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Ministry of Ecology, Sustainable Development, and Northern Region Development

Fourth National Communication and the First Biennial Transparency Report of Montenegro to the UNFCCC

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Abbreviations

- BAU - Business as usual
- BTR – Biennial Transparency Report
- BUR - Biennial Update Report
- CAMP - Integrated Management Program for the Coastal Area of Montenegro
- CBCG - Central Bank of Montenegro
- CBIT - Capacity-Building Initiative for Transparency
- CLC - CORINE Land Cover
- COVID-19 - 2019 coronavirus disease
- CRT - Common Reporting Tables
- DCC – Directorate for Climate Change
- DRR - disaster risk reduction
- EF - Emission Factor
- EUROSTAT - European Statistics
- ETF - Enhanced transparency framework
- ETS - Emissions Trading System
- Eco Fund - Environmental Protection Fund
- EEA - European Environment Agency
- EPCG - Electric Power Utility of Montenegro
- EnCT - Energy Community
- EPA - Environment Protection Agency
- ESG - Environmental, Social and Governance criteria
- EU - European Union
- EUR - Euro
- EURO-CORDEX project
- EUROSTAT - European Statistics
- FEM - Feminine Gender Expression
- FNC- Fourth National Communication
- FAO Food and Agriculture Organization
- GCF - Green Climate Fund
- GDP gross domestic product
- GEF - Global Environment Facility
- GEI - Gender Equality Index
- GFP - Gender Focal Points

- GHG - Greenhouse Gas
- GPG - Gender Pay Gap
- GVA - Gross Value Added
- GWh - Global Warming Potential
- IEA - International Energy Agency
- IHMS - Institute for Hydrometeorology and Seismology Montenegro
- IPA - Instrument for Pre-Accession Assistance
- INDC - Intended Nationally Determined Contribution
- IPCC - Intergovernmental Panel on Climate Change
- IPPU - Industrial Processes and Product Use
- ISCED - International Standard Classification of Education 2011 classification
- KAP - Podgorica Aluminum Plant Podgorica
- LCDS - Low-Carbon Development Strategy
- LEAP- Long-range Energy Alternative Planning software
- LPG - Liquified Petroleum Gas
- LULUCF - Land Use, Land Use Change, and Forestry
- MANU - Montenegrin Academy of Sciences and Arts
- MITICA - Mitigation-Inventory Tool for Integrated Climate Action
- MESDNRD – The Ministry of Ecology, Sustainable Development and North Region Development
- MONSTAT - Statistical Office of Montenegro
- MSW - Municipal Solid Waste
- MRV-E - Monitoring, Reporting, Verification and Evaluation system
- NAP - National Adaptation Plan
- NWMP - National Waste Management Plan
- NCCS -National Climate Change Strategy to 2030
- NCSD - National Council for Sustainable Development
- NDC - Nationally Determined Contribution
- NECP - National Energy and Climate Plan
- NFI - National Forest Inventory
- NMVOC - Non-methane volatile organic compounds
- NGO - Non-Governmental Organization
- NIR - National Inventory Report
- Non-Annex I Party- Party not included in Annex I to the Convention
- PAMs - policies and measures
- PPCA- Powering Past Coal Alliance
- REDD+ programme - Reducing emissions from deforestation and forest degradation in developing countries + programme
- SDG - Sustainable Development Goal
- SBUR - Second Biennial Update Report

- TNC on Climate Change – Third National Communication
- TBUR – Third Biennial Update Report
- TPP - Thermoelectric Power Plant in Pljevlja
- TSC - Total Snow Cover
- QA - Quality Assurance
- QC - Quality Control
- UNDP - United Nations Development Programme
- UNFCCC - United Nations Framework Convention on Climate Change
- WAM - scenarios with additional measure scenarios
- WM - scenarios with existing measures
- WMO - The World Meteorological Organization
- WOM - Scenarios without measures scenario
- WTTC - World Travel and Tourism Council

Chemical formulae

C	carbon
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalents
HFC	hydrofluorocarbon
NF_3	nitrogen trifluoride
N_2O	nitrous oxide
NO_X	nitrogen oxides
PFC	perfluorocarbon
SF_6	sulphur hexafluoride
SO_x	sulphur oxides
SO_2	sulphur dioxide
NMVOC	non-methane volatile organic compound

Units

cm	centimetre (10^{-2} metres)
Gg = kt	gigagram (10^9 grams)
GWh	gigawatt-hours (10^9 watt-hours)
ha	hectare
kg	kilogram (10^3 grams)

km	kilometre (10^3 grams)
kt	kiloton (10^9 grams)
ktoe	kiloton of oil equivalent
l	litre
m	metre
s	second
t	ton (10^6 grams)
m^3 /s	Cubic metre per second
TJ	terajoules

EXECUTIVE SUMMARY

Introduction

Montenegro ratified the United Nations Framework Convention on Climate Change (UNFCCC) by succession in 2006 and became a non-Annex-1 party to the Convention on 27th January 2007. The Kyoto Protocol was ratified on 27th March 2007, and Montenegro became a non-Annex-B party on 2nd September 2007. By ratifying the UNFCCC and the Kyoto Protocol, Montenegro joined countries that share the same concerns and are undertaking an active role in international efforts to address climate change.

On 11th October 2017, the Parliament of Montenegro enacted a law ratifying the Paris Agreement. Thus, Montenegro became a party which has also ratified the Paris Agreement and has undertaken to contribute to a reduction in GHG emissions globally. In line with the revised NDC, Montenegro has set the new target of reducing its GHG emissions by 35% by 2030, compared to 1990 (excluding LULUCF), i.e. reducing its GHG emissions by 2,117 Gg CO2eq by 2030.

With the submission of its combined Fourth National Communication (FNC) and First Biennial Transparency Report (1BTR), Montenegro continues to uphold its international obligations under the UNFCCC. By applying the Modalities, Procedures, and Guidelines (MPG) along with the Enhanced Transparency Framework (ETF), Montenegro is committed to ensuring transparency, consistency, comparability, and accuracy in reporting its climate actions and progress toward national climate targets. This combined report not only enhances the efficiency of the reporting process but also improves the quality of climate data, reinforcing Montenegro's role in global climate action.

The report includes the inventory of GHGs for the years 2016 to 2022 and the recalculation of the inventory time series for the period 1990–2022, along with a comprehensive overview of the strategies Montenegro has formulated, adopted, and implemented to manage and reduce GHG emissions. Additionally, it provides a profile of Montenegro's climate, spotlighting sectors and regions most vulnerable to climate change and analyzing potential adaptation measures.

Furthermore, the FNC/1BTR covers national capacity-building efforts, investment promotion, and financing mechanisms for climate action, among other key areas. This report captures Montenegro's ongoing climate change management efforts, with a focus on developments since the Third National Communication (TNC) in 2017 and the Third Biennial Update Report (TBUR) in 2021.

National circumstances

Montenegro is located in the southeastern part of Europe and, according to its latitude, belongs to the southernmost part of Europe, the Mediterranean. It is located at the junction of two significant geographical units – the Dinarides and the central Mediterranean.

The area of Montenegro is very complex in terms of landscape and has many natural contrasts, which together form a unique geographical whole. The distance between the southernmost and northernmost point of the mainland of Montenegro is 192 km, as the crow flies, and between the westernmost and the easternmost points is 163 km. The surface area of Montenegro is 13,812 km^2.

The **population of the country is 623,663 inhabitants** (2023 Census), of which about 62% live in urban areas, while the rest of the population live in rural settlements. During recent years, the migration of the population has increased from the less developed areas of the northern region to the central and coastal regions, where living conditions are more favorable. This migration has increased pressure on resources in urban settlements. This negative impact has also been reflected in rural areas, especially in the mountains, since a large amount of land is now uncultivated and has reverted to weeds, bushes, and trees.

Forests cover more than 60% of Montenegro's territory, which makes it among the top three most forested countries in Europe. According to the First National Forest Inventory from 2013, 51% is in state ownership, while 49% is in private ownership. However, ownership is changing in favor of private forest owners.

Montenegro's **territory under protection** covers 13.41% or 185,269.69 ha. The biggest areas are the national parks: Durmitor, Lake Skadar, Lovćen, Biogradska Gora, and Prokletije which represent a total of 7.27% or 100,427 ha, while nature parks cover 79,583.10 ha or 5.76% of the territory of Montenegro.

Water resources from the territory of Montenegro drain into two basins: the Adriatic Sea and the Black Sea. There are significant differences in the distribution and abundance of water resources ranging from arid karst areas to areas rich in both surface and ground water. The country is considered to be rich in water resources, given that the average annual runoff is 604 m^3/s.

Economic growth[1] in 2022 and 2023 was stronger than expected, despite global economic and geopolitical uncertainties. In 2022, Montenegro's economy demonstrated resilience, achieving a 6.4% growth rate, driven by a tourism boom, strong private consumption, and high foreign investment inflows. However, high inflation limited spending power and slowed investment. In 2023, economic growth accelerated to 6.3%, with exports and household consumption as the main contributors. According to the preliminary macroeconomic forecasts of the Ministry of Finance, the Montenegrin economy will

[1] Economic Reform Programme of Montenegro for the period 2024-2026, Ministry of Finance of Montenegro

grow at an average annual rate of 3.7% in the medium term, i.e. 4.8% in 2025, 3.1% and 3.2% in 2026 and 2027.

The **energy sector** is the main source of anthropogenic GHG emissions. The share of electricity produced in facilities using renewable energy sources out of the total electricity generation in 2023 was 62.36%.

In the **metal industry sector**, the most prominent activities are aluminum and steel production. Other industrial facilities involve the processing of food, beverages, tobacco, textiles, agricultural lime, leather products, paper, medications, and rubber and plastic products.

Agriculture continues to be an important strategic sector within the economic development of Montenegro and has many economic activities that are linked to it, particularly in the rural parts of the country. In 2023, the agriculture, forestry, and fishing sectors represented 5.7% of GDP. The total number of actively employed persons in agriculture in the country was 10,700 in 2022. Agricultural land in Montenegro covers an area of 515,640 ha and represents 37.4% of the territory. However, utilized agricultural land in 2023 was 263,522 ha, of which perennial meadows and pastures areas prevail with a share of 94.6%, while arable land is present with 2.7%, permanent crops, and 2% from others.

The **tourist sector** in Montenegro in recent years has experienced rapid development with an increase in the number of visitors and investments, becoming the main and most dynamic economic sector. The total (direct and indirect) contribution of the tourism and travel sector to GDP was 29.1%[2] in 2023.

In the **transport sector,** the Transport Development Strategy of Montenegro for the period 2019-2035 was adopted in July 2019. For the purpose of drafting the Strategy, a regional traffic model for Montenegro has been developed to assess traffic flows in different scenarios. A significant increase in road travel is expected in the future, and this will inevitably have an impact on the efficiency of the national network and planned highways.

National policy and institutional framework for climate change

Montenegro is preparing a National Energy and Climate Plan (NECP) in line with the European Commission (EC)[3] proposal. The plan will cover the period up to 2030 and set targets and measures for the five dimensions of the Energy Union (energy security, internal energy market, energy efficiency, decarbonization and research and innovation). The first draft of the NECP was published in June 2024, but has not yet been adopted, although its adoption was expected by the end of 2024. In December 2024, the NECP was submitted to the Energy Community. The NECP will replace the existing SRE and National Climate Change Strategy (NCCS). Moreover, the Energy Community Ministerial Council

[2] World Travel&Tourism Council: Montenegro, 2024 Annual Research: Key Highlights, 2024.

[3] Recommendation of the Ministerial Council of the Energy Community 2018/01/MC-EnG on preparing for the development of integrated national energy and climate plans by the Contracting Parties of the Energy Community.

adopted Decision No. 2022/02/MC-EnCT, which sets new targets for GHG emissions reduction, renewable energy and energy efficiency, for the signatories' EnCT for the period up to 2030. In line with this decision, the new targets for Montenegro are as follows:

1. A 55% reduction in national GHG emissions without LULUCF compared to 1990 levels,
2. A 50% target of the share of energy from renewable sources in gross final consumption,
3. A maximum share of 0.92 ktoe in primary energy consumption and 0.73 ktoe maximum share in final energy consumption.

The NCCS to 2030 is the key policy instrument for the management of climate change in Montenegro and establishes the commitment of the Government to act against climate change in an integrated and multisector manner, complying with the international commitments assumed by the country before the UNFCCC. The strategy sets out a vision to 2030 to enable Montenegro to adapt to the adverse effects of climate change and promote low-carbon sustainable development. The NCCS has a strong focus on harmonization with the EU climate change legislative framework.

In order to lend continuity and legitimacy to the efforts being developed within the framework of the NCCS and to ensure long-term commitments, Montenegro adopted the Law on Protection against Climate Change in December 2019. The objective of the Law is the protection against the adverse effects of climate change, reduction of greenhouse gas emissions, and protection of the ozone layer.

The Government of Montenegro issued the new Decree on Issued Activities for GHG Emissions on 6th February 2020 which entered into force on 21st February 2020. This has brought Montenegro even closer to the EU climate change acquis. Adoption of the regulation was also one of the preconditions for negotiations under Chapter 27: Environment and Climate Change in the EU accession process. In order to further harmonize with the EU legal acquis, the MERS is finalizing the Draft Law on Protection from the Negative Effects of Climate Change and Protection of the Ozone Layer. It is expected that the law will be adopted in the second quarter of 2025. After the adoption of the law, the drafting of new bylaws will follow, which will enable further harmonization with the regulations of the European Union and at the same time ensure the application of the law in practice.

Since 2017, Montenegro has introduced a set of policies and strategies:

- **National Adaptation Plan (NAP)**, under development
- **National Drought Plan**, published in 2020
- **Disaster Risk Reduction Strategy** for 2025-2040, published in 2024
- **Updated Transport Development Strategy of Montenegro 2019-2035**, under development
- **New National Strategy for Sustainable Development (NSSD),** under development

- **Forestry Development Plan**, under development.

The Ministry of Ecology, Sustainable Development and North Region Development (MESDNRD) is the main national entity responsible for national environmental and climate change policy and the National Focal Point to the UNFCCC.

Montenegro has made substantial progress in advancing sustainable development through the establishment of a high-level, multi-institutional Council chaired by the Prime Minister of Montenegro. Originally formed in 2008, this Council represented a significant step toward enhancing inter-institutional coordination and cooperation on sustainable development. The Council's mandate was strengthened in 2013, placing a strategic emphasis on climate change as a government priority toward the creation of a low-carbon society. This led to its evolution in 2016 into the National Council for Sustainable Development, Climate Change, and Integrated Coastal Zone Management. On December 23rd, 2021, the Government of Montenegro further reinforced the institutional framework for sustainable development by reactivating the council into National Council for Sustainable Development (NCSD) and its Office for Sustainable Development within the General Secretariat of the Government. To support the Council's broad mandate, six expert working groups were created to address key priorities: monitoring the implementation of sustainable development policies, climate change mitigation and adaptation, integrated management of Montenegro's coastal areas, sustainable development at the local level, financing for sustainable development, and ensuring a just transition. These groups enable the Council to take a targeted approach to critical areas, supporting Montenegro's commitment to a sustainable, low-carbon future.

The Environmental Protection Fund (Eco Fund) was established by the Decision of the Government of Montenegro (22nd November 2018) on the basis of Article 76 of the Law on the Environment in order to provide funds for financing environmental protection and to respect the basic right of citizens to a clean and healthy environment.

Gender equality and climate change

The 2019 *Law on Protection from the Negative Effects of Climate Change* did not address gender-related issues. However, a forthcoming 2024 law on climate change and ozone layer protection mandates gender-responsive climate policies, including in Montenegro's *NAP* and *Low-Carbon Development Strategy (LCDS)*. Montenegro's 2020 *TNC on Climate Change* and the *2021 Background Report for NDC Revision* also address gender equality in climate contexts. The *National Strategy for Gender Equality (2021-2025)* notes the lack of research on climate change impacts on gender-specific health in Montenegro, which complicates policy development. It calls for health risk analyses in underserved areas to inform adaptation measures, focusing on the wellbeing of vulnerable groups, including women, men, and people of diverse gender identities. Women's leadership and the integration of gender considerations in climate policy planning and implementation are insufficiently developed and sporadic. Although gender-responsive budgeting is gradually being introduced and training is underway, tangible results are still awaited. While some gender-disaggregated data collected by the Statistical Office are utilized, they are inadequate for systematically monitoring the impact of climate policies on gender equality.

National GHG inventory

The figures below (total emissions and removal) show the trends in GHG emissions and removals for the period 1990–2022. These trends have been derived from Montenegro's updated GHG emissions inventory that was prepared in 2024.

The dominant sector regarding total GHG emissions without LULUCF in Montenegro is Energy, causing 74.5% of total national GHG emissions in 2022, followed by the sectors Industrial Processes and Other Product Use (7.5%), Agriculture (7.8%), and Waste (10.3%).

In 1990, the CRT sector Energy accounted for 54.1% of the national total GHG emissions. The CRT sector Industrial Processes and Product Use (IPPU) accounted for 27.0% of the national total GHG emissions. The remaining GHG emissions are split between agriculture (10.3%) and waste (8.7%).

The change in contribution of the CRT sectors in national total GHG emissions is due to the:

- increasing energy consumption here especially the combustion of lignite but also liquid fuels;
- increasing number of vehicles in road transport;
- temporary shut-down of alumina plant (2009) and shutdown of one electrolysis line (2016);
- extensive agricultural activities;
- growing population which implies increasing waste generation.

The net emission removals in the LULUCF sector are a result of Montenegro's forest land acting as a carbon sink.

Figure 1 Trend of national total GHG emissions with and without LULUCF and net emissions/removals from LULUCF

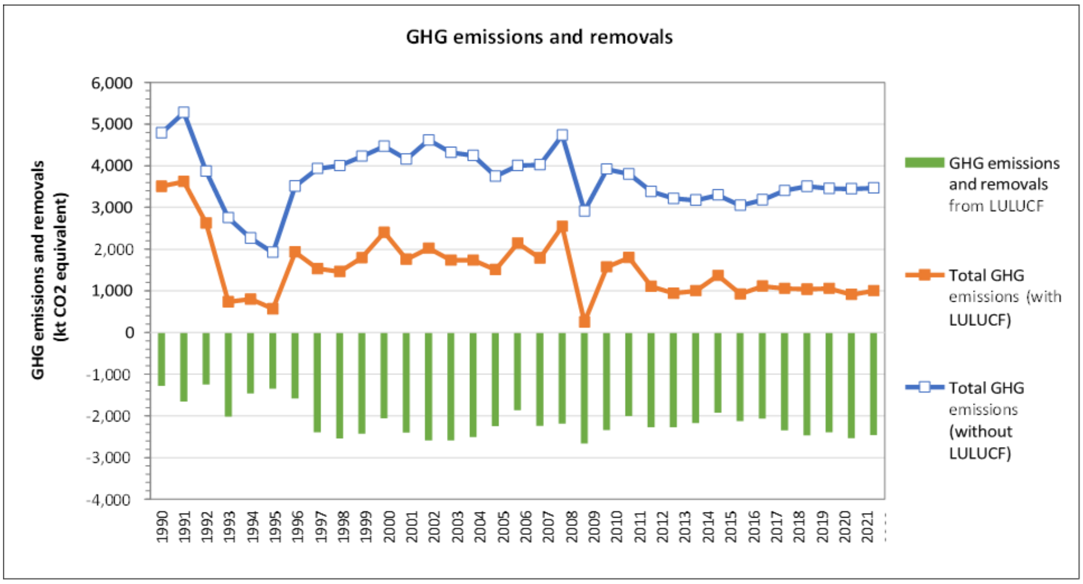
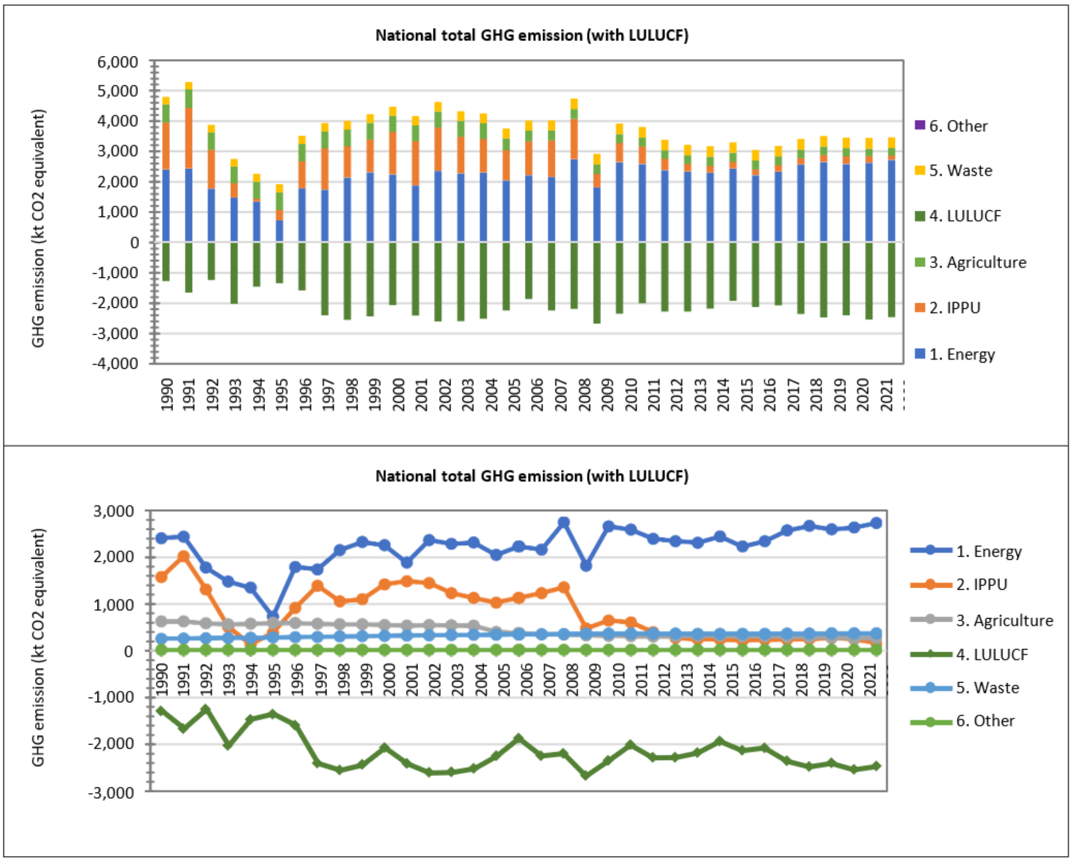


Figure 2 National total GHG emissions by sector, 1990-2022



Energy sector contribution and trend

In the Energy Sector, emissions originating from fuel combustion activities in road transport, in the energy and manufacturing industry and in the commercial, agricultural and residential sectors (Category 1.A) are considered, as well as fugitive emissions from fuels (Category 1.B), although fugitive emissions contribute less than 1% of the total emissions from this sector. Total emissions from Energy sector represent 74.5% in total national GHG emissions in 2022.

Energy industries (IPCC category 1.A.1) which include economic units whose principal activity is energy production covers GHG emissions resulting from fuel combustion activities from public electricity and heat production plants, and most of the emissions come from electricity generation in lignite-fired power plant TTP Pljevlja. Besides TPP Pljevlja, electricity is generated from the hydro power plants and since 2018 also from wind power plants. The operation of power plants in electricity system depends on electricity demand and weather conditions (availability of water, wind and sun for renewable power plants). The share of the emissions from this category in 2022 was 46.3% in total national emissions

Manufacturing Industries and Construction (IPCC category 1.A.2) covers GHG emissions resulting from fuel combustion activities in manufacturing industries and construction. The share of the emissions from this category in 2022 was 6% in total national emissions.

During the period 1990-2022, there is overall decline in emissions, mostly due to industrial activity reduction but also technological improvements and fuel switch in Iron and Steel (Željezara Nikšić steel plant), where the emissions decreased 99% in 2022 compared to 1990 as well as Non-Ferrous Metals industries – aluminum smelter (Kombinat Aluminijuma Podgorica KAP), where the emissions not occurred in 2022 due to production reduction.

Category 1.A.4 Other sectors comprise emissions from stationary fuel combustion in buildings (such as households, commerce, institutions) and for agricultural activities. The category accounted for 2% of the total national emissions in 2022. During 1990-2022 period there is decline of emissions by -63% mostly due to implementation of legislation related to air quality, new survey, allocation of fuels, and the new methodology in energy statistics. The share of CO2 emissions from biomass increased significantly after 2011 due to implementation of legislation related to air quality related to heavy fuel oil

Fugitive emissions from fuels (IPCC category 1.B) covers GHG emissions resulting from the extraction, processing and delivery of fossil fuels to the point of final use from surface and underground mining activities. In 2022, fugitive emissions contributed with 0.4% to the national total GHG emissions.

Transport sector contribution and trend

Transport (IPCC category 1.A.3) covers GHG emissions resulting from fuel combustion in transport sector, where most emissions arise from road transportation. and domestic aviation. Emissions arising from road transportation represent majority of the total transport emissions

The GHG emissions from transport accounted for 20% of the total national emissions in 2022. In the period 1990-2022, the transport emissions are more than doubled due to overall mobility increasing needs, in particular in road transportation with all vehicle categories.

Industrial Processes and Product Use (IPPU) contribution and trend

In the Industrial Processes and Product Use (IPPU) sector, emissions originating from industrial processes (e.g. cement production, metal production), from the use of F-gases as substitutes for ozone depleting substances (ODS) and the use of fossil fuels for 'non-energy' purposes (e.g. lubricants, bitumen) are considered. In Montenegro, emissions from this sector come from the Mineral Industry (2.A), the Metal Industry (2.C); the Non-energy products from fuels and solvent use (2.D), the Product uses as substitutes for ODS (2.F) and Other product manufacture and use (2.G).

The IPPU sector represented 7.3% of the total national GHG emissions in 2022, while in 1990 it represented 32%. The Metal Industry comprises the production of steel and aluminum and contributed in 1990 with 98% to total IPPU sector emissions, whereas in 2022 only with 38%. GHG emissions from Consumption of HFCs, PFCs and SF_6, used as substitutes for ODS increased between 1990 and 2022 very strongly and represent 91% of the IPPU total sector emissions in 2022.

Total emissions from IPPU sector amounted in 1990 to 1555.86 kt CO_{2eq} and decreased by -90.2% to153.03 kt $CO_{2\ eq}$ in 2022. The first drop occurred in the period 1991-1994 due to reducing KAP industrial activities during the economic recession and economic sanctions posed to Yugoslavia. The second drop occurred in 2009, due to the reduced aluminum production. Starting from 2016, emission decreases occurred due to shutdown of one Electrolysis line, but also due to both technological improvements and closure in electrolysis in 2015 which resulted in a significant reduction in PFC emissions from the plant. On the other hand, HFCs emissions from Refrigeration and Stationary Air Conditioning are increasing due to increased cooling needs during heat waves and longer hot summer seasons.

Agriculture contribution and trend

The Agriculture sector represented 7.2% of the total national GHG emissions in 2022. GHG emissions from the agriculture sector amounted in 2022 to 250.80 kt CO_2 eq., which represents a decrease of 59% since 1990. Agricultural emissions are determined by CH_4 and N_2O emissions and the most important source is enteric fermentation (3.A).

Enteric fermentation contributed with 66.4% of total GHG emissions from agriculture in 2022, due to the emissions of CH_4 produced during digestion by animals, mainly cattle, and which is mainly determined by the feed intake.

The decrease in emissions is mainly driven by a decrease in the number of cattle of 64% between 1990 and 2022.

The second most important agricultural emission source is Manure Management (3.B), being responsible for 18.7% of total agricultural emissions in 2022. GHG emissions from Manure Management decreased by -61.3% between 1990 and 2022. The main GHG emitted is CH_4, which results from decomposition of manure under anaerobic conditions during storage and treatment. The amount of CH_4 emissions is depending on the amount of manure produced and how it is treated (e.g. Solid manure deposited on pastures results in much less CH_4 than liquids collected in uncovered storage tanks, as here the conditions are anaerobic). Also, N_2O is emitted from manure, whereby direct N_2O is emitted as a result from nitrification of nitrogen contained in manure occurring during storage under aerobic conditions. Indirect N_2O emissions are due to volatile nitrogen losses when organic nitrogen is mineralized to ammonia.

Another source of N_2O emissions are agricultural soils (3.D), contributing 14.8% to total agriculture emissions. Nitrogen is applied to managed soils as a fertilizer in various forms, synthetic fertilizer, organic fertilizer, crop residues or mineralization of soil organic matter. The amount of N_2O emitted is mainly depending on the amount of N applied to managed soils. A very small share (0.16% in 2022) of GHG emissions in the agriculture sector is caused by CO_2. It is the result of urea application, which is added to soils during fertilization and leads to a loss of CO_2 that was fixed during their industrial production.

Waste contribution and trend

The waste sector covers emissions from the treatment and disposal of solid waste and wastewater treatment plants.

Waste treatment activities such as composting, anaerobic digestion or waste incineration are not relevant in Montenegro. Solid waste disposal represents 78.1% of total waste emissions. These emissions have increased by 62% from 1990 to 2022 while the amount of waste deposited increased only by 11.4% in the same period. This is due to the fact that CH_4 resulting from the anaerobic decomposition of biodegradable waste is emitted over decades in the solid waste disposal sites. This is also the reason why measures to reduce the amount of waste or of biodegradable organic carbon landfilled do not result in immediate emission reductions.

