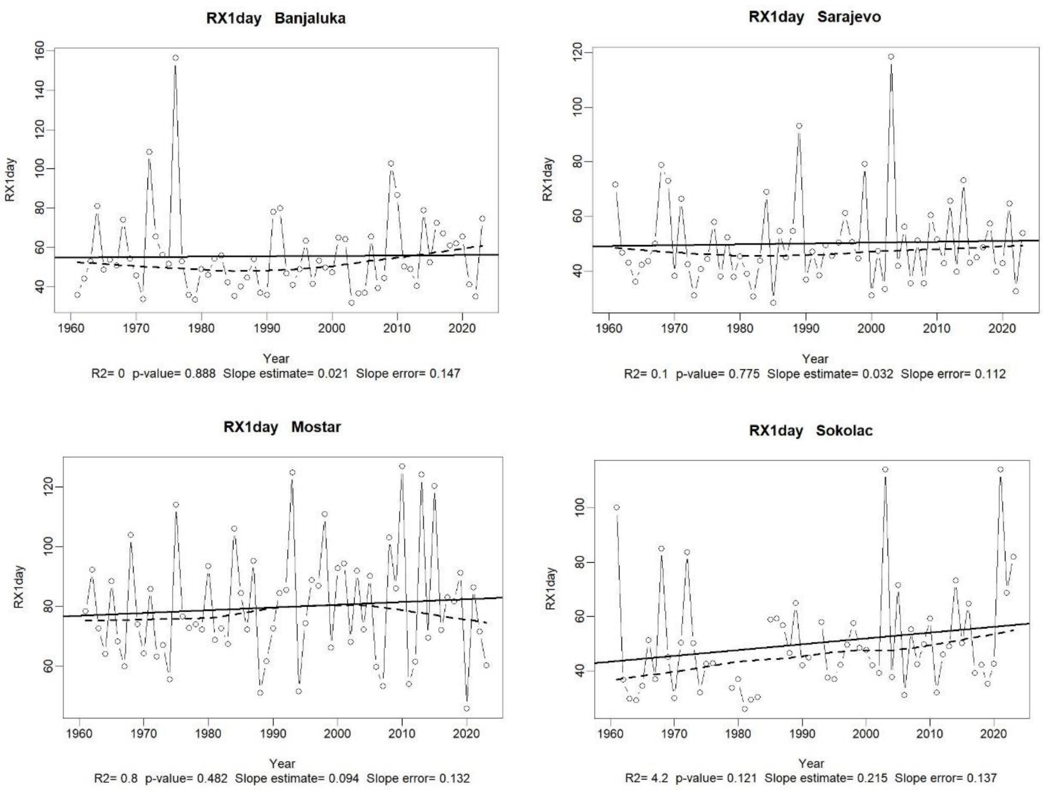



*Figure 15: Trend of maximum one-day precipitation (RX1day) in the period 1961-2022 (in mm)*

#### 5.4.1.9 Maximum five-day precipitation (RX5day)

The maximum five-day precipitation is defined as the annual maximum precipitation for five consecutive days with precipitation. The highest five-day precipitation totals at most stations were recorded after 1990 - in Banja Luka in 1992, Doboj in 2010, Sarajevo in 2014 (catastrophic floods in the Bosna River basin), Sokolac in 2021, and in Trebinje in 1985. In the period 1961-2022, positive trends of the largest five-day precipitation totals were recorded at all analysed stations (statistically significant for the Doboj area - 5.0 mm per decade).

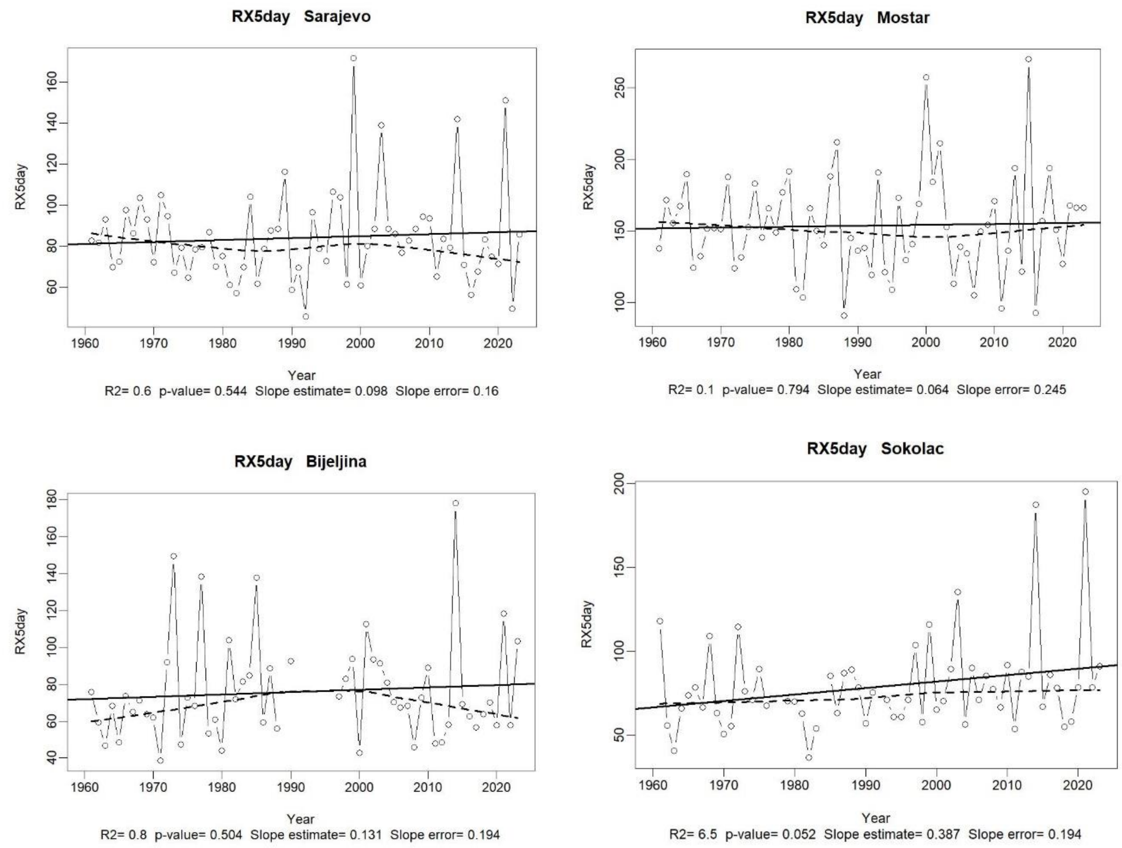



*Figure 16: Trend of maximum five-day precipitation (RX5day) in the period 1961-2022 (in mm)*

#### 5.4.1.10 Number of snow days

The number of days with snow cover at the observed meteorological stations ranges from 36.9 days in Bijeljina to 195.1 days in Bjelašnica. In the northern part of Bosnia and Herzegovina, the number of days with snow cover ranges from 36.9 days in Bijeljina, 37.3 days in Doboj, 47.5 days in Banja Luka, to 44.7 days in Sanski Most. The number of days with snow cover in the central part of BiH ranges from 63.4 days in Sarajevo, 85.7 days in Sokolac, 91.9 days in Ivan Sedlo and 195.1 days in Bjelašnica. The average number of days with snow cover in Livno is 48.7, and in Čemerno 102.7. The occurrence of such days is most common in the period between December and March, while as a rule, their occurrence is mostly absent during the summer months.

In the period 1961-2022, negative trends in the number of days with snowcover were determinedat all analysed stations. The most significant negative (< 0.01) trends were identified in Čemerno, Sokolac, Bijeljina, Doboj, Banja Luka and Sanski Most. Statistically significant (< 0.05) negative trends were also found in Livno and Ivan Sedlo. The largest decrease in the number of days with snowcover was observed in Čemerno, followed by Doboj and Sokolac, where the number decreased along the trend line by as much as 10.3 days per decade, 6.4 days per decade and 5.6 days per decade, respectively. Insignificant negative trends in the number of days with snow cover were also recorded in Bjelašnica (2.5 days per decade) and in Sarajevo (1.7 days per decade).

### 5.4.2. Expected climate change according to the climate scenarios RCP 4.5 and RCP 8.5

BiH is very exposed to climatic influences, where the increase in air temperature and intense precipitation is particularly distinguished, and the decrease in snowfall, but days with total precipitation. These trends are leading to more frequent and intense occurrences of floods and droughts. The report presents the results of future climate projections for BiH, based on different scenarios of future GHG concentrations. Climate change is taking place very intensely and it is already evident that the planning and design of adaptation measures should be based on the most extreme climate scenarios.

The report will show changes in climate elements and indices according to the IPCC climate scenarios RCP4.5 and RCP8.5. The expected changes in mean air temperature and precipitation on an annual and seasonal basis (December-January-February (DJF), March-April-May (MAM), June-July-August (JJA) and September-October-December (SON) were analysed. In addition to these results, changes in selected climate indices are also presented, as indicators of possible changes in the intensity and frequency of extreme weather and climate events, which can cause negative consequences in the functioning of natural ecosystems and various socio-economic sectors, such as agriculture, forestry, water resources, human health, biodiversity, ecosystem services, etc. All future changes are shown for the period from 2016 to 2100, compared to the reference climate period 1986-2005, which was used as a reference in the latest Fifth Report of the Intergovernmental Panel on Climate Change. A special focus will be placed on three future twenty-year periods, *the near future* period 2016-2035, *the mid-twenty-first century* 2046-2065 and *the end of the twenty-first century* 2081-2100.

#### 5.4.2.1 Projections of future climate-regional models

The results of the regional climate models are taken from the EURO-CORDEX database[94], which is the reference database of climate projections for Europe, and which has been the basis for many studies on climate change in Europe in recent years. This database is also the basis for the *Copernicus Climate Change Service* of the European Union, which is dedicated to climate change, risk assessment and adaptation to climate change[95]. The horizontal resolution of the downloaded data is 11 km, which allows spatial changes (maps) of appropriate climatic magnitudes to be displayed. Also, the so-called *Bias-adjusted* data, i.e. data from which systematic deviations that are present in the results of the model have been removed. Data from which the systematic deviation has been removed allows the assessment in future projections of the selected climate indices to be more reliable compared to the situation when data from which the systematic deviation has not been removed are used. Seven representative models for the two climate scenarios RCP4.5 and RCP8.5 were taken from this database.

The following regional models were used in the report: CCLM4-8-17_v1 (CNRM-CM5 r1i1p1), CCLM4-8-17_v1 (EC-EARTH r12i1p1), RACMO22E_v1 (EC-EARTH r1i1p1), RCA4_v1 (CM5A-MR r1i1p1), CCLM4-8-17_v1 (MPI-ESM-LR r1i1p1), REMO2009_v1 (MPI-ESM-LR r1i1p1) and REMO2009_v1 (MPI-ESM-LR r2i1p1).

**(a) Air Temperature**

Expected changes in air temperature according to the climate scenario **RCP4.5** are presented for three future periods 2016-2035, 2046-2065 and 2081-2100, compared to the reference period 1986-2005, on an annual basis (YEAR/GOD.) and for four seasons DJF, MAM, JJA and SON. According to the

[94] https://www.euro-cordex.net/
[95] https://climate.copernicus.eu/

presented results for the RCP4.5 scenario, the changes in all three temperatures for the first period, the near future, range from 0.5 to 1.0 °C, the smallest change is for the DJF season, while the changes for the other seasons and for the annual averages are approximately similar. For the second analysed period, mid-century, 2046-2065, the changes range from 1 to 2°C. For the last period, 2081-2100 temperature rise ranges from 1.5 to 2.5°C, for all seasons. Also on some of the panels it is noticeable that temperature changes are greater in mountainous areas.

For the **RCP8.5 climate scenario,** the changes in mean air temperature are shown in Figure 18 for the three future periods 2016-2035, 2046-2065 and 2081-2100, compared to the reference period 1986-2005, on an annual basis (YEAR/GOD.) and for the four seasons of DJF, MAM, JJA and SON. According to the presented results for the RCP8.5 scenario, the temperature changes for the first period, the near future, range from 0.5 to 1.5 °C, the smallest change is for the DJF season, while the change for the other seasons and for the annual averages are approximately similar. For the second analysed period, mid-century, 2046-2065, the changes range from 1.5 to 3 °C. For the last period, 2081-2100, the temperature increase ranges from 2.5 to 5 °C, for all seasons, among which the increase in daily temperatures for the SE season stands out, when the temperature increase in most of the country is greater than 5 °C. Similar to the RCP4.5 scenario, the general characteristic of temperature change is that the largest increase in terms of seasons is for the JJA season. It is also noticeable on some of the panels that temperature changes are greater in mountainous areas, which is clearly noticeable in the case of changes for the last analysed period 2018-2100. The spring season (MAM) has the least deviation.

Changes in air temperatures in BiH are taking place very quickly and the expected value of changes by 2035 has already been achieved in the total territory. Temperature changes in major urban centers (Sarajevo and Banja Luka) already have the value that was expected in the middle of this century according to the most extreme scenario RCP8.5. This suggests that the definition of measures and activities related to adaptation to climate change must be planned according to the RCP8.5 climate scenario.

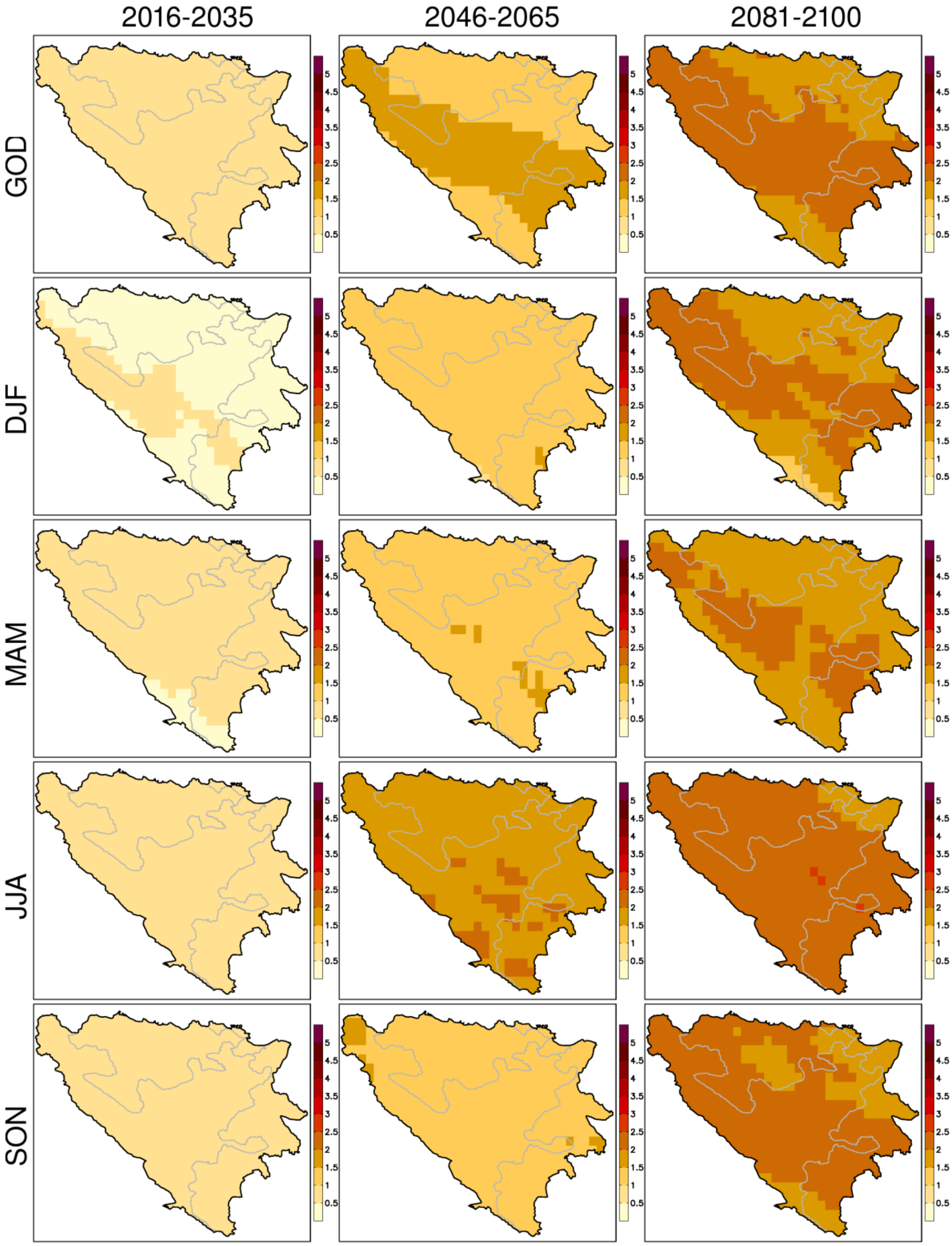



*Figure 17: Expected changes in mean temperature (in °C) compared to the reference period 1986-2005, for the RCP4.5 scenario, on an annual basis (YEAR/GOD.) and for the seasons DJF, MAM, JJA and SON, for the three selected future periods 2016-2035, 2046-2065 and 2081-2100.*



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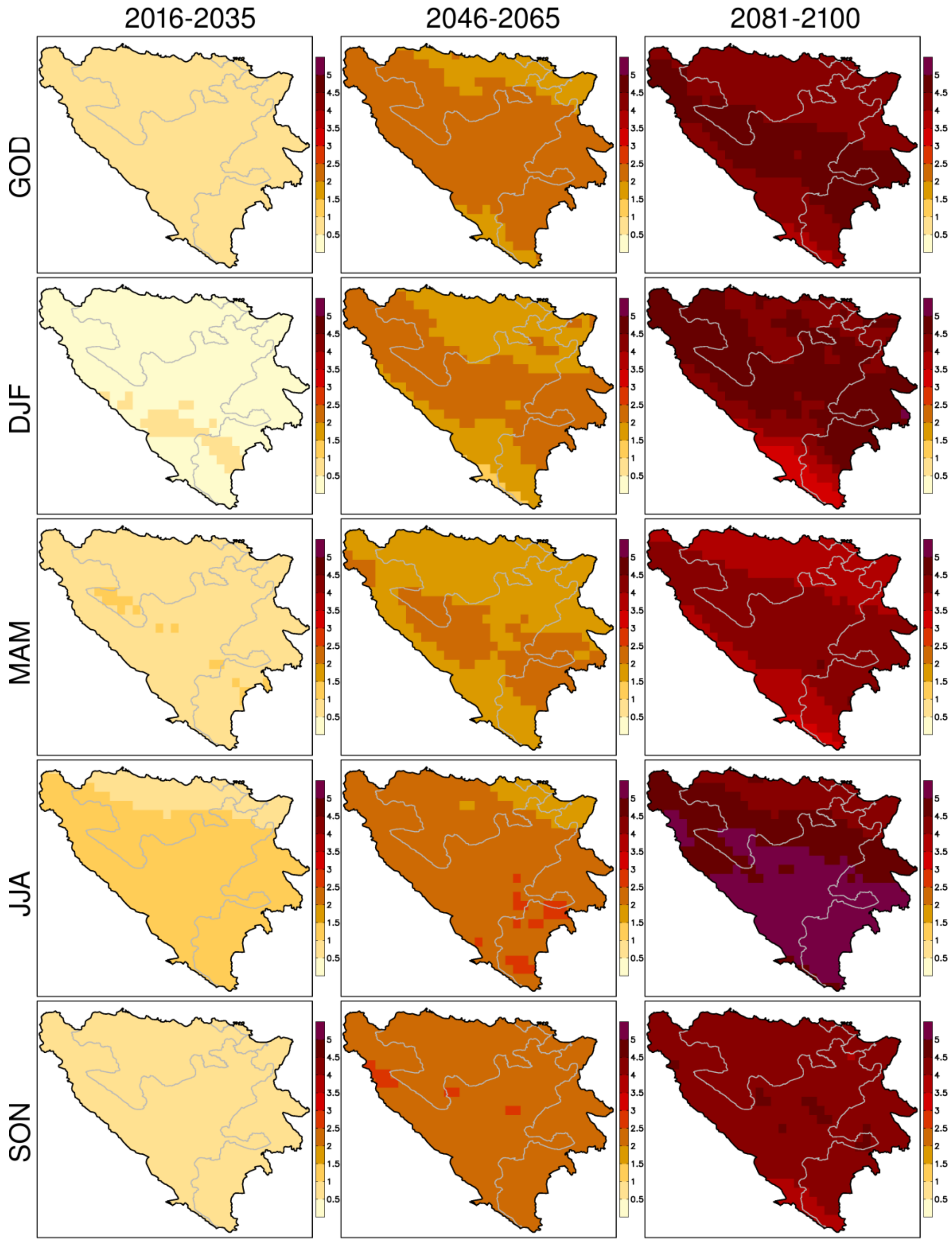


*Figure 18: Change in mean temperature (in °C) compared to the reference period 1986-2005, for the RCP8.5 scenario, on an annual basis (YEAR/GOD.) and for the seasons DJF, MAM, JJA and SON, for the three selected future periods 2016-2035, 2046-2065 and 2081-2100.*



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### (b) Precipitation

The changes in accumulated precipitation for the climate scenarios RCP4.5 and RCP8.5 are shown in the following figures for the three future periods 2016-2035, 2046-2065 and 2081-2100, compared to the reference period 1986-2005, on an annual basis (YEAR/GOD.) and for the four seasons DJF, MAM, JJA and SON. In the case of the RCP4.5 scenario, the change in precipitation for the last analysed period 2081-2100 is negative, while in the case of the RCP8.5 scenario, the expected change is less than -10% in certain parts of BiH. Also, the RCP4.5 and RCP8.5 scenarios are characterised by being the season with the highest precipitation loss. This is especially pronounced for the RCP8.5 climate scenario, which is expected to reduce precipitation by up to -30% in the south of the country during the last period. This deficit of summer precipitation is obviously the main contributor to the negative change in total precipitation on an annual basis. A common characteristic for both scenarios is that for all three analyzed periods, the DJF season has a positive change in precipitation, in the largest part of the territory of BiH, and that it is most pronounced for the last analysed period and scenario RCP8.5. For the remaining two seasons, the change in precipitation is variable and is usually in the range of -10 to 10%, depending on the season and the part of the country. For the MAM season, another common characteristic that is consistent for both scenarios and all periods is that the southern parts of the country generally have negative changes, while the northern parts have positive ones, indicating that the southern parts will be more likely to have a precipitation deficit during this season.