Deposited food waste, which is the fraction with the highest biodegradable carbon content of the municipal solid waste, decreased by more than 58% from 1990 to 2022. Total amount of waste deposited (excluding industrial waste) has increased since 1990 by 11.4% during the same period mainly due to increased landfilling of inert waste (e.g. plastics) with no biodegradable carbon content.

Emissions from wastewater treatment plants, septic tanks, collected but untreated wastewater and latrines represent 21.8% of total waste emissions and have increased by 14.3% during the period 1990-2022 mostly due to increase population connected to wastewater treatment plant and septic tanks.

Land Use, Land Use Changes and Forestry contribution and trend

Land Use, Land Use Changes and Forestry (LULUCF) sector covers the emissions and removals due to changes in the carbon pools in the land uses, as well as emissions due to the management of the lands.

In the GHG Inventory of Montenegro, the definitions of the different land uses are based on their correspondence with the Corine Land Cover (CLC) classes, being CLC the source of information about areas. In order to define Forest Land classes, the National Forest Inventory (NFI) definition for forest is used "land spanning more than 0.5 ha with trees higher than 5 metres and a crown cover of more than 10%, or trees able to reach these thresholds in situ. For tree rows or shelterbelts, a minimum width of 20 m is required. It does not include land that is predominantly under agricultural or urban land use".[4]

During 1990-2022, land use has been rather stable in Montenegro, with only a small proportion of the total territory undergoing land use changes. Changes due to emissions from forest fires lead to significant decreases in the net removal in the years 2007, 2011 and 2017.

In the LULUCF sector, emissions and removals are largely dominated by the Forest Land category (4.A), that govern the inter-annual variability and the long-term trend. This category is mostly driven by the removals of the FL remaining FL that represent total net removals in 2022. The insignificance of the areas being converted to FL (FL in transition) is due the low rate of land use changes in the country.

In general, the overall trend between 1990 and 2022 shows a steady increase in the removals driven by the Forest Land (97.9% increase) and HWP (-71.2% decrease). On the other hand, emissions due to the land use conversions to Settlements increase during the same period (205%).

[4] This definition is now also in the new Law on Forests ("Official Gazette of Montenegro", no. 77/24)

NDC tracking

Progress made in the implementation of Montenegro's revised NDC

As a signatory country to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, Montenegro pledges to contribute to the global effort to limit global warming requiring a collective effort to mitigate emissions across all countries and sectors. In this context, Montenegro since its ratification of the Kyoto Protocol in 2007 and of the Paris Agreement in 2017 has undertaken substantial efforts in reducing its national GHG emissions through the implementation of targeted mitigation policies and measures (PAMs). These efforts are streamlined into national emissions reductions targets formalised in Montenegro's Nationally Determined Contributions (NDCs). The most recent NDC of Montenegro (2021) sets forth the country's key mitigation targets with an array of targeted mitigation PAMs implemented to achieve the stipulated targets.

In its updated NDC submitted in 2021, Montenegro provides a quantified mitigation target, expressed as clear numerical target, covering all sectors defined in the 2006 IPCC Guidelines except Land Use, Land Use Change and Forestry (LULUCF), strengthening its 2015 NDC commitment to reducing or limiting GHG emissions by 2030 and demonstrating increased ambition to address climate change. Montenegro's target aims to reducing its GHG emissions by 35% by 2030, compared to 1990 level (excluding LULUCF).

To assess the progress of implementation of the revised NDC, Montenegro has i) selected an indicator, updated the GHG inventory and recalculated the time series including the base year 1990 for the time series 1990-2022, shifted from the use of GWP values of AR4 to AR5, updated the mitigation potential of policies and measures using the latest and more complete information available and performed projections using the latest GHG inventory available and the current national macro-economic framework.

The indicator selected to track progress in the implementation of the revised NDC is the percentage (%) of total GHG emissions reduction in CO_{2eq} using the latest GHG inventory available without LULUCF in the last year compared to 1990 level. The national GHG inventory reports an emission level of 3 470 kt $CO_{2\text{-}eq}$ for 2022 (excluding LULUCF), representing a **27.60% reduction from 1990 levels**.

The analysis by sector reveals that energy industries and transport are the primary contributors to Montenegro's national GHG emissions in 2022, accounting for 43% and 27% of total emissions, respectively. Transport and waste have shown significant increases since 1990, largely driven by overall population and GDP growth. In contrast, other sectors have experienced substantial emission reductions due to various factors, such as changes in industrial activity and sectoral efficiencies. The following figure illustrates the evolution of these main emission sources in the country compared to the NDC target.

Overarching policy framework on mitigation

As an EU candidate country and actively committed Party to the UNFCCC and the Paris Agreement, Montenegro aspires to comply with European Union (EU) acquis and the EU legislation, standards and regulations, including those related to environmental protection and climate change mitigation, through the Stabilisation and Association Agreement with the European Union which entered into force on 1 May 2010.

The Treaty establishing the Energy Community entered into force in July 2006. Montenegro is a contracting party to the Energy Community since 2007 and is thereby obligated to implement the energy regulations outlined in the treaty and to implement the EU Acquis Communautaire on energy, environment, competition and renewables, upon proposals by the Commission. This has been continuously extended or updated to incorporate new directives and regulations covering electricity, gas, oil, infrastructure, renewable energy, energy efficiency, competition and state aid, environment, statistics, climate and cybersecurity. At the 20th Ministerial meeting of the Energy Community held in 2022, the Contracting Parties agreed to implement the EU electricity market rules. Once this is achieved, they will be able to fully access the EU electricity markets, and therefore to freely trade electricity with the EU. At the 20th Ministerial Council meeting, the Contracting Parties also agreed on a set of ambitious 2030 targets for greenhouse gas emission reduction (60,9% net Greenhouse Gas Emissions reduction compared to 1990 levels), energy efficiency (129,88% maximum share of primary energy consumption and 79,06% maximum share of final energy consumption in 2030) and renewable energy (31% share of energy from renewable sources in gross final consumption of energy in 2030) for the Energy Community as a whole. The targets will constitute the benchmark for the transformation of Contracting Parties economies in line with their national energy and climate plans and their commitments to achieve climate neutrality by 2050. In line with this, Montenegro's target for GHG emission reduction is 55% compared to 1990 level without the Land Use, land Use Change and Forestry sector, its target share of energy from renewable sources in gross final consumption of energy by 2030 is 50% and the country's target energy efficiency contributions in 2030 are 0.92% maximum share of primary energy consumption and 0.73% maximum share of final energy consumption. However, the collective greenhouse gas emissions reduction achievement of all Contracting Parties is indicative, as not all Contracting Parties' individual targets are expressed in equivalent terms[5].

Montenegro has adopted the National Strategy for Climate Change by 2030 (NSCC) in 2015, which represents the horizontal policy document for climate change in the country. The Strategy is closely linked to a number of other sectoral strategies, as well as other documents reoffering to climate change issues and has been developed taking into account the identified effects of climate change, current socio-economic development and future development scenarios based on existing information.

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[5] DECISION OF THE MINISTERIAL COUNCIL OF THE ENERGY COMMUNITY No 2022/02/MC-EnC on amending Ministerial Council Decision No 2021/14/MC- EnC amending Annex I to the Treaty Establishing the Energy Community and incorporating Directive (EU) 2018/2001, Directive (EU) 2018/2002, Regulation (EU) 2018/1999, Delegated Regulation (EU) 2020/1044, and Implementing Regulation (EU) 2020/1208 in the Energy Community *acquis communautaire*

The National Climate Change Strategy (NCCS) is committed to creating a competitive, safe, and sustainable energy sector through coordinated efforts at the national and EU levels, ensuring regulatory certainty, and fostering green growth and job creation through early investments in a low-carbon economy.

On 23rd of December 2019, the Parliament of Montenegro adopted the Law on Protection against the Negative Impacts of Climate Change[6] (OG 73/19). The Law incorporates elements of the EU's Clean Energy Transition policy. It establishes national systems for GHG inventories and projections, carbon storage, and ozone layer protection, and outlines obligations for stationary plants and aircraft operators. The law also includes provisions for the Low Carbon Development Strategy (LCDS) and National Adaptation Plan (NAP). This Law represents the basis for the establishment of the National System for Monitoring, Reporting and Verification of Greenhouse Gases, the operation of the Emissions Trading System, and as well as a system that will ensure the sectoral distribution of efforts to reduce emissions outside the EU ETS System, Effort Sharing System. Moreover, with this Law it was enhanced the regulation of issues dealing with the use of ozone-depleting substances and fluorinated gases. This Law is being amended and a new proposal is expected to be adopted by the end of 2024. In the Draft Law, all relevant mitigation EU Regulations and Directives were transferred.

Mechanisms and instruments focusing on mitigation by NDC sector

Energy
• State Aid and Market Instruments, Decree on activities that emit greenhouse gases for which a permit for the emission of greenhouse gases is issued and additional by-laws • Law on Energy • Law on the use of energy from renewable sources • Law on Efficient Use of Energy • Law on Exploration and Production of Hydrocarbons • Law on Cross-border Exchange of Electricity and Natural Gas
Transport
• Transport Development Strategy of Montenegro for 2019-2035 • Roadmap for the Decarbonisation of Traffic in Montenegro
Industry
• Industrial policy of Montenegro 2024-2028 with the Action Plan for implementation for 2024 • Law on Industrial Emissions • Decree on activities that emit greenhouse gases for which a permit for the emission of greenhouse gases is issued (2020)
Consumption of fluorinated gases
• Legislation and Strategies in Relation to the Montreal Protocol • Tourism Development Strategy of Montenegro 2022-2025. with Action Plan
Solid Waste and Wastewater Management

[6] Chapters of this Law are as follows: I. Basic provisions; II. Documents for the protection against climate change negative impacts; III. Achieving low carbon development; IV. Emission reporting and report verification; V. Geological storage; VI. Ozone layer; VII. Supervision; VIII. Penalty provisions; and IX. Transitional and final provisions.

- Economic Reform Programme (ERP) 2022-2024
- Draft State Waste Management Plan (SWMP) 2023-2028
- Waste Management Strategy (WMS) until 2030
- National Strategy for Circular Transition by 2030 with an Action Plan from 2023 to 2024
- Municipal Wastewater Management Master Plan (MWMMP) 2020-2035
- Tourism Development Strategy 2022-2025
- Smart Specialization Strategy (S3) 2019-2024
- National Integrated Coastal Zone Management (ICZM) Strategy 2015-2030
- Energy Development Strategy until 2030
- Transposition of EU Waste Standards
- Law on Waste Management (2024)

Mitigation actions included in the revised NDC and the WM projections by sector

Energy industry and residential/commercial sector				
Number of mitigation actions		13		
Total estimated GHG emission reductions in 2022		812.17 $ktCO_2e/yr$		
Name and NDC code of mitigation action		**Status (planned, adopted, implemented)**	**Estimated GHG emission reductions achieved in 2022**	**Estimated GHG emission reductions expected in 2030**
1E	Ecological refurbishment of Pljevlja Thermoelectric Power Plant (TPP)	Adopted	0	0
2E	Carbon pricing for TPP	Adopted	556.88	876.53
3E	NDC renewable power plants	Adopted	99.74	214.40
*NA**	New renewable capacity	Adopted	0.00	313.48
4E	District Heating in Pljevlja	Adopted	0.00	5.47
5E	Development and Implementation of Energy Efficiency Regulatory Framework in Buildings	Adopted	151.13	245.43
6E	Increased Energy Efficiency in Public Buildings	Adopted		
7E	Financial Incentives for Citizens/Private Households (for Energy Efficiency Investments)	Adopted		
8E	Energy Labelling and Eco-Design Requirements for Energy-Related Products	Adopted		
9E	Establishment and Implementation of Energy Efficiency Criteria in Public Tendering	Adopted		
10E	Implementation of Energy Efficiency Measures in Public Municipal Companies, Utilities and Services	Adopted		
11E	Development of Transmission and Distribution Power Network (decrease in losses)	Adopted	0.00	22.86

12E	Refurbishment of Small Hydroelectric Power Plants (increased Energy Efficiency)	Adopted	4.42	3.75
Transport sector				
Number of mitigation actions		2		
Total estimated GHG emission reductions in 2022		7.37 ktCO_2e/yr		
Name and NDC code of mitigation action		**Status (planned, adopted, implemented)**	**Estimated GHG emission reductions achieved in 2022**	**Estimated GHG emission reductions expected in 2030**
1T	Electric Cars	No longer in place	7.37	36.88
2T	Financial Incentives for Electric, Plug-In Hybrid and Full Hybrid Vehicles, for Both Citizens and Companies/Entrepreneurs	Adopted		
Industry and Refrigeration and Air-conditioning				
Number of mitigation actions		2		
Total estimated GHG emission reductions in 2022		0 ktCO_2e/yr		
Name and NDC code of mitigation action		**Status (planned, adopted, implemented)**	**Estimated GHG emission reductions achieved in 2022**	**Estimated GHG emission reductions expected in 2030**
1I	Uniprom KAP: electrolysis cell replacement and overhaul (2020–2024) and ETS (2025–2030)	Implemented (no longer applicable)	NA	NA
2I	Reduction of HFCs in line with the Law Acknowledging Amendments to the Montreal Protocol on Substances that Deplete the Ozone Layer	Adopted	0	12.48
Waste sector				
Number of mitigation actions		2		
Total estimated GHG emission reductions in 2022		0 ktCO_2e/yr		
Name and NDC code of mitigation action		**Status (planned, adopted, implemented)**	**Estimated GHG emission reductions achieved in 2022**	**Estimated GHG emission reductions expected in 2030**
W1	Reduction of Bio-Waste in Municipal Waste	Adopted	0	19.44

W2	Increase in Connection Rate to Sewerage System (target 93% by 2035)	Adopted	0	36.41

**This PAM was not included in the NDC submission*

Projections of GHG Emissions and Removals

Projections of GHG emissions and removals are based on the national inventory for 1990–2022,. Projections are developed under different scenarios, each reflecting a specific set of policies and measures (PAMs). By comparing mitigation scenarios, Montenegro can assess the variations in its national emissions profile resulting from policy implementation and evaluate progress toward achieving its defined NDC targets. In alignment with the Modalities, Procedures, and Guidelines (MPGs), Montenegro defines the following three scenarios:

- **Without Measures (WOM) Scenario**: Excludes all PAMs implemented, adopted, or planned after 2020.
- **With Measures (WM) Scenario**: Includes PAMs under Montenegro's Revised NDC, reflecting all measures currently being implemented to meet NDC targets.
- **With Additional Measures (WAM) Scenario**: Incorporates additional PAMs beyond those in the current NDC, planned for future implementation.

The emission projections demonstrate the influence of mitigation measures on Montenegro's future GHG emissions levels. These projections focus specifically on PAMs that directly support the implementation and achievement of the NDC targets, ensuring they provide a clear basis for tracking progress.

The projections cover the time period from 2023 to 2040, using the 1990–2022 inventory as a reference.

Montenegro has applied the Mitigation-Inventory Tool for Integrated Climate Action (MITICA)[7] to develop its national projections of GHG emissions and removals of all scenarios. The Long-range Energy Alternative Planning software (LEAP)[8] was also employed to estimate the impact of the energy efficiency PAMs considered in the WM scenario.

The forecasting modelling approach applies a nationally defined macroeconomic framework considering the evolution of several proxies (parameters in the wording of the MPGs) that determine the composition of the national economy, demography and main sectoral characteristics.

Proxies are first identified based on available data from national planning processes and national prospects available. This notably includes the population projection up to 2050 developed by Monstat[9],

[7] Martín-Ortega, J.L., Chornet, J., Sebos I., Akkermans, S., Lopez Blanco, M.J. (2024). Enhancing Transparency of Climate Efforts: MITICA's Integrated Approach to Greenhouse Gas Mitigation. Sustainability 2024, 16(10), 4219. https://doi.org/10.3390/su16104219

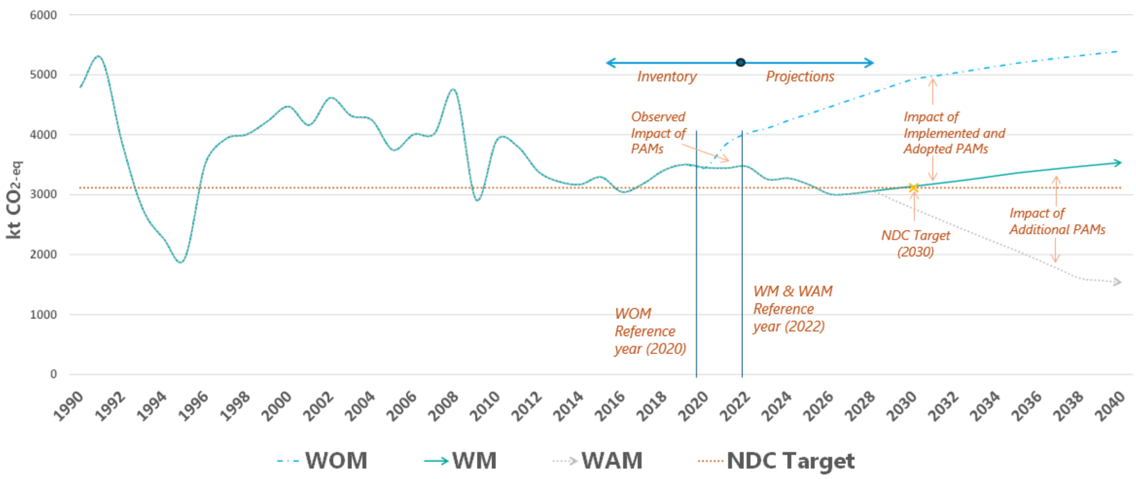
[8] SEI. LEAP; Stockholm Environment Institute: Stockholm, Sweden, 2024

[9] https://www.monstat.org/eng/page.php?id=47&pageid=47

and the GDP projections of the Ministry of Finance of Montenegro[10]. This was complemented by historical statistics from Monstat, and data available in the Shared Socioeconomic Pathways (SSP) database[11] for Montenegro. The GDP time series was constructed using historical data from the Eurostat database and interannual GDP growth rates provided by the Ministry of Finance for 2024–2027 (3.8%, 3.1%, 3.2%, and 3.2%, respectively). From 2028 to 2040, the interannual growth rates of the SSP2 scenario for Montenegro were applied. The composition of the economy (i.e. GDP branches) and the population series are common in all scenarios, and the differences between scenarios are only explained by the impact of PAMs.

The figure below illustrates the results for the WOM, WM, and WAM scenarios in relation to the NDC target **excluding the emissions of the LULUCF sector to allow the tracking of the NDC objectives**.

Figure 3 Summary of results of GHG projections



The WM projections indicate that Montenegro is on track to achieve its NDC target by 2030. While emissions under the WM scenario are slightly above the target, the results demonstrate that the country's efforts are closely aligned with the goal of reducing national GHG emissions (excluding LULUCF) by 35% by 2030 compared to based year (1990).

The WOM scenario serves as the baseline for projections, representing Montenegro's GHG emission profile if no NDC PAMs were implemented. Notably, the implementation of NDC PAMs began primarily in 2020–2021, and their impact is already observed in these inventoried years.

The WAM scenario explores the potential impact of Montenegro's accession to the EU, assumed to occur in 2028. Although Montenegro is making significant efforts to adopt the EU legislative acquis, the projections show that by 2030, the influence of EU PAMs and targets remains limited.

[10] https://wapi.gov.me/download-preview/e5286401-6770-4635-8cd2-d348a6c5e83a?version=1.0
[11] https://iiasa.ac.at/models-tools-data/ssp

Climate vulnerability and adaptation measures

According to both scenarios analysed in the FNC, the results from the climate projections show an increase of 1.5° C to 2°C in the mean annual temperature by 2040 throughout the country. The RCP8.5 scenario also expects that by 2070 the mean annual temperature will increase by up to 2°C and by 2100 up to 5°C. The mean annual rainfall is expected to decrease overall, especially during the summer months, but to increase in the winter months in some parts of the country. By 2070, the country is expected to experience a decrease of up to 10% of the mean annual rainfall throughout the territory, according to the RCP8.5 scenario.

Montenegro is particularly exposed and vulnerable to climate hazards, such as droughts, floods, forest fires, and heatwaves. Climate projections show that these climate extremes will increase in frequency and magnitude in the future.

Droughts in Montenegro have been more frequent since 1990s. Four major droughts occurred between 2003 and 2011. The drought of 2011 evolved into a social and economic challenge that affected the whole country and led to an extreme hydrological deficit in the Zeta-Bjelopavlići region, which includes the largest agricultural area in Montenegro. Additionally, heat waves will become more frequent and longer. In 2012, a strong heat wave hit Montenegro, affecting more than 4,500 people.

Montenegro has suffered three major floods (2007, 2009, and 2010). The damage and losses caused by the 2010 flood alone amounted to around €44 million (1.4% of GDP). Flood risk reduction and management is not being adequately addressed in Montenegro so far, although the consequences are frequently significant.

Montenegro's forests have been affected multiple times by climate-induced forest fires. In the period 2005–2015, there were around 800 large forest fires in Montenegro, and more than 18,000 ha of forests and over 800,000 m^3 of wood mass were damaged or destroyed. Montenegro's fire season was the worst in 2017 with 124 fires covering over 30 ha, affecting a total of 51,661 ha, six times the area affected in 2016.

Montenegro is particularly vulnerable to climate change and variability as well extreme climate events. The sectors most at risk are the water sector, forestry, and agriculture sectors. In terms of geographical vulnerability, the coastal area is highly vulnerable to a rise in the sea level and a decrease in rainfall. Montenegro recognises the urgent need to address the effects of climate change by promoting effective adaptation measures for the key vulnerable sectors. The summary of the vulnerability analysis and proposed adaptation measures by sector includes:

- **The water sector** shows a reduction in the water balance in all river basins in Montenegro. The decrease in rainfall and snowfall will drastically affect surface water availability. Adaptation measures focus on applying an integrated approach to water resources and systems management, and a strengthening of cross-sector planning and activities.

- **The forestry sector** is affected by climate change not only in the current developmental processes and growth, but usually results in cumulative effects that can last for the lifetime of the tree. The greatest risk is to forests located in the coastal and central regions, where high air temperatures during the summer period and the typical vegetation create the necessary preconditions for forest fires to start. The proposed Forest and Forestry Development Strategy for 2025-2030 focuses on promoting sustainable management of forests and strengthening the circular economy.

- **The agricultural sector** is highly vulnerable to climate change due to its dependence on specific temperature conditions and water availability, and it is also exposed to climate hazards such as droughts or floods. A large part of the agricultural areas in Montenegro are located in lowlands, which makes them particularly prone to regular floods. Possible adaptation measures in the agricultural sector include planning and capacity building measures, while other measures require more technology- and information-oriented responses.

Constraints and gaps: Climate finance, technology transfer, and capacity building needs

Montenegro has demonstrated progress in climate mitigation and adaptation, continuing such efforts to move towards meeting its obligations under the UNFCCC, which entail additional investments, technology, and capacity. While these needs can be partially covered by national resources (public and private), for Montenegro, as a country in transition, contributions from international cooperation are essential.

The need to prioritise climate financing in Montenegro arises, to a greater extent, from the scarcity of public and/or private resources to develop and support specific projects needed to comply with adaptation and mitigation targets under the UNFCCC. However, Montenegro has not yet established a system for monitoring and evaluating the effects of climate finance in the field of climate change.

To date, Montenegro has received support from the international community via different financial mechanisms, but predominantly in the form of loans and grants. Financial support from international organisations and knowledge transfer with other countries has enabled Montenegro to implement a series of climate change projects.

Apart from climate finance, Montenegro requires a strong focus on promoting and adopting innovative technologies via technology transfer mechanisms. Montenegro has not taken steps towards a comprehensive analysis of the needs for technology transfer, technology development and research. Institutionally, the Ministry of Education, Science and Innovation is responsible for implementing incentives to support research and innovation, including climate change technologies, in collaboration with other institutions. Additionally, the newly established Innovation Fund plays a crucial role in promoting and supporting innovative technologies and research, particularly those aimed at climate change mitigation and adaptation.

Montenegro has been granted significant capacity building and technical assistance for a number of programmes, projects, and partnerships. The project "Creating a Transparent Framework for Monitoring the National Determined Contribution and Adaptation Actions in Montenegro – CBIT" conducted a comprehensive analysis of the capacities and needs of competent institutions at the national and local level involved in the creation and implementation of climate policies in key areas. The project recommended measures to further strengthen them, in order to enable decision makers to more effectively implement climate change mitigation and adaptation measures sustainably. It also rated knowledge capacity at the national and local levels as low and found that institutions have an insufficient number of employees in specific jobs, professional and communication connections with relevant partners at the national level are weak or negligible, and there is almost no mechanism for capacity building through continuous education.

1.

INTRODUCTION

Montenegro ratified the UNFCCC by succession in 2006, and thus became a non-Annex-1 party to the Convention on 27th January 2007. The Kyoto Protocol was ratified on 27th March 2007, and Montenegro became a non-Annex-B party on 2nd September 2007. By ratifying the UNFCCC and the Kyoto Protocol, Montenegro joined countries that share the same concerns and that are taking an active role in international efforts to address CC.

On 11th October 2017, the Parliament of Montenegro enacted a law ratifying the Paris Agreement. Thus, Montenegro became a party which has also ratified the Paris Agreement and has undertaken to contribute to reductions in GHG emissions globally. Montenegro updated its NDC in 2021, committing to a new target of reducing GHG emissions by 35% by 2030 compared to the reference year 1990 (excluding LULUCF), i.e. reducing GHG emissions by 2,117 kilotons of CO2eq by 2030, over the previous commitment of a 1,572 kt reduction (30%).

With the presentation of the FNC/1BTR, Montenegro is once again fulfilling its international obligations under the UNFCCC. This report includes an update of the 2016 GHG emissions inventories and the results of the new GHG inventories for 2022, as well as a general description of the measures formulated, adopted, and implemented by Montenegro for the management and planning of GHG emission reductions. It also presents the climate profile of the country, highlighting the sectors and regions most vulnerable to climate change impacts, while providing an analysis of potential adaptation measures. The report summarizes information on the processes related to capacity building at the national level and the promotion of investments and financing mechanisms in the country, among other relevant issues. The information described in this FNC/1BTR summarizes the efforts made in the country related to climate change management, with an emphasis on the period following the presentation of TNC in 2017 and the TBUR in 2021.

The compilation of the FNC/1BTR was carried out with financial support from the Global Environment Facility (GEF) in the framework of the facilities for the elaboration of National Communications required by the UNFCCC; and under the leadership and coordination of the MESDNRD as the national Focal Point for the Convention and the support of UNDP.

The FNC/1BTR has included studies in different sectors to build information and capacities, promoting the integration of climate change into the development of public policies for development, competitiveness, and poverty alleviation. Through the FNC/1BTR project, the official information of the GHG inventory has been updated; and detailed climate change projections were carried out as part of the evaluation of the vulnerability of key sectors to climate change.

This report consists of nine chapters, the first being the introductory chapter. The structure and contents of Chapters 2–6 follow the UNFCCC guidelines for the preparation of National Communications and MPGs for the ETF (annex to decision 18/CMA.1) BTR include information on national inventory reports (NIR), progress towards NDCs, policies and measures, climate change impacts and adaptation, levels of financial, technology development and transfer and capacity-building support, capacity-building needs and areas of improvement.

In this regard, **Chapter 2** contains information on the country's national circumstances, emphasising its diversity and the geographical, climatic, environmental, social, economic, political, and cultural wealth of Montenegro and describing the institutional and policy framework for climate change.

Chapter 3 presents the results of the national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using methodologies adopted by the Convention for the base year 1990.

Through chapters 4, 5, 6 and 7, Montenegro reports on their level of achievement of their mitigation targets to enhance global transparency on mitigation efforts. In this regard, these chapters present the key information underpinning Montenegro's progress on its NDC including a discussion on the overarching national climate change policies, the sectoral mitigation PAMs implemented or planned as well as the projections of the GHG emissions in several scenarios considering differential levels of implementation of policies and measures. They contain Montenegro's most recent information on progress in implementing its updated NDC submitted to the UNFCCC in 2021.

The information presented is reported following the specific reporting requirements and the format given in decision 18/CMA.1 and the common tabular formats (CTF tables) that were adopted at CMA 3 in 2021.

The chapters contain both textual information and data in CTF tables for tracking progress in implementing and achieving the updated NDC.

The textual information is structured following the BTR outline contained in annex IV to decision 5/ CMA.3 as follows:

- Information on national circumstances and institutional arrangements relevant to NDC tracking (chapter 1).
- A description of the NDC (chapter 4).
- Information necessary to track progress including indicators, definitions, methodologies, accounting approaches, use of ITMOs under Article 6 and approaches to LULUCF (chapter 5).
- Information on mitigation policies and measures, actions and plans (chapter 6).
- A summary of GHG emissions and removals (chapter 2).
- Projections of GHG emissions and removals (chapter 7).
- Other information including the policies and measures on international transport, long term impacts and economic and social impact of response measures (chapter 6).