The largest positive changes for the RCP4.5 scenario for the period 2016-2035 can be expected in most of the territory of BiH in March, April, June, November and December, while the largest deficits can be expected in July, August and September.



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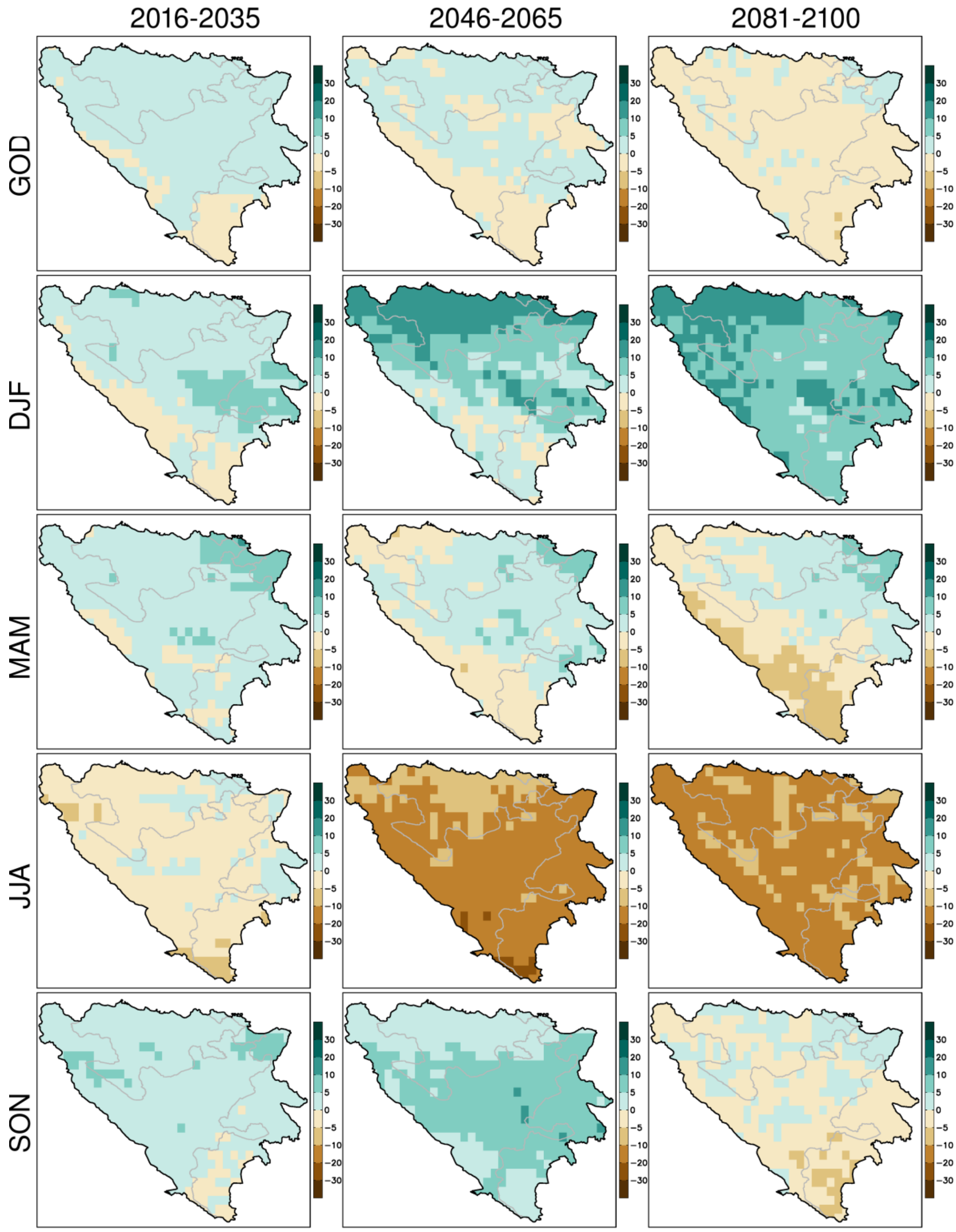


*Figure 19: Expected changes in accumulated precipitation (in %) compared to the reference period 1986-2005, for the RCP4.5 scenario, on an annual basis (YEAR/GOD.) and for the seasons DJF, MAM, JJA and SON, for the three selected future periods 2016-2035, 2046-2065 and 2081-2100*

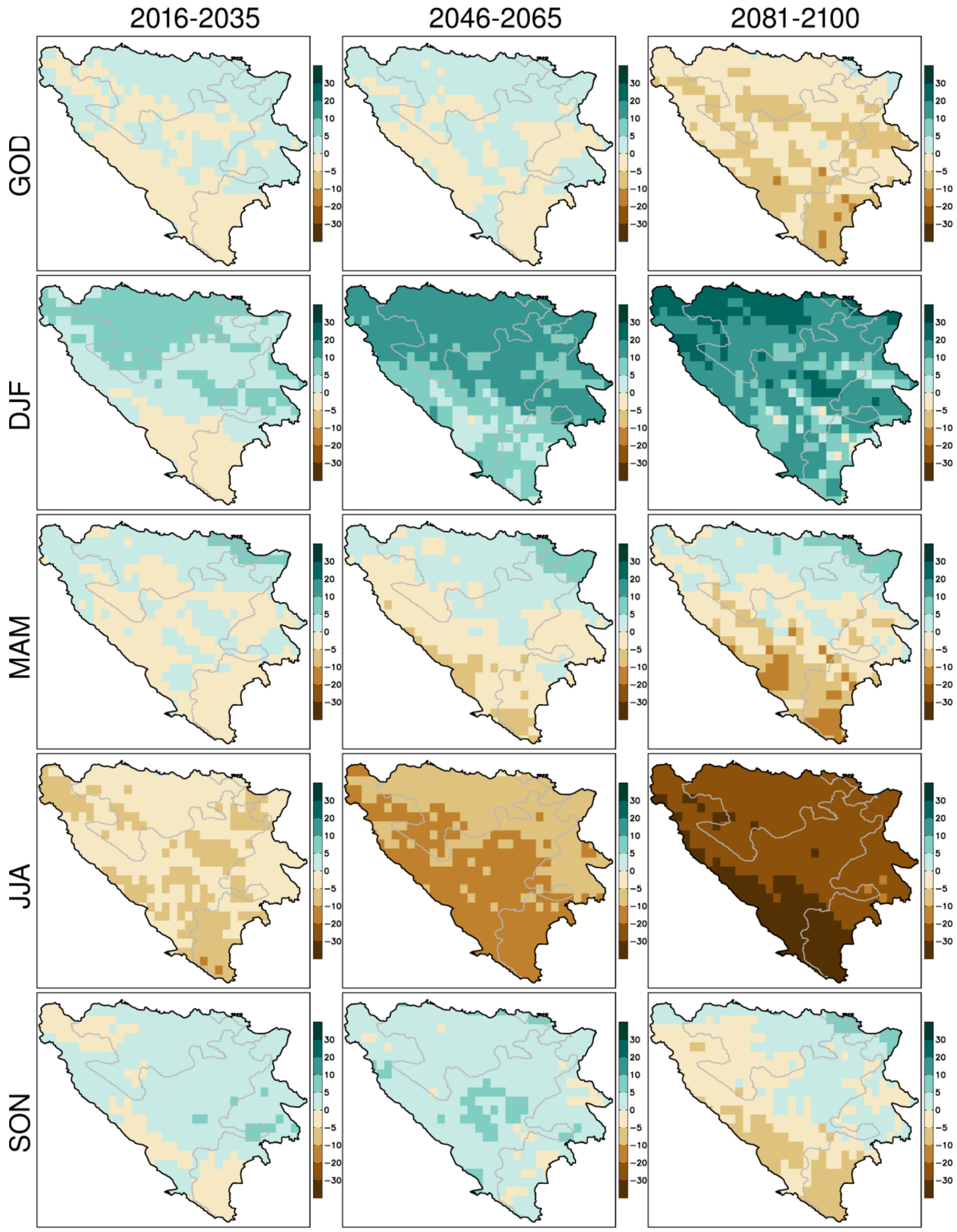


*Figure 20: Expected changes in accumulated precipitation (in %) compared to the reference period 1986-2005, for the RCP4.5 scenario, on an annual basis (YEAR/GOD.) and for the seasons DJF, MAM, JJA and SON, for the three selected future periods 2016-2035, 2046-2065 and 2081-2100.*



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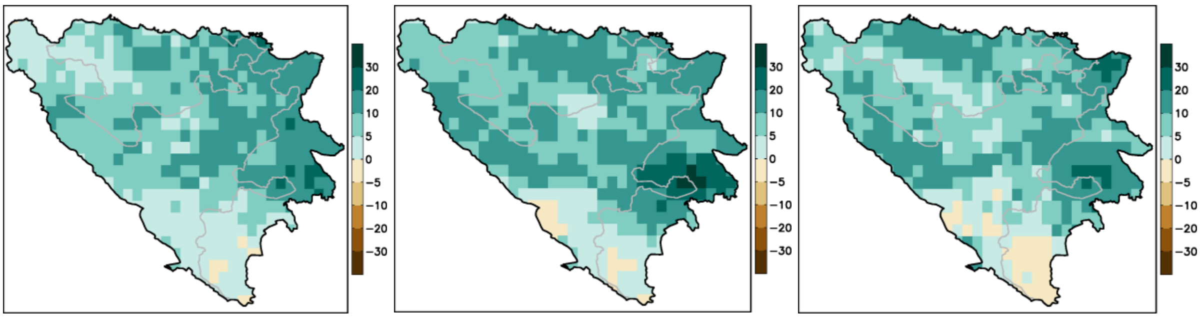
## (c) Climate indices

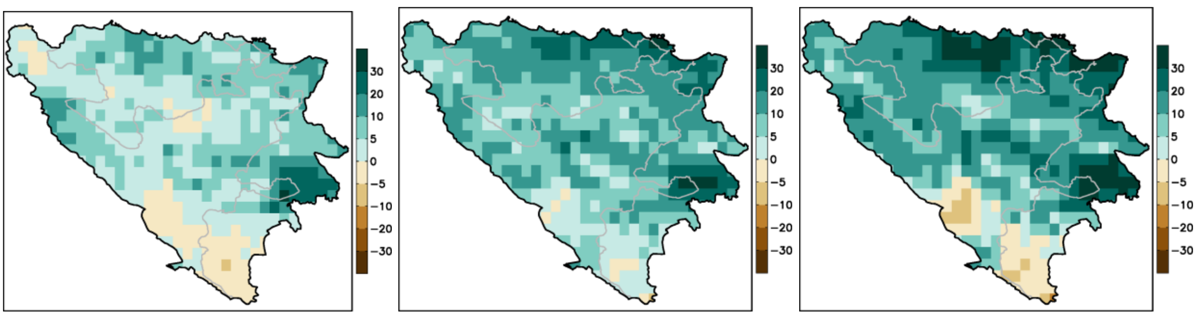
**Intense precipitation r20mm**

The following figures show possible future changes in the number of days with precipitation greater than 20 mm, compared to the reference period 1986-2005 for two climate scenarios, RCP4.5 and RCP8.5, and three future periods, 2016-2035, 2046-2065 and 2081-2100. An increase in the number of days with precipitation of more than 20 mm can be expected under both climate scenarios. The changes are similar for both scenarios and all three periods and in the territory of BiH they range up to +5 to +20% (in most of the territory where the changes are positive) and mostly up to -5% (in the parts where the change is negative). Only in the case of the RCP8.5 scenario, for the time period 2081-2100 this change is somewhat more pronounced in most of the territory and is up to +20%, and in some smaller areas, in the north and east of the country, over +30%. An increase in such precipitation may cause more frequent and intense occurrence of fluvial, torrential and urban floods in the future.




**2016-2035** **2036-2045** **2081-2100**

*Figure 21: Expected changes in intense precipitation of 20 mm (in %) compared to the reference period 1986-2005, for scenario RCP4.5, on an annual basis (YEAR/GOD.) for the three selected future periods 2016-2035, 2046-2065 and 2081-2100.*

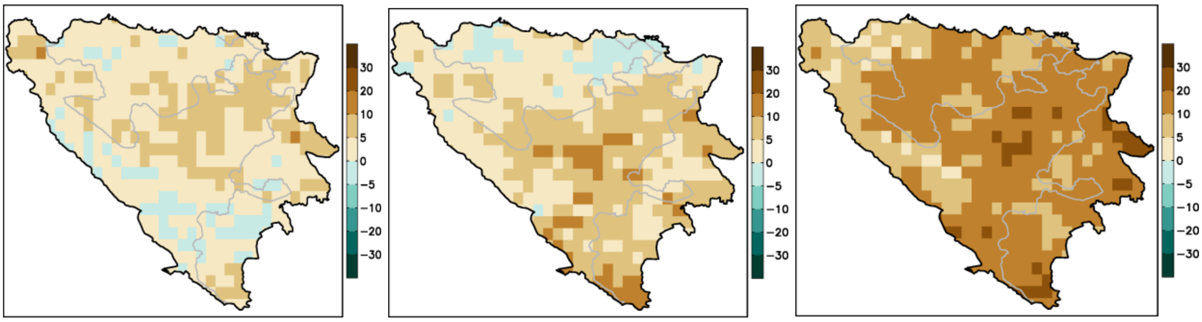



**2016-2035** **2036-2045** **2081-2100**

*Figure 22: Expected changes in intense precipitation of 20 mm (in %) compared to the reference period 1986-2005, for scenario RCP8.5, on an annual basis (YEAR/GOD.) for the three selected future periods 2016-2035, 2046-2065 and 2081-2100.*

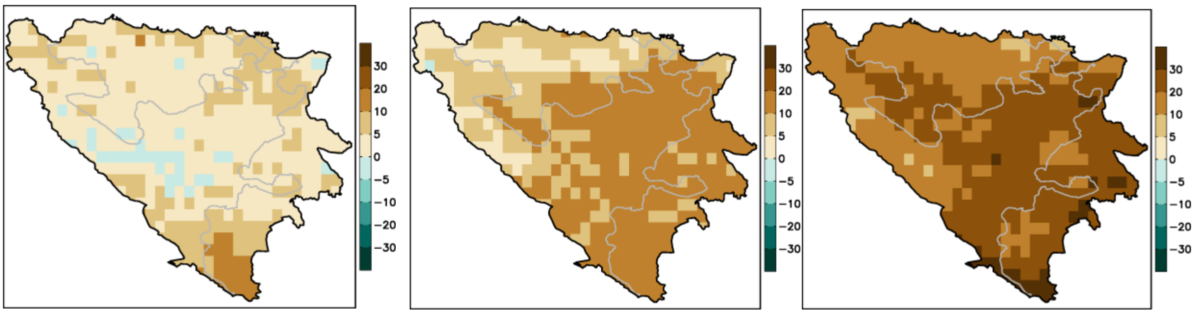
**Days without precipitation (dry days cdd)**

According to the RCP4.5 and RCP8.5 climate scenarios, an increase in the number of consecutive days without precipitation (dry days) can be expected. As can be seen from the pictures, by the end of this century, according to both climate scenarios, the number of consecutive dry days will mostly increase, with the exception of some smaller parts of the territory of BiH. For the period of the near future, the change according to both scenarios is in the largest part of the territory from 0 to 5 days. In the case of the RCP4.5 scenario for the period 2046-2065, this change is 5 to 10 days higher in most of the territory, while for this scenario and the last time period, an increase of 10 to 20 days is expected. Finally, for the RCP8.5 scenario, the change in consecutive dry days increases significantly for further time horizons and for the period 2046-2065, and amounts to 10 to 20 more on these days, while for the last period the change is the most pronounced and amounts to 20 to 30 more these days, in most of the country's territory. The biggest changes can be expected in the far south of Herzegovina, central Podrinje and in the northeast of the country.




**2016-2035** **2036-2045** **2081-2100**

*Figure 23: Expected changes in precipitation-free days (CDD) compared to the reference period 1986-2005, for scenario RCP4.5, on an annual basis (YEAR/GOD.) for the three selected future periods 2016-2035, 2046-2065 and 2081-2100.*

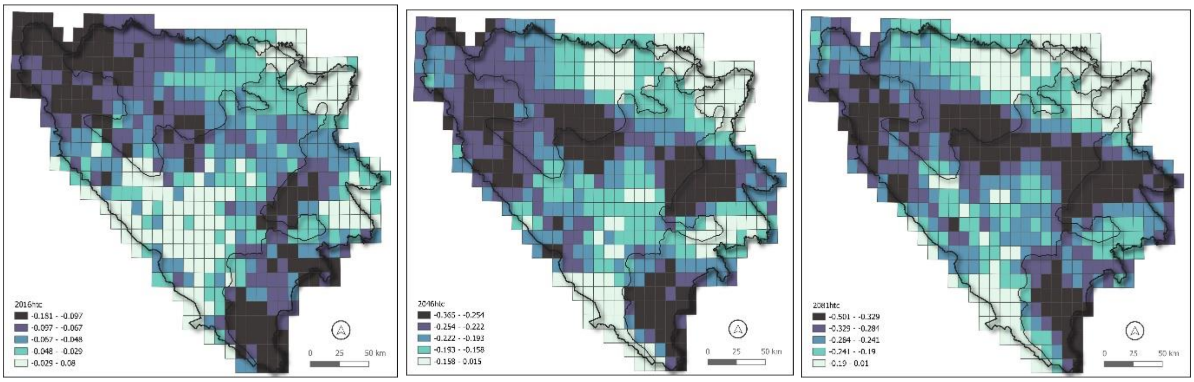



**2016-2035** **2036-2045** **2081-2100**

*Figure 24*: *Expected changes in precipitation-free days (CDD) compared to the reference period 1986-2005, for scenario RCP8.5, on an annual basis (YEAR/GOD.) for the three selected future periods 2016-2035, 2046-2065 and 2081-2100.*

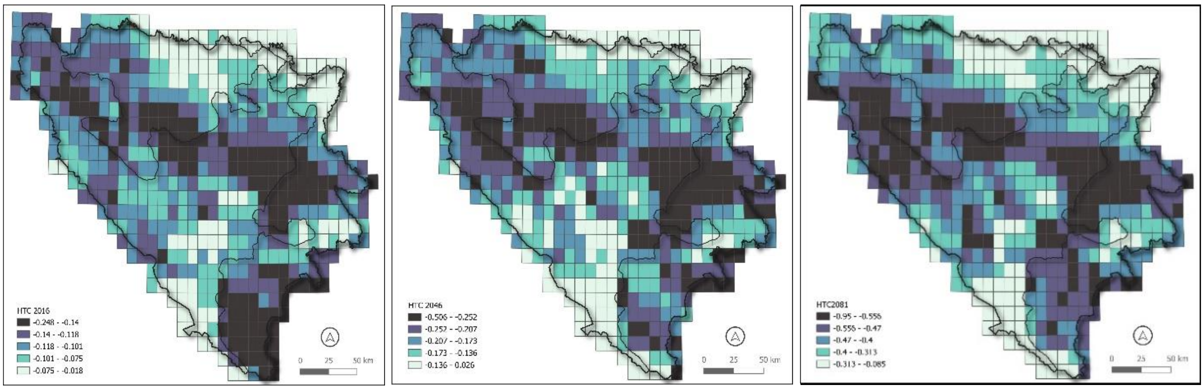
**Hydrothermal coefficient (HTC)**

The Selyaninov hydrothermal coefficient is calculated based on a series of values of mean daily temperatures and daily precipitation accumulations for a selected location and over a selected period of time. The values of the HTC coefficient can be linked to annual grain yields, while its future changes may indicate the degree of vulnerability of the agricultural sector to future changed climatic conditions. The Selyaninov Hydrothermal Coefficient (HTK) is a very commonly used index for estimating the aridity of a region during the warmer part of the year, i.e. from April to September. HTC values below 1 indicate "dry" and below "0.5" indicate extremely dry. On the other hand, values over 1.5 indicate "wet" and over 3.0 indicate "extremely humid". The following figures show possible future changes in the HTC index, compared to the reference period 1986-2005 for two climate scenarios, RCP4.5 and RCP8.5, and three periods in the future, 2016-2035, 2046-2065 and 2081-2100. According to the HTC index, a significant increase in aridity can be expected, especially in the area of southern Herzegovina, the central mountain area and the Podrinje region.



**2016-2035** **2036-2045** **2081-2100**

*Figure 25: Expected changes in the hydrothermal coefficient (htc) for the RCP4.5 scenario, on an annual basis (YEAR/GOD.)*

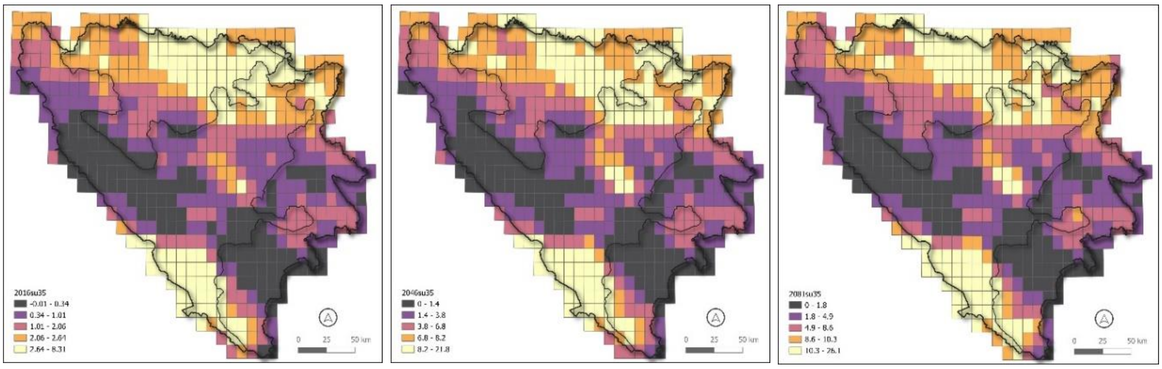


**2016-2035** **2036-2045** **2081-2100**

*Figure 26: Expected changes in the hydrothermal coefficient (htc) compared to the reference period 1986-2005, for the RCP8.5 scenario, on an annual basis (YEAR/GOD.) for the three selected future periods 2016-2035, 2046-2065 and 2081-2100.*

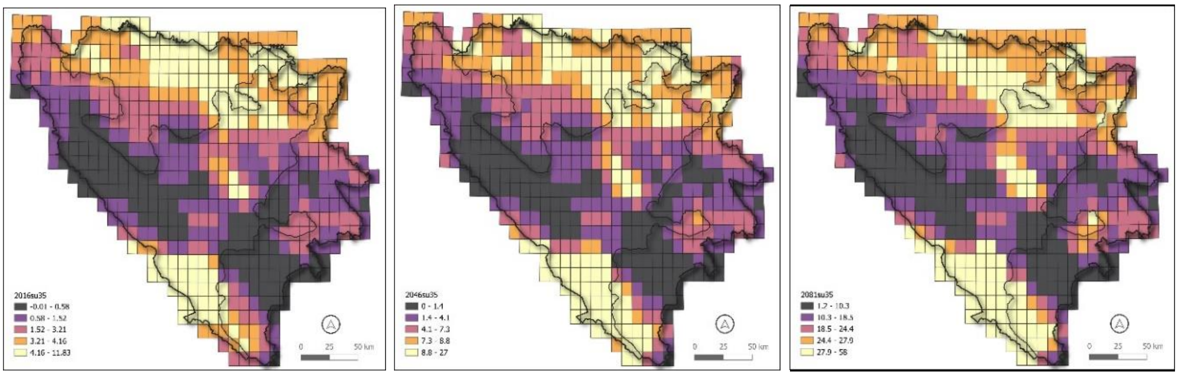
**Heatwaves – tropical days (tx35)**

The following figures show possible future changes in the number of heatwaves expressed over tropical days greater than 35 °C compared to the reference period 1986-2005 for the three climate scenarios RCP8.5, RCP4.5 and RCP2.6 and the three future periods, 2016-2035, 2046-2065 and 2081-2100. As you can see from the figure, by the end of this century, according to both climate scenarios, the number of such tropical days will increase. For the near future, the change according to both scenarios ranges from 0.5 to 11.8. The biggest changes are expected in the north, northeast and in the area of Low Herzegovina. In the case of the RCP4.5 scenario for the period 2036-2045, this change is 8.2 to 21.6 days, while for this scenario and the last time period, the change is up to 26.1 days. For the RCP8.5 scenario, the change in the number of tropical days increases significantly for further time horizons and for the period 2045-2065 it is 8.8 to 27 days, while for the last period the change is the most pronounced and amounts to 27.9 to 58 days. The largest increase is expected in the vicinity of Banja Luka, Doboj, BD BiH, Tuzla, Mostar and Trebinje.




*2016-2035* *2036-2045* *2081-2100*

*Figure 27: Expected changes in the number of tropical days (tx35) compared to the reference period 1986-2005, for scenario RCP4.5, on an annual basis (YEAR/GOD.)*

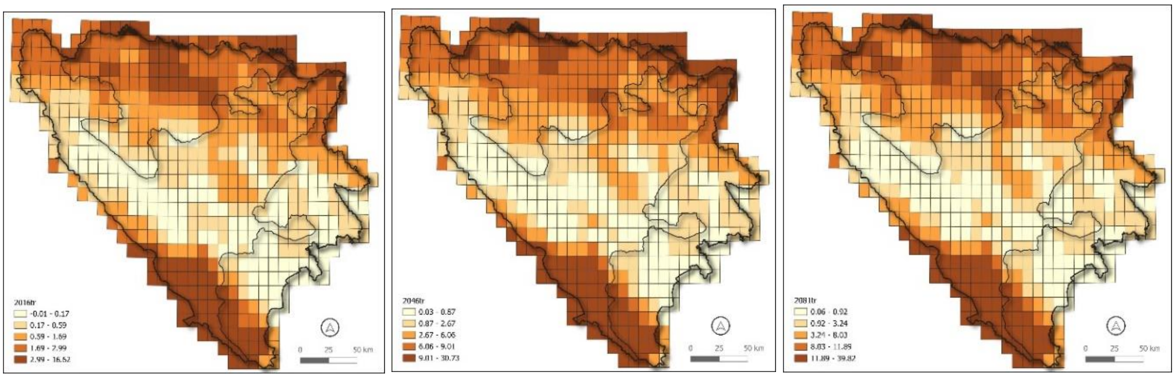



**2016-2035** **2036-2045** **2081-2100**

*Figure 28: Expected changes in the number of tropical days (tx35) compared to the reference period 1986-2005, for scenario RCP8.5, on an annual basis (YEAR/GOD.)*

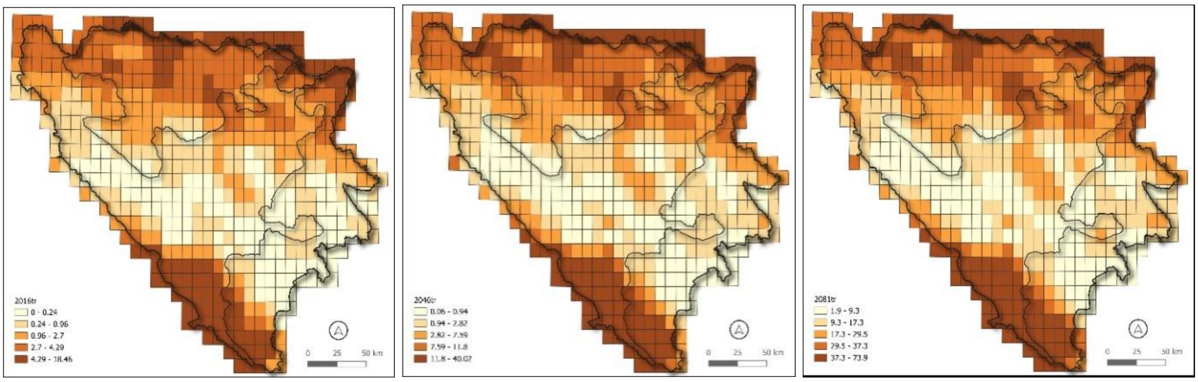
**Tropical nights (tr20)**

The following figures show possible future changes in the number of tropical nights (on a tropical night, the air temperature does not drop below 20°C compared to the reference period 1986-2005 for the three climate scenarios RCP8.5, RCP4.5 and RCP2.6 and three periods in the future, 2016-2035, 2046-2065 and 2081-2100). By the end of this century, according to both climate scenarios, the number of tropical nights will increase. For the near future, the change according to both scenarios ranges from 0 to 18.4. The biggest changes are expected in Banja Luka, Bijeljina, Mostar and Trebinje. In the case of scenario RCP4.5, for the period 2036-2045 this change is 0.2 to 30.7 days, while for this scenario and the last time period the change is up to 39.8 days. For RCP8.5, the change in the number of tropical days increases significantly for further time horizons and for the period 2045-2065 it is 0.68 to 40 days, while for the last period the change is the most pronounced and amounts to 1.9 to 73.9 days. The largest increase is expected in the vicinity of Banja Luka, Doboj, Bihać, Mostar and Trebinje.



**2016-2035** **2036-2045** **2081-2100**

*Figure 29: Expected changes in the number of tropical nights (tr20) compared to the reference period 1986-2005, for the RCP4.5 scenario, on an annual basis (YEAR/GOD.)*



**2016-2035** **2036-2045** **2081-2100**

*Figure 30: Expected changes in the number of tropical nights (tr20) compared to the reference period 1986-2005, for scenario RCP8.5, on an annual basis (YEAR/GOD.)*

*Table 22: Overview table of changes in climate hazards for climate scenarios RCP4.5 and horizons 2016-2035 and 2046-2065 compared to the period 1986-2005.*

| **Climate scenario** / **Climate hazard** | **RCP4.5** (2016-2035) | **RCP4.5** (2046-2065) | **RCP8.5** (2016-2035) | **RCP8.5** (2046-2065) |
|---|---|---|---|---|
| **Heat surplus** | Med.annual t.: **+0.5 do +1.0ºC**<br>Summer (JJA): **+0.5 do +1.0ºC**<br>Heat waves - years:**+2**<br>Warm days (over 35 ºC)**:**<br>**+0,5 do +11,8**<br>Tropical nights: **0 to +18,4** | Med.annual t.:**+1.0 do +2.0ºC**<br>Summer (JJA): **+0.5-+1.0ºC**<br>Heat waves - years**:+3**<br>Warm days (over 35 ºC):<br>**+8,2-+21,6**<br>Tropical nights: +**0.2 to +30,7** | Med.annual t.:**+0.5-+1.5ºC**<br>Summer (JJA): **+1.0-+2.0ºC**<br>Heat waves - years**:+3**<br>Warm days (over 35 ºC):<br>**+0,5-+11,8**<br>Tropical nights: **0 to +18,4** | Med.annual t.:**+1.5-+3.0ºC**<br>Summer (JJA): **+1.5-+3.5ºC**<br>Heat waves - years**:+4**<br>Warm days (over 35 ºC):<br>**+8,8-+27**<br>Tropical nights: **0.7 to +40** |
| | It is expected to increase the historical records of absolute maximum temperatures, increase heat stress from high temperatures, decrease in the frequency of cold waves, frost and frost days, decrease in the number of days with the appearance of snow and the duration of snow cover. | | | |
| **Water surplus** | R20mm: **+5 to +20%** | R20mm: **+10 to +30%** | R20mm: **+5 to +20%** | R20mm: **+10 to +30%** |
| | Increase in intense precipitation r20mm that can cause fluvial, urban and torrential floods (highest probability of occurrence in spring (northern part) and autumn (southern part) | | | |



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| | | | | |
|---|---|---|---|---|
| **Water deficit** | Reduction in precipitation during the summer (JJA): **-5% to 10%**<br>Reduction of the number of days with precipitation: **0 to 5 days**<br>HTC Value: **0 to -0.2** | Reduction in precipitation during the summer (JJA): **-10 do 20%**<br>Reduction of the number of days with precipitation: **5 to 10 days**<br>HTC value: **from -0.1 to -0.4** | Reduction in precipitation during the summer (JJA): **-5% do 10%**<br>Reduction of the number of days with precipitation: **0 to 5 days**<br>HTC value: **from 0 to -0.2** | Reduction in precipitation during the summer (JJA): **-10 do 20%**<br>Reduction of the number of days with precipitation: **5 to 10 days**<br>HTC value: **from -0.1 to -0.5** |
| | Increase in water deficit in the summer months, occurrence of drought during each year (occurrence of extreme drought 3 times per decade), decrease in river flow during summer, increase in the risk of land degradation and decrease in humus and organic matter due to droughts, increase in the risk of fires. | | | |

## 5.5. Loss and Damage Assessment

### 5.5.1. Basic Information about Loss and Damage

Loss and damage are a key challenge in managing the impacts of climate change, especially in sectors that are highly vulnerable to climate change. In BiH, the economic and social consequences of damage to natural resources, infrastructure and production capacities require a systemic approach to reduce vulnerability and improve the resilience of society and the economy.

Bosnia and Herzegovina, a country located in Southeast Europe, is exposed to numerous natural hazards due to its geographic location and climate characteristics. These hazards include floods, landslides, earthquakes, and extreme events such as wildfires and heatwaves[96]. The latest climate research in BiH indicates an increased frequency and intensity of extreme weather events in the southern, northern and northwestern parts of the country, which poses a significant risk to the development and well-being of the country[97]. According to data from the World Bank's Climate Change Knowledge Portal[98], which analysed the average annual frequency of natural disasters in BiH in the period 1990 – 2020, the dominant natural disaster is floods, with 72.73% of the average annual frequency in the mentioned period. The average annual frequency of floods and other natural disasters in the period 1990 – 2020 is shown below.

*Table 23: Average annual incidence of natural disasters in the period 1990 - 2020[99].*

| Natural disaster | Average annual frequency in the period 1990 – 2020 |
|---|---|
| **Floods** | 72.73% |
| **Storm** | 9.09% |
| **Drought** | 9.09% |
| **Landslides** | 4.55% |
| **Epidemic** | 4.55% |

The data indicate that floods are by far the most common natural disaster in BiH, accounting for almost three-quarters of all recorded events. Storms and droughts were recorded with an annual frequency of 9.09% each, while landslides and epidemics were less frequent, with 4.55% each, but still pose relevant risks for individual regions and sectors. This information is crucial for planning adaptation and risk management measures, as it indicates a high level of exposure of the population and infrastructure to flood risk.

[96] *Bosnia and Herzegovina Country Climate and Development Report, World Bank Group, October 2024*
[97] *ibid*
[98] *https://www.climatewatchdata.org/countries/BIH?end_year=2022&start_year=1990#climate-commitments accessed on 30.5.2025.*
[99] *ibid*

In addition to these natural disasters included in the World Bank's research, BiH is also significantly exposed to forest fires, air pollution and heat waves, which have an increasing impact on the health of the population and the environment.

According to the World Bank's Climate and Development Report for BiH, climate-related damages could reduce GDP by as much as 14% by 2050 if adaptation measures are not implemented.

With the aim of improving the recording and more efficient management of loss and damage, the UNFCCC recommends the establishment of a contact point for loss and damage, within the existing national UNFCCC focal points. At the United Nations Climate Change Conference COP22, countries were invited to establish a point of contact on loss and damage through their national UNFCCC focal points, in order to strengthen the implementation of measures to address the adverse impacts of climate change at the national level (Decision 4/CP.22, paragraph 4(d)).

In BiH, although extreme weather conditions are becoming more frequent and intense, official statistical data on climate-related damages have not yet been systematically collected or regularly monitored, and no contact person has been established to report on losses and damages.

### 5.5.2. Loss of Forest Areas

Losses and damages of forest areas caused by climate and certain anthropogenic factors pose a significant threat to natural resources, economic sectors and social stability in BiH. Below are presented data related solely to forest area losses expressed in hectares, incurred in the period 2018–2022, which are caused by fires, insects and plant species, natural disasters, and the human factor. For the area of FBiH and RS, these data were taken from the reports of the entity Bureaus of Statistics, while the data for BD BiH were collected from the Department of Agriculture, Forestry and Water Management.

#### 5.5.2.1. Loss of Forest Area due to Fires

Fires are one of the most common causes of forest loss. The following table shows the data on the burned area for the period 2018-2022.

*Table 24: Loss of Forest Areas due to Fires*

| Year | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|
| **Total burned area of BiH (ha/year)** | **4,262** | **5,068** | **22,379** | **24,491** | **22,782** |
| **FBIH** | 904 | 3,110 | 15,544 | 17,630 | 12,173 |
| **RS** | 3,358 | 1,958 | 6,823 | 6,861 | 10,609 |
| **BD BiH** | 0 | 0 | 12 | 0 | 0 |

In the observed period, the largest burned area was recorded in 2021, when it amounted to 24,491 ha. A special high increase was recorded in 2020, when as much as 22,379 ha of area affected by fires in BiH were registered, which is more than four times compared to 2019. This trend continued in 2021 with a burned area of 24,491 hectares, while in 2022 a slight decrease was recorded to 22,782 hectares. The FBiH and RS had the most pronounced losses in that period, with the RS recording a sharp increase from 6,861 hectares in 2021 to 10,609 hectares in 2022.

*Table 25: Financial losses of forest areas due to fires for the period 2012 – 2021 for the FBiH*

| FBiH | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Estimated damage (BAM)** | 47.753.101 | 2.267.212 | 1.422.487 | 2.640.913 | 2.965.861 | 17.307.510 | 3.667.570 | 2.900.297 | 15,434.534 | 7.659.799 |

In the period from 2012 to 2021, the total estimated damage from forest fires in the FBiH amounted to approximately 104 million BAM. Financially, the annual average is about 10.4 million BAM, with 2012 being the most expensive year – with damage of as much as 47.75 million BAM, which represents more than 45% of the total damages in a ten-year period. In that year, 564 fires were recorded, 26,585 ha of forests were burned, the damage to wood mass amounted to 51,658 m³, and over 150,000 seedlings were destroyed.

On the contrary, 2018 recorded a much more favorable situation: only 146 fires, 1,467 ha of burned area, 87 m³ of burnt wood mass and estimated damage of 3.67 million BAM – which is almost five times less than in 2017.

According to international parameters, indirect damage (habitat loss, erosion, reduced production, soil degradation) can be 10 to 17 times higher than direct damage, which would imply that the actual economic consequences of fires are potentially greater than one billion BAM in the observed period.

Despite the dominance of the human factor as a cause, the damage can be significantly reduced through: better inter-cantonal coordination, annual protection plans, staff education, equipment and timely response of forestry and fire services. This is evidenced by the differences in damages between individual years. However, the spring fires of 2022 once again pointed to the need to strengthen preventive measures, as they caused new, significant damage to the forest ecosystems of the FBiH.

Unfortunately, the available data on damage from forest fires in the RS for the period 2012-2021 are fragmented and do not include all years individually. Below are the data on financial losses due to forest fires in the RS (2012–2021):

- 2012: The estimated damage from forest fires amounted to about 850,000 BAM, according to the statement of the then President of the Republika Srpska Government,
- 2013: In the municipality of Višegrad, ten forest fires were caused by human negligence, with material damage estimated at 1.3 million BAM, and
- 2022: In the first six months, 462 fires were recorded, with a total material damage of over 2 million BAM. 11 people died in the fires.

Although available data are limited, it can be concluded that forest fire damage in the RS varied from year to year, with higher damage recorded in years with extreme weather conditions and increased human carelessness. The lack of comprehensive data makes it difficult to make an accurate financial analysis, but the available information points to significant economic and environmental consequences of wildfires.

#### 5.5.2.2. Loss of forest areas due to insects and plant species

Damage caused by insects and plant species varies significantly from year to year. These losses include degradation, drying and deterioration of vegetation, and in the period 2018-2022 they were registered in the area of both entities, with variable intensity. Data for BD BiH was not available at the time of the document creation.

*Table 26: Loss of forest areas due to insects and plant species*

| Year | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|
| **Total for BiH (ha/year)** | **6,225** | **879** | **3,340** | **7,014** | **6,874** |
| **FBIH** | 4,641 | 3 | 20 | 89 | 1,477 |
| **RS** | 1,584 | 876 | 3,320 | 6,925 | 5,397 |

The largest losses from insects and invasive plants were recorded in 2018 (6,225 ha), 2021 (7,014 ha) and 2022 (6,874 ha). RS has particularly high values of these losses in 2021 (6,925 ha) and 2022 (5,397 ha), while FBiH had growth in 2022 (1,477 ha) after previously low values.

#### 5.5.2.3. Loss of forest areas due to natural disasters

Natural disasters – including storms, floods, landslides and other natural phenomena – contribute significantly to the loss of forest areas in BiH. Although these events are not a regular occurrence every year, their frequency and intensity vary, often depending on local climatic and geographical conditions. Losses for BD BiH were not available at the time of drafting the document.

*Table 27Loss of forest areas due to natural disasters.*

| Year | 2018. | 2019. | 2020. | 2021. | 2022. |
|---|---|---|---|---|---|
| **BiH (ha/y)** | **2.528** | **581** | **5.014** | **4.011** | **3.015** |
| **FBiH** | 669 | 96 | 0 | 106 | 1.542 |
| **RS** | 1.859 | 485 | 5.014 | 3.905 | 1.473 |

The largest loss of forest areas due to natural disasters was recorded in 2020 (5,014 ha), which is entirely related to the RS. This is followed by 2021 with 4,011 ha. The lowest volume of damage was recorded in 2019, with only 581 ha in total, which shows significant year-on-year variability. In 2022, a decrease is observed compared to the previous two years, with a higher share of losses in the FBiH (1,542 ha).