In addition to the narrative, Montenegro reports the following information in the CTF tables:

Structured summary, which is organized as follows:

- Description of selected indicators (CTF table 1);
- Definitions needed to understand the NDC (CTF table 2);
- Methodologies and accounting approaches (CTF table 3);
- Tracking progress made in implementing and achieving the NDC (CTF table 4).
- Mitigation policies and measures, actions and plans (CTF table 5);
- Summary of GHG emissions and removals (CTF table 6);

Information on projections of GHG emissions and removals, organized as follows:

- "With measures" scenario (CTF table 7)
- "With additional measures" scenario (CTF table 8)
- "Without measures" scenarios (CTF table 9)
- Projections of key indicators (CTF table 10)
- Key underlying assumptions and parameters used (CTF table 11).

No flexibilities within the meaning of para 3(c) of the Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement have been applied.

Chapter 8 provides an overview of the main findings regarding climate projections, vulnerability to climate change and adaptation measures.

Chapter 9 summarises the key gaps and constraints with regards to climate finance, technology transfer and capacity building needs.

2.

NATIONAL CIRCUMSTANCES

2.1 General information

Montenegro is located in the southeastern part of Europe and according to its latitude belongs to the southernmost part of Europe. It is located at the junction of two significant geographical units – the Dinarides and the central Mediterranean.

The area of Montenegro is very complex in terms of its landscape and has many natural contrasts, which together form a unique geographical whole. The distance between the southernmost and northernmost points of the mainland of Montenegro is 192 km, as the crow flies, and the distance between the westernmost and the easternmost points is 163 km. The surface area of Montenegro is 13,812 km^2.

Montenegro has a parliamentary political system. Administratively, it is divided into 24 political-territorial units – municipalities – which perform the function of local governance. The capital of Montenegro is Podgorica, which is also the largest city (with 179,505 inhabitants), while the city of Nikšić is the second-largest (with 65,705 inhabitants)[12].

Below is a summary table of the information on Montenegro's national circumstances.

Table 1 Consolidation of national information Included in this chapter

Information		Source
Geography and Population		
Location	Southeastern part of Europe, Europe, Located in the south-eastern part of Europe, the Mediterranean. Positioned at the junction of two significant geographical units – the Dinarides and the central Mediterranean	
Total area Territorial sea area	13,812 km^2 2, 540 km^2	MONSTAT
Land Use	Agricultural land: 309,241 ha or 22.4% of the territory Forested land: 6,225 km2 , approximately 60% of country surface	Montenegro National Drought Plan (2020)
Protected Land Areas (National system of PAs)	185,269.69 ha or 13.414%	Prirodainfo.me
The estimated biomass in the national parks	10,717,149 m^3	TBUR (2021)
Population		

[12] MONSTAT

Information		Source
Population in 2023 (persons)	623,633	MONSTAT
Population in 2011 (persons)	620,079	
Population Growth (2011–2023)	Increased by 2%	
Annual Population Growth Rate (2023)	Approximately 0.048%	
Gender Distribution (2023)	Female: 316,826 (50.80%) Male: 306,807 (49.20%)	
Age groups (2023)	Children (0–14 years): 18.03% (134,363) Working-age (15–64 years): 65.13% (412,085) Seniors (65+ years): 16.84% (97,985)	
Population density	45.1 inhabitants per km^2	
Urbanisation (2024)	**67.8** % of the population is **urban** (432,688 people)	MONSTAT
Life expectancy (2020)	75.9 years	MONSTAT
Migration (2020)	Migration rate: 8.0%	MONSTAT
Economic Activity		
GDP at Current Prices (EUR, millions) (2023)	6,299	MONSTAT
GDP Per Capita (EUR)(2023)	10,988	MONSTAT
Real growth rate of GDP (%)	6.30%	MONSTAT
Unemployment Rate (%)(2023)	13.1%	MONSTAT
Inflation Rate (CPI, %)(2023)	8.7%	MONSTAT
Gini Coefficient (2022)	31.5	MONSTAT
Tourism Revenue (EUR, millions)	1,437	MONSTAT
Tourism's GDP Contribution (%)	~20%	MONSTAT
Energy		Report on the State of the Energy Sector of Montenegro for 2023, Regulatory Agency for Energy and Regulated Utilities.
Installed Electricity Production Capacity (MW)	Total: 1,067.238 MW	
- Hydropower Plants	66.05% (704.904 MW)	

Information		Source
- Thermal Power Plants	21.08% (225 MW)	
- Wind Farms	11.06% (118 MW)	
- Solar Power Plants	1.81% (19.334 MW)	
Electricity Production (GWh)	4,046.71	
- Share of TPP "Pljevlja" in Total Production	37.64%	
- Renewable Energy Sources & High-Efficiency Co-Generation	62.36%	
Electricity Losses (GWh)	474 (2.38% more than planned)	
Industry and mining		
Dominant Sector (2015–2023)	Manufacturing (average share 54%; 48.5% in 2023)	Industrial Policy of Montenegro 2024-2028, Ministry of Economic Development, 2024.
Average Share in Industrial Production (2015–2023)	- Manufacturing: 54% (declined to 48.5% in 2023)	
Industrial Contribution to GVA (2015–2022)	-Overall industry: 12.3% (average) - Manufacturing: 4.7% (average; 4% in 2021)	
Service Sector in GVA (2022)	76.5% (with construction, 80.9%)	
Agriculture Share in GVA (2022)	7.3% (2.5% decrease since 2015)	
GDP per Capita in Industry (2022)	€871	
Industrial GDP Growth (2015–2022)	13% (€374.3 million to €422.1 million)	
Key Manufacturing Exports (2023)	- Pharmaceuticals: 10% - Food industry: 9.6%	
Change in Export Structure (2015–2022)	- Electricity exports grew from 9.4% to 30.7% of industry exports	
Other Export Shares (2023)	- Wood processing: 7.4%, - Food products: 7% - Pharmaceuticals and beverages: 6.2% each	
Agriculture		
Agriculture's Share in GDP (2023)	5.7%	MONSTAT

Information		Source
Total Agricultural Employment (2022)	10,700 people (4.6% of total employment)	MONSTAT
Agricultural Land (Total)	515,740 ha (37.4% of Montenegro's territory)	MONSTAT
Utilised Agricultural Land (2023)	263,522.3 ha (up by 3.9% from 2022)	MONSTAT
Average Agricultural Holding Size	5.84 ha per holding	MONSTAT
Traffic		
Vehicle Registrations (2023)	Total registered vehicles: 285,257 (+6.9% compared to 2022)	MONSTAT

2.2 Government structure

Montenegro operates under a parliamentary political system and is divided into 25 political-territorial units known as municipalities, each responsible for local governance. The capital city, Podgorica, is the largest urban centre with a population of 179,505 inhabitants. The second-largest city is Nikšić, with 65,705 inhabitants .

Till June 2024, the then Ministry of Tourism, Ecology, Sustainable Development and Northern Region Development was the body responsible for climate policy adoption, implementation and monitoring. The Climate Change Division was a focal point for the UNFCCC, GEF and Adaptation Fund. It also dealt with waste and environmental protection. From July 2024, there was a reshuffle and this ministry is now the Ministry of Ecology, Sustainable Development and Northern Region Development.

Montenegro also has a high-level multi-institutional council, chaired by the President of Montenegro, which focuses on sustainable development. Established by the government in 2008, this council marked a positive step toward inter-institutional coordination and cooperation. A reform in 2013 strengthened the council's mandate in the area of climate change, making it a strategic priority in Montenegro's goal of becoming a low-carbon society. In 2016, the council evolved into the National Council for Sustainable Development, Climate Change, and Coastal Area Management. In December 2022, the National Council for Sustainable Development (NSOR) was established. At the same time, the Working Group for Mitigation and Adaptation to Climate Change was formed as a permanent working body of the Council. Members of the workforce are appointed from state administration authorities responsible for certain sectors, local administration, scientific, professional, public and other workers, employers' associations, representatives of civil society associations operating in the field of climate change, independent experts and youth representatives.

Montenegro's climate governance is overseen by the MESDNRD, with the Directorate for Climate Change and Sustainable Development playing a central role in policy adoption, implementation, and monitoring.

The Directorate is also the focal point for the UNFCCC and the GCF. Environmental Protection Agency plays a key role in establishing the greenhouse gas (GHG) emissions inventory. The Institute for Hydrometeorology and Seismology manages meteorological and hydrological systems and is the contact institution for the IPCC. The Environmental Protection Fund (Eco-fund), established in 2020, finances projects related to conservation, sustainable development, and renewable energy. The National Council for Sustainable Development (NSOR), founded in 2022, develops and monitors climate change policies, and aligns them with the European Union's sustainable development framework. The Council's working groups focus on areas such as policy implementation, climate change mitigation, just transition, and sustainable development at both local and national levels.

2.3 Demographic and population trends

According to the 2023 census, the population of Montenegro was 623,633, resulting in a population density of 45.1 inhabitants per square kilometre. When compared to the 2011 Census, it is for 2% bigger. The country experienced a positive annual population growth, with a rate of approximately 0.048%. Of the total population, 316,826 or 50,80% were female and 306,807 or 49,20%, were male.[13]

The data from 2023 shows that Montenegro's population had increased slightly to 623,633 inhabitants, with the following demographic breakdown:

- Children (0–14 years): 18.03% (134,363)
- Working-age population (15–64 years): 65.13% (412,085)
- Seniors (65 years and over): 16.84%. (97,985)

In 2020, the life expectancy at birth was recorded at 75.9 years.

Montenegro is home to approximately 1,256 settlements, of which 40 are classified as urban areas, housing around 62% of the total population. The remaining 38% of the population resides in rural settlements. A notable difference between genders is observed, with 65.5% of females and 63.2% of males living in urban areas.

Migration trends in 2020 indicated a migration rate of 8.0%, continuing an upward trend in population movement, primarily from rural to urban areas. This trend presents two significant challenges:

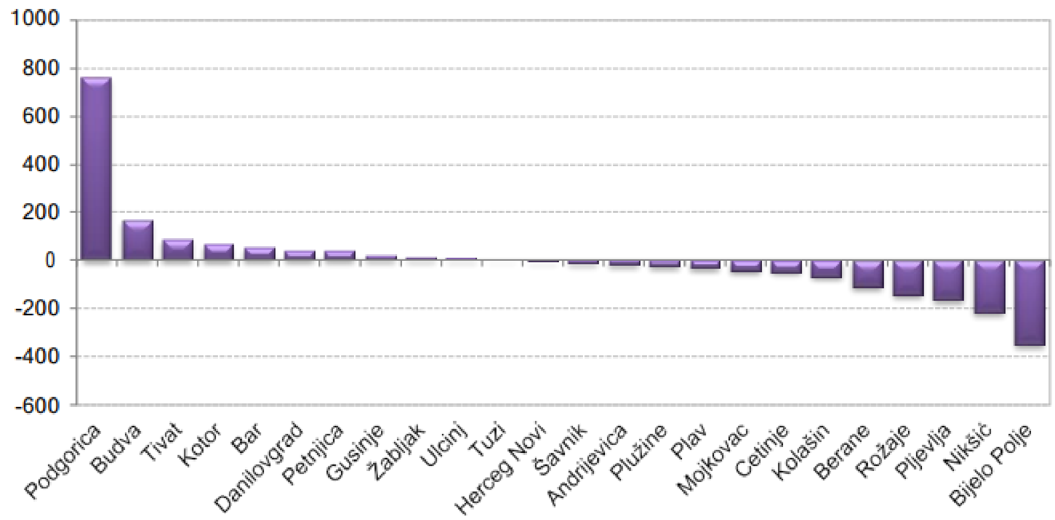
- Increasing pressure on resources in urban regions.
- Depopulation of rural areas, especially in mountainous regions, leading to abandoned land and overgrown pastures.

[13] Ibid.

These issues contribute to reduced investment in these underpopulated areas, further hampering the development of rural Montenegro. Figure 3 illustrates the migration balance across municipalities in Montenegro for the year 2020. During this period, eleven municipalities recorded population growth. However, the municipality of Bijelo Polje experienced the highest population decline.

The coastal region of Montenegro remains the most densely populated and developed area of the country. According to the 2011 Census, the coastal region had 148,683 inhabitants, marking a 3.7% increase compared to the 2003 census.

Figure 3 Migration balance rates by municipality for 2020



The coastal area is the densest and most developed part of Montenegro. According to the 2011 Census, there were 148,683 inhabitants, which is 3.7% more than in 2003. MONSTAT's Montenegro Population Projection to 2061 (revisions from 2017) predicts a continuous increase in the population in this area, with a growth index between 116.2 and 134.0, depending on the assumed scenario Table 2.

Table 2 Population projections in the coastal region of Montenegro until 2061 for different scenarios

Coastal area	Low fertility	Medium fertility	High fertility	Constant fertility	Constant mortality
2011	148,605	148,605	148,605	148,605	148,605
2021	155,082	155,279	155,428	152,993	155,120
2031	159,260	160,995	162,294	155,774	159,347
2041	162,026	166,856	170,485	158,330	162,301
2051	166,144	175,435	182,527	162,270	167,259
2061	172,685	187,536	199,199	168,896	174,802
Growth index for 2061 (2011=100)	116.2	126.2	134.0	113.7	117.6

Source: Projekcije stanovništva regiona Crne Gore, 2011-2061: Revizija

2.4 Land use

Montenegro is located in the southeastern part of Europe, bordered by the Adriatic Sea to the southwest, between latitudes 41° 52’ to 43° 32’ N and longitudes 18° 26’ to 19° 22’ E, covering a land area of 13,812 km^2. The country’s proximity to the Mediterranean and Adriatic Seas significantly influences its climate and biodiversity. Montenegro’s terrain is marked by extreme topographical contrasts, with over 90% of the land above 200 metres in elevation, and approximately 15% of its territory lying above 1,500 metres. Some of the highest peaks are found in the Dinaric Alps, with Bobotov Kuk reaching 2,523 metres. The northern and central regions are primarily mountainous, while the southern part, along the Adriatic coast, features a narrow coastal plain.

The climate in Montenegro varies significantly due to its diverse topography. The coastal areas experience a typical Mediterranean climate, with hot, dry summers and mild, wet winters. In contrast, the mountainous regions in the interior have a more continental climate, characterised by colder winters, heavier snowfall, and frequent frost, resulting in diverse weather patterns over relatively short distances.

Montenegro’s water systems are divided between the Adriatic Sea Basin and the Black Sea Basin. Major rivers in the Adriatic Basin include the Morača and Bojana, with Lake Skadar acting as a crucial water source. The Black Sea Basin is drained by rivers like the Tara, Lim, and Piva, which eventually flow toward the Danube River via the Drina. Lake Skadar, the largest lake in the Balkans, has a surface area that fluctuates between 360 and 500 km^2, depending on the season and rainfall. Along with other natural and artificial lakes, such as Lake Biograd and Lake Piva, these bodies of water are essential for Montenegro’s water balance and ecosystem health.

Montenegro’s geological structure is primarily composed of limestone, dolomite, and igneous rocks, contributing to the formation of a rugged karst landscape. The karst terrain, typical of the Dinaric Alps, allows for the rapid infiltration of rainfall into underground aquifers, leading to the development of numerous caves and underground water systems that are vital to the country’s water supply.

The country is committed to environmental conservation, with 13.41% of its land designated as protected areas, including the five national parks of Durmitor, Biogradska Gora, Lake Skadar, Lovćen, and Prokletije. These areas encompass diverse ecosystems, including forests, lakes, and karst landscapes, which provide essential habitats for a wide range of flora and fauna. However, Montenegro faces growing environmental challenges due to climate change, including an increased risk of wildfires, droughts, and the degradation of its forested areas. The mountainous regions are especially vulnerable to these changes, with more frequent occurrences of flooding and landslides. Rising temperatures have also caused shifts in biodiversity and affected the health of forest ecosystems, requiring continued environmental monitoring and the development of adaptive strategies to mitigate these impacts.

2.5 Climate profile

Montenegro is located in the central part of a moderately warm zone in the northern hemisphere, between latitudes 41° 52’ to 43° 32’ N and longitudes 18° 26’ to 19° 22’ E. Due to its proximity to the Adriatic and Mediterranean Seas, the country experiences a Mediterranean climate characterised by warm, somewhat dry summers and mild, humid winters.

The climate and weather in Montenegro are heavily influenced by several atmospheric systems, including the Genoese Cyclone, Adriatic Cyclone, Icelandic Depression, Black Sea Depression, Azores Anticyclone, Siberian Anticyclone, Central European Anticyclone, the cold Arctic Front from the north, and the warm Tropical Front from the south.

In addition to these atmospheric patterns, the large bodies of water, altitude, and the position of coastal mountains, along with the terrain's relief, significantly affect both the local and regional climates. As a result, Montenegro experiences large climate variations over a relatively small geographical area, particularly between the coastal and highland regions.

The three dominant climate types in Montenegro are maritime, continental and mountainous.

The combination of the extensive water surfaces, mountainous terrain, and land relief contributes to significant climatic differences between the coastal region and the highland region, with numerous transitional climate forms in between.

The mean annual air temperature varies considerably, ranging from 4.6°C in Žabljak (located at an altitude of 1,450 metres) to 15.8°C along the coast. Average annual rainfall also shows considerable variation, from 800 mm in the far north to approximately 5,000 mm in the far southwest.

Montenegro experiences between 115 and 130 days of rainfall annually, with the northern regions seeing up to 172 rainy days. The rainiest month along the coast is November, while July is the driest. Snow cover forms at elevations above 400 metres, and where the snow depth exceeds 50 cm, it lasts from an average of 10 days in Kolašin to 76 days in Žabljak. In mountainous regions, snow is more frequent in the spring than in the autumn.

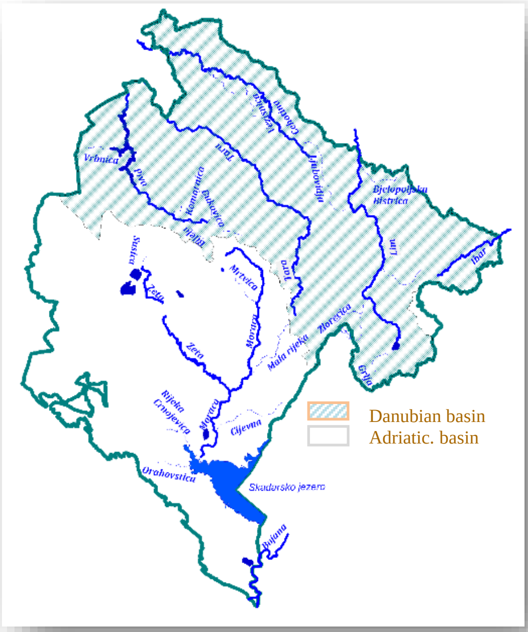
2.6 Natural resources

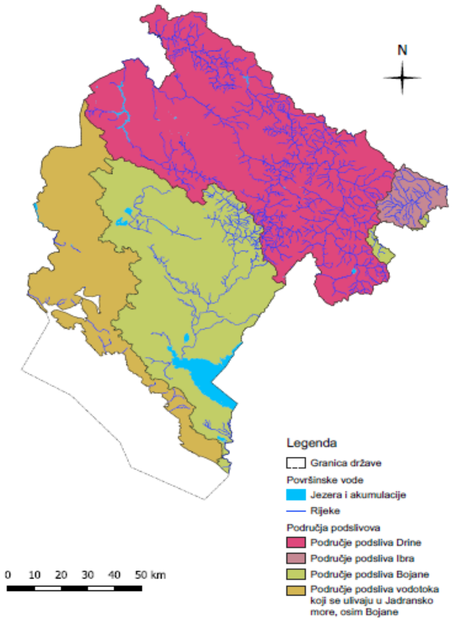
2.6.1 Water resources

As much as 95.3% of river flows in Montenegro are formed on its territory, i.e. Their source and catchment area are located on the territory of the country.

Figure 4 Danubian and Adriatic basins in Montenegro

The territory of Montenegro is hydrographically divided into two almost equal parts. The Danube part of the basin is 52.5% or 7,260 km^2, and the Adriatic part of the basin is 47.5% or 6,560 km^2.





In order to ensure comprehensive water management, taking into account the hydrographic characteristics, uniqueness and interconnection of the water regime, in the territory of Montenegro, river basin districts are determined as the basic units for water management, as follows:

- The Danube River Basin is part of the Danube International River Basin District on the territory of Montenegro, which includes the basins of the Ibar, Lim, Ćehotina, Tara And Piva rivers, with their groundwaters;

- The Adriatic Basin is part of the International Adriatic Sea River Basin in the territory of Montenegro, which includes the basins of Zeta, Morača, Skadar Lake, Bojana, Trebišnjica and watercourses of the Montenegrin Littoral, which flow directly into the Adriatic Sea, with the associated underground and coastal sea waters.

Watersheds are divided into sub-basin areas and small catchment areas. Watersheds can be formed by combining small watersheds with larger ones or by connecting them to nearby small watersheds.

Numerous lakes are also of great importance for the hydrography of Montenegro. The largest is Lake Skadar, which is located in the lower southern part of Montenegro, in a vast depression and at the same time is the largest lake in the Balkans. Three-fifths of the surface of Lake Skadar belongs to Montenegro. Other natural lakes that are part of the water balance of Montenegro are Biogradsko, Plavsko, Crno and Šasko lakes. The largest artificial reservoir is Pivsko. In addition to it, significant reservoirs are the lakes Slano, Krupac and Vrtac, as well as the Otilovići reservoir.

Wetlands can be found mainly in areas around lakes and to a lesser extent in the coastal area. The most important wetland area is in the vicinity of Lake Skadar and is on the list of internationally important wetland areas (based on the Ramsar Convention).

The total runoff from the territory of Montenegro is 604 m^3/s, and the average is 44 $l/s/km^2$ (the world average runoff is 6.9). Groundwater potentials are estimated at about 14,000 l/s. However, despite the great water wealth, Montenegro is characterised by an unfavourable spatial and temporal distribution of water. There are very long periods of small water when even large rivers, such as the Morača River, dry up on a longer stretch of the riverbed, with very severe consequences for the ecological and social environment.

Conclusions on the water capacity of Montenegro must be considered according to specific individual indicators of the water regime, because examination of only especially from the position of average flow values, can lead to wrong conclusions.

The analysis of the existing river flows indicates that Montenegro can be considered satisfactorily aquatic. Specific swellings are quite variable. The smallest are on the Ibar, where they drop to about 14 l/skm^2 (HS Bać) and on the Ćehotina River (HS Gradac about 16 l/skm^2). The largest specific runoff is in the Morača basin, where it ranges in the range of about 50-70 l/skm^2. The relativity of this data is confirmed by the HS Zlatica, whose specific runoff is very high and amounts to about 60 l/skm^2, while in the low-water period this watercourse can dry up.

The average water level in the Lima basin is quite variable and decreases quite sharply going downstream. In the upstream part of the flow to HS Plav, the specific runoff is about 53 l/skm^2 and then it constantly decreases going downstream, so that on HS Dobrakovo it is about 26 l/skm^2.

In the Tara basin, the specific runoff modulus on the Crna Poljana HS is about 48 l/skm^2 and on the Trebaljevo HS 48.5 l/skm^2.

On some rivers, in extremely karst conditions, this indicator (specific runoff modulus) is not reliable, because the orographic and hydrological watersheds do not coincide.

In complex forms of runoff, in conditions of highly developed forms of karstification, i.e. hydrographic-hydrological discontinuities in runoff, the way out is in the installation of a denser network of water measuring stations, so that the flows before and after all major karst springs and abysses can be monitored.

The analysis of the small water regime shows that small waters are extremely small, reduced to symbolic flows in low-water periods, even on larger rivers. Extremely low waters are twenty or more times lower than the average values. On some rivers, these relations are even more unfavourable (HS Duklov Most na Zeta).

Specific runoff on some profiles is less than 1 l/skm^2. According to these indicators, the Ibar and Ćehotina rivers are the most endangered in the low-water period, while the situation on the Lim is much more favourable, where the specific runoff is around 4-6 l/skm^2, which is mostly the result of the effect of regulating the flow in the regulation volume of Plav Lake.

In the case of high waters, specific flows range from about 500 l/skm^2 (Lim, Zeta) to 2200 l/skm^2 (Morača), which is an indicator of what kind of torrential regime it is.

Groundwater

Groundwater in Montenegro is present in rocks of different ages, from the Palaeozoic Era to the Quaternary Period. It is a very important resource that represents the only practical source of water for the population. In addition to supplying water to the population, ground water is also used in industry, as well as in agriculture. 75 sources are used to provide public water supplies to 40 urban settlements; 21 of these are municipal centres and suburbs. Of the total number of sources, ground water from karst aquifers is abstracted from 64 of them and ground water from inter-granular aquifers is abstracted from eleven sources. The chapter section “Additional information” includes a detailed report on reserves, use, protection, and other issues related to ground water.

2.6.2 Forests

60% of Montenegro’s territory is covered by forests, which makes it among the top three most forested countries in Europe, behind Finland (86%) and Sweden (67%). The forest cover is far above the average European (46%) and world (30%) level of forest cover. The high percentage of forest cover represents a big advantage in terms of environmental protection and improvement, and is also positive in terms of adapting ecosystems to meet future changes.

Orographic features and the refugial character of many habitats have made the abundance and diversity of wildlife (flora and fauna) a quality specific to Montenegro. The floristic diversity comprises 3,250 plant species and the index (S/A-species/area) of 0.837 makes Montenegro one of the most important biodiversity centres in Europe. The refugial character of habitats predominates; however, there is also evidence that species of flora and fauna that are endemic in Europe, Alpine, and in other Mediterranean regions are also present here.

Major diversity in terms of dendroflora is illustrated by the fact that the National Forest Inventory registered 68 species of trees (57 broadleaf and eleven coniferous species). Woody species form pure and mixed forests and cover 59.9% (832,900 ha), while forest land covers an additional 135,800 ha or 9.8%, which represents 69.7% of the territory of Montenegro. When comparing the data from the National Forest Inventory (NFI) with the data from the Spatial Plan of Montenegro to 2020, which states that forests and forest land covers an area of 738,000 ha or 53.4%, an increase of 16.3% is evident.

Dominant species in the forest include beech, spruce, fir, black pine, etc. Figure 5 shows the distribution of high forests and coppice forests.

High forests cover 61%, shoots cover 12%, shrubs 13%, and forest land 14% of the total forest area. In the national parks (Lake Skadar, Lovćen, Biogradska Gora, Prokletije, and Durmitor), forests (37,125 ha) and forest land (2,825 ha) cover 40.5% of the area. Compared to the total area under forests in Montenegro, this is 53.7% and 14.6%, respectively, in the Emerald Network zone. In national parks, 66% of the area under forests is high forest (24,475 ha). Conifer forests cover 20.4% (7,575 ha), shrubs 13.6% (5,050 ha), while artificially raised communities cover 25 ha. The dominant share of self-renewing stands indicates a still high level of bioecological stability and productivity, especially in the national parks of Biogradska Gora, Prokletije, and Durmitor, in which forest ecosystems were one of the basic motives for declaring and establishing their status as national parks. The percentage of the area where the young trees are registered can be considered favourable in relation to the total forest structure.

The estimated biomass in the national parks of Montenegro is 10,717,149 m^3, while the forest ecosystem permanently captures 979,966 tonnes of carbon. The total amount of dead trees in deep condition and the stand is estimated at 258,079 m^3 and 238,967 trees of different tree species.

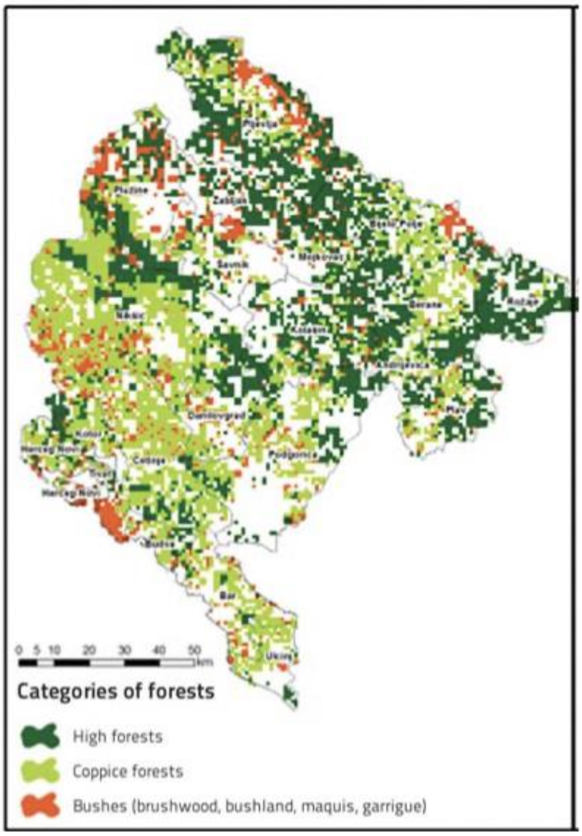
According to data from the Spatial Plan of Montenegro, 67% of the forests are state-owned. However, there are some indications that the balance of ownership has changed in favour of private forest owners, due to updates in the cadastre, restitution, whereby49% of forests and forest land are now privately owned.[14]

Currently, 185,269.69 ha, or 13.41% of Montenegrin territory is protected. The national parks Durmitor, Lake Skadar, Lovćen, Biogradska Gora, and Prokletije occupy a total of 100,427 ha (7.27%), while nature reserves cover 79,583.10 ha, or 5.76% of the territory.

The factors that threaten forest ecosystems are primarily wildfires, abiotic factors (droughts, floods, frost, snow, high winds, etc.), and pests and diseases. The number of wildfires varies from year to year. Given the ecological and economical damage, wildfires are the biggest threat to forest ecosystems in Montenegro. Although currently their coverage is about 0.5% of the total forest area at the annual level, they could impose a serious threat in the future, especially in the southern forest region, where forests spread along the coast and in karst terrains. Here access to put out wildfires is difficult.

[14] Source: First National Forest Inventory (2013)

Figure 5 Distribution of high and coppice forests



Source: NFI (2012)

Unsustainable forest management practices have resulted in the deterioration of forest ecosystems. It has been observed that forests have become more susceptible to climate change, air pollution, and fires, as well as parasitic fungi, insects, and to a lesser extent rodents and parasitic flowering plants. The threats to forest ecosystems in Montenegro include:

- weakening of the immunity of certain tree species;
- reduced productivity and bioecological stability;
- intensive drying of forests, especially conifers, spruce and fir but also relatively poor defoliation;
- occurrence of pathogenic fungal epiphytocia and/or gradation of harmful insects;
- rodent damage;
- the appearance of mistletoe;
- occurrence of forest fires;

- snowstorms, snowstorms, windbreaks and frost;
- impact of air pollution;
- illegal logging.

According to available detailed information from Montenegro's national forest health monitoring system, which is obtained from 49 locations and covers the entire territory of Montenegro, the average health and condition of forests is satisfactory. In most of the bioindication points, the recorded degree of defoliation is within expected limits (0–25%). Of all the inspected trees (1,176 trees), 43% fell into the category of no defoliation (0–10% no defoliation), 37% showed signs of slight defoliation (10–25% slight (warning) defoliation), and major changes in defoliation were only recorded in 20% of trees (25–60% medium defoliation).

Common insects and fungi, causing tree degeneration, were identified during tree inspections. It should be stressed that, according to the ICP7 2011 Report, total damage caused by pests and fungi was found in 21% of trees (insects – 181 trees (15.39%) and plant diseases – 68 trees (5.78%)). Compared to 2010, this damage was identified in 26 additional trees or 2.21% more, which is an insignificant change.

Some of these phenomena are a direct consequence of climate change, i.e. increased air temperature, altered precipitation, more frequent droughts, storms, and generally extreme weather events. Climate change, as one of the major drivers of ecological change in forests, creates the need to review current forest management methods and reassess the plant and breeding methods used.

2.7 Economic Profile

Montenegro is a small upper-middle income country, with a total gross domestic product (GDP) of EUR 6.96 billion as of 2023. Its economy is based predominantly on services, which account for 61.5% of its GDP. Industry and agriculture respectively contribute 13% and 6% to GDP. Employment is even more services-heavy: 74% of employment is concentrated in services, while industry (including construction) and agriculture respectively comprise 18% and 7% of employment.

According to the national statistics, GDP has growth in recent years, rising from €4,140.7 million in 2017 to €6.299,5 million in 2023 (at constant prices), equivalent to a Cumulative Annual Growth Rate (CAGR) of 11%. Despite a significant drop in 2020 due to the COVID-19 pandemic, where GDP recorded a decrease of 15,3%, GDP per capita increased to € 10,998 in 2023 compared to €9,598 in 2022.

Table 3 shows an overview of the important economic and social indicators in Montenegro for the period 2020-2023[15].

[15] https://monstat.org/eng/page.php?id=19&pageid=19

Table 3 Gross Domestic Product (2020–2023)

Parameter	2020	2021	2022	2023
GDP at current prices in millions EUR	4,186	4,955	5,924	6,299
Population in thousands	621	619	617	633
GDP per capita EUR	6,737	8,002	9,598	10,988
GDP at constant prices (prices of previous year), millions EUR	4,193	4,731	5,273	6,299
Real growth rate of GDP (%)	-15.30%	13.00%	6.40%	6.30%
GDP per capita in EUR	6,737	8,002	9,598	10,988
GDP at constant prices (prices of previous year), millions EUR	4,193	4,731	5,273	6,299

A decline in GDP is evident in 2020, caused primarily by the COVID-19 pandemic and related economic crisis which affected tourism sector. The statistics clearly showed that the Montenegrin economy has been highly dependent on tourism, which was the sector most severely afflicted by the global COVID-19 pandemic. Since 2021, the recovery and growth is stable as illustrated by relatively strong real growth rate of GDP.

Montenegro's population is experiencing poverty and income inequality. The persons at risk of relative poverty after transfers rate in Montenegro in 2020 was 22.6% of total population, for 2021 was 21.2% and for 2022 were 20.3%, which shows the decreasing trend of poverty rate in Montenegro. Meanwhile, EU average for persons at risk of relative poverty after transfers, was 16,8% in 2022.[16] A decreasing trend is recorded in the relative at-risk-of-poverty gap, since the value of this indicator evolved from 34,7% in 2018 to 31.5% in 2022. The risk of poverty in 2022 is present for almost every third resident of rural areas (27.3%). At-risk-of poverty rate in urban area was 16.4% in 2022. For the same year, at-risk-of-poverty rate of men was 20.0%, and rate of women was 20.6%. Northern region of Montenegro has the highest level of

[16] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Enlargement_countries_-_statistics_on_living_conditions&oldid=638507#Risk_of_poverty

population at risk of poverty with 37.6%, while population of South region had the lowest risk of poverty of 9.8%.

Gini coefficient of equivalised disposable income, as indicator of income inequality in 2022 was 31.5.[17]

Unemployment rate at end of 2023 was 13.1% of the economically active population, with 14% of the females and 12.2% males unemployed[18]. Average wages without taxes and contributions (net) in 2023 were €792 with growth trend continuing into 2024. with the average earnings without taxes and contributions (net) in July at €851[19].

Since Montenegro is small economy, global economic trends have strong influence on its economy which is illustrated by the inflation rate in the country as result of inflation on the global scales. Inflation rate (CPI) has been 2.4%, 13% and 8.7% in 2021, 2022 and 2023 respectively.[20]

The Government adopted the Guidelines for Macroeconomic and Fiscal Policy for the Period 2024-2027[21]. Preliminary forecasts indicate a real economic growth of 3.8% in 2024, driven by further growth in tourism, continued high private consumption, and recovery and growth in investments, supported by the capital budget for 2024.

Montenegro's economy is expected to grow at an average annual rate of 3.7% over the medium term, with projections of 4.8% growth in 2025, 3.1% in 2026, and 3.2% in 2027. The primary drivers of growth over the next three years will be strong domestic demand, particularly private consumption and investments, bolstered by the removal of business barriers. The medium-term economic growth prospects are supported by the EU's financial instruments under the Growth Plan.

In terms of public revenues, projections for 2024-2027 range from €3.162.5 million (45.4% of GDP) in 2024 to €3.497.1 million (40.6% of GDP) in 2027. Notably, budget revenues for the first seven months of 2024 exceeded expectations by €95.5 million (6.5%) and were €124 million (8.6%) higher than the same period in 2023. Excluding one-off revenues, the budget revenues for the first seven months of 2024 were €237.2 million (18.2%) higher than in 2023.

Public expenditure in 2024 is planned at €3.401 million or 46.7% of GDP. From 2025 to 2027, public expenditure will nominally increase but will decrease as a share of GDP, reaching 43.9% by 2027.

The tourism sector has been critical driver of Montenegro's economy in recent years, contributing significantly to GDP, employment, and foreign exchange earnings. Its impact is particularly visible in areas like job creation, infrastructure development, and foreign investment, but it also presents challenges related to sustainability and economic vulnerability. In 2023. Montenegro recorded positive Balance of Payment from tourism in amount of €1.437 mil which accounts for approximately 20% of GDP (not including

[17] https://www.monstat.org/uploads/files/SILC/2022/RELEASE_Survey_on_Income_and_Living_Conditions_EU-SILC_2022.pdf
[18] https://www.monstat.org/eng/page.php?id=22&pageid=22
[19] https://www.monstat.org/uploads/files/zarade/2024/7/RAD_EN_Jul_2024.pdf
[20] https://www.monstat.org/eng/page.php?id=26&pageid=26
[21] https://www.gov.me/en/article/press-release-from-the-49th-cabinet-session

revenue from domestic tourism) 22. In 2023, tourists realised 2,613,306 arrivals and 16,389,279 overnights. Of the total number of overnights, 96.3%, were realized by foreign tourists, and 3.7% of overnights were realized by domestic tourists[23]. According to CBCG data, tourism revenues for the period January - September 2024 amount to EUR 1,361.2 million and are 3.6% lower than the previous year. In the first quarter of 2024, revenues were 21% lower compared to the same period in 2023, which is a consequence of the bad winter season due to the lack of snow.[24]

The tourism sector is a significant employer in Montenegro, particularly in coastal regions Many jobs are directly linked to hotels, restaurants, and transport, while indirect employment arises from the supply chains supporting the sector. It is estimated that approximately 20% of jobs are related to tourism.

The growth of tourism has spurred investment in infrastructure, particularly in transportation and hospitality. Montenegro has invested in improving roads, ports, and airports to accommodate the increasing number of tourists. In 2023, the European Commission's support for the construction of a highway through Montenegro aimed to further integrate the tourism-driven economy with neighbouring regions. It is expected that, projects in tourism and infrastructure, in addition to energy projects, will also make a strong contribution to economic growth in the coming period High-value complexes in tourism, and construction of hotel facilities in the Northern region based on the programme of investments of special importance for economic interests; while the biggest investments in the infrastructure segment are coming from projects planned under the capital budget for 2023, of which the most important is a continuation of construction of the second section of the Bar-Boljare Highway (section Matesevo-Andrijevica), reconstruction of the existing road infrastructure, projects in healthcare and education areas.[25]

Montenegro’s heavy reliance on tourism makes it highly susceptible to external shocks. The COVID-19 pandemic in 2020 demonstrated this vulnerability, as the near-total collapse of international travel led to a 15.3% contraction in GDP. In 2022, after recovering from the pandemic, tourism helped Montenegro achieve GDP growth of 6.4%, mainly thanks to an increase in the number of foreign visitors and tourism-related spending. While the sector rebounded strongly by 2021 and 2022, the reliance on tourism means that any future crises, such as geopolitical tensions or climate-related events, as the absence of snow cover, could similarly disrupt the economy.

2.8 Economic sectors

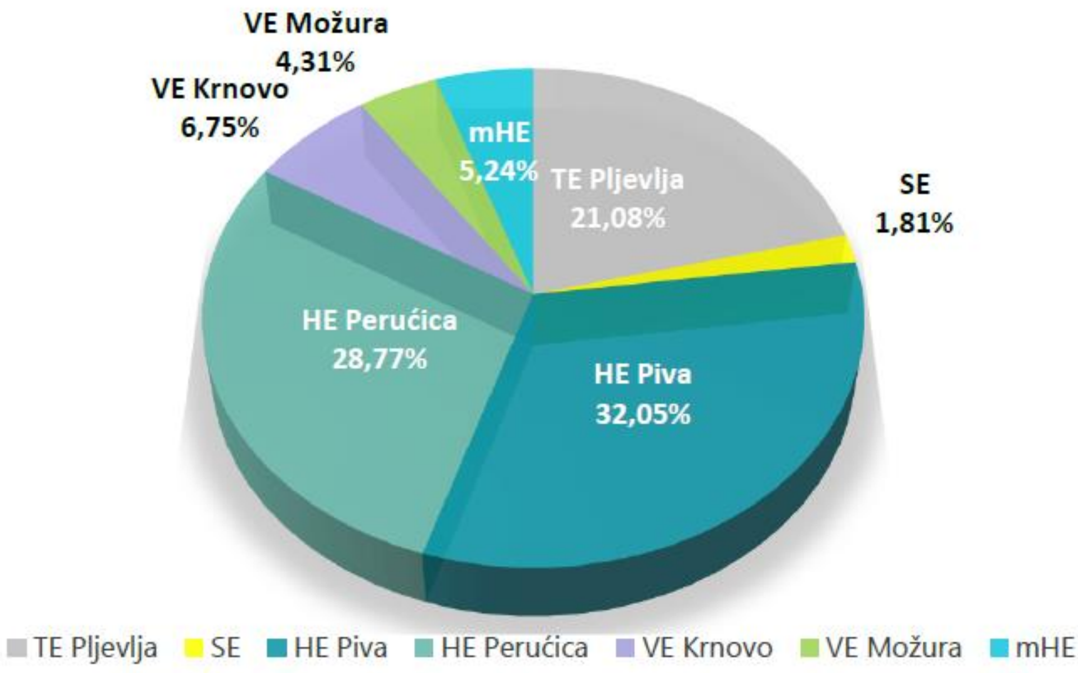
2.8.1 Energy sector

Production capacities in Montenegro consist of hydroelectric power plants, thermal power plants, wind farms and solar power plants. In the electricity mix of Montenegro, in the total installed production

[22] https://www.cbcg.me/en/statistics/statistical-data/international-economic-relations/balance-of-payments
[23] https://monstat.org/eng/novosti.php?id=3884
[24] ANALIZA POSLOVANJA CRNOGORSKE PRIVREDE U 2024. GODINI, PKCG, str.57.
[25] https://www.gov.me/en/documents/97a5b5fd-9e83-4b63-82fa-c8692a242f82

capacity, hydro power plants account for 66.05% (704.904 MW), thermal power plants – 21.08% (225 MW), wind farms – 11.06% (118 MW), and solar power plants – 1.81% (19.334 MW).

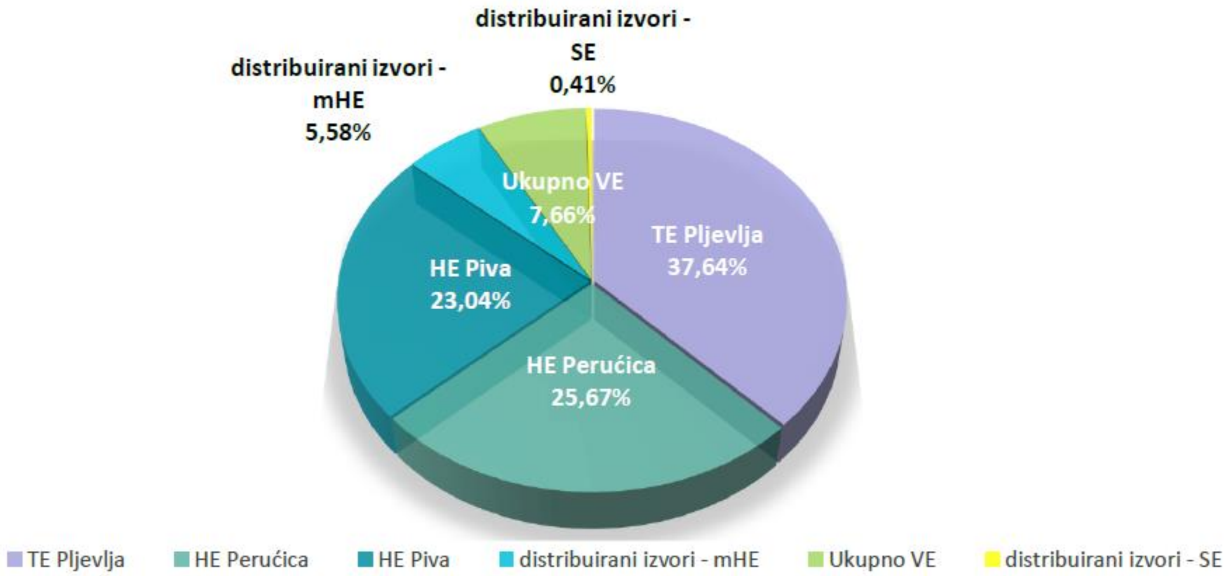
Figure 6 Share of installed capacities of production facilities in the total installed production capacity



Note: TE means thermal power plant, SE is solar power plant, and HE is hydroelectric plant

In 2023, 4,046.71 GWh of electricity was produced in Montenegro. Figure 6 shows the realisation of production by production facilities in 2023 and shows that the production of TPP "Pljevlja" is dominant in the energy mix and represents 37.64% of the total realised production, while the share of renewable energy sources and high-efficiency co-generation in the total electricity production in the same year was 62.36%.

Figure 7 Distribution sources



Note: distribuirani izvori - mHE / SE means distributed sources - micro-hydro plants / solar power plants, Ukupno VE means total wind power

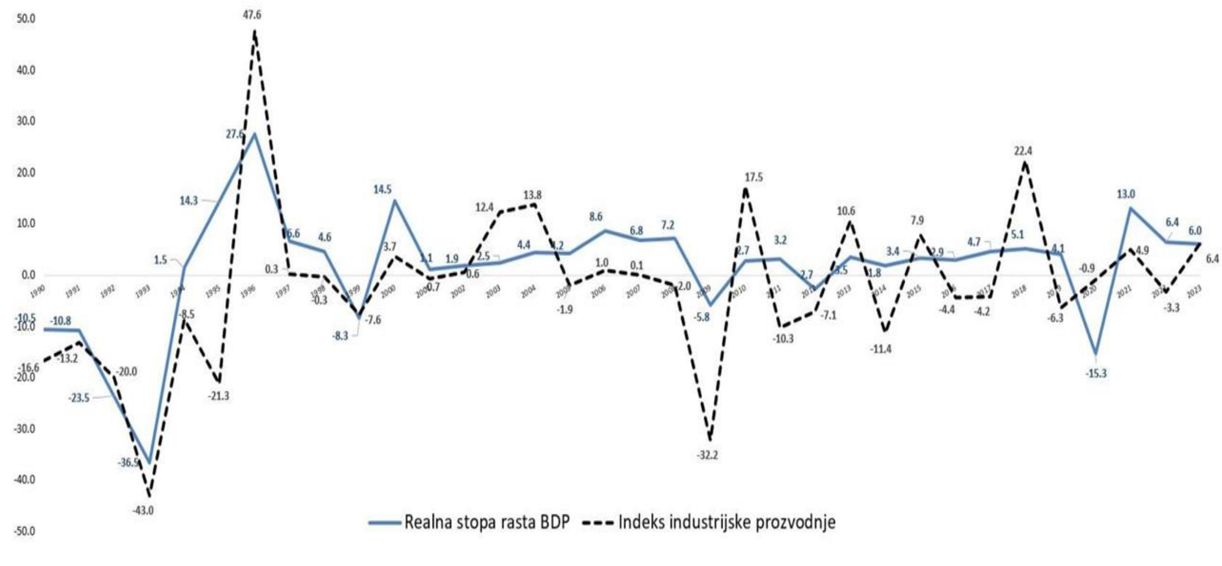
Total electricity consumption in 2023 amounted to 2,694,513,522 kWh of electricity. In 2023, customers directly connected to the electricity transmission system consumed 88,065,846 kWh (3.27%), while distribution customers consumed 2,606,447,676 kWh (96.73%) of electricity. Compared to 2022, customers connected to the transmission system recorded a decrease in electricity consumption of 36.57%, while customers connected to the distribution system recorded an increase in electricity consumption by 4.9%. At the level of the power system, there was an increase in electricity consumption of 2.71% compared to 2022. The largest increase in electricity consumption was recorded among customers connected to the 0.4 kV voltage level (5.51% compared to 2022), followed by customers connected to the 10 kV voltage level (3.31% compared to 2022). A decrease in electricity consumption was recorded among customers connected to the 35 kV voltage level (0.66% compared to 2022). Total losses amounted to 474 GWh, which is about 11 GWh or 2.38% more than planned, and at the level of realised losses in 2022.

The total turnover of petroleum products for consumption in Montenegro in 2023 was 375,620 tonnes. Compared to 2022, consumption is higher by 6,443 tonnes or 1.75%. Compared to 2022, the largest increase in consumption was achieved for heating oil and motor gasoline (98/100). There was no consumption of petrol coke due to the suspension of primary production in KAP, and there was a certain decline in other derivatives as well. The largest share in the total consumption of petroleum products, expressed in tonnes, has diesel fuel about 77%, and the least fuel oil and motor gasoline 98/100 0.7% and 1.85%, respectively. In 2023, it imported natural gas for its own needs and used it in the production process "Uniprom KAP"-Podgorica. A total of 1,889 tonnes were consumed, while in 2022 there were no imports and consumption of natural gas. Data from the MONSTAT regarding biomass consumption for 2022 indicate that the consumption of firewood amounted to 601,911 m^3, wood residue and wood chips 38,565 m^3, wood pellets 21,023 tonnes and charcoal 1,417 tonnes, which is a total of 6,207 terajoules (TJ).

2.8.2 Industry and mining

Industrial production, observed by sectors, consists of manufacturing, electricity, gas and steam supply, and mining and quarrying. In the period 2015-2023, the dominant sector is the manufacturing industry, but with a tendency to decrease the share (54% on average, and 48.5% in 2023), while the share of electricity production was on average 37%, and mining and quarrying 9%. The structure of the physical volume of industrial production is not stable and annual proportions are subject to the effect of a number of factors, depending on the quality of supply and changes in the number of actors, the performance of the economic entities themselves, changes in demand, various external shocks, and weather conditions that affect the volume of electricity production from renewable sources. In recent years, the production of basic pharmaceutical products and preparations has recorded the highest growth in the structure of the physical volume of industrial production (2023 – 10%) and is higher than the share of the food industry (9.6%). This is followed by the manufacture of products from other non-metallic minerals and the production of base metals (8.1% and 7.8% respectively). Figure 8 shows the movement of the GDP and industrial production index in the period 1990-2023.

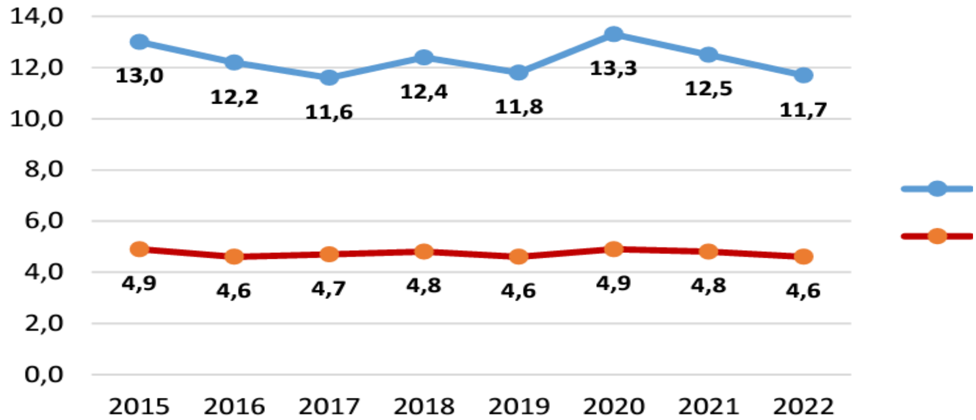
Figure 8 Trends in GDP and industrial production indices in the period 1990-2023



Source: UNSTAT and MONSTAT

The share of industry in the gross value added (GVA) of Montenegro is significant, as can be seen in Figure 9.

Figure 9 Participation of industry and especially the manufacturing industry in the GVA (in % terms) of Montenegro in the period 2015-2022



The industry in the GVA of Montenegro recorded an average share of 12.3% in the observed period, and the manufacturing industry itself 4.7% (2021 – 12.5% and 4% respectively). In the structure of GVA, services are the most represented, which in 2022 had a share of 76.5%, and with construction reached 80.9%, while agriculture had a share of 7.3%, which represents a decrease of 2.5% compared to 2015. GDP per capita in the industrial sector in 2022 is 871 euros, and the same indicator for the manufacturing industry is 375 euros. In the period 2015-2022, the GDP of the industry grew by 13%, from 374.3 to 422.1 million euros. In the observed period, exports of the manufacturing industry increased by 72% in absolute terms, but in structure they decreased by 14.4%, from 75.1% to 60.7%. This change in the structure is conditioned by the growth of the share of electricity production in industry exports from 9.4% in 2015 to 30.7% in 2022. In addition, in the structure of exports, the production of base metals has lost its convincing primacy, namely the average of the period 2015-2022 was 28%, then 25% in 2022, and finally with a significant drop in share to only 11% in 2023. The second area in the structure of exports is wood processing with a 7.4% share in exports in 2023, while the third place is the production of food products with 7%. Pharmaceuticals and beverage production are tied at the level of 6.2% share in total exports.

2.8.3 Agriculture

Agriculture is still an important strategic sector in the economic development of Montenegro and many economic activities are related to it, especially in rural parts of the country. In 2023, the agriculture, forestry and fisheries sector accounted for 5.7% of GDP.[26]The total number of people employed in Montenegro in the agriculture, fisheries and forestry sector in 2022 was 10,700 or 4.6%[27] of the total number of persons employed. In the period January - September 2023, employment in the agricultural sector increased by 9%, according to statistics.

[26] https://www.monstat.org/uploads/files/BDP/BDP%202023/Godisnji%20BDP%202023_crn.pdf
[27] https://www.monstat.org/uploads/files/publikacije/GODISNJAK%202023.pdf

Table 4 Overview of data for the agriculture, fisheries and forestry sector in the Montenegrin economy, 2017 – 2023

	2017	2018	2019	2020	2021	2022	2023
Share of the agriculture, forestry and fisheries sectors in GDP (%)	6.9	6.7	6.4	7.6	6.5	6.0	5.7
Number of employees in the agricultural sector, forestry and fisheries[28]	17,100	18,100	17,200	14,100	13,600	10,700	13,500

On the territory of Montenegro, agricultural land occupies 515,740 ha, which makes 37.4% of the total territory of Montenegro. Utilised agricultural land in 2023 is 263,522.3 ha, which is an increase of 3.9% compared to 2022. In the total utilised agricultural land, the area of perennial meadows and pastures prevails with a share of 94.6%, while arable land is represented by 2.7%, permanent plantings 2% and gardens 0.7%. Compared to 2022, the area of perennial meadows and pastures recorded an increase of 4%, arable land by 5.8%, while a decrease was recorded in permanent plantings by 2.8% and gardens by 0.8%.[29]

The structure of agricultural land use remained approximately the same for the period 2018-2023, with a slight decrease in the use of land for arable land, vineyards and nurseries and a slight increase in the use of land for perennial plantations and meadows.

Table 5 Utilised agricultural land by category (ha) (p-preliminary data)

	2018 (p)	2019 (p)	2020(p)	2021(p)	2022(p)	2023(p)
Used agricultural land	256,807.7	257,469.6	257,949.8	255,564.4 0	253,671.4	263,522.3
Used arable land	7,199.6	7,204.6	7,055.3	6,884.40	6,723.2	7,111.3
Used yards and/or gardens	2,014.3	2,009.8	2,038.8	2,015.70	1,952.0	1,937.1
Vineyards	116.6	111.5	113.8	111.6	105.1	102.7
Orchards-extensive	1,214.6	1,214.6	1,204.1	1,212.00	1,172.7	1,168.4
Orchards-plantations	1,356.0	1,373.3	1,390.7	1,423.20	1,425.3	1,445.0
Nurseries	72.4	69.8	68.5	70.7	67.2	64.1

[28] Persons engaged in employment, i.e. self-employed persons who work on an agricultural holding for the purpose of earning profit, or persons who are in the process of forming their business or agricultural holding, such as the purchase and installation of equipment, renting premises or purchasing materials for starting a new business, and persons who work on their agricultural holding and produce agricultural products, and if the main part of these products is intended for sale or exchange (barter) are considered to be Employees.
[29] https://www.monstat.org/uploads/files/Biljna/Biljna%20proizvodnja%20u%202023.godini.pdf

Perennial meadows and pastures	242,112.9	242,717.5	243,304.4	241,123.5	239,547.1	249,179.3

Source: MONSTAT

The structure of agricultural land is unfavourable in terms of the size of agricultural holdings compared to the size of agricultural holdings in the Member States of the European Union and the countries of the region. According to the 2016 Farm Structure Survey of MONSTAT the average area of utilised agricultural land, per holding, in Montenegro is 5.84 ha. However, it should be taken into account that 58% of agricultural holdings own up to 2 ha of land, which indicates that the used agricultural land is highly parcelled, which further negatively affects the full utilisation.

For the inhabitants of rural areas of Montenegro, agriculture is the most important sector. Livestock breeding is particularly important, as a separate subsector of agriculture, which allows for the exploitation of less fertile areas (pastures and meadows).

Imports of agricultural and food products (including silk, essential oils, leather, etc.) in the first nine months of 2023 amounted to EUR 710.9 million, which is 20% more than in the same period in 2022, while exports amounted to EUR 59.9 million, which is 41% more.[30]

There is a noticeable trend of increasing food imports from year to year, along with the growing deficit. The reasons for this are limited resources, a small number of professional producers who apply modern production technologies and relatively low average yields of dominant types of fruits and vegetables.

About 20,000 to 30,000 tonnes of various types of fruit are produced annually in Montenegro, mainly plums, apples, peaches, pears and tangerines, with an average production growth of 6.8% per year. Fruit production is dominated by plums and apples, which make up about 80% of the total amount of fruit produced in Montenegro.[31]

Vegetable production in Montenegro in the last ten years is based on about 3,800 hectares on average, which makes up about 28% of the total arable area. The area under vegetables recorded an average annual growth of 2.8%, and the total average vegetable production in the last 10 years is 72,000 tonnes with an average annual growth rate of 4%. Non-perishable vegetables (potatoes, onions, carrots, cabbage, beans and peas) dominate the total area under vegetables in Montenegro with a share of 67%, while they participate in the production structure with 59%. In the structure of imports, non-perishable vegetables account for 42%. Perishable vegetables (watermelons, tomatoes, peppers, melons and cucumbers) account for 33% of the total vegetable production.[32]

Recently, the production of grapes and wine has increased.