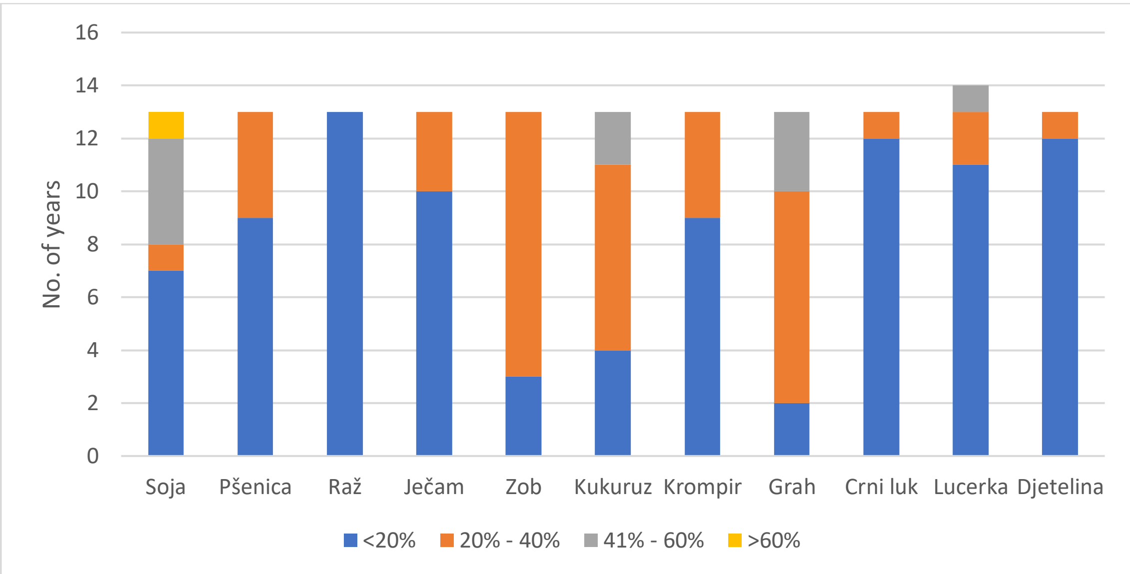
### 5.5.3. Decline in yield

Over the past 25 years, the area has been affected by the alternation of dry and wet years. In addition to normal years in terms of climatic conditions, there were wet years with catastrophic floods that caused great damage. However, the impact of droughts is not negligible, of which those from 2000, 2003, 2011 and especially 2012 stand out, which is the driest in terms of its intensity and affected area for a monitoring period of 130 years. According to estimates by the Agricultural Producers' Association, the drought caused about $1 billion in damage in 2012 alone[100]. In order to look at the potential impact of drought in possible climate change scenarios, an estimate of the decline in yields for the period 2000-2024 was made[101], as well as an estimate of the decline in yields for the period 2010-2024. First, the yield drops for the most important crops by area were estimated, to determine

[100] *Climate Change Adaptation and Low-Emission Development Strategy for Bosnia and Herzegovina. 2013,*
[101] *Bosnia and Herzegovina's Climate Change Adaptation Plan - NAP*

which year was hydrologically favorable throughout the country to be adopted as a reference year, in order to determine the yield drops for the FBiH and RS. By estimating the yield drops by representative meteorological stations, it was determined that the largest yield drops occur almost every year on shallow soils throughout the country, on all summer crops, from 5 to 90%. Medium-deep soils provide slightly more water, so the yield drops of summer crops do not exceed 50%, except in extreme drought conditions, when they can be up to 80%. Deep and fertile soils such as those located in the northern part of Bosnia and Herzegovina provide a large water reserve, even over 200 mm, which allows the average drops in corn yield, for example, from 0 to 20%, and even in extreme years not to exceed 35%, which is confirmed by data obtained by other studies[102].

By looking at the average yields of the last 15 years (2010-2024 for the RS and 2011-2023 for the FBiH), it can be stated that on average higher yields were achieved compared to the period 2004-2013, probably due to the general improvement of agrotenic measures. On the other hand, greater variations in yields have been observed due to changed climate conditions. It can be noted that the climatic conditions in both entities are more favorable for winter crops, and less for summer crops. On the FBiH entity, lower yields are achieved in most years compared to the most favorable year, they are in the range of 0-20%, with the exception of 20-40%, as can be seen in the figure below.

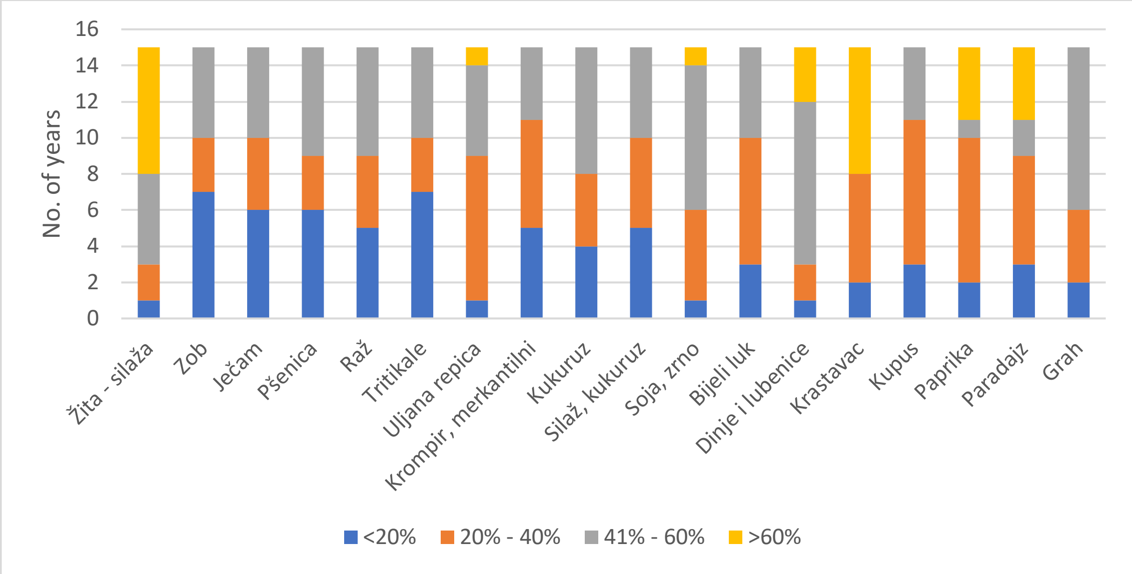



(LEGEND: Soja - *Soybeans; Pšenica - Wheat; Raž - Rye; Ječam - Barley; Zob - Oats*; Kukuruz – Corn; Kropmpir – Potato; Grah - *Beans*; Crveni luk - *Onion*; Lucerka - *Lucerne*; Djetelina - Clover.)

*Figure 31: Variation of yields on arable land in FBiH*

Greater variations were observed in the RS area, where lower yields of 40-60% and more are more often achieved compared to a favorable climate year, which is visible in the figure below. The variation in the yield of summer crops is significantly higher, since drought and heat waves have a more significant effect on the yield. Soybeans, corn and even melons, watermelons, cucumbers and beans suffer significantly due to unfavorable climate conditions, where yields fall every other year over 40%. However, the greatest influences are reflected in fruit growing and viticulture, even in the intensive cultivation method.

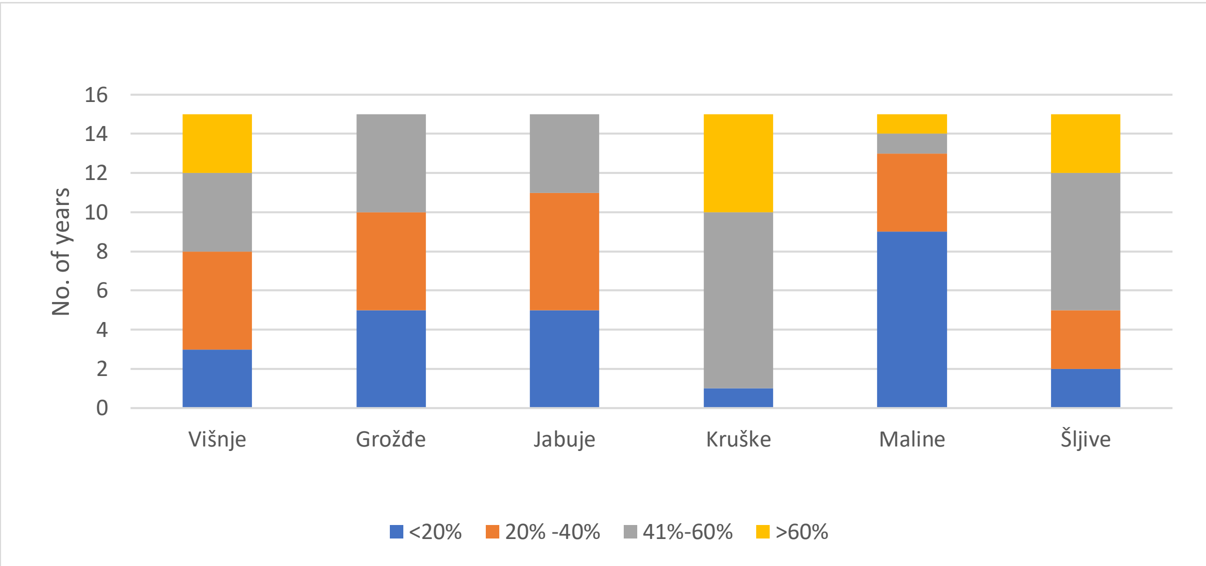
[102] *Žurovec J., S.čadro (2011). Decrease in crop yield in conditions without irrigation in the area of northeastern Bosnia. Proceedings. 46th Croatian and 6th International Symposium on Agriculture. Opatija. Croatia (760-764)*




(LEGEND: *Cereals – silage*; Zob – Oats; Ječam – Barley; Pšenica – Wheat; Raž – Rye; Tritikale - *Triticale; Uljana repica - Rapeseed*; Krompri, merkantilni - *Potatoes, mercantile*; Kukuruz – Corn; Silaž, kukuruz – Silage, corn; Soja, zrno – Soybeans; Bijeli luk – Garlic; Dinje I lubenice – Melons and watermelons; Krastavac – Cucamber; Kupus - Cabbage; Paprika – Pepper; Paradajz – Tomato; Grah – Beans.)

*Figure 32: Variation of yield on arable land in the RS*

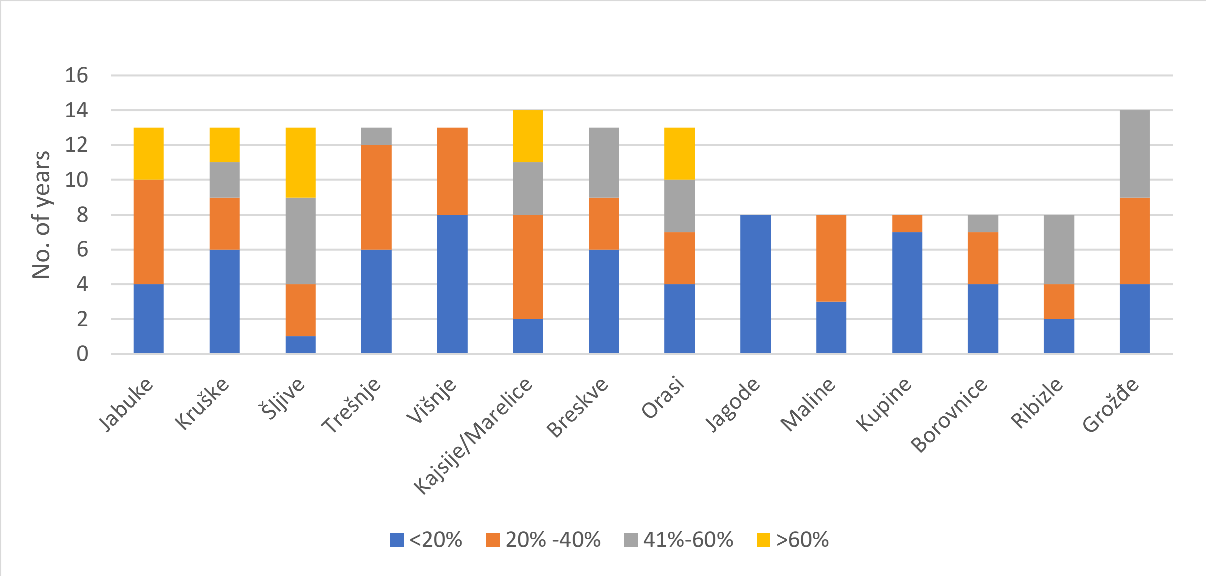
Namely, climate conditions have the greatest impact on pears, cherries and plums in the territory of the Republika Srpska, as can be seen in the figure below. Almost every other year, there is a drop in yield of 40-60% or more compared to favorable conditions.




(LEGEND: Višnje – Sour cherries; Grožđe – Grapes; Jabuke – Apples; Kruške – Pears; Maline – Raspberries; Šljive – Plums.)

*Figure 33: Variation of fruit and grape yield in RS*

In the FBiH, plum, apricot and walnut plantings are most endangered when the yield is reduced by over 40% every second or third year, as can be seen in the figure below. Plantings under berries are least affected. This is probably a consequence of growing at a slightly higher altitude, when the plants develop after the onset of spring frosts, because yield drops are rarely over 40%, the exception is currants, which are less sensitive than other berries.




(LEGEND: Jabuke – Apples; Kruške – Pears; Šljive – Plums; Trešnje – Cherries; Višnje – Sour cherries; Kajsije/Marelice – Appricots; Breskve – Peaches; Orasi – Walnuts; Jagode – Strawberries; Maline – Raspberries; Kupine – Blackbarries; Borovnice – Blueberries; Ribizle – Currants; Grožđe – Grapes.)

*Figure 34: Variation of fruit and grape yield in FBiH*

According to statistics, orchards and vineyards cover about 97,000 ha. The most common fruit trees are plums, followed by apples, pears, vines, walnuts, cherries, sour cherries, apricots, raspberries and strawberries.

Based on the number of trees that bear fruit trees, it can be concludedthat it is largely a matter of production on small family farms, in a fairly extensive way. However, it should be noted that fruit production is still developing across the country. Modern cultivation technologies are applied, especially in Herzegovina, which are fully adapted to modern climatic requirements and can be applied in future climatic conditions. Orchards will be most affected by climate change due to their long growing season. Indeed, high temperatures and more intense solar radiation cause sunburn, which affects the quality and class of the fruit. Prolonged dry periods require the use of irrigation, which increases production costsand market competitiveness. On the other hand, heavy rainfall during the flowering and ripening of fruits, especially cherries, sour cherries and berries (strawberry, blackberry, raspberry), cause mold, which either leads to a loss of yield or requires the use of a higher amount of pesticides, creating the risk of excessive pesticide residues in the fruit and the inability to sell them.
Such a trend of yield variation, and perhaps even more intense, can be expected in the coming period. In terms of $CO_2$ emissions, there will be no major change, because biomass will be created in all cultivated crops, but there will be no pollination or there will be a loss of fruit due to hail, frost or heat waves or rains at the time of harvest and the appearance of rot, especially in berries.

#### 5.5.4. Public Health

The reports of the European Environment Agency ("Climate change as a threat to health and well-being in Europe: focus on heatwaves and infectious diseases" and "Responding to the impacts of climate change on human health in Europe: focus on floods, droughts and water quality") point to the increasing health risks associated with climate change, in particular due to:

- Heatwaves are increasing, increasing mortality, especially among the elderly and vulnerable groups.
- Spread of climate-sensitive infectious diseases, including vector-borne diseases (mosquitoes, ticks) and waterborne diseases;

- Impacts on water resources, including an increased risk of contamination of water sources during floods and disruptions to water supplies during droughts.

In addition to these risks, air quality has a significant impact on public health in BiH, which is directly related to climate conditions (e.g. air stagnation during warm periods). According to the European Environment Agency, BiH records alarming indicators of exposure to air pollution, as shown in the following table.

*Table 28: Indicators of exposure to air pollution and related mortality in BiH and the EU27*[103]

| Parameter | BiH | EU27 |
|---|---|---|
| **Population (x1000)** | 3,825 | 442,519 |
| **Weighted mean annual PM2.5 emissions** | 21.90 | 11.40 |
| **Deaths associated with PM2.5** | 8,980 | 253,000 |
| **Weighted Mean Annual $NO_2$ Emissions** | 12.80 | 14.40 |
| **Deaths associated with $NO_2$** | 550.00 | 52,000 |
| **Weighted Annual Sum of ozone exceedances (SOMO35)** | 5,152 | 3,794 |
| **Deaths associated with ozone exceedances** | 450 | 22,000 |

The weighted mean annual $PM_{2.5}$ emission in BiH is 21.9 µg/m³, almost twice as high as the EU27 average (11.4 µg/m³), which is associated with 8,980 premature deaths per year. A similar trend is recorded in ground-level ozone ($O_3$), where the SOMO35 value is higher in BiH (5,152) compared to the EU27 (3,794), with 450 annual deaths related to exposure to exceeded ozone values. Although $NO_2$ values are slightly lower in BiH than in the EU27, the number of deaths per capita remains significant.

### 5.5.5. Impact on Water Supply and Water Management

Floods and droughts, as the two most pronounced hydrological extremes in BiH, have different, but equally significant consequences on the water sector and the water supply system. Floods threaten physical infrastructure, including dams, canals, and irrigation systems, causing physical damage, turbidity of springs, and contamination of water resources. On the other hand, droughts result in a decrease in available water quantities, drying up of springs and reservoirs, which directly affects the continuity and quality of water supply. Dry periods particularly affect rural areas and agricultural activities that depend on irrigation systems. The impacts of these extremes are further intensifying in the context of increasingly pronounced climate change, with projections for BiH indicating an increase in the number of consecutive dry days and intense precipitation, which will further burden water systems and require improved risk management mechanisms.

The water supply and water management sector in BiH was particularly exposed to the impact of climate change in the period 2019-2022. Dry periods and intense rainfall have caused a reduction in available water supplies, damage to infrastructure, a decrease in water quality, and economic losses in households and agriculture.

[103] *Taken over from [https://www.eea.europa.eu/en/analysis/maps-and-charts/bosnia-and-herzegovina-air-2023-country-fact-sheets](https://www.eea.europa.eu/en/analysis/maps-and-charts/bosnia-and-herzegovina-air-2023-country-fact-sheets) as of 02.06.2025.*

#### 5.5.5.1. Impact of droughts (2019, 2021, 2022)

Long-term trends show an increase in the number of days with extremely high temperatures and a decrease in the amount of precipitation in the summer months, which led to the drying up of smaller springs and a significant decrease in flows in rivers. During 2022, the average flow of the Sava, Drina and Neretva rivers decreased by over 40% compared to the ten-year average[104]. In the summer months of 2021 and 2022, more than 20 municipalities in BiH introduced reductions in water supply due to reduced amounts of groundwater and pressure on the water supply network[105]. Karst springs supplying East Sarajevo, Trebinje and parts of Herzegovina recorded record low levels, resulting in several days of interruptions in water supplies to consumers[106].

Droughts have also had a strong impact on agriculture. Given that less than 1% of arable land in BiH is irrigated, droughts have resulted in a decrease in yields and economically measurable damage. During 2022, drought caused losses in agriculture estimated at over 180 million BAM[107], a significant part of which refers to damage due to the inability to irrigate.

#### 5.5.5.2. Impact of floods (2019, 2020, 2021).

Several days of heavy rainfall in May 2019 and November 2021 led to rivers overflowing and flooding of urban and rural areas. According to data from the Sava River Basin Agency, the floods in November 2021 caused damage to more than 35 water infrastructure facilities (embankments, culverts, defenses), and contamination of water intakes and wells in more than 15 local communities[108]. Temporary interruptions in water supply were recorded in the zones of urban centers (Sarajevo, Banja Luka, Mostar), and the repair of damage and urgent distribution of water (by tanks) required additional financial expenditures. The estimated costs of interventions and rehabilitation on water protection systems in the Federation of BiH after the floods in 2021 amounted to about 4.6 million BAM[109].

Overall, the water supply and water management sector is experiencing a trend of increasing exposure to hydrological extremes, with direct material consequences, disruption of public supply services and increased economic losses in related sectors.
The following table shows the most dominant extremes in each year, the number of municipalities affected, the estimated damage, and additional notes on the nature of the impact.

*Table 29: The most significant hydrological extremes and their consequences in BiH (2019 - 2022)*

| Year | The dominant influence | Number of affected municipalities | Estimated damage (KM) | Notes |
|---|---|---|---|---|
| **2019** | Floods, drought | >15 | >30 million BAM | Floods in May, reductions in summer |
| **2020** | Localised floods | 10–12 | ~10 mil. BAM | Landslide occurrence, minor disturbances |

[104] *Annual report on the cnditions of waters for 2022, Sava River Basin Agency, 2023*
[105] *Country Climate and Development Report – Bosnia and Herzegovina, UNDP BiH, 2023.*
[106] *Hydrometeorological Institute of the Republika Srpska, Bulletin of Hydrological Analyses 2021–2022, 2022.*
[107] *Bosnia and Herzegovina Country Climate and Development Report (CCDR), World Bank, 2023.*
[108] *Report on Extraordinary Hydrological Conditions in November 2021, Sava River Basin Agency, 2022.*
[109] *Plan of Intervention Measures after the Floods 2021, Ministry of Agriculture, Water Management and Forestry of FBiH, 2022.*

| | | | | |
|---|---|---|---|---|
| **2021** | Drought, floods | >20 | >40 million BAM | Long-term reductions, remediation |
| **2022** | Drought | >25 | >180 million BAM | Record drought, damage to agriculture |

There is a trend of increasing the intensity and spatial coverage of droughts, especially in 2022, which recorded the most economic damage. Floods, although more frequent in previous years, have had a strong impact on infrastructure, while droughts have hit resource availability and agriculture the hardest. These dynamics point to the need for an integrated approach to water management in the context of climate resilience.

#### 5.5.5.3. Technical Losses and Efficiency of the System

In addition to the impact of climate extremes, a significant challenge in the water supply sector is the high level of technical losses in the water supply network. According to data from sectoral analyses, on average, about 55% of water is lost before it reaches the end users. These losses, which include leaks, unauthorized connections and technically obsolete systems, further exacerbate the effects of dry periods and strain system capacity during crises. Reduced water inflow in crisis years, combined with systemic losses, increases the risk of reductions, reduces the resilience of the system and increases the costs of exploitation, maintenance and emergency interventions.

In the context of climate change, technical losses have a significant impact on the ability of systems to adapt to new conditions. First, losses increase the exposure of systems in drought conditions, as they further reduce the amount of resources already available. Second, they limit adaptive capacity because a system that loses half of its water cannot respond effectively to crises caused by flooding or source contamination. Third, the economic cost of maintaining high-loss networks in conditions of frequent climate shocks becomes unsustainable for local budgets. Finally, losses directly affect the continuity and reliability of service, thus becoming a factor that increases the vulnerability of communities to the effects of climate change.

For these reasons, the reduction of technical losses is not only an engineering or managerial issue, but also a key adaptive measure in planning the response to climate challenges in the water sector.

## 5.6. Analysis of Forest Resources as Carbon Sinks

BiH is one of the most forested countries in Europe, with almost half of the territory covered by forests. According to the data, the total area of forests in BiH is about 2.5 – 2.6 million hectares, which is approximately 50% of the land area. With this percentage, BiH ranks among the top European countries in terms of the share of forests in the total area.

*Table 30: Forest areas in BiH*

| Type of land | RS | FBiH | BD BiH | Total |
|---|---|---|---|---|
| **Forests (ha)** | 1,059,108 | 978,624 | 10,396 | 2,048,128 |
| **Forest land** (areas suitable for afforestation, areas unsuitable for afforestation, usurpations) (ha) | 284,310 | 265,070 | 1,157 | 550,537 |
| **Total (ha)** | **1,343,418** | **1,243,694** | **11,553** | **2,598,665** |



I hereby confirm that the above is a true and fair translation of an authentic document as written in Bosnian language.
30.04.2026, Sarajevo Log No. 63/26
Staša Elezović, Certified Court Translator for English Language

From the previous table it is evident that the largest share in the total forests has the RS with 1,343,418 ha (52%), followed by the FBiH with 1,243,694 ha (48%), while BD BiH participates with only 11,553 ha (0.4%) in the total area of 2,598,665 ha. Below are the areas of individual categories of forests in RS, FBiH and BD BiH.

High-yielding forests (beech, oak) and coniferous species (fir, spruce, etc.) dominate, with a significant diversity of forest ecosystems thanks to the various climate and geographic conditions in the country. About 55% of the mushrooms are of natural origin, while the rest is the result of afforestation and plantation cultivation.

Such high forest coverage makes the land use and forestry sector crucial for the greenhouse gas balance in BiH. According to the BiH GHG Emissions Inventory for the period 2014-2022, the Forest Land category (IPCC Category 3.B.1) represents the main carbon sink in the country. In all observed years, forests in BiH act as a net sink of $CO_2$ – that is, the amount of carbon absorbed by photosynthesis and deposited in trees and soil is greater than the amount emitted due to respiration, biomass rotting or eventual losses. The net balance of forests is positive from a climate perspective, which means that forests remove some of the $CO_2$ from the atmosphere that is generated from the burning of fossil fuels and other sources. In the period 2019–2022, Bosnia and Herzegovina's forests absorbed an average of about 6–7 million tons of $CO_2$ per year, which is a significant contribution to the reduction of net emissions at the national level. Trends from 2019 to 2022 show a slight increase in sinks, which can be attributed to natural regeneration and stable forest management. Below is the amount of carbon sinks in the period 2014 – 2022, in accordance with the data from the greenhouse gas emission inventory.

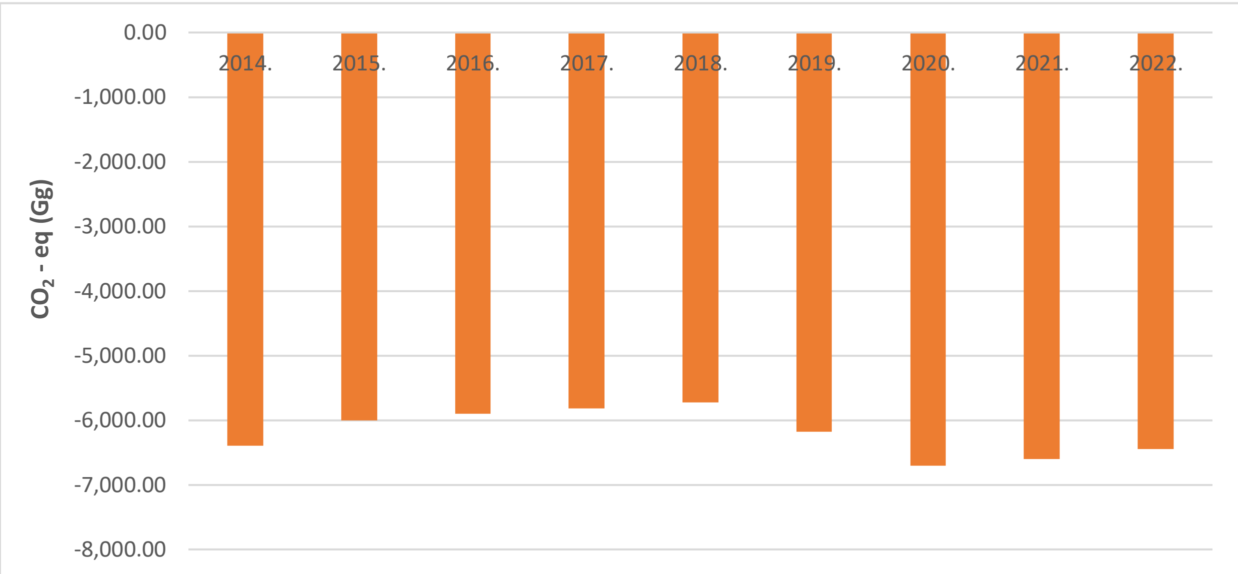



*Chart 12: Forest land emissions sink trends 3.B.1.1 for the period 2014-2022*

From the previous chart it is evident that in the period 2014-2018 a continuous decline in sinks was recorded, and in the period 2019-2022 the values of sinks are increasing compared to the period from 2014, which can be attributed to natural regeneration and stable forest management. The highest value of sinks was recorded in 2020, when it amounted to -6,700.38 Gg CO2-eq, and the lowest in 2018, when it amounted to -5,722.90 Gg CO2-eq.

According to the inventory, net $CO_2$ removals from forests in BiH are approximately equivalent to 20-25% of the total annual greenhouse gas emissions emitted by the country (when looking at all sectors).

In 2022, total emissions without sinks amounted to 28,031.44 Gg CO2-eq, while emissions with sinks amounted to 21,102.73 Gg CO2-eq.

However, forest resources in BiH face a number of challenges, of which forest fires are one of the most significant. A temperature increase of 2.5 to 5 °C and a decrease in precipitation of up to 20% by the end of the century can increase the frequency and intensity of fires, threatening the structure and productivity of forest communities. Fires currently release large amounts of $CO_2$ into the atmosphere, and in the long term can significantly reduce the capacity of forests to absorb carbon.

While maintaining the current level of sinks, at 2022 levels, is a realistic and justifiable goal in the short and medium term, it is highly dependent on the successful management of risks such as fires, pests and other climate impacts. Focusing only on preserving existing capacity without active risk mitigation measures can lead to sudden and unforeseen drops in forests' ability to absorb carbon. Also, the degradation of natural sinks due to human activities, such as deforestation and unsustainable management, makes this task even more difficult. Given the importance of forests as GHG sinks and their vulnerability, it is necessary to invest in tailored management strategies that include fire prevention and control, biodiversity conservation and improving the resilience of forest ecosystems.

Taking into account the above challenges, future strategies for the forestry sector should focus not only on conservation, but also on the active management and enhancement of carbon sinks, taking into account climate projections and potential risks.

## 5.7. Introducing an Integrated Approach for Forests and Biodiversity Ecosystems

In previous communications and strategic documents of BiH on climate change, the issues of an integrated approach were not addressed. The Nexus approach for forestry and biodiversity will be introduced in the BTR1 report, with a focus on adaptation to climate change. The aim is to synthesize and highlight existing data and examples relevant to BiH. The results will provide the basis for the expansion of the Green Corridor Initiative in NC5 and BTR2.

This approach, which seeks to integrate the interdependencies between water, energy and land use in the context of sustainable development, will be introduced as a key framework for fostering resilience in forest ecosystems and biodiversity in BiH. This framework recognises the need to reconcile environmental efforts with development activities, especially in sectors that affect or are affected by biodiversity, such as transport infrastructure, energy production and land use management.

The Glasgow Climate Pact (2021) recognises the importance of protecting biodiversity for climate action. While climate and biodiversity governance processes remain separate at the intergovernmental level, transnational initiatives can provide opportunities for better integration of these two important issues. The integrated approach addresses the synergies and trade-offs between climate action and biodiversity protection, as well as the role of nature-based solutions (NbS). Biodiversity degradation reduces ecosystems' capacity to store carbon, intensifying climate change, while climate change accelerates biodiversity loss by pushing species beyond survival thresholds. An integrated approach to biodiversity and climate is needed to address the problem.

Previous international treaties such as the UN Framework Convention on Climate Change and the UN Convention on Biological Diversity were determined on the basis of separate negotiations and had different focuses. It is evident that integrating climate change adaptation and biodiversity protection requires synergistic solutions. This is due to the recognition that the climate and biodiversity crises have common root causes. These include changes in land use such as conventional agriculture, deforestation, urbanization, the expansion of transportation networks, and the continued use of fossil fuels[110].

Climate change is disrupting ecosystems, while biodiversity loss is reducing ecosystem services such as carbon sequestration, air purification, and water filtration[111]. Therefore, the climate and biodiversity crises are not isolated phenomena, but are deeply interconnected. They are mutually reinforcing and create complex environmental risks[112]. Addressing the link between climate and biodiversity requires a holistic and integrated approach to biodiversity and climate conservation. Such an approach would ensure that climate mitigation interventions do not threaten biodiversity, and vice versa. Effective management of this nexus is essential for planetary stability, maintaining resilience to change, and dealing with climate tipping points[113].

The concept of nexus has become popular in global governance. Integrated thinking is committed to addressing problem areas such as biodiversity, water, food and energy in a holistic way. Nature-based solutions (NnS), which use biodiversity and ecosystems to address climate challenges, have emerged as key strategic directions[114].

### 5.7.1. Concept and Significance of Green/Ecological Corridors

According to the International Union for Conservation of Nature (IUCN), ecological corridors[115] are clearly defined geographic spaces that are managed over long term to maintain or restore effective ecological connectivity. When used in addition to basic habitats in protected areas and other effective conservation mechanisms, these components are fundamental basic elements of conservation and any ecological network. It is important to consider the size of the basic habitats and isolation when meeting the needs of connecting some species in conservation networks.

Maintaining ecological connectivity through corridors is key to preserving the natural environment. Connected, protected and conserved areas are stronger, and corridors are a major component in the successful fight against fragmentation and enhancement of biodiversity. These physical connections are one of the most important ways to ensure that species can move between protected areas and maintain genetic strength. Wildlife often migrates across landscapes and between large protected habitats. Daily movements, seasonal migrations, habitat change, avoidance of natural ecosystem disturbances or the need to adapt to climate change are possible. Different types of barriers to the movement of wildlife such as fences, highways, cities, and other developments often stand in the way of finding mates, food, or new places to thrive. Maintaining connectivity is therefore needed at the local, regional and global levels and across landscapes with varying degrees of human impact. Connectivity management ranges from smaller-scale, such as between streams or berries, to regional

[110] *Okorondu et al. 2022*
[111] *Hald-Mortensen, C, 2024*
[112] *Pörtner, H-O., et al., 2023*
[113] *Newell, R, 2023*
[114] *Koloffon, R, M and Pattberg P, 2023*
[115] *https://portals.iucn.org/library/sites/library/files/documents/PAG-030-En.pdf*



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and even continental scales, such as large rivers or mountain ranges. Increasingly, observing landscapes at the scale of their use by wildlife is becoming a focus in terms of conservation.

In addition to preserving nature, ecological corridors can benefit people. In some cases, they can also serve as pathways for mobile communities in hunting/gathering cultures and livestock farmers. In other places, ecological corridors can also provide recreational benefits or can protect rivers, streams and wetlands. In some cases, corridors can serve as homes for crop pollinators or serve as sources of seeds for forest restoration.

Ecological corridors on land, fresh water and in the sea are critical conservation hallmarks needed to ensure that ecosystem functioning and ecological processes are maintained or even restored. These corridors are an essential part of ecological conservation networks, naturally complementing protected areas or other effective conservation mechanisms (OECMs). Providing a clear definition of ecological conservation networks and guidance on how to identify, establish, measure, and report on ecological corridors helps many countries achieve the goal of identifying, establishing, managing, and restoring "well-connected systems" listed in Aichi Goal 11 of the Convention on Biological Diversity (CBD). For the global biodiversity framework critical and progress towards achieving the CBD's vision for 2050 of "living in harmony with nature".

The reality is that no method will solve the pressing issue of mass extinction of species caused by widespread human ecosystem changes and climate change. However, together, protected areas, OECMs and ecological corridors are a set of tools for creating effective terrestrial, freshwater and marine ecological networks to effectively enhance and conserve biodiversity today and in the future.

### 5.7.2. Identifying Hotspots and Relevant Sectors

The next step involves identifying key sectors and geographic areas where green corridors could be effectively implemented in BiH. Using existing research and case studies, the following hotspots will be prioritised:

- Transport infrastructure: Highways and railways as major transport corridors often pose barriers to the movement of wildlife and fragment ecosystems. It is crucial to identify areas along these transport points where green corridors could be established. For example, overpasses or wildlife underpasses could be installed to allow species to move safely across these corridors. It is evident that in the current practice of building highways through BiH (both in the RS and in the FBiH), adequate attention has not been paid to the construction of green corridors for the passage of animals over or under the road. It is necessary to intensify advocacy for the introduction of approaches for the establishment of green corridors in the future construction of highways and expressways in BiH.
- Development of hydropower plants (mini-hydropower plants): Mini-hydropower plants in BiH affect river ecosystems and local biodiversity. In the construction of mini-hydroelectric power plants and reservoirs that can also have a multifunctional character, it is necessary to insist on the establishment of adequate fish trails that must be in operation even at the biological minimum of water flow.
- Agricultural and forest landscapes: Areas dominated by intensive agricultural and forestry practices could benefit from green corridors that connect isolated parts of forests and other

natural habitats. These corridors can improve biodiversity, improve carbon sequestration, and provide ecosystem services, such as regulating floods and combating soil erosion.

- Protected areas and biodiversity hotspots: There are protected areas, such as national parks and nature reserves, that provide opportunities for the expansion of green corridors. Increasing connectivity between these protected areas will improve the migration routes of the species, especially for one species that are at risk due to habitat fragmentation.

#### 5.7.3. Integration of Existing Knowledge and Best Practices

In order to develop practical recommendations for green corridors, existing studies and best practices from similar regions and projects will be analysed. Prior research on the connectivity of landscapes, biodiversity conservation and the environmental impact of infrastructure will be integrated into the analysis. The identification of successful Green Corridor projects will serve as a model for the potential implementation of similar measures in BiH.

#### 5.7.4. Recommendations for Improvement in NC5 and BTR2

The final step will involve identifying the potential to scale up the Green Corridor initiative in future reports, NC5 and BTR2. This will include identifying additional sectors, locations and policy frameworks that could support the integration of green corridors into broader climate change adaptation strategies. Concrete actions will be proposed to strengthen cross-sectoral cooperation and ensure the inclusion of the Green Corridor Initiative in future development plans, in particular in sectors such as energy, transport and land-use planning.

Researchers working on Nexus access issues have found that the lack of data availability is a general limitation for the corresponding Nexus ratings. Consequently, there is a general need to improve data collection in different areas of the sector, and to develop an overall strategy oriented towards open data policy. Some researchers have also considered potential alternative data sources, such as remote sensing and field research, but the need for a more systematic data management system has been strongly emphasized. Addressing this issue has been identified as a key milestone to support decision-making in the areas of food security, poverty reduction, sustainable river basin management and inclusive development. The problem of access to available data is also emphasised[116].

[116] *Hald-Mortensen, C, 2024*

# 6. Information on Financing, Technological Development and Transfer and Capacity-building Support required and received under Articles 9-11 of the Paris Agreement

## 6.1. Circumstances and Institutional Framework in BiH

As previously stated, BiH is administratively divided into two entities and a district, which leads to complexity in the adoption and implementation of its own policies, including those related to energy, spatial planning, environment and natural resource management. This decentralisation leads to significant challenges in the planning, coordination, and implementation of climate projects.

The current state of climate finance in BiH is characterised by high dependence on international support, a fragmented domestic financing system and the existence of some innovative, but insufficiently developed instruments. The country still does not have a functioning and coordinated climate finance framework, nor clearly integrated budget lines for low-carbon investments at the entity, cantonal or local level.

Domestic financing mechanisms are based primarily on two entity funds – the FBiH Environmental Protection Fund and the RS Environmental Protection and Energy Efficiency Fund. Their revenues come predominantly from environmental fees, aligned with the "polluter pays" principle. However, implementation of this principle varies between entities, and there is a lack of a clear orientation of the funds towards climate change mitigation goals. Total environmental tax revenues amounted to BAM 1.47 billion (2021), accounting for 3.7% of GDP – higher than the EU average – but still without a clear link to climate performance. In addition to funds, as a recent change, the FBiH Ministry of Energy uses revolving funds through Union Bank to support investments in OiE and modernisation of the industry.

As a developing country, BiH relies heavily on international financial and technical support for the implementation of climate change mitigation and adaptation measures. This support is crucial for the realisation of infrastructure investments, strengthening institutional capacities, knowledge transfer and the adoption of advanced technologies that contribute to the achievement of climate goals. BiH has so far benefited from various sources of international assistance, including grants, soft loans, technical assistance and program support, with the active participation of bilateral and multilateral partners. In the field of international financing, the most important partners of BiH are the EU, KfW, Sweden (SIDA), WB, EBRD, GCF, GEF and bilateral donors. EU funds (IPA II, IPA III, WBIF) finance infrastructure projects, energy efficiency, OiE and support to citizens and businesses.

BiH's capacity to absorb and mobilise funds is low due to its complex governance structure, weak institutional capacity, lack of project documentation and limited private initiative. There is no coordinated national financing plan for NDC targets, and the private sector is only partially involved, although there is a growing interest in ESCO models, OiE projects and energy efficiency.

BiH has recently begun testing new instruments, including green bonds and crowdfunding. In 2023, our Bank AD launched an issue of green bonds (7 million BAM) to support the purchase of green technologies. Sustainable bonds and bonds related to ESG performance represent the potential for the development of the climate investment market, while crowdfunding offers an alternative for local initiatives.

Overall, BiH's climate finance system is fragmented, reactive and dependent on external aid, but it shows potential through institutional funds, revolving mechanisms, public-private partnerships and new financial instruments. To ensure the implementation of the objectives of the draft NECP, a systematic approach to domestic financial capacity building, regulatory harmonisation and the development of a coherent climate finance strategy in line with international commitments are necessary.

The envisaged financial mechanisms include subsidies and grants, with a particular focus on energy-poor households and at-risk market segments. Preferential credit lines from domestic and international sources, including foreign loans with low interest rates and favorable repayment terms, are additional instruments for initiating investments. In the public infrastructure and industry sector, the use of public-private partnership (PPP) models and ESCO contracts is envisaged, while multi-year contracts are planned to be supported through the mechanism of multiannual budget planning (the so-called "budget capturing"). In addition, the introduction of obligation schemes for energy suppliers and distributors through the EEE scheme should ensure stable sources of investment in energy efficiency measures.

The main sources of funding include public budgets at all levels of government – state, entity, cantonal and municipal – and revenue from taxes and fees, such as $CO_2$ taxes, energy and environmental fees. Funding from International Financial Institutions (IFIs), including the EBRD, the European Investment Bank (EIB), WB, GCF and GEF, is also planned. European funds, such as IPA III, LIFE, Horizon Europe, Interreg and COSME, provide key support for strategic investments, with additional opportunities through UN funds and bilateral donors. Private capital – both domestic commercial banks and foreign investors – also plays an important role, while income from the future introduction of the ETS system is seen as an additional potential source.

## 6.2. Information on Financial Support needed by Developing Countries under Article 11. of the Paris Agreement

As part of the drafting of the NECP, an assessment of the total financial needs for implementation of the planned measures in the range of 14.5 billion BAM to 17 billion BAM was made, and it did not include the sectors of agriculture, waste and industrial processes. Approximately 12 billion BAM is needed to implement key mitigation measures, and taking into account other measures regarding the modernization of the electricity grid, just transition and healthcare, up to 18.6 billion BAM will be needed without taking into account the costs of climate change adaptation measures. The table below provides an overview of the distribution of investments by sectors in accordance with the estimates made during the preparation of this document, and the data taken from the draft NECP.