[30] Montenegrin Investment Agency, Guidelines/Investing in Agriculture in Montenegro, 2024.
[31] ibid.
[32] Ibid.

The total production of maize for grain in 2023 amounted to 3,166.3 t, which is 12.5% more than in 2022. The following crops also recorded an increase in production: peppers (by 1.3%), cucumber (3.7%), watermelons (by 6.4%) and melons (by 3.6%). Compared to 2022, the total production of mandarins increased (by 3.1%), while the production of plums, apples, pears, peaches and olives decreased. Total grape production in 2023 decreased by 23.1% compared to the previous year (MONSTAT, 2024).

Organic farming

The Register of Organic Producers is maintained by the Ministry of Agriculture, Forestry and Water Management, and has 445 registered producers and 169 certified producers (data from 2021). In 2021, the number of registered producers increased by 7.5%. The largest number of organic producers is located in the northern part (92%), while 8% is in the central and southern part of Montenegro.

The total arable area that is in the process of certification is 863.35 ha. Of this, 606.55 ha is in the status of organic production, and 256.8 ha is in the transition period, which means that 70.25% of arable land is in organic status. The largest part of the area is under fruit (65.24%), followed by areas under plant crops (34.31%), while the area under vegetables is represented with 0.44% in relation to the total arable land (863.35 ha) that are in the process of certification. The area of 3563.98 ha is under meadows and pastures, which are mainly used for mowing.

2.8.4 Tourism

Tourism is a strategic component of the Montenegrin economy. Until 2020, which was characterised by the emergence of the COVID-19 pandemic, the tourism sector recorded an increase in the number of tourists and overnight stays, investments, and ultimately generated revenues from year to year.

The key indicators from the World Travel and Tourism Council (WTTC) Report for Montenegro[33], which refer to 2023, are as follows: the total (direct and indirect) contribution of the tourism and travel sector to GDP was 29,1%, the total contribution of employment was 22.1% (53,453 jobs), and income of 1,460.8 million euros was achieved through exports associated with the arrival of foreign tourists (visitor exports). This revenue represents a key component of the direct contribution of the travel and tourism sector to the country's economy and has increased by 0.2% compared to 2019. Forecasts for 2034 indicate that the number of international tourist arrivals will reach 3,282,000, with an expected tourist expenditure will amount to 2,090.4 million euros. This represents an average annual growth of 3.1% in the period from 2024 onwards.

In 2019, Montenegro generated revenues from tourism at the level of 1.14 billion euros. In 2020, these revenues reached a much lower level, due to the emergence of the COVID-19 pandemic, which left significant consequences on the tourism sector. In 2021, the recovery of economic activity in the tourism sector was achieved and revenue of EUR 834.00 million was achieved. According to the data of the CBCG,

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33 https://assets-global.website-files.com/6329bc97af73223b575983ac/66438278ff1ee8f42aa6c8bf_EIR2024-Montenegro.pdf

the total revenues from tourism in 2022 amounted to EUR 1.507 billion, in 2023 they were EUR 1.437 billion, while for the period January - September 2024 they amount to EUR 1,361.2 million and less are by 3.6% compared to the previous year.

After two years of gradual recovery from the crisis caused by the coronavirus pandemic in the tourism sector, during the first quarter of 2023, results were achieved that exceed the record level from 2019. According to preliminary data from MONSTAT, in the observed period, 135,786 tourists stayed in collective accommodation in Montenegro, which is 61.90% more compared to the previous comparative period, i.e. 11.35% compared to the same period in 2019. In 2023, 2,613,306 tourist arrivals and 16,389,279 overnight stays were realized in Montenegro. Out of the total number of overnight stays, 96.3% were made by foreigners, and 3.7% were made by domestic tourists.[34] In the structure of overnight stays by foreign tourists, in 2023, the most overnight stays were made by tourists from Russia (23.6%), Serbia (21.5%), Bosnia and Herzegovina (8.5%), Germany (4.9%), Ukraine (4.1%), Kosovo (3.6%), Turkey (2.9%). Tourists from other countries accounted for 31.0% of overnight stays.

In the structure of overnight stays by type of tourist places in 2023, the most overnight stays were realized

According to the CBCG Macroeconomic Report for the first quarter of 2024,[35] a significant decrease in indicators was recorded in the tourism sector, compared to the same period of the previous year. The high base of the previous year and the lack of snowfall, which prevented the operation of ski centres in the north of the country affected the poor results in the winter tourist season. According to preliminary data from MONSTAT, Montenegro was visited by 192,215 tourists in the observed period, which is 11.98% less than in the previous period, but at the same time 15.33% more than in the same period of pre-crisis 2019. Compared to the first quarter of the previous year, there was a decrease in the number of arrivals of both domestic (6.59%) and foreign tourists (12.68%), while compared to the pre-crisis year, there was an increase in both domestic (17.26%) and foreign tourists (15.06%).

According to preliminary data from MONSTAT, during the first nine months of 2024, there were 1,226,499 arrivals in collective accommodation, which is 0.3% more compared to the comparative period of the previous year. At the same time, the number of overnight stays is 4,636,138, which represents an increase of 2% compared to the comparative period of 2023. Out of the total number of overnight stays in collective accommodation, 90% were made by foreigners, and 10% by domestic tourists. In the structure of overnight stays by foreign tourists, the most overnight stays were made by tourists from Serbia 20.7%, Great Britain 7.7%, Germany 6.4%, Turkey 6.1%, Bosnia and Herzegovina 6%, France 5.7%, Israel 4.7%, Poland 4%, Russia 3.1% and Ukraine 2%.[36]

In the structure of overnight stays by type of tourist places, the most overnight stays were in coastal towns (89.6%), the capital (5.9%), mountain towns (2.2%) and other towns (2.3%).

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[34] https://www.monstat.org/cg/novosti.php?id=4186
[35] https://www.cbcg.me/slike_i_fajlovi/fajlovi/fajlovi_publikacije/makroekonomski/i_kv_2024/realni_sektor.pdf
[36] https://komora.me/wp-content/uploads/2025/01/cg-privreda-2024-w.pdf

If we look at the total accommodation (collective and individual) according to the preliminary data of MONSTAT, in the period January - August 2024, there were 2,020,618 tourist arrivals, which is 1.2% less than in 2023 or 2.7 % less compared to 2019. In the observed period, a total of 12,201,038 overnight stays were realized, which is 5.5% less compared to the same period in 2023 or 4.7% more compared to the same period in 2019.[37]

In 2024, Montenegro records a slight increase in collective accommodation (+0.3% of arrivals and +2% of overnight stays compared to 2023), but overall accommodation shows a decline in arrivals (-1.2%) and overnight stays (-5, 5%) compared to the previous year, although overnight stays increased by 4.7% compared to 2019. Foreign tourists dominate with 90% of overnight stays, while the key markets are Serbia, Great Britain and Germany. Although the longer stay of tourists can be considered a positive trend, the overall results indicate the need to strengthen promotion, diversify the market and encourage domestic tourism in order to improve the tourist season and surpass the record year 2019.

2.8.5. Traffic

NSCC lists transport as one of the most important priorities for action in the field of climate change and provides a number of measures and targets specifically related to increasing the use of public transport and promoting more energy-efficient vehicles and electric vehicles for public and individual transport. The strategy also highlights the need to increase the resilience of the transport sector to projected climate impacts due to its vulnerability, and the key role it plays in the country's economic and social development.

The Transport Development Strategy of Montenegro for the period 2019-2035 was adopted in July 2019. For the purpose of drafting the Strategy, a regional traffic model for Montenegro wasdeveloped to assess traffic flows in different scenarios. A significant increase in road travel is expected in the future, and this will inevitably have an impact on the efficiency of the national network and planned highways.

In the first quarter of 2024, the results achieved in the field of transport indicate positive trends in most of its segments. The best indicators were achieved in the traffic of goods in rail and road traffic, and passenger traffic at airports, with traffic higher than the comparable period from the pre-crisis year 2019.

According to preliminary data from MONSTAT, 3.20% more passengers were transported in road transport than in the same period last year, while the transport of goods was higher by 18.14%. In railway transport in the same period, passenger transport increased by 6.80% and freight transport by 43.36%.[38]

In March, the Government of Montenegro adopted the Program for the Construction, Reconstruction, Maintenance and Protection of Main and Regional Roads in Montenegro for 2024[39] with the aim of

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[37] https://komora.me/wp-content/uploads/2025/01/cg-privreda-2024-w.pdf
[38] Central Bank of Montenegro, Macroeconomic Report CBCG 1st quarter 2023
[39] Source: 21. Session of the Government of Montenegro, 14 March 2024.

organising the smooth and safe flow of traffic on the roads, raising the level of traffic services and encouraging the investment environment, worth around EUR 71 million. The program is divided into three parts: reconstruction of main and regional roads, solving bottlenecks on the traffic network and rehabilitation of bridges, landslides and slopes on main and regional roads. In order to ensure the safe and secure operation of railway traffic, the Government also adopted the Program for the Construction, Maintenance, Reconstruction and Modernisation of Railway Infrastructure for 2024[40], which includes current and investment maintenance, reconstruction and modernisation of public railway infrastructure, as well as the project "Replacement of bridge structure on the Tara I Bridge" in Mojkovac.

In the field of air transport in the first quarter, a total of 318,539 passengers were transported, which is 5.03%more than in the same period of the previous year, and at the same time the highest number of passengers in the comparable ten-year period. Growth was recorded at both airports, at Podgorica Airport by 5.70% and at Tivat Airport by 1.58%. As for the traffic of goods at airports in the first three months of the current year, compared to the same period of the previous year, a decrease of 2.17% was recorded, in the amount of 135 tonnes.

The total turnover of goods in ports amounted to 554,462 tonnes and was higher by 1.81% compared to the same period of the previous year. Of this amount, exports accounted for 68.26% and imports for 31.74%. According to MONSTAT data, exports of goods from Montenegrin ports, expressed in tonnes, increased in this period by 19.59%, mostly to China, Italy and Turkey.

The number of registered road motor vehicles and trailers in 2023 amounted to 285,257, which is 6.9% more than in 2022, when the number of registered road motor vehicles and trailers amounted to 266,747.[41] The share of vehicles with a diesel unit was 78.38%, with the existence of 552 electric vehicles, while there were 1,232 hybrid vehicles.

A significant increase in road travel is expected in the future, and this will inevitably have an impact on the efficiency of the national network and planned highways. Road traffic is expected to increase by at least 45% by 2025 and by a further 25% by 2035. Motorways are expected to take on high average daily traffic volumes (from over 22,000 vehicles per day in 2025 and 27,000 vehicles in 2035 for the network segments with the lowest traffic volumes).

The total distance travelled (vehicles - km) will increase in the future, given the fact that the total lengths of routes have not been radically shortened (new highways run parallel to the existing network) and the volume of traffic is increasing. On the other hand, the introduction of the highway contributes to the reduction of travel time and thus the overall vehicle-hour ratio is reduced compared to the core network, at least for 2025 and almost identical for 2035 (bearing in mind that traffic will increase significantly by 2035).

[40] Ibid.
[41] Source: MONSTAT, Annual Traffic, Storage and Communications Statistics – 2023, April 2024. https://www.monstat.org/cg/page.php?id=2124&pageid=36

2.8.5 Waste management

Municipal waste

Insufficient capacity for safe waste disposal, slow progress in waste recycling and poor public awareness of waste reduction and conscientious waste disposal continues to be difficulties that hinder effective waste management in Montenegro. Currently, there are two regional sanitary landfills in Montenegro: in Podgorica – landfill Livade (for the needs of the Capital City of Podgorica, the Municipality of Danilovgrad and the Capital of Cetinje) and Bar (for the needs of the municipalities of Bar and Ulcinj, but also the municipalities of Budva, Kotor and Tivat).

Compared to the TNR, the situation has changed in terms of recycling capacities. There are four recycling centres (Podgorica, Hervceg Novi, Žabljak and Kotor), while Bijelo Polje is preparing the 5th regional centre for waste recycling. Podgorica also has six recycling yards, while four recycling yards are also located in Herceg Novi, Kotor, Budva and Mojkovac. There are five end-of-life vehicle ELVs in Podgorica (1), Berane (1) and NikŠić (3). In Bar there is a plant for the treatment of electrical and electronic waste, and in Podgorica and Berane there are plants for the treatment of hazardous medical waste.[42]

According to statistics, the total amount of municipal waste collected in 2022 was 335,797.6 tonnes or 3.1% more than in 2021. Utility companies collected 314,612.4 tonnes, which makes 93.7% of the total collected quantities. Municipal waste generated per capita amounted to 544.1 kg, which is 3.4% more than in the previous year.

The total amount of treated waste with exports in 2022 amounted to 1,174,745.7 t, which is 7.1% less than in the previous year. Of the total processed quantity, 645 715.3 t was deposited/disposed of or 55.0%. Recycled quantities of waste recorded an increase of 35.2% compared to the previous year. The total amount of processed municipal waste with export, in 2022, amounted to 313,155.2 t, which is 1.9% less than in 2021. Of the total processed quantity, 300,049.8 t or 95.5% was deposited/ disposed of. The amount of processed municipal waste in 2022 is 1,028.3 t, which is 81.9% less than in the previous year.[43]

Table 6 Waste collection statistics

Years	Total annual amount of municipal waste collected (tonnes)	Amount of waste collected by PUC (tonnes)	The amount of waste collected by other companies and individuals (tonnes)	Amount of waste collected per capita (kg/day)	Coverage of the population by waste collection service (%)
2019	322,567.9	308,103.6	14,464.3	1.5	86.2
2020	287,315.9	273,742.5	13,573.4	1.3	87.0

[42] MEPPU (2023). NationalWaste Management Plan for the period 2023-2028
[43] https://monstat.org/uploads/files/otpad/2022/Stvoreni%20i%20obra%C4%91eni%20otpad%20u%202022.godini.pdf

2021	308,904.2	293,294.3	15,609.9	1.4	87.6
2022	321 139,5	314 612,4	6,527.1	1.4	87,7

Source: MONSTAT, 2022

According to the draft State Waste Management Plan for the period 2023-2028, in the period between 2022 and 2041, the amount of waste will increase by almost 12%, while remaining relatively stable. As for waste production per capita, it is expected to increase from 504 to 547 kg/per capita per year.

During 2022, the following items were collected and prepared for reuse and recycling: 66,000 tonnes of waste packaging (non-hazardous waste); 1,780 tonnes of waste packaging (hazardous waste); 590 tonnes of hazardous waste from EE equipment; 2,100 tonnes of batteries and accumulators; 335,039 tonnes of waste from thermal processes.

Municipal companies (all utility companies in Montenegro) collected (primary and secondary selection) 4,479 tonnes of paper, plastic, metal and glass. In addition, individual (informal) collectors collected 14,658.1 tonnes of paper, cardboard, plastic, glass and metal. In the same year, 16,512 tonnes of green waste, 17,352 tonnes of bulky waste and 20,153 tonnes of non-hazardous construction waste were collected separately.[44]

Projections in the draft State Waste Management Plan for the period 2023-2028 in the period between 2022 and 2041 envisage an increase in the recycling fraction of waste per capita by about 24% in the next 20 years.

Industrial waste

During 2022, 1,411,673.7 t of waste was generated in Montenegro, of which 638,630.3 t or 45.2% in the sectors of manufacturing, mining and quarrying and other industries. Of the total amount of waste generated during 2022, 294,466.0 t of hazardous waste or 20.9% was generated.[45]

During 2021, a total of 1,447,865.8 tonnes of waste was generated in Montenegro, of which 47% (682,773 tonnes) is from the industrial sector.[46]

Table 7 Total amount of industrial waste generated in Montenegro (tonnes)

	2018	2019	2020	2021	2022
Generated Industrial Waste	758,186.20	753,239.00	763,270.90	682,773.00	638,630.30

Source: MONSTAT, 2022

[44] MEPPU (2023). Report on the Implementation of the State Waste Management Plan for 2022

[45] https://monstat.org/uploads/files/otpad/2022/Stvoreni%20i%20obra%C4%91eni%20otpad%20u%202022.godini.pdf

[46] MEPPU (2023). NationalWaste Management Plan for the period 2023-2028

The table below shows the generated quantities industrial non-hazardous waste in Montenegro.

Table 8 Quantities of generated industrial non-hazardous waste in Montenegro

	2018	2019	2020	2021	2022
Non-hazardous industrial waste	421.437,00	427.235,80	446.134,30	390.276,70	Not yet available

Source: MONSTAT, 2022

Out of a total of 763,270.90 tonnes of waste generated in industry in 2020, the mining sector accounted for 47.9%, the manufacturing industry 4.1%, the electricity, gas and steam supply sector 47.4%, while the water supply, wastewater management, waste disposal process control and similar activities accounted for 0.6%.[47]

Table 9 Industrial waste generated by sector, in 2020 (tonnes)

	Mining	Processing industry	Supply Electric Energy, gas. and steam	Water supply, waste management On the other hand, control The Process of Disposal waste, etc.	Altogether
Non-hazardous waste	49,620.20	30,986.10	361,285.40	4,242.60	446,134.30
Hazardous waste	315,920.10	566.40	558.90	91.20	317,136.60
Total	365,540.30	31,552.50	361,844.30	4,333.80	763,270.90

Source: MONSTAT, 2022

2.9 National MRV for GHG Inventory and NDC tracking

2.9.1 Institutional arrangements

The main institutions involved in climate change matters are:

[47] MEPPU (2023). NationalWaste Management Plan for the period 2023-2028

- The national Environmental Protection Agency, which is mandated to update GHG emission inventory regularly;

- Ministry of Energy, which is mandated to elaborate the National Energy and Climate Plan to achieve strategic goals by 2030 and transition to a low-carbon economy by 2050;

- Institute of Hydrometeorology and Seismology that has competencies in meteorology, climatology, hydrology, hydrography, oceanography and seismology. It oversees the establishment, development, and work of the meteorological and hydrological observation and forecasting stations on the entire territory of Montenegro. It coordinates information and data on climate, ensuring it contributes to analysing the challenges that require adaptation action. The Institute is responsible for most of the physical climate data tracking and analysis of climate scenarios. It is the contact institution for the IPCC and the World Meteorological Organization;

- Ministry of Economic Development that oversees industrial policies, economic recovery programmes, and green economy development.

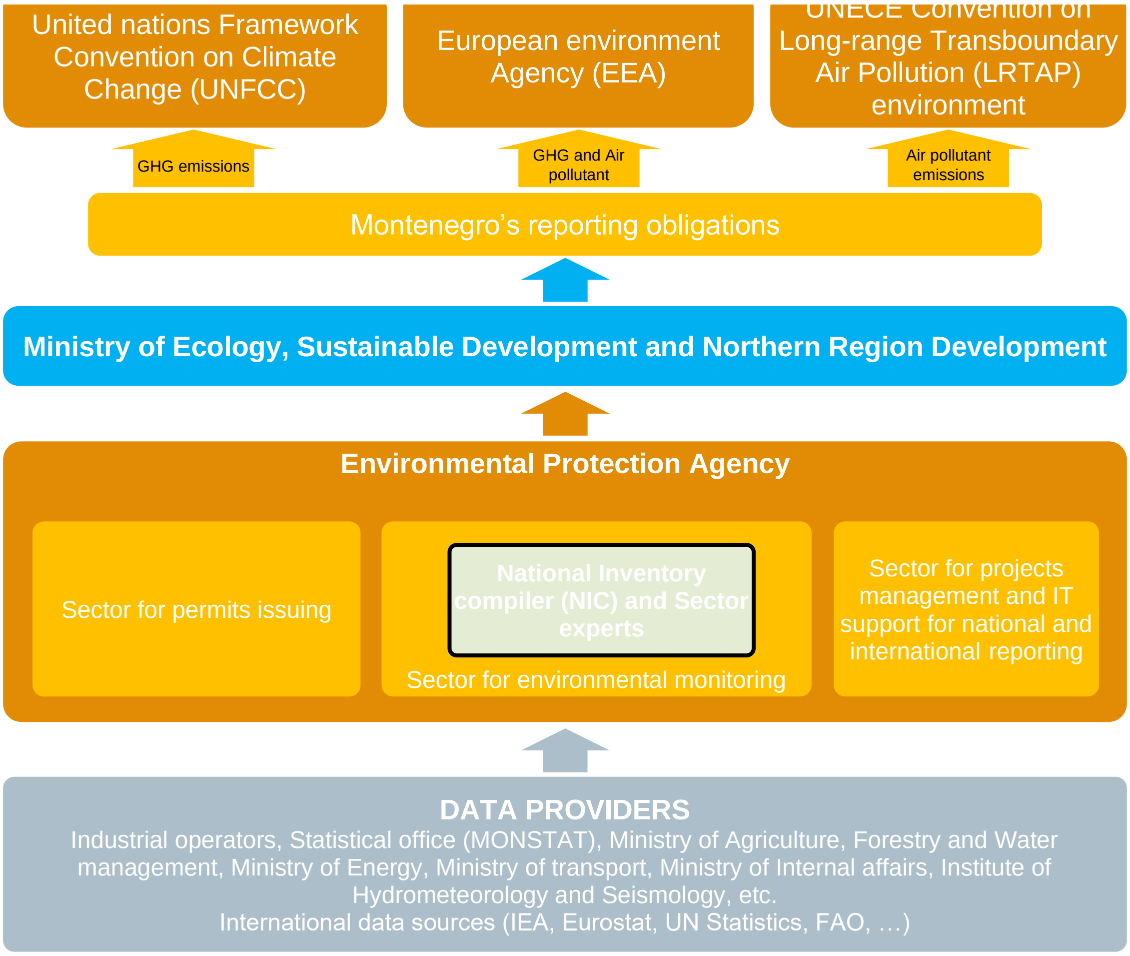
The MESDNRD is the main national entity responsible for national environmental and climate change policy and the National Focal Point to the UNFCCC. The Directorate Climate Change and Sustainable Development is responsible for submitting national reports (NCs and BTRs) to the UNFCCC.

Up to the end of 2021, development of the national reports was fully supported by the United Nations Development Program (UNDP), which hired and coordinated the experts, through GEF-funded projects. From 2022 onwards, MESDNRD is fully in charge of the development of national reports, while UNDP has an oversight role. For instance, this FNC/1BTR has already been developed by MESDNRD in cooperation with UNDP, according to the national implementation modality.

The preparation process of three National Communications, three Biennial Update Reports and two NDCs to the Conference of the Parties of the UNFCCC from 2011 to date, has contributed to the institutional strengthening of the Ministry, as competent institution for the application of the Convention, but also to other relevant institutions at national level: Environmental Protection Agency, MONSTAT, Institute for Hydrometeorology and Seismology, ministries in charge for energy, agriculture, transport, etc.

The figure below illustrates the National System for the preparation of the national reports.

Figure 10 National System for the preparation of the national reports



EPA has main responsibility for preparation of the GHG inventory.

An EU funded Twinning light project called "Development of Upgraded Integrated Tool and Update of Air Emissions Inventory" was implemented to build the capacity of EPA for regular reporting on air emissions and GHG emissions and to enable the sustainability of the national air emission and GHG inventory system. The project was implemented in cooperation between the beneficiary institution (EPA) and the Environment Agency Austria and MS Experts of the Environment Agency Germany. Under this project, the EPA succeeded to develop a new integrated excel tool for both air pollutants and GHG inventory. The inventories were recalculated for the time series 1990–2019 and updated for 2020 in accordance with EMEP/EEA Guidebook 2019 and IPCC 2006 Guidelines and trainings were provided for each sector and on cross-cutting issues such as Uncertainty, QA/QC and Institutional Arrangements.

Currently, implementation contracts have been signed with the EPA and MONSTAT, which are focused on and implement activities for: improvement of GHG inventory data, development and implementation of a quality assurance and control plan, improvement of national capacities for the preparation of GHG inventories and its management, and the monitoring, verification and reporting on GHG emissions by source type and removals by sinks.

In 2024, there is still a lack of fully operational and formalised horizontal coordination among different entities responsible for climate change and limited vertical coordination between the national and local levels. However, at the date of the submission of this FNC/1BTR, the MESDNRD actively continues the implementation of the project "Strengthening the Montenegrin Nationally Determined Contribution (NDC) and adaptation actions within the framework of transparency - CBIT". The goal of the CBIT project is to strengthen the capacity of national institutions in the field of climate change, including synergistic action in terms of transparency, as well as adopting or improving methodologies (manuals) and improving data to increase transparency, in order to achieve low-carbon development. Capacity building activities focus on strengthening the capacity of national institutions that are responsible for policies and measures in the field of mitigation and adaptation, as well as those that provide and collect data for the GHG inventory and prepare national reports. The project will thus enable the creation of a fully operational national system for monitoring, reporting, verification and evaluation (MRV-E), including a clear definition of the roles and responsibilities of all relevant actors with fully developed methodologies, procedures and guidelines for the various elements of the system.

2.9.2 Main legislative and regulatory framework

The Government has included climate change in its national strategy for sustainable development. In 2015, the Government adopted the National Strategy in the Field of Climate Change by 2030. The strategy includes measures to reduce GHG emissions, a draft strategic framework for adapting to climate change, and an assessment of the costs and socio-economic impacts of implementing the proposed measures. The strategy explores options for low-carbon development and aligning domestic legislation with EU legislation to support the European integration process. It considers institutional strengthening and governance, education and training of actors, research on climate change and technological development, and financing as means of implementation. It incorporated the Intended NDCs and outlined guidelines for developing a NAP following the UNFCCC Adaptation Framework. The Strategy identifies transport as a priority sector for climate change actions. It outlines some measures and targets explicitly related to increasing the use of public transport and the promotion of more energy-efficient vehicles and electric vehicles for public and individual transportation.

In 2019, the Parliament of Montenegro approved the Law on the Protection against the Negative Effects of Climate Change[48] (OG 73/19). The Law on the Protection against the Negative Effects of Climate

[48] Chapters of this Law are as follows: I. Basic provisions; II. Documents for the protection against climate change negative impacts; III. Achieving low carbon development; IV. Emission reporting and report verification; V. Geological storage; VI. Ozone layer; VII. Supervision; VIII. Penalty provisions; and IX. Transitional and final provisions.

Change entered into force mandating the development of a GHG inventory, a low-carbon development strategy, a national system of MRV and a national ETS covering emissions from the industrial and power sectors. The Law lays the groundwork for the National Monitoring, Reporting and Verification of GHG System and the operation of the Emissions Trading System (ETS). Additionally, this law addresses the use of ozone-depleting substances and fluorinated gases.

In 2020, the Government issued the Decree on activities that emit greenhouse gases for which a permit for the emission of greenhouse gases in line with the EU climate change acquis.

Carbon pricing is a requirement to join the EU ETS and the EU Accession. The 2020 Decree on activities that emit greenhouse gases for which a permit for the emission of greenhouse gases includes provisions for ETS in Montenegro. The ETS started in 2020 and applied to three plants: the Pljevlja TPP, KAP and the Tosčelik steel mill. The last two plants reduced the production to levels under the threshold for ETS and are currently out of the ETS.

Through the World Bank Partnership for Market Implementation (PMI) program, Montenegro received 2 million US dollars grant to develop the Readiness Support Plan (RSP) for carbon pricing. The project activities have already started. The ultimate goal is to establish a stable national system of carbon pricing in accordance with EU policy requirements.

The Law on the Protection against the Negative Effects of Climate Change has been subject to further amendments to ensure compliance with EU and Paris Agreement standards, establishing a Low-Carbon Development Strategy and a National Adaptation Plan. MESDNRD prepared a draft of a new Law which is fully aligned with European Union (EU) Climate Law and Governance regulation with the aim to improve the monitoring, reporting and verification in the area of mitigation and adaptation of climate change. If adopted, the draft law on the protection from the negative effects of climate change and protection of the ozone layer would improve:

- Further harmonisation with EU ETS legislation such as the extension of the scope of the law to the sector of maritime transport and establishment of the legal base for EU ETS which includes also CO2 emissions from road transport and central heating systems (Shipment companies and fuel distributors will be also included in ETS).
- Institutional set-up of the National ETS by 1) setting up more precise roles and responsibilities of institutions related to operation of the ETS, as well as procedures for issuing of permits, managing the system of allocation of allowances and reporting; 2) improving the National GHG emissions register and 3) defining the users of EU funds for modernization and innovation.
- The existing MRV System through more precise procedures for institutions including the improvement of punitive policy.

The Law on Efficient Use of Energy introduces measures on energy efficiency, such as actions and activities aimed to directly achieve the improvement of energy efficiency.

In August of 2024, Montenegro adopted the Law on the use of energy from renewable sources. With this law, Montenegro fulfils its obligation towards the Energy Community to transpose and implement Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources.

NECPs are a new framework for EU member states to plan climate and energy objectives, targets, policies and measures in an integrated manner. The previous Ministry of Ecology, Spatial Planning and Urbanism, together with the Ministry of Capital Investments, continued to work on the NECP, which is currently finalised by the Ministry of Energy and should be adopted by the end of 2024. The plan will enable the implementation of necessary measures to meet the strategic goals by 2030 as well as a transition to a low-carbon economy by 2050.

The long-term low greenhouse gas emission development strategy, in accordance with Article 4 of the Paris Agreement, is planned to be developed in two stages. The first strategy framework will enable the creation of models and scenarios for further low-carbon development (funded in 2023 by the World Bank). The implementation of this activity is planned for 2025. In this context, Montenegro has received support from the World Bank for the development of the Low Carbon Development Strategy Framework. This activity will include preparatory activities for the development of a detailed Low-carbon development strategy and its implementation plan.

As far as latest developments in Montenegro in the field of climate change is concerned, main activities have been related of the drafting of the new Law on protection against adverse impacts of climate change, which will be adopted by the end of 2024. The main motivation behind the adoption of the new law is improvement of legislative framework for protection against the negative effects of climate change and further harmonization with the EU acquis in this field, as well as fulfilment of obligations defined by the Energy Community Decarbonization Roadmap.

Climate change is not yet fully integrated into all sectoral policies and sectoral plans are not fully integrated with local development plans. The key challenges are still in the area of the permanent need to build and enhance the capacity to plan and implement climate policy, which must be increasingly integrated into all relevant national policies and strategies. This refers to all key aspects in the field of climate change and the NDC, such as: GHG Inventory and Projections elaboration and reporting; mitigation policies assessment, monitoring and implementation and the establishment of a fully functioning MRV system, including the MRV system for market mechanisms that contribute to GHG emission reduction, i.e. for the ETS system which has been partially established in Montenegro.

2.10 Gender equality and climate change

Women and men are affected differently by climate change and are differently prepared to adapt to climate change. This is due to underlying inequality in socio-economic status, influenced by three factors: 1) The degree of equality of rights of women and men in national legislation; 2) The degree of law enforcement; 3) The tradition and customs that define the role of men and women in society (so-called "gender roles").

Countries can successfully address climate change risks only if they recognise the different perspectives, impacts, and interests of women and men in sector-level policies relevant to climate change (e.g. energy, transport, agriculture, tourism, and forestry, etc.). Additionally, so-called "horizontal policies" concerning human rights and gender equality are of key importance.

2.10.1 Current situation

According to the Global Gender Gap Report for 2021,[49] Montenegro is ranked 48 out of 156 countries. Gender Inequality Index was 0,114, in 2022, with -0,010 change from the previous year. In 2019, Montenegro produced its first Gender Equality Index (GEI) in accordance with methodology of the European Institute for Gender Equality, in order to monitor its achievements in the area on its path towards the European Union membership. In 2023 the GEI was 59.3, which is an increase of 4.3 index points compared to 2019. The index of key domains of gender equality shows that women in Montenegro are least equal when it comes to power, followed sequentially by time, knowledge, money and work. Highest equality was observed in the domain of health. The greatest differences between the EU countries and Montenegro were recorded in the domains of power and money.[50]

Since declaring independence in 2006, Montenegro has never had a woman in the position of president or prime minister, while a woman has been elected only once as the president of the national parliament. Women are underrepresented in the parliament: in June 2024, the share of women among MPs in the first quarter of 2024 was 27,2%, ranking Montenegro in 85th place among 182 countries.[51]

The average educational achievements of employees in Montenegro are higher among women than men, but women are less present in the labour market and in decision-making positions. In 2024, of the total number of the working-age population, 56.7% are men and 43.3% are women, while the total number of the population outside the labour force consists of 61.5% women and 38.5% men. Of the total number of employed individuals, 57.7% are men and 42.3% are women, and of the total number of unemployed individuals, 48.7% are men and 51.3% are women[52]. Women represent 40.5% of employees with low levels of education (levels 0-2 according to the ISCED 2011 classification). The share of women increases to 43.4% among all wage earners with medium educational achievements (levels 3 and 4) and, notably, 59.2% among highly educated employees (i.e., those with tertiary education, corresponding to ISCED levels 5 to

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[49] The report analysis progress towards gender parity in four dimensions: economic participation and opportunities, scientific achievements, health and political empowerment.https://www.weforum.org/reports/global-gender-gap-report-2021

[50] The index value is displayed on a scale from 1 to 100, where 1 represents complete inequality, and a value of 100 represents complete equality. Indeks rodne ravnopravnosti u Crnoj Gori, Uprava za statistiku Crne Gore, 2023: https://www.monstat.org/uploads/files/Mediji/Indeks rodne ravnopravnosti MNE (2)_25.7.pdf

[51] Inter-parliamentary Union, https://data.ipu.org/women-ranking/?date_month=6&date_year=2024

[52] Anketa o radnoj snazi, Statistical Office Montenegro, First quarter 2024, https://monstat.org/uploads/files/ARS/2024/ARS saopstenje_2024_Q1.pdf

8)[53]. Looking at the distribution by age groups, women make up about 43.9% of all employees aged 15 to 24; 49.3% of all employees aged 25 to 49; and 47.5% of all employees aged 50 to 64.[54]

Regarding the distribution of employed men and women by occupation groups, gender segregation in the labour market and concentration of women in lower-paid occupation is evident. According to economic activity sectors, there is a clear gender segregation in certain professions. Women are overrepresented among employees in the sectors of "Human Health and Social Work" (81.5%), "Education" (76.1%), and "Wholesale and Retail Trade" (60%), as well as in "Financial Activities and Insurance" and "Information and Communication." At the same time, women are underrepresented in sectors such as "Manufacturing" (34.7%), "Construction" (15.8%), and "Transportation and Storage" (17%) In terms of occupation groups, women constitute the majority of total employees in many categories, including managers (54.5%), professionals (64.1%), and service and sales workers (52.5%), but have a small share of employment in two occupations: craft workers and related trades (11.3%) and machine operators and assemblers (5.2%).[55]Women participate in agricultural production; 60.40%, persons engaged in family farms are male, and 39.60% are female. In 2010, out of a total of 48,824 holders of family farms, 12.87% were women and 87.13% were men.[56]

The Gender Pay Gap (GPG) is around 21% when calculated based on the arithmetic mean of wage distribution, and about 11% when calculated using the median.[57] At the same time, empirical analysis has shown that trends in the GPG have not shown any clear signs of improvement over the past decade. The GPG is particularly high for certain groups of workers, such as highly educated individuals, workers in their prime working years, foreigners, and fixed-term employees. Additionally, the GPG is greater for individuals at the top of the wage distribution. GPG cannot be explained by differences in observable characteristics between men and women in employment, such as age, education, sector, or occupation. Instead, the GPG remains largely unexplained, especially at the top of the wage distribution. GPG is associated with the presence of wage disparities based on motherhood, horizontal segregation within occupations, and differences in earnings for feminised professions.[58]

Women make up slightly more than one-third (36%) of the total number of registered property owners in Montenegro, while nearly two-thirds (64%) are men.[59]The total area of properties owned by women accounts for 25% of the overall square footage, as men own more properties simultaneously (four out of five owners who have five or more properties are men). In terms of property type, women own 31% of

[53] Clemente Pignatti, Rodni jaz u zaradama u Crnoj Gori: Ažuriranje statističkog pristupa i uticaj na politike. Ženeva: Međunarodna organizacija rada, 2023 © ILO. https://www.ilo.org/media/480796/download
[54] Ibid.
[55] Ibid.
[56] Agricultural Census 2010, Statistical Office of Montenegro, https://www.monstat.org/userfiles/file/popis poljoprivrede/VI knjiga CG v3.pdf
[57] Clemente Pignatti, Rodni jaz u zaradama u Crnoj Gori: Ažuriranje statističkog pristupa i uticaj na politike. Ženeva: Međunarodna organizacija rada, 2023 © ILO. - https://www.ilo.org/media/480796/download
[58] Ibid.
[59] Komar, O., Batrićević, N.: Pol i vlasništvo nad nekretninama u Crnoj Gori. - De Facto Consultancy, Podgorica, 2023. -https://www.osce.org/files/f/documents/8/a/547832.pdf

business units. Regarding regional distribution, the share of women among total property owners in the southern region is 41%, in the central region 37%, and in the northern region 27%.[60]

2.10.2 National legislation and policies on gender and climate change

The Constitution of Montenegro (adopted in 2007 and amended in 2013)[61] guarantees the respect of human rights and freedoms and equality of all citizens, and prohibits direct or indirect discrimination on any grounds. The Constitution explicitly guarantees gender equality of women and men through the State obligation to develop the policy of equal opportunities.

The Law on Gender Equality[62] guarantees equality between women and men in all areas of public and private life, and promotes equal opportunities policy. The Law defines and prohibits direct and indirect gender-based discrimination, as well as discrimination based on pregnancy and maternity. The Law mandates that all state bodies, governmental agencies, local self-governments, public institutions, public enterprises, and other legal entities exercising public authority must, in order to achieve gender equality, evaluate and assess the impact of their decisions and activities on the position of women and men at all stages of planning, decision making, and implementation, as well as when undertaking activities within their jurisdiction. Additionally, the Law explicitly requires that statistical data and information collected, recorded, and processed by these bodies, companies, and other legal entities, as well as by entrepreneurs, must be reported by gender. These data and information are an integral part of the official statistics in the Republic of Montenegro and must be made available to the public in accordance with the law. The Law also includes the definition of gender-based violence.

The Law on Protection from the Negative Effects of Climate Change (2019)[63] did not recognise or regulate any gender-related issues. However, the new Law on Protection from the Negative Effects of Climate Change and Protection of the Ozone Layer[64] that is expected to be enacted by the end of 2024, stipulates the integration of the gender dimension into climate policies and stipulates for gender responsiveness in the two key climate strategies, the NAP and the LCDS. A discussion on the gender dimension is provided in Montenegro`s *TNC on Climate Change 2020*, under Section 2.9 on Gender equality and climate change, as well as in the *Background Report – NDC revision 2021* (Section 9.1.1), within the section on policy alignment on gender and climate change.

The *National Strategy for Gender Equality 2021-2025*[65] stresses that no research has been conducted in Montenegro on the impact of climate change on women's and men's health, making it very difficult to plan

[60] Ibid.
[61] "Official Gazette of Montenegro", No. 01/2007, 38/2013,http://www.skupstina.me/index.php/en
[62] "Official Gazette of Montenegro", No. 46/07, 35/15,https://www.gov.me/dokumenta

[63] Official Gazette of Montenegro, No. 073/1927, https://epa.org.me/wp-content/uploads/2021/09/Zakon-o-zastiti-od-negativnih-uticaja-klimatskih-promjena.pdf
[64] The Draft Law: https://www.gov.me/dokumenta/85ca203a-cec3-4d82-82bb-eb58439c81b0
[65] National Strategy for Gender Equality 2021-2025. - Ministry for Human and Minority Rights, 2021. - https://www.gov.me/dokumenta/41e3ee6a-757a-4684-9763-9fee5e933afd

national policies for adaptation to climate change. Adaptation policies require knowledge not only of the general incidence of certain diseases, but also of other parameters such as climatic, geographical and social risks for the population. The strategy highlights the need for detailed health risk analyses for populations in settlements that do not meet standards set via the Paris Agreement. It includes assessing the impact of climate change and natural hazards, as well as implementing prevention measures to protect the health of all individuals, particularly marginalised and vulnerable groups, and men, women and people of various sexual and gender identities.

The *National Strategy for Sustainable Development of Montenegro until 2030*[66] is the overarching, horizontal and long-term development strategy of Montenegro, which pertains not only to the environment and the economy but also to indispensable human resources and valuable social capital which enable prosperous development. The Strategy is aimed at supporting equal access to natural and social resources and equal opportunities for men and women, as well as for individuals and groups that are in any way marginalised or particularly vulnerable. It calls for inclusive, gender-equitable, and non-discriminatory policies for economic growth and labour productivity, poverty reduction, strengthening human capital through health and education, achieving food security, addressing the impacts of climate change, or enhancing resilience to natural disasters.

2.10.3 Institutional framework on gender equality and climate change

Stakeholders involved in the implementation, coordination, and monitoring of gender equality policies and protection against discrimination based on gender, gender identity, sexual orientation, and/or intersex characteristics in Montenegro are:

1. **The Department for Gender Equality in the Ministry of Human Rights, and Minorities**, which coordinates activities related to gender equality, conducts gender analyses and participates in the development of action plans at the national and local levels, publishes data related to violence, monitors the implementation of international documents and conventions, and takes measures to incorporate them into the legal system of Montenegro. Ministries and administrative bodies have gender focal points (GFP) who, within their competencies, coordinate activities related to gender equality and participate in the preparation and implementation of activities of the national strategic document for gender equality. In the area of climate change, gender focal point also serves as a GFP for UNFCCC. Local governments develop their own action plans for gender equality and climate change related plans, and appoint local coordinators for gender equality to implement relevant local action plans and to serve as points of contact for cooperation with the Department for Gender Equality.

2. **The Gender Equality Committee**, a permanent body of the national Parliament is responsible for adopting laws and overseeing the implementation of policies in the field of gender equality. This body reviews proposals for laws, other regulations, and general acts related to the realisation

[66] National Strategy for Sustainable Development of Montenegro until 2030. - Ministry for Sustainable Development and Tourism, 2016. - https://www.gov.me/dokumenta/67dc487e-097d-41d2-8fd5-7827a19a1f5a

of the principles of gender equality; monitors the application of these rights through the implementation of laws; and promotes the principles of gender equality.

3. **The National Council for Sustainable Development,** manages the consideration and provision of opinions on national reports and communications on strategic, planning, and program documents of significance for realising Sustainable Development Goals, the Green Deal, the EU Climate Package, the Green Agenda for the Western Balkans, the UNFCCC, the Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona Convention), and other national and international regulations. The Council consists of representatives of the Government, national and local institutions, the business sector, academia, NGOs and independent experts. This body has 36 members, 10 of them being women, including the independent expert for gender equality.

Other actors are non-governmental organisations that implement programs for the protection of women's human rights, the promotion of gender equality, protection against violence, and programs for the empowerment of women, as well as numerous women's business associations that work to support women's entrepreneurship and empower women to participate in economic life.

2.11 Drivers of GHG emissions and removals

Montenegro is a service-based economy. The energy sector, comprising energy supply and consumption in the transport, residential and service sectors, has the highest share of 2022 net GHG emissions.

A very important feature of Montenegro is that the size of the country causes reduced flexibility in the application of policies in some emitting sectors such as energy and industry where single source of emissions can be dominant, distorting the emission profile of the country. At the same time emission reductions in few of these single sources are reflected in the total GHG emission trend. Indeed, drops in the GHG emission trend are mainly driven by activity decrease in two point sources (namely lignite-fired power plant Pljevlja and primary aluminium production in Uniprom KAP).

This section provides, by sector, statistical and political/regulatory information which constitute the drivers of the emissions in each GHG emitting sector.

Energy

The energy sector is the main contributor to GHG emissions in Montenegro, accounting for 74.6% of the national total without LULUCF. Overall, the sectoral emissions show an increasing trend over the past years with the majority of emissions in 2022 stemming from fuel combustion in the energy industry (55%) and the transport sector (34%). Similarly, energy intensity in Montenegro remains high compared to the EU average, indicating significant potential for energy efficiency gains.

Montenegro's energy sector caters to a population of around 630,000 with an annual demand of approximately 3,000 gigawatt hours (GWh). The majority of electricity comes from hydropower plants (Perućica and Piva) and the Pljevlja coal-fired power plant, all operated by the state-owned Electricity Power Company of Montenegro (EPCG).

Montenegro has promising additional renewable energy production potential that it can leverage from its natural resources. These resources include hydropower, solar, wind, and biomass energy which can be crucial in reducing the country's reliance on fossil fuels and in increasing the share of renewables in its energy mix. While a diversified energy mix supports energy security and sustainability objectives, it also aligns Montenegro with the EU energy and climate policies.

Disaggregated by category, Montenegro's energy sector displays the following characteristics.

- Electricity and Heat Production: This subcategory, dominated by the coal-fired Pljevlja power plant whose primary activity is to supply the public, is the largest emitter. Emissions have remained relatively constant overall due to offsetting factors like economic downturns and plant upgrades.

- Manufacturing Industries and Construction: This sector's emissions have declined by -30.4% since 1990 due to reduced industrial activity and improvements in technology and fuel types. The share of the emissions from this category in 2022 was 5.8% in total national emissions, exhibiting an 99.1% and 99.4% decrease compared to 1990 due to fuel switch in Iron and Steel (Željezara Nikšić), as well as Non-Ferrous Metals industries – aluminium smelter (Kombinat Aluminijuma Podgorica KAP), respectively.

- Transport: Emissions from this sector, primarily road transportation, have more than doubled since 1990 due to increased vehicle use. The emissions it this category accounted for 20.3% emissions of the total national emissions in 2022.

- Energy Consumption in Households, Commerce, Institutions and Other: Emissions from this category have decreased in recent years due to energy efficiency measures and adoption of cleaner heating technologies. The category accounted for 1.8% of the total national emissions in 2022.

- Fugitive emissions resulting from the extraction, processing and delivery of fossil fuels to the point of final use represent a very small contribution of 0.4% to the national GHG emissions.

Total installed capacity in 2023 was 1,067.239 MW. Depending on the energy source used for electricity generation in 2023., the capacities are divided into hydropower plants, thermal power plants, wind power plants and solar power plants. In the energy mix, hydropower plants are represented with 66.05% (704.904 MW), thermal power plants with 21.08% (225 MW), wind power plants with 11.06% (118 MW), and solar power plants with 1.81% (19.334 MW) in relation to the total installed production capacity.

An overview of the installed power by type of power plant and the operator is given in the following table[67]:

Table 10 Installed generation capacity by type of technology (2023)

Operator	Power Plant	Installed power [MW]
EPCG	TPP Pljevlja	225
	HPP Piva	342
	HE Perućica	307
	sHPP Rijeka Crnojevića	0,65
	sHPP Rijeka Mušovića	1.95
	sHPP Lijeva Rijeka	0.11
	sHPP Podgor	0.465
	sHPP Šavnik	0.2
DOO Zeta Energy Danilovgrad	sHPP Glava Zete	4.48
	sHPP Slap Zete	1.672
DOO Hidroenergija Montenegro Podgorica	sHPP Jezerštica	0.844
	sHPP Bistrica	5.6
	sHPP Rmuš	0.474
	sHPP Spaljevići 1	0.65
	sHPP Orah	0.954
	sHPP Šekular	1.665
	sHPP Jelovica 2	0.619
	sHPP Jelovica 1	3.285
DOO Synergy Podgorica	sHPP Vrelo	0.615
DOO Igma Energy Andrijevica	sHPP Bradavec	0.954
	sHPP Piševska rijeka	1.08
DOO Kronor Podgorica	sHPP Jara	4.568
	sHPP Babino polje	2.214
DOO Hydro Bistrica Podgorica	sHPP Bistrica Majstorovina	3.6
DOO Nord Energy Andrijevica	sHPP Šeremet Potok	0.792
DOO Simes Inžinjering Podgorica	sHPP Ljevak	0.551
DOO Viridi Progressum	sHPP Paljevinska	0.553
Power AB Group	sHPP Bukovica	0.282
sHPP Bistrica Lipovska	sHPP Lipovska Bistrica	0.993
DOO Small Power Plants Kutska	sHPP Kutska 1	1.8
	sHPP Kutska 2	0.81
DOO Small Power Plants Mojanska	sHPP Mojanska 1	1.8
	sHPP Mojanska 2	1.111
	sHPP Mojanska 3	0.761
Đekić DOO	sHPP Pecka	0821
DOO sHPP Vrbnica	sHPP Vrbnica	6.75
DOO Manira Hydro	sHPP Elektrana Mišnjića	0.222

[67] https://regagen.co.me/o-nama/planovi-i-izvjestaji/izvjestaj-o-stanju-energetskog-sektora-crne-gore-za-2023-godinu/

DOO Benergo Berane	sHPP Milje Polje	0.288
DOO Hidroenergija Andrijevica	sHPP Umska	0.442
	sHPP Štitska	0.893
DOO Vodovod i kanalizacija Andrijevica	sHPP Krkori	0.374
DOO Krnovo Green Energy Podgorica	WPP Krnovo	72
DOO Možura Wind Park Podgorica	WPP Možura	46
DOO Eco Solar System Danilovgrad	SPP DG	0.997
DOO Bar-Kod Podgorica	SPP Bar-Kod	0.585
DOO Invicta Podgorica	SPP Invicta	0.416
DOO Alliance	SPP Alliance	0.203
FSCG	SPP FSCG	0.032
SPP Milenijum[1]	SPP Milenijum	0.086
DOO Čevo Solar Podgorica (trial)	SPP Čevo	3.25
Prosumers	SPP	13.77
	sHPP	0.012
Total		1,067.239

Source: https://regagen.co.me/o-nama/planovi-i-izvjestaji/izvjestaj-o-stanju-energetskog-sektora-crne-gore-za-2023-godinu/

In 2023, total net electricity consumption was 3,174.52 GWh. Direct customers used 83.77 GWh and distribution customers spent 2,616.75 GWh. Households represent the largest share of electricity consumption with 46.01%, followed by other customers (small and medium size enterprises) with 36.06%. The following table shows the electricity production by type of power plant and consumption of customers connected to the transmission and distribution system during the period 2020 – 2023.

Table 11 Production and electricity consumption (2023)

ELECTRICITY BALANCE 2020-2023 (GWh)				
POWER PLANT/TYPE OF CUSTOMER	2020	2021	2022	2023
HPP Piva	657.32	838.48	558.77	932.55
HPP Perućica	672.44	989.01	715.67	1,038.96
Distributed energy sources – SHPP	99.15	166.66	180.00	225.70
WPP Krnovo	180.69	192.19	190.77	187.40
WPP Možura	126.18	128.28	131.89	122.56

TE Pljevlja	1,487.46	1,332.61	1,454.14	1,522.98
Distributed energy sources – SSPP	2.59	2.66	3.85	12.69
TOTAL ELECTRICITY GENERATION	3,225.83	3,649.89	3,235.09	4,042.84
Total distribution customers	2,185.22	2,373.33	2,483.71	2,616.75
Direct customers 110 kV	633.76	606.89	138.85	83.77
Transmission system losses	163.59	153.59	142.25	146.27
Distirubution system losses	328.84	345.54	334.85	327.73
TOTAL ELECTRICITY NEEDS	3,311.41	3,479.35	3,099.66	3,174.52
ELECTRICITY BALANCE (generation-needs)	85.58	170.54	135.43	868.32

Sources: (1) Report on the realization of the energy balance 2023 (https://www.gov.me/cyr/clanak/izvjestaj-o-realizaciji-energetskog-bilansa-za-2023-godinu); (2) Report on the realization of the energy balance 2022 (https://www.gov.me/dokumenta/f89fb858-d428-4a8b-ab12-4bc56d0ff325); (3) Report on the realization of the energy balance 2021 (https://www.gov.me/dokumenta/bc8fe451-1bdc-4d49-9320-741e7e9c2692).

Montenegro currently does not have any oil or gas reserves. In 2022, concession agreements were signed for the production of hydrocarbons, with the companies Eni Montenegro, BV Netherlands and Novatek Montenegro, BV Netherlands, as well as with Energean Montenegro Limited Cyprus for blocks with a total area of 338 km2. This consortium paid 12 million euros into the state budget in 2022 as a guarantee for the unfinished part of the work defined by the contract on oil exploration in the Montenegrin sea, due to the abandonment of further exploration. Montenegro is about to launch a new public tender for oil and gas exploration in the country's seabed68.

Most of the energy industry emissions comes from the thermal power plant (TPP) Pljevlja which is the only coal-fired power station in Montenegro into service since 1982 with a generation capacity of 225 MW and produces a third of the country's electricity.

There are four types of fuels in final energy use in Montenegro: coal (mostly lignite), oil products, wood fuels and electricity. Total final energy consumption varies between 29.86 PJ and 23.91 PJ in the period 1990-2022. Oil products are the most dominant fuel in the final energy balance (73.08 % in 2022) and all of it is imported. Electricity is also an important part of the final energy balance but almost all the needs for it are supplied from domestic production. The most energy intensive sectors are transport and residential sector which consume more than two thirds of the total final energy use.

As for primary energy production, there are several sources: coal, wood fuels and renewables (hydro, wind and solar). Almost all the coal production is used in thermal power plant for electricity production, as well as all renewables (2 large hydro power plants and currently 32 small hydro power plants, 2 wind power

[68] https://www.gov.me/clanak/susret-ministra-sahmanovic-i-nje-ambasadorke-meken

plants and 6 small solar power plants)69. Hydropower is the country's most important energy resource and Montenegro is ranked high in terms of availability of hydropower resources. However, environmental protection requirements and seismic risks reduce its utilization. Total primary energy production varies between 32.42 PJ and 32.17 PJ in the period 1990-2022. Although coal has the most dominant place in the structure of the primary energy balance, renewable energy will play the most important role in the further development of the energy mix in Montenegro.

While Montenegro is reliant on fossil fuels, particularly on coal for electricity generation, the county possesses significant potential for renewable energy sources and improved efficiency. To address these challenges, Montenegro has established several crucial national and energy-specific policies and strategic directives, which highlight the country's development trajectory and its ambition to reduce GHG emissions in the energy sector.

In recent years, a volume of investments for the development of energy infrastructure in Montenegro have been increased. New major investments have supported green economy growth and energy efficiency improvements. Other major investments were focused on the reconstruction of existing hydropower plants, construction of new wind and hydropower plants and various other activities. The development of renewable energy sources has been set as a priority for the next period in accordance with international obligations. For this reason, additional major investments are planned and are already being implemented in order to develop this sector.

The Industrial Policy of Montenegro 2019–2023 is a strategic document for the development of the competitiveness of the Montenegrin economy with a focus on the industrial sector. The Industrial Policy recognizes that the real drivers of change and development are companies that, with adequate support, should maximize their potential for growth, development and competitiveness. The Industry Policy of Montenegro 2019–2023 represents a continuation of the activities implemented under the Industrial Policy to 2020, adopted in June 2016.

Industrial policy also recognizes the circular economy as one of the important directions for future development. According to the Strategy, in 2015 the European Commission adopted an action plan to help accelerate Europe's transition to a circular economy, to strengthen global competitiveness, to promote sustainable economic growth and to create jobs. The Action Plan sets out 54 measures to "round out" the product lifecycle: from production and consumption to waste management and the secondary raw materials market.

Concerning energy consumption in industry, in 2022 the production of the following products increased compared with the production from 2021[70]:

- Sacks and bags of polymers of ethylene (including cones) from 11 450 t to 2 635 t, i.e. 81.7%;
- Fresh or chilled whole chickens from 754 t to 1 282 t, i.e. 70.0%;
- Hams, shoulders and cuts thereof with bone in, from 2 519 t to 4 042 t, i.e. 60.5%;

[69] https://regagen.co.me/wp-content/uploads/2024/08/2024.26.07_REGAGEN_-IZVJESTAJ-O-STANJU-ENERGETSKOG-SEKTORA-CRNE-GORE-ZA-2023.pdf

[70] https://monstat.org/uploads/files/industrija/prodcom/2022/Industrial%20production%20-%20PRODCOM%20%202022.pdf

- Sausages and similar products of meat from 4 254 t to 5 220 t, i.e. 22.7%.

In 2022 there was a decrease of production among the following products when compared with the production from 2021:

- Bituminous mixtures based on natural and artificial aggregate and bitumen or natural asphalt as a binder from 307 276 t to 163 894 t, i.e. -46.7%
- Ready-mixed concrete from 551 895 t to 440 175 t, i.e. -20.2%;
- Aluminum ores and concentrates from 542 049 t to 442 067 t i.e. -18.4%;
- Unwrought non-alloy aluminum (excluding powders and flakes) from 45 214 t to 43 196 t i.e. -4.5%

Within the framework of the Industrial Policy, a Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis of the potential for industrial development was also carried out. The analysis showed that the main weaknesses include the use of energy-intensive and often outdated technology and equipment. This results in industrial production characterized by a high share of products at lower processing stages and high import dependency. To address these weaknesses, it is necessary to develop products and services with greater added value, fostering innovation and introducing new technologies through collaboration with the scientific research community and digital transformation. In addition, the gradual introduction of the principles of circular and low-carbon economies can make a significant contribution towards further developing a more resource-efficient economy and good environmental management.

Transport

Road transportation is the major GHG emitter of the transport sector in Montenegro. According to the national statistics [71] for 2023 the overall length of roads in Montenegro was 9,912 km, of which 6,762 km are modern road (asphalt) connecting bigger cities or economic regions of Montenegro. Rail and water-borne transport are not well developed in Montenegro. Road transport is the main mode for passengers, while for freight transport it is rail which is mostly electrified.

Montenegro's rivers are generally not navigable, except for tourist attractions such as rafting on Tara River.

Port of Bar is the major seaport in Montenegro. It is capable of handling about 5 million tons of cargo, and is a port for ferries to Bari and Ancona in Italy. Kotor, Risan, Tivat and Zelenika (in Bay of Kotor) are smaller ports.

Montenegro has two international airports (Podgorica Airport – TGD and Tivat Airport – TIV) with a combined traffic of more than two million passengers annually. There are also airports at Berane, Žabljak and Nikšić, used mostly for general aviation, and are not equipped to handle larger aircraft. Ulcinj has a grass-type airport.

[71] https://monstat.org/uploads/files/publikacije/statistika%20saobracaja/2023k/PUBLIKACIJA-%20GODISNJA%20STATISTIKA%20SAOBRACAJA%202023-en%20(2).pdf

Industrial processes

The major contributor to GHG emissions from industrial processes in Montenegro is the primary aluminium production.