*Table 31: Overview of investment needed by sector*

| Measure | Rationale | Total investment, million EUR |
|---|---|---|
| **Construction of new photovoltaic prosumer systems and energy communities** | 92 MW planned for industry and 500 MW for the residential/public sector. Used market costs of 850 EUR/kW (industry) and 1,100 EUR/kW (residential). | 628 |



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| Measure | Rationale | Total investment, million EUR |
|---|---|---|
| **Construction of new capacities of commercial photovoltaic power plants** | 292.36 MW is planned. CAPEX used for large PV power plants of 750 EUR/kW. | 219 |
| **Construction of new wind farm capacities** | 381 MW is planned. The investment cost is estimated at 1,500 EUR/kW in accordance with regional projects. | 572 |
| **Decommissioning of thermal power plant units** | A total of 410 MW for disconnection. The cost of decontamination, decommissioning and remediation is estimated at 200 EUR/kW. | 82 |
| **Construction of new biomass CHP plant capacities** | 25 MW is planned. The average cost of 3,000 EUR/kW includes the turbine, boilers and connection. | 75 |
| **Construction of new capacities of small and large hydro power plants** | 190.04 MW of large and 38.26 MW of small are planned. Cost 2,000 EUR/kW (large) and 3,000 EUR/kW (small). | 495 |
| **Implementation of fossil fuel replacement projects and construction of new district heating systems** | Replacement of 40 MW of coal-fired boilers with wood chip systems (~1.4 million KM/MW), including construction work, automation, tanks and system integration. | 28 |
| **Implementation of fossil fuel replacement projects and construction of new district heating systems using heat pumps in OiE** | Installation of 14 MW heat pumps (~2.0 million KM/MW). Assembly, automation and integration costs included. | 14 |
| **Reconstruction and modernisation of the district heating network and heating substations** | Modernisation of 200 km of the network, at a cost of ~350,000 EUR/km (includes pipelines, insulation, SCADA). | 70 |
| **Installation of measuring devices for monitoring heat energy consumption in facilities connected to SDG** | Installation of measuring devices for 2,100,000 m² (~0.15 million KM per 1,000 m² for central and individual meters, software and installation). | 158 |
| **Energy renovation of buildings in the residential sector** | It accounts for 23.2% of the housing stock (~140,000 buildings). The average cost of energy renovation (façade, carpentry, insulation) is approximately 25,000 KM per building. | 1.750 |
| **Replacement of heating and DHW preparation systems in the residential sector** | Replacement of heating in 25,000 households. Average cost of 8,000 KM per household (heat pumps and biomass boilers). | 100 |
| **Energy renovation of building envelopes in the non-residential sector (public and commercial buildings)** | Renovation of 1.8 million m² by 2030, with an average cost of 450 KM/m² for public and commercial buildings. | 405 |
| **Replacement of heating and DHW systems in the non-residential sector** | Replacement of heating systems in 1,000 buildings at an average price of 50,000 KM per building. | 25 |
| **Completion of the construction of unfinished family housing for refugees and internally displaced persons** | It has ~30,000 properties. The average cost of completion (façade, insulation, roof, DHW) is estimated at 6,000 KM per building. | 90 |
| **Increasing the share of environmentally friendly vehicles** | Replacement of 103,500 passenger vehicles with biodiesel versions (approx. 20,000 KM per vehicle) and 10,000 trucks/buses with electric vehicles (approx. 300,000 KM per vehicle). | 1.501 |

| Measure | Rationale | Total investment, million EUR |
|---|---|---|
| **Development of new and modernisation of existing public and private transport infrastructure** | Construction of approximately 2,500 charging stations (approx. 80,000 BAM per charging station), service centers, terminals for EV buses and logistics for CNG/biodiesel. It includes charging and energy storage infrastructure and a battery disposal system. | 125 |
| **Improving the utilisation and Efficiency of Rail Transport** | The modernization of 361 km of the railway (average cost of about 1.5 million BAM/km) includes construction works, signaling, bridges, tunnel facilities, IT systems and electrification. | 270 |
| **Reducing the energy intensity of industry through implementation of energy efficiency measures, optimisation of production processes and replacement of heating systems** | The estimate includes about 500 industrial plants in BiH. The average cost for conducting an energy audit, installing EE equipment, replacing the heating system and implementing the ISO 50001 system is estimated at 250,000 BAM per facility. Funds for technical assistance, co-financing through funds and training are also included. | 63 |
| **Reduction of process emissions in the cement, lime and metal industries through optimisation of raw material composition and processes** | The assessment includes 15 large industrial plants (6 cement plants/lime plants, 9 metal plants). The average investment per plant is 6-7 million BAM and includes laboratory equipment for raw material analysis, modified silos and dispensers, control systems, installation of new alloys and additives, and staff training. Certification and digital quality control costs are also included. | 50 |
| **Introduction of circular practices in industrial production and use of waste materials** | The assessment includes support for approximately 400 companies in the metals, woodworking, food and textile sectors through the introduction of systems for internal recycling, replacement of raw materials, heat and water recovery, and digital solutions for flow management. The average cost per company is approximately 200,000 BAM, including equipment, software, consulting and training. | 40 |
| **Reducing PFC emissions from aluminium production** | The investment includes the modernization of electrolytic cells at the Aluminij Mostar plant – including sensor installation, automation, software monitoring and training. The modernisation of approximately 200 electrolytic cells is assumed, at a cost of about 125,000 BAM per cell (including equipment, software, integration and training). | 13 |
| **Phasing out high-GWP HFCs and switching to environmentally friendly cooling technologies** | The estimate includes the costs of replacing and reconstructing about 25,000 units of cooling equipment (domestic, commercial and industrial sectors), training and licensing of 2,000 servicing staff, establishing a system of records and monitoring of leaks, as well as recycling infrastructure. The | 18 |

| Measure | Rationale | Total investment, million EUR |
|---|---|---|
| | average subsidy and technical cost per unit is estimated at 1,200 BAM. Regulatory and educational costs are additionally included (~5 million BAM). | |
| **Energy recovery of waste and landfill gas** | The assessment is based on the construction of a landfill gas facility. It is planned to implement at least 5 such systems, with an average capacity of 2–4 MWe per location. Taking into account the costs of gas capture and processing systems, construction of cogeneration units, emission treatment system and grid connection, the unit cost is approximately 10 million BAM per site. | 25 |
| **Sanitary management of landfills and recultivation of unregulated landfills** | The investment includes the remediation of existing illegal landfills and the recultivation of approximately 80 locations throughout BiH. The average cost of remediation with monitoring is 0.6 million BAM per location. | 24 |
| **Development of circular infrastructure for recycling and biological treatment of waste** | The estimate is based on investments in 15 sorting and composting centers. The average cost of building and equipping one center is 4 million BAM, including education and a selective collection system. | 30 |
| **Improving urban wastewater treatment and emission control** | The assessment includes the construction of 10 new smaller wastewater treatment plants in urban areas and the upgrade of existing systems in 5 major cities. Cost per new plant: approx. 5 million BAM, upgrades: 3 million BAM. | 33 |
| **Integrated optimisation of animal feed and fermentation** | The investment estimate is based on covering the cost of food additives (e.g. red algae, oils) for 235,000 head of cattle (50% cattle and 20% sheep) over 5 years. The average cost of additives is approximately 150 BAM per head per year, including the costs of distribution and technical assistance. In addition, technical training and monitoring are included (approx. 7 million BAM in total). | 91 |
| **Modernisation of manure management and implementation of technologies for energy utilisation of biogas** | The estimate includes the construction of a storage facility for approximately 241,000 tons of manure and the installation of 3 MW of biogas plants. The unit of cost for storage is approximately 120 BAM/t of capacity, and for the biogas plant (including digesters and CHP system) about 7 million BAM/MW, which, with additional costs for network equipment, automation and monitoring, gives a total investment. | 27 |
| **Precise management of mineral and organic fertilizers** | The estimate is based on the coverage of 75,000 ha of arable land by 2030. The unit cost includes the purchase of GPS applicators, nitrification inhibitors, slow-release fertilizers and advisory support (on average 300 BAM/ha for the introduction of the measure). The total value includes subsidies, digital tools and education. | 11 |

| Measure | Rationale | Total investment, million EUR |
|---|---|---|
| **Implementation of agrotechnical measures in crop production** | The investment includes support for 40,000 ha through subsidized sowing of cover crops, introduction of crop rotation, reduced tillage and soil analysis. The average cost for sowing cover crops, minimal tillage and advisory services is estimated at 250 BAM/ha. Costs for the purchase of equipment, training and system support are included. | 5 |
| **Reforestation of barren, degraded and erosion-affected areas** | The investment includes planting on 25,000 ha by 2030. The average cost of afforestation is approximately 4,000 BAM / ha and includes ground preparation, procurement of planting material, planting, protection of seedlings and three-year monitoring. Costs for local nurseries and technical support are also included. | 50 |
| **Establishment of plantations of fast-growing species for energy and industrial use** | The investment includes land preparation, planting, irrigation, care, protection and monitoring on 1,000 ha by 2030. The average cost of plantation afforestation with fast-growing species is approximately 7,000 BAM/ha due to higher planting density, more frequent care and shorter cycle times. Pilot facilities and advisory support are also included. | 4 |
| **Adaptive management of natural forests and transformation of degraded stands** | The measure is implemented on 10,000 ha through selective felling, stand care, succession regulation and replacement of allochthonous species. The average cost of the intervention is approximately 1,200 BAM/ha, including soil analysis, project planning, professional management and sequestration monitoring. | 6 |
| **Establishment of a system for the protection of forest ecosystems from fires and biological stressors** | The assessment includes investments in sensor systems, drones, observation posts, roads and firefighting points on 5,000 hectares of forests. The average cost for combined preventive-operational protection is approximately 5,000 BAM/ha, including staff training and continuous monitoring. | 13 |
| **Conservation and expansion of protected forest areas and conservation of genetic diversity** | The assessment includes the costs of legal declaration, development of management plans, ecological monitoring, establishment of genetic banks, technical infrastructure and education for approximately 750 ha of new protected areas. The average cost for complex measures for the protection and conservation of genetic resources is about 15,000 KM/ha. | 6 |
| **TOTAL (measures from key sectors for mitigation), million EUR** | | **7.116** |
| **Electricity generation from coal** | Modernisation and maintenance of existing TE capacities | 390 |
| **Development of the electricity transmission network** | New interconnector transmission lines, New substations and transmission lines, Reconstruction and rehabilitation of plants, Installation of inductors | 353 |



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| Measure | Rationale | Total investment, million EUR |
|---|---|---|
| **Development of the electricity distribution network** | Implementation of plans to expand the electricity distribution network | 830 |
| **Natural Gas Transmission and Storage Infrastructure** | Construction of a new interconnection for the transmission of natural gas, Construction of capacities for storage of natural gas | 490 |
| **Just transition** | Mine closures, land rehabilitation, other socio-economic issues | up to 1,395 |
| **Healthcare** | Improving the health status of citizens | 7 |
| **TOTAL (with additional measures from the draft NECP), million EUR** | | **10.581** |

BiH's financial needs include significant investments in energy efficiency measures, increasing the share of OiE, modernisation of electricity infrastructure and the introduction of advanced technologies in all sectors. In addition, funding is needed to set up social funds to support vulnerable categories, fund research and innovation, as well as strengthen monitoring, reporting and verification (MRV) capacity and assess progress.

For the sake of sustainability of financing, the plan envisages a reform of the legislative framework, including amendments to the Energy Efficiency Act to establish EEE schemes, a legal basis for PPP and ESCO models, and the development of innovative financial instruments such as green bonds and crowd-financing. In parallel, it is necessary to strengthen institutional capacities for the preparation, management and monitoring of projects financed from these sources, in order to ensure the effective and transparent implementation of the objectives defined in the draft NECP.

This financial framework is a key component for the implementation of the NDC targets, because without stable and diversified sources of financing, the implementation of the planned measures and the achievement of the 2030 targets would not be possible.

A detailed overview of the information on the financial support needed by developing countries under Article 11 of the Paris Agreement on a case-by-case basis is set out in Annex II.

## 6.3. Information on Financial assistance received.

As already stated, BiH is a developing country that benefits from the assistance of international institutions such as the EU through IPA funds, UNDP, KfW, SIDA, WB, EBRD, GCF, GEF and bilateral donors.

The focus of the donations shifted to the green transition, implementation of the Sustainable Development Goals and preparation for EU integration, with an emphasis on:

- Energy efficiency in the public and private sectors.
- Water resources management and flood protection, which are becoming more frequent due to climate change,
- Promotion of OiE and reduction of dependence on fossil fuels.

Despite the challenges, BiH has been able to make progress through international cooperation, which has helped the country lay the groundwork for a more sustainable approach to tackling climate change. Total development financial assistance to BiH focused on climate change in the period 2002-2021 It is $17.1 billion.[117] Of the 2002-2019 funds, $1.33 billion was directed to climate change mitigation activities. In the same period, $598 million was focused on adjustment activities.

Payments of development financial assistance to BiH focused on climate change came from different donors and were allocated to different beneficiaries, as shown in the following figure. The largest sources of financing were the EIB ($2.94 billion), the EBRD ($2.57 billion) and EU institutions ($2.37 billion). The most important donors of funds for BiH in the period 2002 – 2021 are presented below.

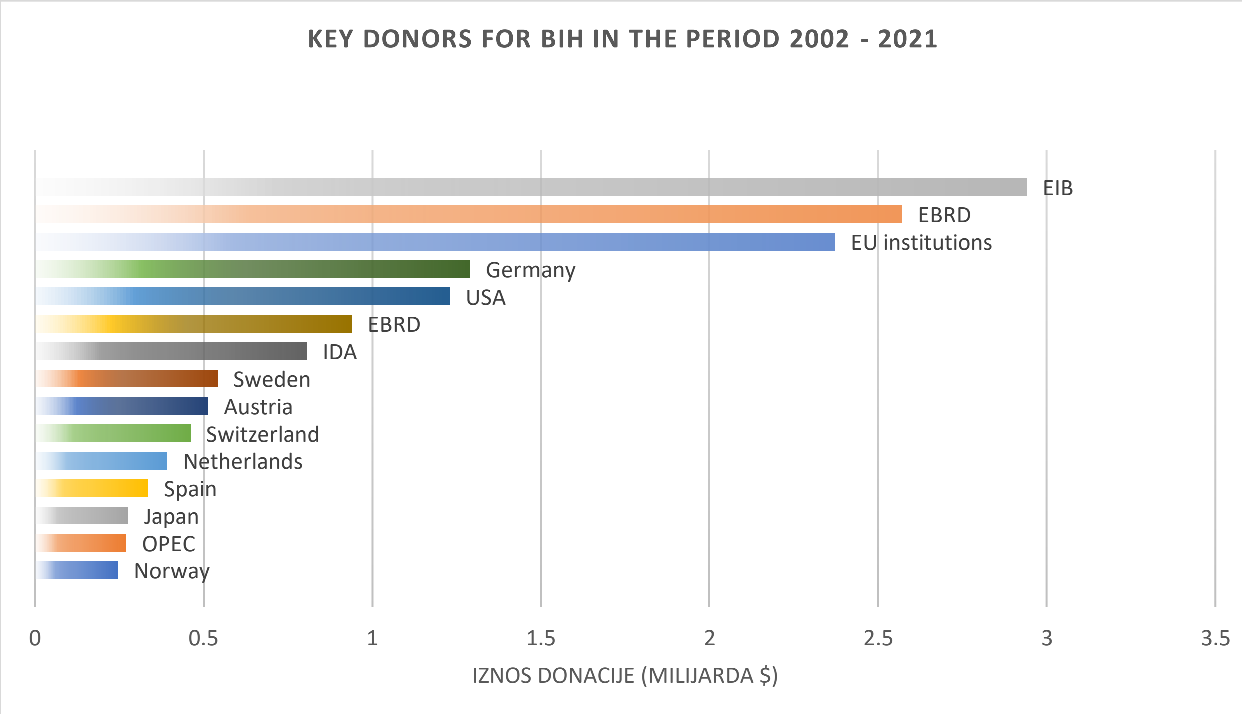


*Figure 35: Key donors of funds for BiH in the period 2002 – 2021[118]*

Development funds for BiH are provided by different sectors, as shown in the table below. The largest liabilities were $2.62 billion for Transportation and Storage, $2.36 billion for Government and Civil Society, and $1.77 billion for Banking and Financial Services.

*Table 32: Total funding by support category[119]*

| Title | Amount (million $) | Share |
|---|---|---|
| **Transport and storage** | 2,616.22 | 15.3% |
| **Government and civil society** | 2,356.71 | 13.8% |
| **Banking & Financial Services** | 1,772.63 | 104% |
| **Industry, Mining, Construction** | 1,134.47 | 6.6% |
| **Conflicts, peace and security** | 1,027.26 | 6% |
| **Energy** | 1,015.32 | 5.9% |
| **Other social infrastructure and services** | 916.71 | 5.4% |
| **Water supply and sanitation** | 867.92 | 5.1% |
| **Education** | 846.15 | 5% |

[117] *https://aid-atlas.org/profile/all/bosnia-and-herzegovina/all/2002-2021?usdType=usd_commitment*
[118] *https://aid-atlas.org/profile/all/bosnia-and-herzegovina/all/2002-2021?usdType=usd_commitment*
[119] *https://aid-atlas.org/profile/all/bosnia-and-herzegovina/all/2002-2021?usdType=usd_commitment*

| Title | Amount (million $) | Share |
|---|---|---|
| **Other Multi-Sectoral / Cross-Sectoral** | 838.70 | 4.9% |
| **Unallocated / Unspecified** | 660.02 | 3.9% |
| **Healthcare** | 474.38 | 2.8% |
| **Business and other services** | 392.77 | 2.3% |
| **Agriculture, forestry, fisheries** | 339.14 | 2% |
| **Responding to Emergencies** | 335.21 | 2% |
| **General budget support** | 313.20 | 1.8% |
| **Reconstruction, assistance and rehabilitation** | 295.78 | 1.7% |
| **Other economic infrastructure and services** | 270.64 | 1.6% |
| **General environmental protection** | 124.41 | 0.73% |
| **Trade Policies & Regulations** | 117.25 | 0.69% |
| **Donor Administrative Costs** | 90.17 | 0.53% |
| **Communications** | 52.98 | 0.31% |
| **Disaster prevention and preparedness** | 48.22 | 0.28% |
| **Refugees in donor countries** | 46.99 | 0.28% |
| **Population Policies/Programs and Reproductive Health** | 43.71 | 0.26% |
| **Food development aid** | 29.97 | 0.18% |
| **Debt-related activities** | 29.27 | 0.17% |
| **Tourism** | 15.83 | <0.001% |
| **Other aid in goods** | 11.58 | <0.001% |
| **TOTAL** | 17,083.61 | |

In the period from 2002 to 2021, BiH received development support in the amount of EUR 14.60 billion. When reporting to the Organisation for Economic Co-operation and Development (OECD), funders can indicate whether each component of the financial support they provided was directed towards one or more different "global goals". The orientation of BiH development finance towards various global goals is shown in the table below. A single project can be classified as a project focused on more than one goal, while some projects do not target any of these goals.

For BiH, the targeted global goals that received the most funding were Climate Change (total) ($1.9 billion), Environment ($1.35 billion) and Climate Change Mitigation ($1.33 billion).[120]

*Table 33: Total funding by support category[121]*

| Global goal | Amount (million $) |
|---|---|
| **Climate changes (total)** | 1,898 |
| **Environment** | 1,353 |
| **Climate change mitigation** | 1,333 |
| **Adapting to climate change** | 598 |
| **Gender equality** | 429 |
| **Trade** | 301 |
| **COVID-19 (not an OECD target)** | 290 |
| **Disability** | 34.1 |
| **Biodiversity** | 18.1 |

[120] *https://aid-atlas.org/profile/all/bosnia-and-herzegovina/all/2002-2021?usdType=usd_commitment*
[121] *https://aid-atlas.org/profile/all/bosnia-and-herzegovina/all/2002-2021?usdType=usd_commitment*

| | |
|---|---|
| **Disaster Risk Reduction (DRR)** | 5.63 |
| **Desertification** | 1.34 |
| **Reproductive, Maternal, Newborn and Child Health (RMNCH)** | 0.89 |
| **Nutrition** | 0.14 |
| **Participatory development and good governance** | 0 |
| **TOTAL** | **6,262** |

Of the total amount of USD 4,854 million, or EUR 4.42 billion, invested as development funds in the field of climate goals in the past nineteen years (climate change, environment and climate change mitigation), the average annual investment amount was EUR 0.23 billion. Given that BiH, in order to achieve its climate goals in the period 2023-2030, has a total investment need of EUR 10.58 billion, or EUR 1.51 billion per year, an increase in development support and resources of EUR 1.28 billion per year is necessary, representing an increase of 557%. If BiH could cover 50% of the costs of achieving the determined contribution from its own resources, the remaining need for development support and funds would amount to EUR 0.53 billion per year, which represents an increase of 228% compared to the current average annual level of investment.

A detailed overview of the information on the financial support received by individual measures is given in Attachment II.

### 6.4. Information on Necessary Support for Capacity Building

There is still a strong need for further capacity building in BiH to successfully meet its commitments under the Enhanced Transparency Framework and achieve more ambitious climate goals. Institutional strengthening is a priority: coordination needs to be improved and climate competences between different levels of government clearly defined. Also, continued support is needed for the establishment of sustainable financial mechanisms (climate funds, green budget lines) within BiH, which requires advice in the field of climate-related fiscal and budgetary policy.

Staffing is equally important. Although many people have been trained through previous projects, staff turnover and the emergence of new responsibilities mean that the training of civil servants at all levels is still a continuous need. Of particular importance is the training of civil servants in the preparation of project proposals for climate funds, integration of climate criteria into sectoral policies, and the keeping of records on climate finance (e.g. climate budgeting). At the local level, municipalities need to build capacity to implement and monitor climate action – many smaller municipalities still lack enough trained staff to prepare energy efficiency projects or manage climate hazard risks.

In the domain of transparency (MRV system), BiH has identified shortcomings in the technological basis for monitoring emissions and in the capacity to manage climate data in BTR1. This implies the need to train staff to use new software tools, to manage GHG inventory, and to improve the process of making GHG inventory. BiH, as a Non-Annex I country, faces a number of challenges in the process of preparing GHG inventory:

- The preparation of the GHG inventory is carried out within the framework of a project financed by international financial institutions, with a noted lack of experts in authorised institutions for the preparation of inventory,
- Institutional arrangements and coordination of institutions in the process of collecting, processing and submitting data,
- Lack of a standardised methodology for data collection, incomplete or inconsistent data, and limited access to relevant data;
- Lack of harmonised databases with data from both entities in BiH on activities, emission factors and emissions for the period since 1990,
- Inconsistencies between existing data and data necessary for calculation according to the IPCC methodology and
- Lack of legislation on the type and scope of data collected in BiH.

The lack of a standardised methodology for data collection, incomplete or inconsistent data, and limited access to relevant data are problems that significantly hamper the accuracy and consistency of inventory. These challenges can lead to inaccurate emission estimates and make it difficult to produce reliable reports. Also, the lack of harmonised databases, covering data on emissions, activities and emission factors for the period since 1990, is a significant aggravating circumstance for showing the complete and consistent trend of emissions.

To overcome these challenges, it is necessary to introduce standardised data collection methodologies that will enable consistency and alignment with international practices. In addition, it is necessary to continuously work on harmonising the data collected, analysed and presented in statistical reports (at the BiH and entity levels), with the data needed for the calculation of the GHG inventory according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, taking into account the improvements from 2019 (Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories). The need for more clear definition of obligations regarding the submission of data by entity and cantonal institutions was emphasised, with the aim of improving the consistency and reliability of data used for the preparation of GHG inventory.

Also, it is necessary to create harmonised databases in both entities that would include all information on data on activities, emission factors and emissions, which would enable easier analysis and reporting. Improving institutional arrangements and coordination among relevant institutions is also crucial for the efficient collection and exchange of data, and it is particularly important to comply with legislation that would define the type and scope of data to be collected.

In addition, it is important to strengthen the capacities of institutions (hydrometeorological institutes) through additional training and employment of experts, in order to ensure the sustainability and quality of the inventory on a long-term basis. In order to improve the quality of inventory, it is recommended to participate in trainings and projects such as, among other things, RIPAP and CBIT projects. Some of the units that should be included in the training are data collection and analysis, improvement of inter-institutional cooperation and the use of software tools for calculating emissions. In order to define the initial condition and improve the consistency and completeness of the time series, it is necessary, through recalculation by 1990, to determine the zero/initial condition according to the latest methodology, given that BiH has used the flexibility of showing emissions since 2014 in the last inventory. For all sectors, especially for the LULUCF sector, additional methods of data collection should be introduced, as well as the implementation of expert analyses that will improve the data used for the creation of the inventory, and new methods of data collection should be found. During the preparation of the last GHG inventory for the period 2019 – 2022, the necessary improvements in the collection, processing and analysis of emission data were identified.

Also, it is necessary to strengthen the awareness of institutions about the importance of inventory, about the importance of using inventory data for NDC and about the importance of providing data in the manner required by those who create the inventory. Capacity building in this segment implies the establishment of sustainable financing mechanisms through increasing funds from the budget, strengthening institutional knowledge and skills, and training of staff in charge of data collection, processing and verification. Also, it is important to develop capacities for identification and application for international projects and funds, as well as to consider the introduction of mandatory contributions from the high-emission sector in order to ensure stable financing of this process.

Better digitisation and standardisation of data and greater participation of academic and research institutions would improve the quality and availability of data.

Greater investment in education and awareness raising on climate change could improve policies and measures to reduce emissions. Stricter regulations and controls for polluters and incentives for the transition to OiE would also have an impact on reducing emissions.

Also, it is necessary to strengthen the capacities for emission projections and policy analysis – experts in BiH need training in the use of models for energy and climate planning (LEAP, MARKAL, etc.), so that they can independently create scenarios and monitor the effect of measures.

There is also a need for international knowledge exchange in the field of climate policy. This includes twinning programs with institutions from EU countries, where employees of BiH institutions would collaborate with colleagues from abroad to take over the best practices of climate management. Also, study visits and participation in international trainings (e.g. through city networks) would help domestic staff gain practical experience on how other countries are solving similar challenges. Examples of useful lessons include: how Croatia has established the Social Climate Fund, how the Czech Republic is implementing a just transition in its mining regions, how Slovenia integrates climate risks into local planning, etc.

It is important to emphasize that capacities should be built not only in the public sector, but also in the private and civil sectors. Private companies in BiH are mostly just starting to deal with climate risks and green investments, and training is needed for the corporate sector on climate reporting, emission inventories and adapting business models to the green transition. Similarly, NGOs and local communities need support to develop skills to monitor the implementation of climate strategies and engage citizens in climate action. A detailed overview of the information on the necessary support for capacity building by individual measures is provided in Attachment II.

## 6.5. Information on received capacity building support

Through international support in the past period, the capacities of institutions and experts in BiH for the implementation of climate measures have been significantly strengthened. Capacity-building programs have covered all levels, from state ministries, through entity and local authorities, to the private and non-governmental sectors. The USAID Energy Policy Activity project (2019–2024) provided expert assistance to ministries and regulatory bodies in the creation and implementation of energy



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and climate policies. Through this project, strategies and laws related to energy efficiency, renewable energy and energy market have been developed or improved, and officials have been trained on how to implement them. In parallel, the EU4Energy initiative (2018–2021), funded by the EU and the German BMZ, engaged experts who worked with the entity ministries on the harmonisation of energy legislation with EU standards, development of action plans for EE, establishment of an energy statistics system, etc. These projects significantly improved the institutional knowledge of the staff of ministries, regulatory commissions and system operators, who underwent training on market liberalisation, regulation of energy services, integration of OiE, etc. As a result, new laws have been adopted (e.g. the Law on Energy Efficiency of FBiH, amendments to the Law on Electricity and Gas) and the basis for complex reforms such as the establishment of an organised electricity market has been prepared.

At the local level, initiatives such as the German project CAfET (Joint Action for Energy Transition) have empowered municipalities, NGOs and citizens to participate in climate action. CAfET brought together local stakeholders with the aim of increasing community participation in the energy transition, whereby educational campaigns for citizens on energy saving and the use of OiE were organised, energy cooperatives were formed and pilot projects were launched in communities. Through the project, GIZ experts transferred know-how on citizen energy models, and study visits to the region were organised for practical exchange of experiences. This initiative has strengthened capacities on the ground in such a way that citizens and local officials are trained to independently initiate and implement smaller energy efficiency and OiE projects, which contributes to the sustainability of the transition "bottom-up".

Long-term programmes implemented by UNDP, with the support of donors, have made a significant contribution to capacity building. The Green Economic Development (GED) program, supported by Sida, combined investments in the renovation of public buildings with the strengthening of local experts. Hundreds of schools, hospitals and other public buildings have been renovated through the GAD, with local companies and engineers gaining the knowledge to carry out energy renovations. An energy management system has also been established in public institutions, and energy managers have been appointed who are trained to monitor energy consumption and identify savings. Swedish experts provided technical assistance in the development of these systems. Furthermore, the Scaling-up Low-Carbon Public Buildings project (funded by GCF) has expanded these efforts: a national framework for investing in low-carbon buildings has been established, financing models have been developed, and in 2022, 2,763 public sector energy managers were trained through the FBiH Environmental Fund. Virtually every public institution has received a trained person for energy management, which has given thousands of people, from municipal mayors to school janitors, the skills to implement energy-saving measures and monitor results. Cumulatively, these UNDP programs have resulted in energy and budget savings at the local level, reduced $CO_2$ emissions, and created local expert teams (architects, engineers) specializing in energy efficiency.

At the city level, the URBANLED project (GEF), in addition to technological pilot measures, as already described, has also made a significant contribution to local self-governments. City administrations (Sarajevo, Banja Luka, Zenica, etc.) received international experts to help develop action plans to reduce emissions, and officials were trained on how to integrate climate action into daily planning and utility projects. Through trainings and practical projects, URBANLED has empowered cities to independently apply for funds and implement climate projects, which has resulted in some municipalities already continuing similar activities with their own funds.

Overall, international support through training, mentoring and institutional counselling has significantly increased BiH's internal capacity for climate action. Today, there are a much larger number of officials and experts familiar with climate policies, technologies and procedures in ministries, agencies, municipalities and companies than there were a few years ago. This will allow BiH to plan and implement its commitments under the Paris Agreement more effectively.

*Table 34: Major Projects of International Support for Capacity Building (2018-2024)*

| Project/Program | Capacity area | Amount | Period | Funding/Support |
|---|---|---|---|---|
| **USAID Energy Policy Activity** | Energy sector reforms (policies, regulations) | \$7.5 million | 2019–2024 | USA (USAID grant, technical assistance) |
| **EU4Energy - Technical assistance to the energy sector** | Harmonization of regulations with the EU, action plans | — | 2018–2021 | EU/Germany (GIZ project TA) |
| **GIZ CAfET - ET Joint Action** | Local energy transition (citizens' initiatives) | €3.0 million | 2023–2026 | Germany (BMZ/GIZ grant) |
| **CBIT transparency (UNDP/GEF 5NC/BTR)** | ETF capacities (GHG inventory, MRV) | ~\$1.23 million | 2020–2024 | GEF (CBIT grant, via UNDP) |

An overview of the information received for capacity building by measure is provided in Attachment II.

## 6.6. Information on necessary assistance for the development and transfer of technologies

Specific needs for technology transfer in several sectors have been identified, with the aim of improving the transparency system and accelerating the transition to low-carbon development.

In the energy sector and in the field of energy efficiency, there is a need for modern technologies for clean energy and efficiency improvement, such as advanced OiE, smart grids, energy storage systems, with appropriate training of personnel for their work. These technologies are key to accelerating the energy transition from fossil fuels to renewable energy in BiH and reducing the intensity of emissions per unit of energy. Also, the lack of a technical basis for monitoring emissions and managing climate data has been identified. Modernisation of monitoring, reporting and verification (MRV) systems is needed, including the procurement of specialised equipment for measuring emissions in industry, energy and other sectors, the development of software tools for the collection and processing of climate data, and the establishment of integrated databases that connect different institutions. Without these technological improvements, it will not be possible to meet the increased transparency requirements or to monitor the progress in reducing emissions.

In some sectors of the economy, specific technology is needed to reduce emissions and adapt to modern standards. The forestry sector needs new tools for monitoring forest resources and carbon stocks (e.g. satellite monitoring, GIS technologies) to better manage forests and increase their role as carbon sinks. In the cooling gas industry (refrigeration/cooling and air conditioning), BiH needs technologies with low global warming (low-GWP) and a system for monitoring F-gas emissions. In particular, it is necessary to provide devices for detecting refrigerant leaks, vacuum pumps and systems for collecting and recycling/filling refrigerants. This would enable the gradual phase-out of old appliances (refrigerators, air conditioners, refrigerated display cases) with high GWP and the transition to new generations, which also requires the training of service technicians to operate this equipment.

Given the risks of climate change, adaptation technologies are needed, e.g. advanced early warning systems for floods and fires, climate-resilient materials for the construction of infrastructure facilities, technologies for efficient irrigation, and the like. It is necessary to strengthen the capacities for disaster risk management in BiH through technical solutions (meteorological radars, sensor network, climate projection software) in order to protect against increasingly frequent extreme events.

Institutions in Bosnia and Herzegovina currently have limited domestic resources and knowledge for the procurement and implementation of these technologies. Implementation of the recommended technologies is directly related to the availability of international assistance, because local budgets and professional staff are not enough to perform such a broad technological modernisation on their own. That is why international cooperation mechanisms will be used for the transfer of priority technologies to BiH – from technological development programs under the auspices of the UNFCCC, through regional initiatives of the Energy Community, to bilateral agreements with developed countries that can offer both technology and training.

An overview of the necessary assistance for the development and transfer of technologies by individual measures is provided in Attachment II.

## 6.7. Information on assistance received for the development and transfer of technologies

In the period 2018-2024, the competent institutions in BiH used a number of initiatives that ensured the transfer of technologies and knowledge in the field of climate change. These activities were often complementary to financial assistance, while grants and loans provided equipment and investments, technical programs strengthened HR capacities and enabled the sustainability of interventions. In other words, technology was mostly transferred to BiH through projects that simultaneously built capacities for its use.

Examples of successful technology transfers include projects in the energy and utility sectors. The Global Environment Facility (GEF) funded the URBANLED project, which introduced the concept of low-carbon urban development in 7 cities, whereby cities received expert assistance in developing climate action plans and identifying priority measures, and pilot projects such as the installation of LED public lighting were implemented. Through URBANLED, municipal officials were trained on how to integrate climate aspects into urbanism, and demonstrations (LED lights, bicycle schemes, urban green spaces) showed new technologies on the ground. Also, UNDP's "Inclusive Decarbonisation" project (with the support of Japan) provided technological and financial assistance to SMEs to introduce energy efficiency measures and OiE, including the procurement of low-emission equipment and the development of just transition strategies for the economy. Within the Caritas Switzerland project "Combating Climate Change and Energy Poverty through Energy Efficiency" implemented in urban and rural areas of BiH, target households received support through energy efficiency measures and promotion of OiE, with additional education of the local population about the benefits of sustainable energy solutions. Such pilot projects have not only brought concrete technology (e.g. photovoltaic systems, energy-efficient lighting), but have also increased the awareness of local communities about the benefits of clean technologies. Through the integration of financial and technical components, BiH has been able to test and adopt new technologies in practice. Almost all major investments were accompanied by knowledge transfer activities: e.g. the GCF project for the renovation of public buildings not only renovated the buildings but also trained the staff in energy management, the WBIF support for wind farms included technical assistance for studies and training of operators, the EU budget support for energy efficiency was accompanied by the engagement of advisors who helped users how to properly use the funds. Such an integrated approach ensures that the transferred technology is used sustainably, because local experts at the same time acquire knowledge for its implementation.

*Table 35: Received Technology Transfer (Climate Technology) Projects in BiH 2018–2024*

| Project/Initiative | Sector (focus) | Amount | Period | Funded/Implemented. |
|---|---|---|---|---|
| **URBANLED – Low-Carbon Urban Development** | Urbanism / Energy Efficiency | $2.37 million | 2018–2024 | GEF/UNDP (grant) |
| **"Inclusive Decarbonisation" (IDA) – support for SMEs** | Economy (SME, EE and OiE) | $1.87 million | 2022–2023 | Japan/UNDP (grant) |
| **OiE/EE in Rural Development (Pilot Community)** | Rural development (solar, biogas) | 0.201 mil. KM | 2017–2018 | Caritas Switzerland + local partners (grant) |

An overview of the information received for the development and transfer of technologies by individual measures is provided in Attachment II.

### 6.8. Information on the support needed and received by developing countries for implementation of Article 13 of the Paris Agreement and transparency activities, including capacity building on transparency

For purpose of preparing BTR1, BiH received technical and financial support through the project "Preparation of the Fifth National Communication of BiH and the First and Second Biennial Transparency Reports as Combined Reports according to the UNFCCC (5NC)", funded by the GEF and implemented by UNDP in partnership with MVTEO BiH, the Ministry of Spatial Planning, Construction and Ecology of RS, the FBiH Ministry of Environment and Tourism and the Department of Spatial Planning and Property Affairs of the BD BiH. Through the project, in addition to supporting the preparation of BTR1, awareness raising and capacity building was carried out through organised trainings and workshops on the preparation of GHG inventory, especially in the sector of land use and land use change and forestry.

However, the support received for the development of BTR1 does not cover all the capacities and needs of the country in relation to the sustainable establishment of a transparency system. Therefore, the need for additional and long-term support was expressed, which includes:

- Strengthening the institutional framework and formalising accountability for MRV and ETF activities,
- Development of sectoral protocols and methodologies for data collection,
- Continuous training of staff at all levels of government,
- Improving information systems and databases and
- Building sustainable financial mechanisms for continuous reporting.



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## 6.9. Progress at the level of implementation of the Technology Needs Assessment (TNA) – developed within the Fourth National Climate Change Report (NC4)

TNA BiH was developed as part of the FNC on Climate Change, with a focus on the agriculture and water resources sectors, where existing and potential technologies for climate change mitigation and adaptation were identified.

In the water resources sector, 102 different technologies were considered, of which 14 were selected as priority adaptation technologies specific to the situation in BiH. These priority measures include, but are not limited to, the development of urban green spaces for stormwater management, the collection of rainwater to improve water supply during dry periods, the improvement of the efficiency of wastewater treatment plants, and the optimisation of urban drainage systems to reduce the risk of flash floods.

In agriculture, a multi-criteria analysis (MCA) identified 22 priority adaptation technologies. These include measures such as the introduction of combined systems of agricultural production and forestry (agroforestry) for more efficient land use and a more resilient system of crop rotation to preserve soil fertility, improvement of irrigation systems and soil moisture conservation, selective breeding of crops and breeds resistant to drought and disease, construction of drainage channels to drain excess water, and the establishment of protective belts (windbreaks) to reduce soil erosion. These technologies and measures are prioritised with the aim of increasing the resilience of agriculture and the water sector to the increasingly pronounced climate stress in BiH.

Below is an overview of adaptation technologies in the sector of water resources from BiH TNA, [122]with a review of the degree of their implementation.

[122] *Fourth National Communication of BiH, 2021.*

*Table 36: Overview of progress in TNA implementation*

| Ord. No. | Technology | Description | Overview of progress in implementation of the measure |
|---|---|---|---|
| 1. | **Mixed farms and agroforestry** | Adaptation technology to increase resilience and productivity in agriculture (combined crop and livestock production, agroforest systems).<br>**Response**: production safety and resilience of plants and animals to climate extremes. | **Partial progress.** The concept of agroforestry systems has been recognised in new resilience projects: for example, as part of the proposed IFAD/Adaptation Fund project STAZA, it is planned to establish a variety of agroforestry plantations for better resilience of small farms. Although widespread use has not yet been recorded, there has been increased awareness of the benefits of integrating perennial woody species on farms and combining livestock and crop production to adapt to climate change (this is promoted through expert workshops and NAP initiatives in BiH). |
| 2. | **Crop rotation** | Adaptation technology to increase plant resistance and yield.<br>**Response**: reducing the risk of plant diseases and pest attacks, better crop resistance to climate extremes, and preserving soil fertility. | Experts continuously emphasize the importance of crop rotation as an adaptation measure – it is integrated into strategic documents such as the FBiH Strategy for Agriculture and Rural Development, which states that **changes in the way of tillage (e.g. conservation tillage, anti-erosion measures) and agronomic measures such as wider crop rotation** should be applied to adapt to climate change. EPBiH has started test planting of fast-growing trees at two locations of abandoned mines, Đurđenik and Kreka. Advisory services and projects (e.g. EU4AGRI) promote crop rotation as part of sustainable agriculture in a changing climate. |
| 3. | **Irrigation and system selection, water collection** | Water shortage adaptation technology.<br>**Response**: Effective management of water resources through appropriate irrigation systems and rainwater capture/storage. | Significant progress in infrastructure investments. Projects to expand the irrigation system have been launched in both entities. An example is the region of Semberija (RS), where a modern irrigation system has been built in several phases since 2019 – by 2022, over 2,200 hectares of arable land have been coveredwith a new network of canals and pumps. This project plans a total irrigation of ~11,000 ha according to the priorities determinedby the needs analysis (the most intensive agricultural area is covered first). Investment is also growing in the FBiH: for example, through EU4AGRI-Recovery 2023, grants were awarded to farms for the introduction of |



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| | | | irrigation systems (drip irrigation systems, rainwater collection systems) for drought resistance. In Herzegovina, irrigation systems were reconstructed (financed by the World Bank, the Spanish Government and the Government of Bosnia and Herzegovina) on the area of Zlatac – Sopilja (30 ha), Trebinje field (250 ha) and Popovo polje (350 ha). Also, in Trebinje, in the past few years, about 15 million BAM has been allocated for the irrigation system, which was financed by the City of Trebinje, the Hydroelectric Power Plant on Trebišnjica and the Ministry of Agriculture of the Republika Srpska. A positive example is the initiative of the Association of Water Users in Trebinje and its surroundings (Pištet, Ubosko) for the rational distribution of water for irrigation.<br><br>These developments show that irrigation has been recognized as a priority adaptation measure, with the supportof entity governments and international projects. |
| **4.** | **Selective livestock breeding (breed selection)** | Adaptation technology to reduce risk in animal husbandry.<br>**Response**: greater resilience of livestock systems to climate change while maintaining productivity (selection of adapted breeds and genetic improvement). | **Limited progress.** The livestock sector in BiH is aware of the need to preserve indigenous and more resistant breeds, but the concrete measures are modest. The strategies point out that indigenous breeds are threatened with disappearance and that financial support for their protection has so far been very modest. After 2021, there are no indications of major climate-related genetic selection programs, other than the continuation of existing subsidies (e.g. lower incentives for native species in entity support programs). The Ministry of Economy of Sarajevo Canton, in cooperation with the Faculty of Agriculture and Food and Veterinary Medicine of the University of Sarajevo, as well as veterinary stations and the FBiH Institute of Agriculture, has been successfully implementing the project "Insemination of cattle in the Sarajevo Canton, with the aim of improving the production and health status of dairy cattle" for two years. |
| **5.** | **Soil moisture conservation measures** | Water shortage adaptation technology.<br>**Response**: conservation of water in the soil for more efficient consumption (application of mulch, conservation tillage, ploughing of harvest residues, etc.). | **At the promotion stage, without wide application.** Conservation agriculture and related moisture conservation measures (minimal tillage, mulching, cover crops) are increasingly recommended through scientific and professional projects and trainings. The strategies emphasize **conservation tillage and anti-erosion measures** as key to adaptation to droughts. Since 2021, faculties and institutes (e.g. through European HORIZON projects such as SMARTWATER and SUS-Soil) have been working on research on soil degradation due to climate change and promoting smart irrigation and treatment techniques. |