Perfluorocarbons (PFCs), a GHG with a high global warming potential, is produced in the primary aluminium reduction process, during events referred to as anode effects. An anode effect is a process upset condition, where an insufficient amount of alumina is dissolved in the electrolyte bath. This causes the voltage in the pot to be elevated above the normal operating range, resulting in the emission of gases containing the PFCs tetrafluoromethane (CF4) and hexafluoroethane (C2F6).

The Aluminium Plant Podgorica also known latterly as Uniprom KAP, is a Montenegrin aluminium smelter company located in Podgorica. Production of primary aluminium began in 1971. The KAP produced its own alumina, extracting it via the Bayer process out of the bauxite shipped from the Nikšić bauxite mine. The factory also had its own production of pre-baked anodes. The smelter had an installed capacity of 120,000 tons of liquid aluminium per year. KAP was connected by railway with bauxite mines near Nikšić and the Port of Bar, and the Podgorica Airport is only a few kilometers away.

The plant had its most difficult times during UN-imposed economic sanctions on FR Yugoslavia. During the sanctions, the production was reduced to 13% of capacity. In the period 1997–1999 KAP participated with 8.2–6.7% in GDP of Montenegro, and 65–67% in export for the same period. Most of the time, the KAP acquired necessary raw materials and spare parts from Glencore. The entire export was also conducted by Glencore.

The company was one of the few Montenegrin companies to recover quickly after the breakup of Yugoslavia. As of 2008, the KAP has struggled to survive the impact of ongoing economic crisis. The low trading price of aluminium, and expensive production inputs, primarily the electricity and alumina production, resulted in KAP generating daily losses of up to €200,000. The company has been unable to survive ever since without the constant Government subsidies, primarily in writing off the debt for electricity.

In 2009, the financial situation at the company had not improved, leaving KAP in danger of being closed. KAP entered bankruptcy proceedings in 2013 and was sold by Montenegro's government to Uniprom in 2014.

In 2023, Montenegro's Uniprom has shut down the last 12 remaining electrolysis cells at aluminium smelter KAP, discontinuing aluminium production at the plant after 52 years of operation. The facilities for the production of aluminium logs and alloys will remain in operation, but the plant will import the metal to manufacture them.

Solid Waste Management

Montenegro's waste sector is initiating an unprecedented transformational change. Despite a stagnating population, the amount of waste generated per capita in Montenegro continues to significantly increase, estimated at 534.4 kg and 374.1 kg per year as of 2021 in urban and rural areas, respectively, of which 40% is biowaste. Approximately 95% of the population is covered by unsorted municipal waste collection services, of which 60% is disposed of in unsorted sanitary landfills, about 20% in unsorted temporary storage facilities, and 10% in illegal dumpsites, with the remaining percentage collected for recycling. Historically, the coverage for waste management services has been hindered by infrastructural and operational limitations, particularly in rural areas. Montenegro is re-organizing its waste management infrastructure to help manage waste in four central centres under three administrative regions.

While there have been initiatives to remediate illegal landfills and to develop recycling centres with sorting facilities and transfer stations, the operational and financial effectiveness of waste sorting and processing remains low in Montenegro. Under this context, Montenegro has set ambitious targets both to reduce the quantities of waste generated, to expand the coverage of waste management systems through segregated primary collection services for each and every waste stream, and to foster innovative revalorization of waste through the principles of economic circularity, ultimately minimizing the quantities of waste disposed of by fostering composting, recycling, and mechanical-biological treatment methods, including waste-to-energy alternatives.

Concerning wastewater treatment, approximately 50% of the Montenegrin population utilises septic tanks. While the remaining 50% is collected to sewerage systems, only 56% of those are treated at wastewater treatment plants. Montenegro aims to achieve universal sewerage connection treatment in urban settlements.

According to MONSTAT, the total amount of waste generated in 2022 is 1,5 million tonnes (so a 12% increase compared to the previous year).

Industrial waste accounts for 46% of the total amount of generated waste, and hazardous waste for 21%.

The total amount of municipal waste is 325,707.5 t (7.1% increase compared to the previous year). The amount of municipal waste per capita is 526.0 kg, (7.5% increase compared to the previous year), i.e. 1.4 kilograms per day per capita.

The total amount of processed waste is 303,041.5 t, of which 87.7% was disposed of.

The waste infrastructure in Montenegro consists of 1) regional landfills for non-hazardous waste in Podgorica and Bar, 2) recycling/sorting centres in Podgorica, Herceg Novi, Kotor and Žabljak, 3) vehicles waste processing plants in Podgorica (1), Berane (1) and Nikšić (3), 4) transfer stations in Kotor and Herceg Novi, 5) recycling yards in Podgorica (6), Herceg Novi (1), Kotor (1) and Budva (1), 6) medical waste processing facilities in Berane and Podgorica, 7) electrical and electronic waste processing facilities in Bar, and 8) composting plant in Kotor for managing green waste in the municipalities of Kotor, Tivat, Budva and Herceg Novi.

According to MONSTAT, 87.6% of Montenegro's population is covered by public waste collection services in 2022 (a 0,6% increase from the previous year). Of the 297 thousand tons of municipal waste collected, 5.6 thousand tons, or only 1.8%, were recycled.

In 2018, The Ministry of Sustainable Development and Tourism accepted the two-bin system for separate waste collection of "dry" and "wet" fractions and sent consent for its implementation to local administrations and utility companies. The container for the "dry" fraction is intended for the disposal of paper, cardboard, plastic, metal and glass, while the container for the "wet" fraction is intended for the disposal of all the other types of municipal waste (waste that by its composition mostly wet due to the presence of food residues, organic waste, garden waste, hygiene products, etc.), not including bulky waste and edible oils and fats.

Separate waste collection is hardly giving results because the infrastructure is lacking in most parts of the country and there are no financial incentives for sorting waste at the source, nor penalties for not doing it. A few municipalities have started to implement the 2 bins separation system but have had very poor results so far, mostly due to a lack of incentives for separating waste at source (such as door-to-door systems), lack of communication and awareness raising, and also inadequate collection bins. Gusinje municipality has implemented the separation of waste at the source (door-to-door collection), which is easier to control. Since 2020, Gusinje is working on becoming a Zero Waste City following the Zero Waste City program and is expanding its separation system to a 5 bins system, the first one in Montenegro: organics, cardboard/paper, metal/glass, plastics, residual waste.

Recycling activities are very limited in Montenegro (under 2%) as recyclables collected remain very low. Some recyclables collected (such as PET and HDPE bottles, cardboard, aluminum and glass) are sold to be recycled abroad, but the issue of low quantity makes it often unattractive to foreign recyclers.

Littering is still a major issue in Montenegro. There is a lack of infrastructure for bulk waste, construction waste and in some areas hazardous waste as well. Around 13% of domestic waste remains uncollected by public authorities which also contributes to the littering issue. There is also an important lack of environmental inspectors in the country and penalties for littering are not enforced.

Regarding waste management, efforts on strategic planning and investments are needed to implement the national strategy for waste management until 2030. Infrastructure for separate waste collection and recycling remains to be established across the country.

In April 2024 the new Law on Waste Management has been adopted. This law is crucial for aligning Montenegro's waste management practices with EU standards, particularly focusing on increased waste separation at the source, improved recycling rates, and establishing necessary waste management infrastructure. The new law introduces several key provisions, including the Extended Producer Responsibility (EPR), which requires producers and importers to manage waste from their products. To find out more visit our webpage about EPR. Additionally, the law bans the use of lightweight plastic bags with a thickness between 15 and 50 microns. For plastic bags with a wall thickness of 50 microns and above there will be a fee, and the funds from this fee will be paid into the account of the Environmental Protection Fund and can be used exclusively for financing and co-financing activities to raise awareness about environmental protection. The ban is mandated to be put in force from October 2024.

The drafting of the new National Waste Management Plan (NWMP) has also been in progress. The plan's finalization was contingent on the adoption of the new waste management law, which has now been completed. The adoption of NWMP should enable municipalities to update their local waste management plans in line with the new national framework.

Water resources, Water Supply and Wastewater Management

Montenegro's water resources are abundant and vary across the country.

- Surface Water: Montenegro is rich in both surface and ground water, which play vital roles in the country's ecosystem and economy.

- Ground Water: Present in rocks from the Palaeozoic Era to the Quaternary Period, ground water is the primary source of drinking water for the population and is also used in industry and agriculture. Seventy-five sources supply water to 40 urban settlements, with 64 sources drawing from karst aquifers and 11 from inter-granular aquifers.

Montenegro covers an area of 13,812 km^2. Including its part of the Adriatic Sea (2,540 km^2), the total area extends to 16,352 km^2. Water from Montenegro drains into two major basins:

- The Black Sea Basin covers 7,545 km^2 (54.6% of the territory) and drains through the Ibar, Tara, Piva, Lim, and Ćehotina rivers.

- The Adriatic Sea Basin covers 6,560 km^2 (45.4% of the territory), with major watercourses including the Morača, Zeta, and Bojana rivers.

With an average annual runoff of 624 m^3/s (19.67 billion m^3 of water), Montenegro is considered a water-rich country, with about 95% of its runoff coming from inland sources and 5% from transit water.

Montenegro's natural lakes include Lake Biograd (0.23 km^2), Lake Plav (1.99 km^2), Black Lake (0.52 km^2), Lake Šas (3.6 km^2), and Lake Skadar, whose surface area fluctuates between 360 km^2 and 500 km^2 depending on the water level. The largest artificial reservoir is Lake Piva, with a total capacity of 880 million m^3. Other significant reservoirs include Lakes Slano, Krupac, Vrtac (225 million m^3), and Otilovići (18 million m^3).

The country is committed to environmental conservation, with 13.41% of its land designated as protected areas, including the five national parks of Durmitor, Biogradska Gora, Lake Skadar, Lovćen, and Prokletije. These areas encompass diverse ecosystems, including forests, lakes, and karst landscapes, which provide essential habitats for a wide range of flora and fauna.

Water management is critical to the sustainable development of the Montenegrin economy. The conservation of water as a natural resource is the basis of national development strategy for Montenegro as an ecological state.

According to MONSTAT latest published data, the volume of water abstracted from business entities that manage public water supply and sewage in Montenegro in 2023 compared to 2020 increased by 24.6%.

Volume of water abstracted by businesses that manage public water supply and public sewage system in 2023 amounted to 151 141 000.0 m3. Water is mainly abstracted from groundwater and spring water 86.2%, 1.2% is abstracted from surface water, while 12.6% of the total volume of water abstracted is from other water supply systems. In 2023 water distributed in Montenegro amounted to 62 410 000.0 m3, which is 33.4% more than in 2020. Water losses in Montenegro in 2023 compared to 2020, increased by 19.1% and amounted to 88 730 000.0 m3. Length of public water supply in 2023 amounted to 4 922.0 km. The total amount of wastewater from settlements in Montenegro in 2023 amounted to 28 837 000.0 m3. The amount of treated wastewater in 2023 decreased by 60.7% compared to 2020. Length of public sewage system in Montenegro in 2023 amounted to 1 396.0 km.

To improve the situation in the field of wastewater management, two strategic documents were prepared with the support of the EU - a master plan for treating and removing wastewater from the Montenegrin coast and Cetinje municipality and a strategic master plan for sewerage and wastewater in the central and northern region of Montenegro. The master plans set out a programme for the treatment and removal of wastewater including the improvement of the existing sewerage network and the installation of wastewater treatment infrastructure.

Agriculture, Land Use and Forestry

Although agriculture's share of GDP has declined in recent years, it continues to be an important strategic sector within Montenegro’s economic development and has many economic activities that are linked to it, particularly in rural parts of the country. The production of fruits, vegetables, and olive oil is significant. In 2023, the agriculture, forestry and fishing sector constituted 5.67% of GDP, while in 2022 this share was 5.89%.

Used agricultural land in 2023 amounted to 263,522.3 ha, which compared to 2022 represents an increase of 3.9%. The total used agricultural land is dominated by areas of perennial meadows and pastures with a share of 94.6%, while arable land is represented by 2.7%, permanent crops by 2% and back gardens by 0.7%. Compared to 2022, the area of perennial meadows and pastures increased by 4% and arable land by 5,8%, while the area of permanent crops decreased by 2.8% and kitchen gardens by 0.8%[72].

Total production of maize for grain in 2023 was 3,166.3 t, what is a rise of 12.5% compared to 2022. An increase in production was also recorded in the following crops: pepper (1.3%), cucumber (3.7%), watermelon (6.4%) and melon (3,6%). Compared to 2022 an increase is recorded in total production of: mandarins (3.1%), while recorded lower production of plums, apples, pears, peaches and olives. Total production of grapes in 2023 records a decrease by 23.1% in comparison with previous year.

According to the Corine Land Cover database and the MONSTAT Statistical Yearbook:

- 64% of Montenegro's territory is covered by forests.

[72] http://monstat.org/uploads/files/Biljna/Crop%20production_2023.pdf

- 14% is arable land, and 9% consists of pastures.
- Agricultural land covers 309,241 hectares, representing 22.4% of the territory, with 95.2% comprising family farms and 4.8% agricultural businesses.

Agriculture in Montenegro is very diverse, from the cultivation of olives and citruses in the coastal belt, vegetables, and viticulture in the central part, to extensive livestock breeding, especially in the northern part of Montenegro.

Agricultural land[73] is dominated by permanent meadows and pastures (249,000 ha), and together represent 95% of the total agricultural land in the country. They are mostly used extensively in almost all regions. They are mostly concentrated in the north and northwestern parts of Montenegro.

Arable land and home gardens cover less than 3% of agricultural land. These systems are gradually decreasing mainly due to urbanization and construction of infrastructure facilities.

On the other hand, the area of orchards (2,600 ha) and vineyards (2,600 ha) is slowly increasing by 1%.

Agriculture is mainly labour-intensive and represents the major or significant source of income for about 50,000 rural households. Agricultural practices are of very low intensity. They are characterized by a low level of mechanization and/or use of chemicals.

The karst region consists of the central regions of the municipalities of Cetinje and Nikšić. The most important agricultural sector in this region is livestock production, particularly goat and sheep breeding, for which karst pastures are mostly suitable.

In Montenegro, traditional orchards are still prevalent, especially in the continental part of the country. Most olive trees are cultivated in the traditional manner, without regular pruning, and with alternate yields. In Montenegro, mountainous terrain limits agricultural production to valley systems and narrow coastal belt. Terraced production and dry walls that retain stones covering very shallow surface soil are traditional practices. This well-organized agricultural infrastructure is extremely vulnerable to depopulation that leads to the abandonment of rural areas. Crop production is carried out only in some valleys, where alluvial deposits are accumulated. It is further restricted by scarce water resources. Most households maintain small family plots near their houses for the production of fruit and vegetables. The dominant agricultural system is extensive grazing of cattle, sheep, and goats on semi-natural pastures.

MONSTAT's latest published data on livestock for 2023 shows a decrease in the total number of cattle and sheep compared to 2022 confirming the continued decrease of livestock among the years in Montenegro. The total number of cattle is 68 826 in 2023, which is 2.8% less than 2022. The trend of decrease in the total number of dairy cows is still continuing, by 5.3%. Compared to 2022, there is a decrease in the total number of sheep in sheep farming by 3.9%, while the number of milking sheep is lower by 2.4%. In 2023, the number of goats is at the same level as in 2022. The total number of pigs (24 227)

[73] https://monstat.org/eng/page.php?id=1357&pageid=62

records a decrease of less than 1.2% in 2023 compared to 2022. The total number of poultry in 2023 is higher by 1.2%. The largest share is held by laying hens, with the total number 801 926, and compared to 2022, it records a decrease of 2.4%.

As for the forestry sector, data from the National Forest Inventory (2010) show that forests cover 59.9% of Montenegro's surface, forest land covers 9.8% of Montenegro's surface, while together forests and forestland cover 69.7% of Montenegro's surface.[74] Montenegro's forest cover is well above the European average of 46% and the global average of 30%. Forests represent a net sink in Montenegro.

The biomass in Montenegro's national parks is estimated at 10,717,149 m^3, and the forest ecosystem sequesters approximately 2,979,966 tonnes of carbon. Additionally, the total volume of dead trees in coarse woody debris and snags is estimated at 258,079 m^3, comprising 238,967 trees of various species.

According to data from the Spatial Plan of Montenegro, 67% of the forests are state-owned. However, there are indications that the balance of ownership has shifted toward private ownership due to updates in the cadastre and restitution processes, with 49% of forests and forest land now privately owned.[75]

The most important wetland is located near Lake Skadar, which is recognized as an internationally important site under the Ramsar Convention.

Montenegro's forest ecosystems are primarily threatened by:

- Wildfires: These present the greatest ecological and economic risk, especially in the southern forest regions where difficult access complicates firefighting efforts. Fires vary from year to year, sometimes covering up to 7% of the territory of all forests in Montenegro (2012).[76]

- Abiotic factors: Including droughts, floods, frost, snow, and high winds.

- Pests and diseases: Forests have become more susceptible to parasitic fungi, insects, rodents, and parasitic flowering plants. Climate change, air pollution, and extreme weather events exacerbate these vulnerabilities.

The major threats to forests include:

- Weakening immunity of certain tree species.
- Reduced productivity and bioecological stability.
- Intensive forest drying, particularly among conifers like spruce and fir.
- Pathogenic fungal outbreaks and insect infestations.
- Illegal logging, forest fires, and damage from snowstorms and frost.
- Air pollution impacts.

[74] https://www.gov.me/clanak/110750--saopstenje-nacionalna-inventura-suma-crne-gore, sajtu pristupljeno 31.01.2025.
[75] Prva nacionalna inventura šuma (2011).
[76] Ministarstvo poljoprivrede, šumarstva i vodoprivrede Crne Gore

According to Montenegro's national forest monitoring data, gathered from 49 locations, the overall health of the forests is satisfactory. Of the 1,176 trees inspected:

- 43% showed no defoliation.
- 37% showed slight defoliation (10–25%).
- 20% exhibited medium defoliation (25–60%).

Insects and fungi causing tree degeneration were commonly identified, often linked to climate change effects, such as increased air temperatures, altered precipitation patterns, and more frequent droughts and storms. These findings emphasize the need for revised forest management practices to adapt to climate change and ensure sustainable forestry.

Montenegro's forests are home to a remarkable diversity of flora and fauna. The country is a biodiversity hotspot with 3,250 plant species, and an S/A index (species per area) of 0.837, making it one of Europe's key biodiversity centers. The diversity of tree species is impressive, with the National Forest Inventory documenting 68 tree species (57 broadleaf and 11 coniferous species).

Forest ecosystems cover 59.9% (832,900 ha) of the country, with forest land accounting for another 9.8% (135,800 ha). Comparing the 2010 National Forest Inventory data with the 2020 Spatial Plan shows an increase of 16.3% in forest cover.

The dominant species in Montenegro's forests include beech, spruce, fir, and black pine. High forests are primarily found in the northern part of the country, while coppice forests are typical in the central and coastal regions. The coastal areas also have significant expanses of forest underbrush, wild scrubland, and degraded forest formations.

Montenegro's national parks—Lake Skadar, Lovćen, Biogradska Gora, Prokletije, and Durmitor—contain 37,125 hectares of forests and 2,825 hectares of forest land, covering 40.5% of the parks' area. 66% of the national park forests are high forests, with coniferous forests occupying 20.4%.

In national parks like Biogradska Gora, Prokletije, and Durmitor, forest ecosystems were one of the main reasons for their designation as protected areas. These parks are particularly important for maintaining bioecological stability and productivity. The proportion of young trees observed in the parks is also favorable, indicating healthy regeneration and resilience.

3.

INVENTORY OF GREENHOUSE GASES

Montenegro is a non-Annex-B country for the Kyoto Protocol (2007) and a signatory country to the Paris Agreement (2017), pledging to contribute to reducing greenhouse gas emissions globally. Montenegro has pledged to reduce GHG emissions by at least 1,572 kt CO_2eq, to 3,667 kt CO_2eq or less. Montenegro's contribution to the efforts of the international community in the fight against climate change, expressed through the 2021 updated INDC to GHG Reduction, is at least 35% by 2030 compared to the 1990 baseline level.

This chapter provides information on the sources of data used for calculating emissions, the methods applied, emission factors, GHG emission trends, and the quality control and assurance procedures.

3.1 Methodological approach

This National Greenhouse Gas Inventory Report has been prepared for the FNC/1BTR and covers the period 1990–2022. The report provides data on the preparation of the inventory of GHGs for the years 2016 to 2022 and the recalculation of the inventory time series for the period 1990–2022. It was implemented using an integrated tool based on Excel tables received through the European Twinning Light project in cooperation with the Austrian Environmental Protection Agency (UBA).

All recommendations of the audit report have been taken into account and, in accordance with the real circumstances, have been applied in the final version of this report. This activity has contributed to a significant improvement in the knowledge of the inventory and NIR/NID team as well as the quality of this report.

Following the recommendations of the IPCC Guidelines, inventory verification was performed through a series of simple completeness and accuracy checks, including arithmetical errors, comparisons of national statistics with international statistics, and verification of estimated carbon dioxide emissions from the energy sector, comparing the results obtained using the Sector and Reference approaches.
The GHG emissions inventory included the calculation of emissions of the following direct greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrogen suboxide (N_2O), and synthetic gases (PFC, HFCs and SF_6).
The inventory also includes calculations for the following indirect greenhouse gases based on the EMEP/ EEA Air Pollutant Emission Inventory Guidebook (2009): carbon monoxide (CO), nitrogen suboxide (N_2O), non-methane volatile organic compounds (NMVOC), and sulphur dioxide (SO_2).
The sources and sinks of emissions of direct and indirect GHG are divided into five main categories:

- Energy
- Industrial processes
- Agriculture
- Land use change and forestry
- Waste

This report has been prepared in accordance with the guidelines of the UNFCCC for the reporting of annual inventories, as adopted by Decision 18/CP.8COP (Conference of Parties). In line with the IPCC guidelines, national emission factors were used where possible (in certain activities of the energy, industry, agriculture, and forestry sectors), thereby increasing the accuracy of the calculated emissions. For other activities representing sources of GHG emissions, the recommended (default) emission factor values were used.

3.1.1 Activity indicators and emission factors

The 2006 Intergovernmental Panel on Climate Change's Combined Approach 1 and 2 (Tiers 1 and 2) methodology (IPCC 2006). This methodology includes a combined approach to the use of the default and national emission factors, i.e. lower thermoelectric power and specific carbon emissions in fossil fuels. An oxidation factor of one was used for the entire time series. The emission factors of fossil fuels and the type of biomass used are given in the tables below.

Table 12 Lower heating value and carbon contents of fuels and non-energy oil derivatives

Fossil fuel	Lower heating value	Unit
Brown coal	16.75	MJ/kg
Lignite	9.21	MJ/kg
Wood and wood waste	9.17	MJ/m^3
Charcoal	35	MJ/kg
Other solid biomass	12.05	MJ/kg
Liquified natural gas	44.00	MJ/MJ
Liquified petroleum gas	46.89	MJ/kg
Motor gasoline	44.59	MJ/kg
Jet kerosene	43.96	MJ/kg
Diesel fuel	42.71	MJ/kg
Fuel oil	42.71	MJ/kg
Fuel oil – fuel oil, S <1%	40.19	MJ/kg
Fuel oil – fuel oil, S ≥ 1%	40.19	MJ/kg
Lubricants	33.50	MJ/kg
Bitumen	33.50	MJ/kg
Petrol coke	31.00	MJ/kg
Other petroleum products	40.19	MJ/kg

Table 13 National CO_2 emission factors for fossil fuels

Fossil Fuel	CO_2 Emission Factor (kg/TJ)
Dark coal	94,145

Lignite	99,176
Wood and wood waste	107,440
Liquified petroleum gas	630,366
Motor gasoline	69,300
Jet fuel	71,500
Diesel fuel	74,066
Fuel oil	77,366
Petrol coke	98,817

Source: MONSTAT Statistics Office and the Environmental and Environmental Protection Agency

Table 14 Default CO_2 emission factors for fuels

Fossil fuel	CO_2 emission factor (kg/TJ)
Wood and wood waste	107,440
Charcoal	112,000
Other solid biomass	100,000
Jet kerosene	70,785

To calculate the N_2O and CH_4 emissions, the default emissions factors from the IPCC methodology were used.

Table 15 CH_4 and N_2O emissions factors

Subsector	Fossil fuel	CH_4 emission factor (kg/TJ)	N_2O emission factor (kg/TJ)
1A1a – Energy and heat production	Brown coal	10	1.5
	Lignite	10	1.5
1A2 – Manufacturing industries and construction	Wood and wood waste	30	4
	Liquified petroleum gas	3	0.1
	Diesel oil	3	0.6
	Motor gasoline	3	0.6
	Light distillate oil	3	0.6
	Petroleum coke	3	0.6
	Other solid biomass	30	4
	Charcoal	200	4
1A3ai – International aviation (international bunkers)	Jet kerosene	0.5	2
1A3aii – Domestic aviation			
1A3b – Road transportation	Motor gasoline		

		33	3.2
	Diesel oil	3.9	3.9
	Liquified petroleum gas (LPG)	62	0.2
1A3c – Railways	Diesel oil	4.15	28.6
1A3di – Domestic water-borne navigation	Motor gasoline	7	2
	Diesel oil	7	2
	Light distillate oil	7	2
1A4cii – Off-road vehicles and other machinery	Motor gasoline	10	0.6
	Diesel oil	10	0.6
	Light distillate oil	10	0.6
1A4ci – Stationary	Light distillate oil	10	0.6
1A4b – Residential	Light distillate oil	10	0.6
	LPG	5	0.1
	Brown coal	300	1.5
	Lignite	300	1.5
	Other solid biomass	30	4
	Charcoal	300	4
1A4a – Commercial/ institutional	Light distillate oil	10	0.6
	LPG	5	0.1
	Lignite	10	1.5
	Other solid biomass	30	4
	Charcoal	300	4
	Wood and wood waste	300	4
1A5biii – Mobile (other)	Diesel oil	7	2

Table 16 Emission factors for CH_4 – Fugitive emissions

Subsector Fugitive emissions	CH_4 emission factor (m^3/t)	N_2O emission factor (kg/TJ)
1B1ai1 – Coal mining – underground mines	18	-
1B1ai2 – Post-mining seam gas emissions	2.5	-
1B1aii1 – Coal mining – surface mines	1.2	-
1B1aii2 – Post-mining seam gas emissions	0.1	-

Table 17 GHG Emission factor TIER 1 for CRT category International Bunkers - International Navigation

Fuel type	Fuel	CO2 (kg/TJ)		CH4 (kg/TJ)		N2O (kg/TJ)	
		EF	type	EF	type	EF	type
liquid	Gas/diesel oil	74,100	D	7	D	2	D
Source	2006 IPCC Guidelines Vol. 2, Chap. 3 (3.5.1.2) Table 3.5.2 CO2 EF and Table 3.5.3 NON-CO2 EF						
Note:							
D Default	CS Country specific		PS Plant specific		IEF Implied emission factor		

3.2 Greenhouse gas emissions by gases

3.2.1 Total CO2eq emissions

This section describes total GHG emissions expressed as carbon dioxide equivalents (CO_2eq). GHG emissions are expressed as CO_2eq in line with the guidance provided in the Intergovernmental Panel for Climate Change - Fourth Assessment Report (IPCC AR4).