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| **6.** | **Construction of a drainage system to drain excess water from the plots** | Technology of adaptation to excess water and landscaping.<br>**Response**: flood protection and retention/diversion of excess water from the field. | **Moderate progress through flood protection projects.** After the catastrophic floods in 2014, investments in drainage channels and drainage systems continued. As part of the expansion of irrigation in Semberija, for example, the main drainage channel "Stara Dašnica" (12.5 km) was rehabilitated and extended in parallel in order to regulate the excess surface water. Similar interventions on the cleaning and arrangement of the canal network were carried out in Posavina and Lijevče polje through entity water projects. Also, some cantons have published public calls for agricultural land development projects that include canal cleaning and wetland reclamation. Although there is not yet an integrated drainage system at the state level, these steps show the gradual resolution of excess water at the local level to protect crops from flooding. |
| **7.** | **Contour tillage** | Adaptation technology to reduce surface soil erosion and preserve moisture – a measure of land shaping by ploughing/sowing on contour lines.<br>**Response**: reducing or preventing soil erosion and degradation due to water runoff. | **Mostly in the form of recommendations, rarely applied.** Contour ploughing and slope sowing are highlighted in manuals as an effective low-cost anti-erosion measure. Adaptation guidelines (e.g. those presented to municipalities in the Vrbas basin) recommend that farmers cultivate slopes according to contours and other counter-erosive practices to reduce soil leaching during heavy rainfall. In the strategies, contouring is implicitly mentioned through "counter-erosive measures". However, in the field, the application is limited to individual farms in hilly and mountainous areas, due to the lack of adequate machinery (craft plough). There is no record that major projects have been launched to subsidize contouring, progress is reflected more in education (agronomists' advice) than in systemic implementation. |
| **8.** | **Production of animal feed** | Adaptation technology to reduce risk in animal husbandry.<br>**Response**: safety in the production of animal feed and welfare of domestic animals through a stable supply of nutrients. | **Slight progress through support and emergency measures.** Increasingly frequent droughts reduce the natural yield of pastures and meadows, so the provision of fodder has become a priority. The entity authorities have increased allocations to support crop production, which includes fodder crops (e.g. maize for silage). After the drought episodes of 2021–2022, ad-hoc measures were recorded: in the RS and FBiH, intervention packages of fodder or subsidies for the purchase of hay were occasionally allocated to farmers in the most affected areas (to prevent the loss of |



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| | | | livestock). Nevertheless, domestic feed production is still dependent on weather conditions – initiatives for agricultural land irrigation and **sustainable pasture management** (see Action 21) indirectly contribute to addressing this problem. |
| **9.** | **Terraces** | Technology of adaptation of agriculture on steep terrains, erosion control and drainage of excess water – shaping land into terraces.<br>**Response**: reducing or preventing soil erosion and degradation by water or tillage land. | **Minimal progress.** Terraces are recognized as a traditional method of erosion protection in hilly and mountainous areas of Bosnia and Herzegovina (e.g. historic vineyards and orchards in terraces). However, after 2021, there was no wider launch of projects to build new terraces. In strategic documents, placing terraces is indirectly mentioned (through erosion control measures on sloping lands), but there is a lack of funding for its implementation due to high costs. Locally, some river basin management projects (with the support of the GEF/UNDP) have considered terracering smaller areas as part of anti-erosion demonstrations, but this has remained on a limited scale. All in all, there are no significant new terraces, other than maintaining the existing ones and raising awareness of this measure. |
| **10.** | **Advisory services for agriculture and rural development** | Adaptation technology aimed at spotting climate risks.<br>**Response**: hazard and risk assessment, support for production sustainability (education and expert advice to producers). | **Moderate progress through capacity building.** After 2021, staff training activities and strengthening advisory services on climate change were intensified. Within the NAP project, a large number of representatives of entity ministries, cantonal services and municipalities were educated on the impact of climate change on land degradation and on adaptation measures on agricultural plots. In this way, advisors are trained to transfer practical knowledge to farmers (e.g. how to reduce the risk of droughts and floods by applying appropriate agrotechnics). Also, EU-funded projects (EU4AGRI, EU4Climate) organised information sessions and info days for farmers on adaptation. Although there is still a lack of systematic financing of new jobs in advisory services, existing agronomists are increasingly incorporating climate advice into their work, which is a step forward. |
| **11.** | **Insurance of agricultural production** (through insurance companies) | Adaptation technology to perceive and cover climate risks. | **Significant advances in insurance support.** Over the past few years, entity governments have increased subsidies for agricultural insurance premiums, in an effort to encourage more producers to provide crops and livestock. The result is a growing interest from farmers. Although the overall coverage of insurance is still not at an enviable level, as evidenced by the fact that insurance companies do not have |

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| | | **Response**: risk assessment and financial protection of agricultural production from damages (crop and livestock insurance). | a clear definition of what drought/flood is and are reluctant to insure properties against these damages, these steps show a concrete shift towards the financial resilience of the sector to climate disasters. |
| **12.** | **Microaccumulations (small reservoirs, wells, catchers) in hilly-mountainous areas** | Water shortage adaptation technology.<br>**Response**: local water storage (for irrigation of small plots, watering livestock and game) through the construction of smaller reservoirs, cisterns, watering holes, etc. | **Planned progress through projects, limited at the pilot level.** In the adaptation plans of BiH, the need for the construction of micro-reservoirs has been recognized in order to better water supply to remote rural areas during droughts. The STAZA project envisages the implementation of **rainwater harvesting and water storage systems** on farms to mitigate the effects of dry periods. Previously, some municipalities (e.g. in Herzegovina) with the support of UNDP/GEF projects built smaller reservoirs for local irrigation and watering holes, but after 2021 there is no mass implementation of new facilities. However, through EU4AGRI calls, several farms received funds for wells and irrigation tanks in 2023. In short, awareness and plans exist, and more intensive implementation is expected when the implementation of the STAZA project and similar initiatives begins. |
| **13.** | **Disease and pest control on plants** | Adaptation technology to address climate risks.<br>**Response**: hazard and risk assessment in crop production (timely detection and control of plant diseases and insect pests in changing climate conditions). | **Modern orchards install agrometeorological stations for monitoring temperature and humidity for early detection of conditions for the occurrence of diseases and pests.** No special early warning system for the spread of plant pests has been established at the level of BiH, but entity plant protection services monitor the situation and issue warnings (e.g. about the appearance of new invasive insects). Projects such as EU4Agri and FAO initiatives have organized trainings on integrated pest management, which is part of climate-smart agriculture. |
| **14.** | **Disease control in farm animals** | Adaptation technology to address climate risks.<br>**Response**: Hazard and risk assessment in animal husbandry (monitoring, prevention | **Enhanced monitoring, without a special adaptation program.** Veterinary services of BiH are monitoring new trends in climate-related diseases. In the last decade, changes have already been observed in the occurrence and prevalence of certain vector-borne diseases (such as Lyme disease, leishmaniasis, dengue fever) due to the increase in temperature. After 2021, no new early warning system has been put in place, but existing biosecurity measures and controls have been strengthened |

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| | | and control of infectious diseases of animals in changing climatic conditions). | when a risk arises (e.g. surveillance of the occurrence of bluetongue in sheep or African swine fever in the environment). |
| **15.** | **Production management in greenhouses** | Adaptation technology to increase plant resistance and productivity. **REsponse**: Safer food production under controlled conditions while reducing greenhouse gas emissions (energy-efficient and climate-smart greenhouse technologies). | **Gradual progress – expansion of protected crops.** Since 2021, there has been a noticeable increase in investment in greenhouse production in response to unpredictable external conditions. Federal and cantonal rural development programs co-finance **the construction and equipping of facilities for agricultural production**, which includes greenhouses, up to 50% of the costs. Through EU4AGRI grants, several producers received support in 2022–2023 for the purchase of modern greenhouses with ventilation and irrigation systems to adapt to extreme weather conditions. This increases resistance – vegetable production in a protected area suffers less from heavy rains, hail or late frosts. In parallel, energy efficiency improvements (e.g. solar heating in greenhouses on pilot bases) are being introduced to reduce emissions and costs. Although small producers still need support for such investments, the trend is positive: the increasing area under greenhouses in BiH implies that this adaptation measure is gradually being implemented. |
| **16.** | **Windbreaks** | Adaptation technology to increase plant resistance and productivity. **Response**: reducing the impact of strong winds on plant stress, improving yields and microclimate on agricultural land. | **Progress mainly in the form of recommendations and awareness-raising.** There were no direct programs for the erection of wind protection belts after 2021, but the agricultural profession is actively promoting this measure. Educational articles have appeared in the agrarian media – e.g. advice on how to plan and plant windbreaks in orchards in windy areas, which shows that the importance of windbreaks is recognized. In some places, individual producers, with the support of local authorities, have planted tree avenues around the plots (examples in Semberija and Posavina where poplar, acacia, etc. are planted around the fields to protect against the wind). |
| **17.** | **Establishment of forest belts and afforestation on steep terrain** | Adaptation technology to protect against soil erosion and reduce the risk of landslides.<br>**Response**: reducing or preventing soil erosion and landslides by erecting | **Continuous progress through forestry programs.** Even before 2021, there were plans to reforest erosive areas, and they have continued. Entity forestry companies plant thousands of seedlings on landslides and bare landslides every year – this is not formally branded as climate adaptation, but it contributes to reducing erosion. Adaptation projects highlight this measure: e.g. STAZA plans the conservation and restoration of forests to stabilize slopes and reduce the risk of erosion. In 2022, the FBiH adopted a new environmental protection strategy that includes the goal of |



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| | | protective forest plantings. | afforestation of degraded land (which also includes agricultural land prone to erosion). On the ground, a positive example is Tuzla Canton, where in 2023 an action was launched to reforest forest belts above agricultural land to protect against torrents. In general, afforestation of steep terrain is carried out continuously and is one of the most successful aspects of adaptation, with funding from forest funds and the support of international organizations (the FAO project in 2021 in the Neretva basin included the planting of forest belts on the hills above settlements and arable land). |
| **18.** | **Selection of different crops, new species and varieties** | Adaptation technology to increase plant resistance and productivity. **Response**: adapting to change through the introduction of new stress-resistant crops and varieties, while preserving biodiversity and food production security. | **Significant progress in practice – crop diversification.** Climate change is changing agroecological conditions in BiH, which some producers have used to introduce non-traditional crops. Especially in Herzegovina, in the last 10 years, olive, pomegranate, fig and lemon plantations have been successfully introduced, crops that were previously not typical for this climate. |
| **19.** | **Planning of irrigation needs (spatial and by culture)** | Water shortage adaptation technology. **Response**: efficient water management with a strategic projection of where and for which crops irrigation is most needed. | **In the course of developing plans, partial implementation.** Identification of priority areas for irrigation has become an integral part of entity strategies. The RS updated (2022) its spatial irrigation plan – for example, for Semberija, it was determined that 11,000 ha should be irrigated on ~50,000 ha of arable land, and the construction of the system is planned in phases. The implementation of the system still depends on finances, but planning has advanced significantly: investment decisions are now based on projections of climate scenarios and crop needs, rather than ad-hoc. |
| **20.** | **Establishing coastal buffer zones** | Technology of adaptation to excess water and landscaping. **Response**: preventing watercourse pollution and reducing erosion through | **No particular progress has been recorded.** Although the concept of coastal buffer zones (protective green belts along watercourses) exists in strategic documents to reduce erosion and filtration of pollutants, as of 2021, no purposefully named project for their establishment in the agricultural context has been launched. The only "coastal" part of BiH at sea (Neum coast) has no reported buffer zone measures, except for regular monitoring of the sea. In short, this measure remains |



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| | | vegetation buffer strips along the banks of rivers/lakes (or seas). | identified as necessary, with no measurable progress. The protection of water from agro-pollution is currently being addressed through other measures (such as better fertilizer management – see measure 22). |
| **21.** | **Sustainable pasture management** | Adaptation technology to reduce risk in animal husbandry.<br>**Response**: traditional seasonal nomadic cattle breeding in mountainous areas and rotational use of pastures in karst areas of the Dinarides, for sustainable livestock production and pasture conservation. | **Progress through projects and policies.** The livestock sector is slowly returning the focus to pastures as a resource of resilience. In practice, traditional models are still applied – e.g. seasonal grazing (katuns/transhumance) in the mountains and sending livestock to high mountain pastures for several months in the summer, which reduces the pressure on lowland resources during droughts. Post-2021 projects include components of sustainable pasture management: IFAD's new project envisages demonstrating improved pasture management with reduced fire risk and better water availability for grazing livestock. Also, entity farmland laws now require use plans for state pastures. In practice, only some steps are visible – for example, in Livno, in 2023, a pilot project of controlled burning of dry grass was launched for the restoration of pasture plants. In general, traditional grazing models survive and are recognized as part of climate resilience, and new projects seek to strengthen them scientifically (by planning grazing capacity, setting up watering holes, educating livestock breeders). |
| **22.** | **Integral system of fertilization with organic and mineral fertilizers** | Adaptation technology to increase plant resistance and productivity. **Response**: a sustainable fertilization system that supports production and protects the environment (combination of organic and mineral fertilizers, optimization of plant nutrition). | **Gradual progress through regulation and education.** Awareness of the importance of proper use of organic and mineral fertilizers is growing, primarily due to land degradation and water pollution. However, the inadequate disposal of manure remains a major problem – the strategies admit that there is **still** no adequate system for the disposal of animal waste and that the investments made so far have been modest. Also, through projects (FAO, GIZ), trainings were held for farmers on integral fertilization – how to combine organic and mineral fertilizers to increase crop resistance to drought and improve soil structure. Some producers are switching to green manure and compost on their fields, especially in organic production that is subsidized by the entities. In short, there is no single "integral fertilization" program, but through legislation and support, a framework is created for this measure to be spontaneously applied, with benefits for soil resilience to climate stress. |

## 6.10. Climate Finance Monitoring Options

Transparent monitoring of climate finance has become a key element in meeting international commitments and ensuring accountability in the fight against climate change. The Paris Agreement emphasizes that in addition to ambitious climate action, there must also be an "enhanced transparency framework for action and support" (Article 13), in particular with regard to the financial, technologicaland other support that developed countries provide to developing countries. Article 9 of the Agreement obliges developed countries to report on climate finance they have made available, while recipient countries are expected to increase transparency on the use of these funds and the need for additional support. The connection with Articles 10 and 11 is reflected in the fact that effective monitoring of finances directly affects the success in technology transfer and capacity building, and without insight into cash flows, it is difficult to plan the introduction of priority technologies or strengthening capacities where it is most needed. Therefore, establishment of a climate finance monitoring system in BiH would be an important step towards fulfilling the spirit of the Paris Agreement, as it would enable better planning, use and reporting of funds earmarked for climate action.

There is no comprehensive system in place to monitor and track climate finance. Climate-relevant projects and investments are financed from various sources – state and entity budgets, international donor programs, development banks, EU funds, private sector, but these financial flows are not monitored centrally or labeled as "climate" in official financial statistics. Responsibilities for monitoring finance and reporting on climate investments are not clearly defined, as they are divided between different levels of government and sectoral institutions, without a named lead institution. In the absence of a formal framework, it is difficult to determine how much of public spending or foreign investment actually contributes to climate change mitigation or adaptation to its consequences. This gap has been identified as a key gap in the capacity of institutions in BiH to effectively manage climate investments[123]. Currently, there is no legal obligation or established procedure for institutions at various levels to collect information on climate projects. As a consequence, climate finance data is fragmented, inconsistent and often insufficiently detailed.

Institutional capacity to monitor climate investments is also limited. Climate change is still not fully integrated into public investment planning, so many ministries and agencies look at projects from their portfolio traditionally, without specifically recording the contribution of these projects to climate goals. According to a recent capacity analysis, BiH faces a lack of expertise and clear networks of communication between institutions when it comes to climate [124]. For example, different sectors (agriculture, energy, transport) may have projects relevant to climate objectives, but there is no mechanism to ensure that these projects are monitored together or that information is consolidated. Donor funds are mostly monitored through individual projects and donor reports, but without a common framework, BiH does not have a complete picture of how much climate finance it receives and spends annually. An aggravating circumstance is that many climate activities overlap with development activities of a general nature, without a clear definition of what is included in "climate finance".

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[123] *Readiness Proposal with Food and Agriculture Organization of the United Nations (FAO) for BiH, 2022.*
[124] *ibid*

The identified barriers to climate finance can be summarized through 5 key items:

- Lack of a uniform system and methodology – currently there are no standardised criteria or platform for mapping climate costs, resulting in the impossibility of extracting reliable data on total climate investment;
- Institutional fragmentation and unclear competencies – there are no clearly defined institutions in charge of monitoring climate finance, nor a formalized flow of information between, for example, ministries of finance and ministries of the environment at different levels of government,
- Limited capacity and awareness – officials in the finance and planning sector are not sufficiently familiar with the concept of climate budgeting and transparency of climate investments, while climate issues are often still treated as secondary to primary development priorities,
- Technical barriers in data collection – information on donor projects, loans and grants that BiH receives for climate purposes is not integrated, different donors have different reporting formats, and domestic information systems (e.g. for managing public investments or foreign donations) are not set up to extract data by climate markers,
- Regulatory framework – although strategies and action plans recognize the importance of climate finance, there is no specific regulation that would introduce the obligation to keep records or label climate expenditures in budgets, nor a regulation that would define what exactly is considered climate finance in BiH.

### 6.10.1. Recommendations for establishment of a climate finance monitoring system

Despite these challenges, there are specific steps that can be taken to establish a functioning climate finance monitoring system, drawing on international experience and its own development needs. The key to success lies in combining technical solutions with institutional and legal measures that will ensure the sustainability of the system.

#### *6.10.1.1.* Technical aspect

The first step is to develop a clear methodology and definitions for climate finance adapted to the legal competencies in BiH. It is necessary to agree on what will be counted as climate-relevant investments (e.g. investments in OiE, energy efficiency projects, forestation, early warning systems, infrastructure resilience, etc.), taking into account that the definition is aligned with international standards for the sake of comparability. In doing so, the OECD "Rio Marker" methodology can be used to label climate investments or the methodology of development banks, but with adaptation to local priorities. The example of Colombia shows that it is useful to exclude categories that are not relevant to national targets (e.g. in their case, large hydropower and nuclear power were not considered climate projects and the focus was placed on other technologies). By defining a framework at the state level, a basis would be created for all actors to classify their projects consistently.

The next technical step is to set up a database or platform to track climate finance flows. This platform should collect data from several sources: budget expenditures of domestic institutions (with the possible introduction of "labelling" of climate expenditures in the budget), international official assistance and donations, private investments in green projects, loans for climate projects, etc. The system can be a digital platform available to relevant institutions, and even to the public, where data could be filtered by sectors, source of funding, type of instrument (grant, loan, budget) and so on. The experience of Colombia, which has developed an online registry of climate projects, shows that such a system can record thousands of climate actions and billions of dollars invested, and display the data through interactive maps and graphs. It is important to anticipate the possibility of upgrading and improving the quality of the data in the system over time, as it is expected that the data may be incomplete initially. The system should be flexible (e.g. allow for the subsequent entry of more precise information about projects when it becomes available, such as the practice in Colombia where the location or other details of the project can be completed at a later date). It should also be possible to introduce new categories of finance, which will make the system sustainable in the long term.

#### 6.10.1.2. Institutional aspect

For successful implementation, it is crucial to identify institutions and establish coordination mechanisms. Forming an inter-ministerial working group or climate finance body would help to involve representatives of finance ministries, entity and cantonal authorities, statistical agencies, as well as representatives of international organisations providing support. Each actor needs to clearly define the role and responsibilities in the system. For example, finance ministries may be tasked with collecting and consolidating data on domestic budget expenditures and loans, while bodies responsible for coordinating international aid (such as the Directorate for Economic Planning or donor funding coordination agencies) provide information on foreign aid and projects. Experience from other countries shows that it is crucial to ensure "buy-in", i.e. the support of institutions that provide data, so that they themselves will benefit from the established system. In the case of BiH, this means that the climate finance monitoring system should also serve domestic decision-makers, e.g. the Ministry of Finance can use this data for better budget planning, the Ministry of Environment for reporting and project development, entity governments to monitor the implementation of their climate strategies.

#### 6.10.1.3. Legal aspect

In order for the system to survive and function in the long term, the legal framework needs to be strengthened. One option is to introduce the obligation of climate labeling of the budget in accordance with the competencies of each level of government, which, when planning the budget, would mark programs and projects that contribute to mitigation or adaptation to climate change. This can also be in the form of methodological guidelines that the competent ministries of finance would apply as part of their budget procedures. In parallel, the flow of information on international climate projects should be formalised and the integration of climate-financial reporting requirements within the transparency framework should be considered. This would make reporting on support (received and needed) an integral part of the obligations, which would require the monitoring system to provide quality data.

Establishment of a climate finance monitoring system in BiH would strengthen the transparency and credibility of climate change efforts. Such a system would allow decision-makers to have a clear view of how and where funds earmarked for climate projects are spent, and to spot any gaps in funding for specific sectors or priorities. As a result, resources can be channelled more efficiently. For example, if the data shows that too little is being invested in climate change adaptation in certain regions, governments may decide to increase investment precisely where the risks are greatest. At the same time, citizens and civil society would be able to more easily monitor money flows and hold institutions accountable through publicly available information, thereby strengthening overall accountability and trust in public policies. Last but not least, BiH would also fulfil its international obligations in terms of reporting on the support received in a transparent manner. Ultimately, establishment of a climate finance monitoring system should be seen as an investment in better climate governance: with relatively little investment in methodology development, staff training and information tools, the state gains a powerful instrument for managing climate action. Such a system would enable institutions in BiH to identify needs more quickly, apply for international funds more efficiently (because it can prove how they use existing funds) and ensure that invested funds are maximized in the transition to a sustainable and more resilient future.

# 6 Attachments

**Attachment I:** CTF denoting progress in NDC implementation

**Attachment II:** CTF on received and required financial support, technology transfer and capacity building under the Paris Agreement

**Attachment III:** Mitigation policies and measures, actions and plans relating to implementation and achievement of the nationally determined contribution pursuant to Article 4 of the Paris Agreement