Table 18 Conversion factors

	CO2	CH4	N2O	CF4	C2F6	SF6	HFC-23
CO2eq	1	25	298	7,390	12,200	22,800	14,800
	HFC-125	HFC-134	HFC-134a	HFC-152a	HFC-227ea	HFC-236fa	HFC-4310mee
CO2eq	3,500	1,430	4,470	124	3,220	63,009,810	1,640

Table 19 National total GHG emissions by gases with LULUCF: 1990-2022

GHG emissions with LULUCF	TOTAL GHG (excluding CO_2 biomass)	CO_2 (excluding biomass)	CH_4	N_2O	SF_6	HFC	PFC	NF_3	MEMO ITEM CO_2 from biomass
	kt CO_2 eq	kt	kt CO_2 equivalent (CO_2 eq)						kt
1990	3 511.51	1 283.34	774.84	107.66	5.19	NA	1 340.48	NO	0.80
1991	3 621.23	935.37	778.03	106.15	5.19	0.01	1 796.49	NO	0.68

1992	2 631.48	655.84	750.49	100.41	5.19	0.11	1 119.45	NO	0.74
1993	738.67	-504.88	734.95	94.38	5.19	0.31	408.72	NO	0.82
1994	804.95	-122.63	745.25	94.24	5.19	0.81	82.10	NO	0.56
1995	575.94	-602.59	763.24	98.44	5.19	1.37	310.30	NO	0.64
1996	1 930.48	252.98	773.74	104.36	5.19	2.07	792.14	NO	0.61
1997	1 537.00	-554.41	762.01	101.74	5.19	2.88	1 219.58	NO	0.55
1998	1 462.77	-307.05	765.30	105.62	5.19	3.80	889.92	NO	0.50
1999	1 798.97	-15.09	769.23	104.08	5.19	4.78	930.78	NO	0.52
2000	2 407.16	277.07	781.49	113.09	5.19	5.77	1 224.54	NO	0.54
2001	1 758.98	-373.34	752.58	102.05	5.19	6.76	1 265.73	NO	0.46
2002	2 020.31	-78.02	771.49	104.74	5.19	9.43	1 207.48	NO	0.66
2003	1 731.73	-161.23	781.89	105.71	5.19	10.38	989.78	NO	0.68
2004	1 732.84	-37.66	770.74	107.18	5.19	11.33	876.05	NO	0.70
2005	1 504.10	-33.31	656.30	81.55	5.19	12.56	781.75	NE	0.67
2006	2 139.54	529.85	638.75	79.69	5.19	15.03	870.87	NE	0.69
2007	1 782.24	28.19	667.16	98.64	5.19	18.48	964.30	NE	0.72
2008	2 542.31	697.11	635.13	79.98	5.19	22.72	1 101.74	NE	0.71
2009	250.06	-769.72	611.25	69.54	5.19	27.56	305.63	NE	0.75
2010	1 570.01	397.61	612.38	73.97	5.19	32.96	447.09	NE	0.75
2011	1 795.39	497.13	739.03	133.87	5.19	38.72	380.44	NE	4.12
2012	1 103.84	170.07	606.42	74.95	5.19	45.24	200.72	NE	4.13
2013	941.41	104.50	602.63	68.77	5.19	54.95	103.76	NE	4.09
2014	997.18	163.43	613.23	70.56	5.19	64.91	77.88	NE	4.07
2015	1 367.39	531.45	614.84	76.27	5.19	72.73	64.69	NE	4.13
2016	922.24	122.99	598.31	73.64	5.19	78.71	40.99	NE	4.13
2017	1 110.43	215.22	651.66	100.60	5.19	93.97	40.59	NE	4.17
2018	1 056.21	235.23	601.00	75.99	5.19	101.58	33.56	NE	4.13
2019	1 034.39	212.03	590.85	72.76	5.19	119.68	30.60	NE	4.15
2020	1 056.87	202.91	595.94	74.48	5.19	141.61	31.92	NE	4.16
2021	908.34	45.95	610.20	92.34	5.19	133.48	17.89	NE	5.16
2022	1008.36	212.13	575.76	74.88	5.19	135.50	1.66	NE	5.40
Trend									
1990 - 2022	*-71.3%*	*-143.3%*	*-25.7%*	*-30.4%*	*0%*	*NA*	*-100%*	*NA*	*574.9%*

2005 - 2022	*-33.0%*	*274.5%*	*- 12.3%*	*-8.2%*	*0%*	*979%*	*-100%*	*NA*	*704.8%*
2021 - 2022	*11.0%*	*128.8%*	*-5.6%*	*- 18.9%*	*0%*	*2%*	*-91%*	*NA*	*4.6%*

Table 20 shows the total GHG emissions, expressed as kt CO_2eq for the period 1990–2022. **Table 21** provides the GHG emissions breakdown by sector.

Table 20 National total GHG emissions (with and without LULUCF) and net emissions/removal from LULU

GHG emissions	Total GHG emissions without LULUCF	Total GHG emissions with LULUCF	GHG emissions and removals from LULUCF
	kt CO_2 equivalent		
1990	4 793.16	3 511.51	-1 281.65
1991	5 280.17	3 621.23	-1 658.94
1992	3 875.95	2 631.48	-1 244.47
1993	2 759.08	738.67	-2 020.41
1994	2 268.13	804.95	-1 463.17
1995	1 925.69	575.94	-1 349.75
1996	3 516.91	1 930.48	-1 586.44
1997	3 934.30	1 537.00	-2 397.30
1998	4 006.34	1 462.77	-2 543.57
1999	4 228.59	1 798.97	-2 429.62
2000	4 472.30	2 407.16	-2 065.14
2001	4 162.98	1 758.98	-2 404.00
2002	4 617.16	2 020.31	-2 596.85
2003	4 317.42	1 731.73	-2 585.69
2004	4 244.35	1 732.84	-2 511.51
2005	3 746.96	1 504.10	-2 242.86
2006	4 005.74	2 139.54	-1 866.20
2007	4 021.76	1 782.24	-2 239.52
2008	4 730.63	2 542.31	-2 188.33
2009	2 914.25	250.06	-2 664.19
2010	3 915.16	1 570.01	-2 345.15
2011	3 801.77	1 795.39	-2 006.38
2012	3 380.39	1 103.84	-2 276.56
2013	3 216.03	941.41	-2 274.61
2014	3 171.81	997.18	-2 174.63

2015	3 294.64	1 367.39	-1 927.25
2016	3 047.23	922.24	-2 124.99
2017	3 180.31	1 110.43	-2 069.88
2018	3 406.12	1 056.21	-2 349.92
2019	3 504.55	1 034.39	-2 470.16
2020	3 451.35	1 056.87	-2 394.48
2021	3 442.02	908.34	-2 533.68
2022	3 470.94	1 008.36	-2 462.58
Trend			
1990 - 2022	-27.6%	-71.3%	92.1%
2005 - 2022	-7.4%	-33.0%	9.8%
2021 - 2022	0.8%	11.0%	-2.8%

Table 21 National GHG Emissions by sector from 1990 - 2022

GHG emissions (With LULUCF)	TOTAL GHG (with LULUCF)	1 Energy	2 IPPU	3 Agriculture	4 Land Use, Land Use Change and Forestry (LULUCF)	5 Waste	6 Other
kt CO2 equivalent							
1990	3 511.51	2 386.90	1 555.86	610.32	-1 281.65	240.07	NO
1991	3 621.23	2 422.46	2 004.52	607.90	-1 658.94	245.30	NO
1992	2 631.48	1 759.24	1 295.44	570.34	-1 244.47	250.93	NO
1993	738.67	1 460.91	494.23	548.28	-2 020.41	255.66	NO
1994	804.95	1 331.42	118.48	558.11	-1 463.17	260.11	NO
1995	575.94	711.17	370.95	576.67	-1 349.75	266.89	NO
1996	1 930.48	1 772.78	895.38	575.08	-1 586.44	273.68	NO
1997	1 537.00	1 722.51	1 373.26	557.76	-2 397.30	280.76	NO
1998	1 462.77	2 133.03	1 038.78	547.03	-2 543.57	287.50	NO
1999	1 798.97	2 304.56	1 083.31	546.78	-2 429.62	293.95	NO

2000	2 407.16	2 237.67	1 400.51	533.22	-2 065.14	300.90	NO
2001	1 758.98	1 866.09	1 469.28	520.36	-2 404.00	307.25	NO
2002	2 020.31	2 349.15	1 423.50	530.85	-2 596.85	313.65	NO
2003	1 731.73	2 266.79	1 208.56	523.59	-2 585.69	318.48	NO
2004	1 732.84	2 295.00	1 105.89	520.33	-2 511.51	323.14	NO
2005	1 504.10	2 028.79	1 006.08	386.03	-2 242.86	326.06	NO
2006	2 139.54	2 209.36	1 106.36	360.80	-1 866.20	329.22	NO
2007	1 782.24	2 144.71	1 207.49	335.21	-2 239.52	334.35	NO
2008	2 542.31	2 727.53	1 333.02	328.99	-2 188.33	341.10	NO
2009	250.06	1 801.86	453.26	313.76	-2 664.19	345.37	NO
2010	1 570.01	2 639.71	623.83	302.06	-2 345.15	349.56	NO
2011	1 795.39	2 570.17	583.82	293.92	-2 006.38	353.86	NO
2012	1 103.84	2 375.21	374.10	281.78	-2 276.56	349.30	NO
2013	941.41	2 325.29	247.37	293.73	-2 274.61	349.64	NO
2014	997.18	2 290.30	224.85	308.27	-2 174.63	348.39	NO
2015	1 367.39	2 423.49	221.07	303.95	-1 927.25	346.13	NO
2016	922.24	2 210.29	194.70	294.44	-2 124.99	347.80	NO
2017	1 110.43	2 323.28	215.44	295.31	-2 069.88	346.28	NO
2018	1 056.21	2 553.74	217.82	285.60	-2 349.92	348.96	NO
2019	1 034.39	2 648.55	226.55	278.70	-2 470.16	350.74	NO
2020	1 056.87	2 576.22	251.76	268.87	-2 394.48	354.50	NO
2021	908.34	2 614.52	221.97	250.97	-2 533.68	354.55	NO

2022	1 008.36	2 710.95	153.03	250.79	-2 462.58	356.17	NO
Trend							
1990 - 2022	-71.3%	13.6%	-90.2%	-58.9%	92.1%	48.4%	NA
2005 - 2022	-33.0%	33.6%	-84.8%	-35.0%	9.8%	9.2%	NA
2021 - 2022	11.0%	3.7%	-31.1%	-0.1%	-2.8%	0.5%	NA

Figure 11, **Figure 12** and **Figure 13** show the net GHG emissions expressed as CO_2eq over the period 1990–2022.

In 2022 Montenegro's total GHG emissions (with LULUCF) amounted to 1,008.36 kt CO2 equivalents (CO_2eq). Compared to 1990 GHG emissions decreased by -71.3%, compared to 2005 GHG emissions increased by -33.0%, compared to 2021 GHG emissions increased by 11.0%.

In 2005 total GHG emissions (with LULUCF) amounted to 1,504.10 kt CO_2eq and in 1990 total GHG emissions (with LULUCF) amounted to 3 511.51kt CO2eq.

The sector LULUCF is an important sector in Montenegro due to its significant removals. In 2022, the net emissions and removals of the sector LULUCF are with -2,462.58 kt CO_2 equivalent almost equal to the emissions of the sector Energy (2,710.95 kt CO_2 equivalent). In 2005, the emissions and removals of the sector LULUCF are with -2,242.86 kt CO_2 equivalent almost equal to the emissions of the sector Energy (2,028.79 kt CO_2 equivalent). In 1990, the emissions and removals of the sector LULUCF are with -1,281.65 kt CO_2 equivalent.

The net removal and the related land use has been rather stable, with only a small proportion of the total territory undergoing land use change. Nevertheless, considerable dynamics in Forest land remaining Forest land have resulted the long-term trend as well as significant inter-annual variability. These fluctuations are primarily due to changes in total drain due to timber harvest and biomass losses due to forest fires.

Figure 11 National total GHG emissions by sector 1990-2022

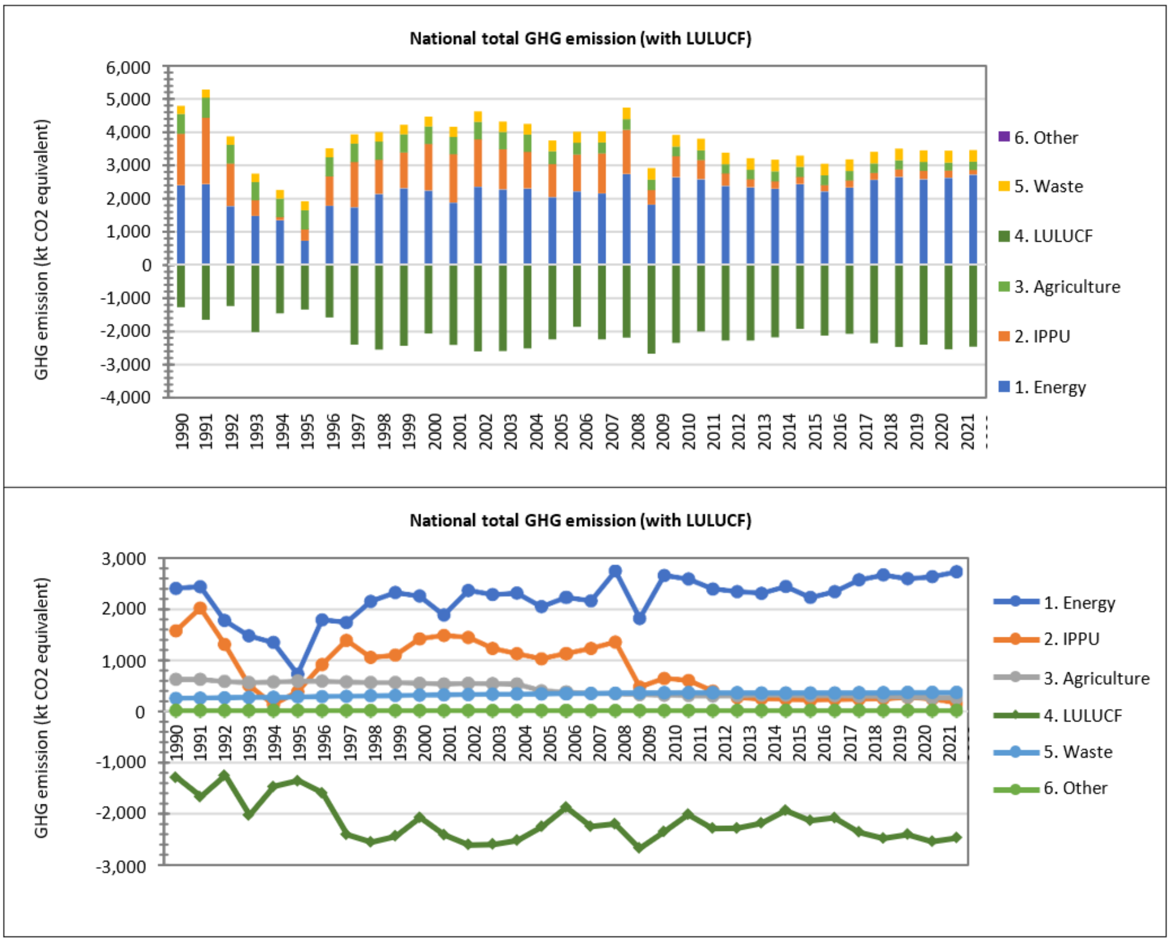


Figure 12 Trend of national total GHG emissions (with LULUCF): 1990 – 2022

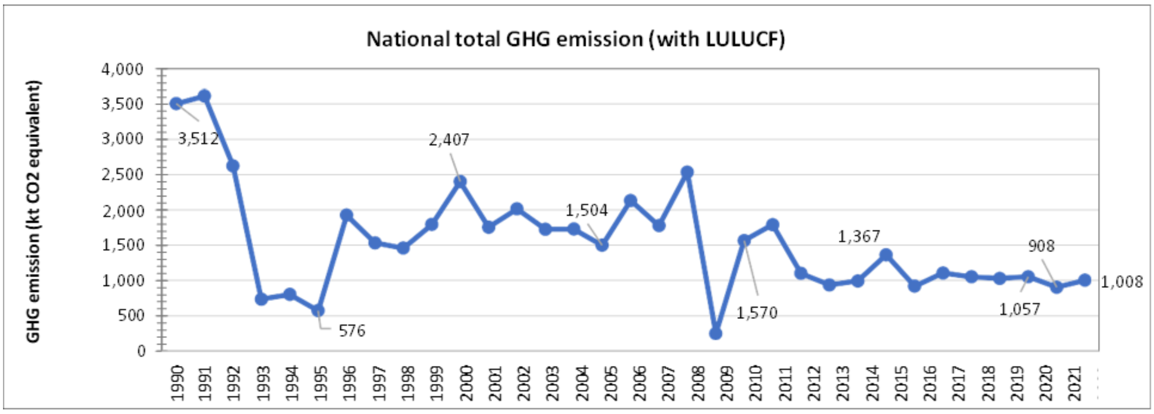
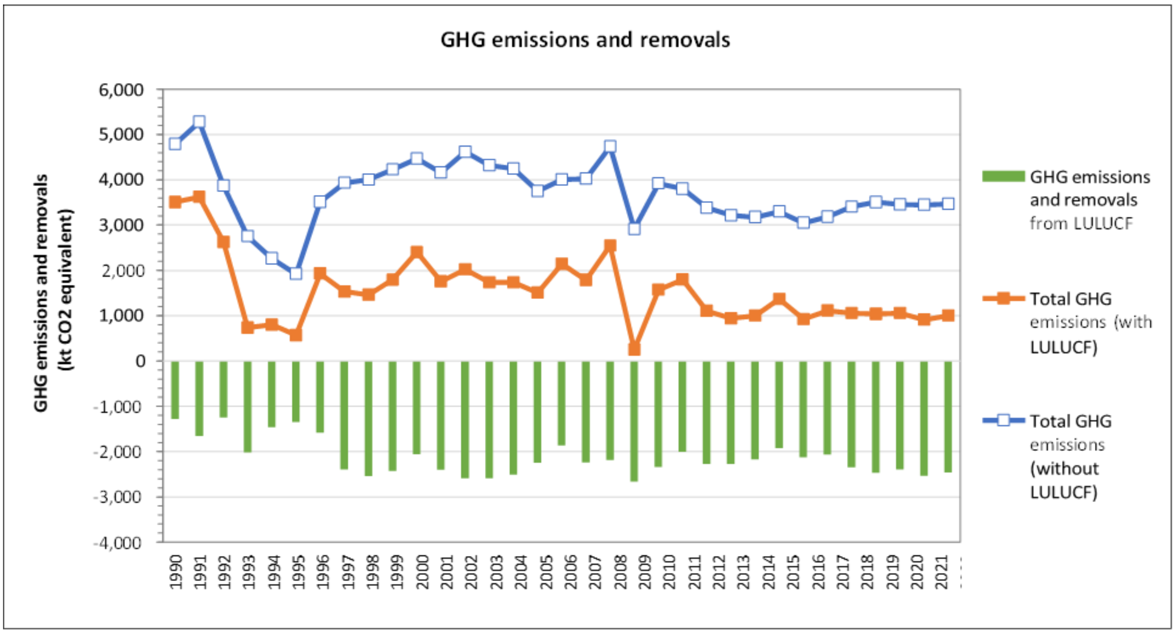


Figure 13 Trend of national total GHG emissions and net emissions/removal from LULUCF

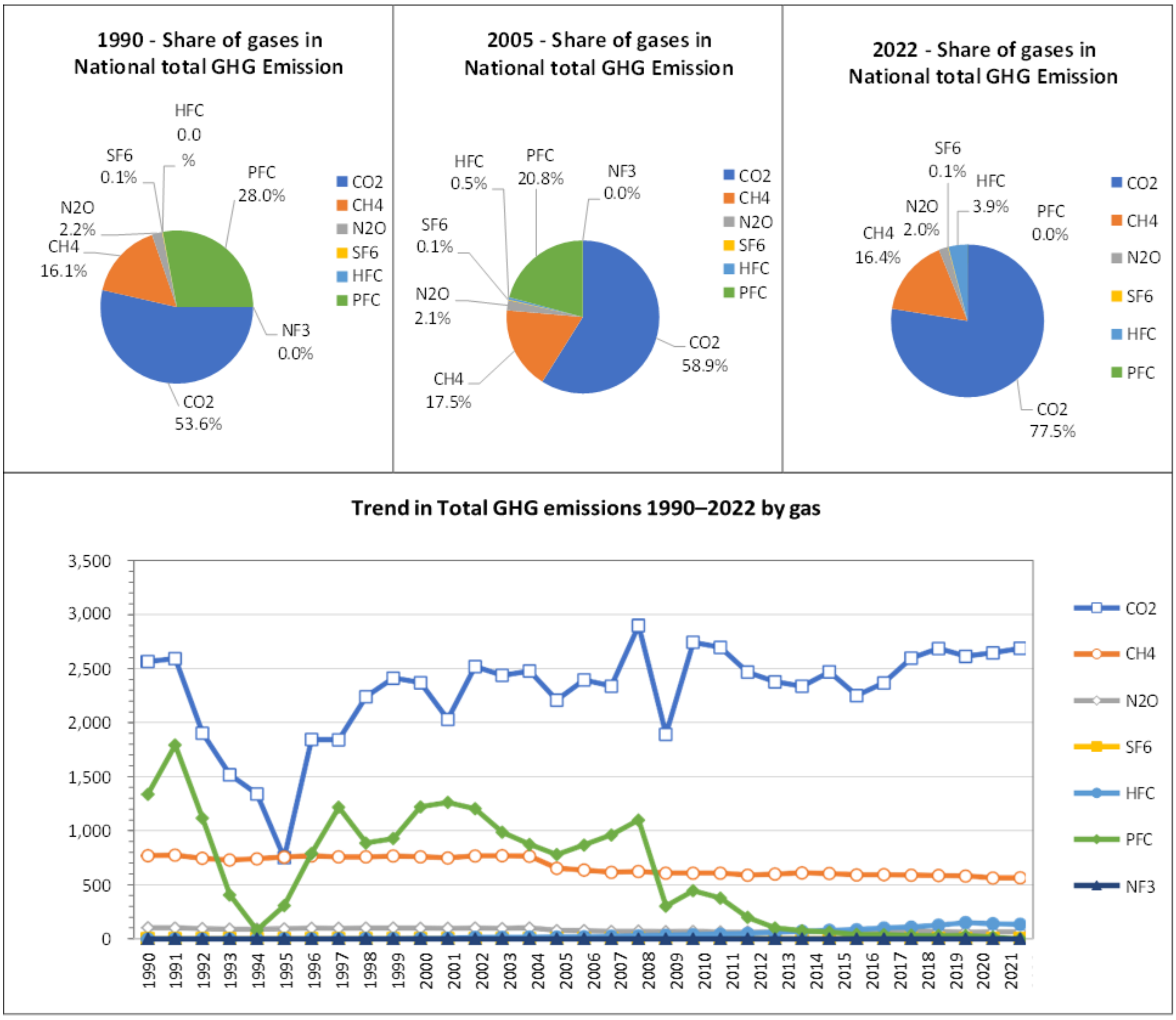


In 2022, the most important GHG (without LULUCF) in Montenegro is CO_2 with a share of 77.5%. The CO_2 emissions primarily result from combustion activities, here mainly in the coal-fired power plant, but also from road transport. CH_4 emissions, which mainly arises from livestock farming and waste disposal, contributes 16.3% to total national GHG emissions; N_2O emissions, with agricultural soils and other sector (households) as the main source, contributes 2.0% in 2022. The remaining 4.1% are emissions of fluorinated compounds, which are mostly emitted from the use of HFC as substitutes for ODS in refrigeration equipment.

Also in 2005, the most important GHG (without LULUCF) in Montenegro was CO_2 with a share of 59.0%. CH_4 emissions contributed 17.5% to total national GHG emissions; N_2O emissions contributes 2.1% in 2005. The remaining 21.3% are emissions of fluorinated compounds.

In 1990, the most important GHG (without LULUCF) in Montenegro was CO_2 with a share of 53.6%. The CO_2 emissions primarily result from combustion activities, here mainly in the coal-fired power plant. CH_4 emissions contributed 16.1% to total national GHG emissions; N_2O emissions, with agricultural soils and other sector (households) as the main source, contributes 2.2% in 1990. The remaining 28.1% are emissions of fluorinated compounds, which are mostly emitted from the use of PFC in aluminium production.

Figure 14 Trend and share of National total GHG emissions (without LULUCF) by greenhouse gas



3.2.2 Total CO2 emissions

Table 22 shows the total CO_2 emissions.

Table 22 National CO_2 Emissions (with LULUCF) by CRT sector from 1990 - 2022

CO2 emissions (with LULUCF)	TOTAL CO2 (with LULUCF)	1 Energy	2 IPPU	3 Agriculture	4 Land use LULUCF	5 Waste	6 Other
kt							
1990	1 283.34	2,358.42	210.13	0.49	-1,285.70	NE	NO
1991	935.37	2,393.60	202.78	0.49	-1,661.49	NE	NO

1992	655.84	1,735.58	170.65	0.48	-1,250.88	NE	NO
1993	-504.88	1,441.09	79.98	0.48	-2,026.44	NE	NO
1994	-122.63	1,313.14	30.35	0.49	-1,466.60	NE	NO
1995	-602.59	698.77	54.07	0.48	-1,355.92	NE	NO
1996	252.98	1,749.71	95.95	0.48	-1,593.16	NE	NO
1997	-554.41	1,699.53	145.58	0.48	-2,400.00	NE	NO
1998	-307.05	2,103.63	139.83	0.47	-2,550.99	NE	NO
1999	-15.09	2,273.23	142.53	0.47	-2,431.32	NE	NO
2000	277.07	2,207.74	164.98	0.47	-2,096.12	NE	NO
2001	-373.34	1,841.72	191.56	0.46	-2,407.08	NE	NO
2002	-78.02	2,319.77	201.38	0.46	-2,599.63	NE	NO
2003	-161.23	2,237.87	203.19	0.45	-2,602.75	NE	NO
2004	-37.66	2,266.80	213.26	0.44	-2,518.16	NE	NO
2005	-33.31	2,004.22	206.49	0.43	-2,244.46	NE	NO
2006	529.85	2,182.58	215.08	0.42	-1,868.23	NE	NO
2007	28.19	2,122.05	219.20	0.42	-2,313.47	NE	NO
2008	697.11	2,697.87	202.88	0.42	-2,204.05	NE	NO
2009	-769.72	1,781.55	114.25	0.42	-2,665.93	NE	NO
2010	397.61	2,608.79	137.77	0.41	-2,349.36	NE	NO
2011	497.13	2,540.75	158.45	0.40	-2,202.46	NE	NO
2012	170.07	2,348.18	121.70	0.32	-2,300.13	NE	NO
2013	104.50	2,299.25	81.84	0.38	-2,276.98	NE	NO
2014	163.43	2,264.83	74.88	0.38	-2,176.66	NE	NO
2015	531.45	2,396.37	76.23	0.38	-1,941.54	NE	NO
2016	122.99	2,186.56	67.39	0.38	-2,131.33	NE	NO
2017	215.22	2,298.56	72.47	0.37	-2,156.18	NE	NO
2018	235.23	2,526.69	73.82	0.37	-2,365.65	NE	NO
2019	212.03	2,620.94	67.80	0.37	-2,477.08	NE	NO
2020	202.91	2,549.62	68.20	0.37	-2,415.29	NE	NO
2021	45.95	2,587.49	62.13	0.37	-2,604.04	NE	NO
2022	212.13	2,682.34	7.44	0.41	-2,478.06	NE	NO
Trend							
1990 - 2022	-143.3%	13.7%	-96.5%	-15.5%	92.7%	NA	NA
2005 - 2022	274.5%	33.8%	-96.4%	-4.4%	10.4%	NA	NA
2021 - 2022	128.8%	3.7%	-88.0%	11.7%	-4.8%	NA	NA

3.2.3 Total CH4 emissions

Table 23 shows the total CH_4 emissions.

Table 23 National CH4 Emissions (with LULUCF) by CRT sector from 1990 - 2022

CH4 emissions (with LULUCF)	TOTAL CH4 (with LULUCF)	1 Energy	2 IPPU	3 Agriculture	4 Land use, LULUCF	5 Waste	6 Other
kt							
1990	27.67	0.62	0.0021	18.79	0.067	8.19	NO
1991	27.79	0.63	0.0020	18.74	0.032	8.38	NO
1992	26.80	0.55	0.0014	17.58	0.122	8.55	NO
1993	26.25	0.46	0.0012	16.94	0.113	8.73	NO
1994	26.62	0.41	0.0011	17.23	0.052	8.91	NO
1995	27.26	0.28	0.0009	17.73	0.117	9.13	NO
1996	27.63	0.49	0.0010	17.65	0.130	9.36	NO
1997	27.21	0.48	0.0013	17.08	0.035	9.62	NO
1998	27.33	0.60	0.0014	16.72	0.146	9.87	NO
1999	27.47	0.60	0.0009	16.74	0.012	10.12	NO
2000	27.91	0.59	0.0008	16.22	0.698	10.39	NO
2001	26.88	0.47	0.0011	15.73	0.044	10.63	NO
2002	27.55	0.61	0.0008	16.06	0.037	10.84	NO
2003	27.92	0.57	0.0006	15.95	0.372	11.03	NO
2004	27.53	0.55	0.0015	15.67	0.128	11.18	NO
2005	23.44	0.47	0.0010	11.67	0.010	11.29	NO
2006	22.81	0.52	0.0016	10.88	0.020	11.39	NO
2007	23.83	0.44	0.0017	10.13	1.704	11.55	NO
2008	22.68	0.58	0.0020	9.98	0.338	11.78	NO
2009	21.83	0.37	0.0010	9.53	0.008	11.93	NO
2010	21.87	0.63	0.0005	9.11	0.065	12.07	NO
2011	26.39	0.62	0.0006	9.01	4.561	12.21	NO
2012	21.66	0.56	0.0003	8.53	0.515	12.05	NO
2013	21.52	0.53	0.0002	8.92	0.016	12.05	NO
2014	21.90	0.53	0.0001	9.35	0.006	12.02	NO
2015	21.96	0.56	0.0004	9.18	0.291	11.93	NO

2016	21.37	0.46	0.0005	8.83	0.102	11.97	NO
2017	23.27	0.47	0.0005	8.91	1.974	11.92	NO
2018	21.46	0.51	0.0005	8.63	0.318	12.01	NO
2019	21.10	0.51	0.0002	8.41	0.109	12.07	NO
2020	21.28	0.51	0.0003	8.14	0.432	12.20	NO
2021	21.79	0.49	<0.0001	7.52	1.59	12.19	NO
2022	20.56	0.53	NO	7.48	0.30	12.24	NO
Trend							
1990 - 2022	*-25.7%*	*-13.7%*	*NA*	*-60.2%*	*351.6%*	*49.4%*	*NA*
2005 - 2022	*-12.3%*	*14.1%*	*NA*	*-35.9%*	*3056.8%*	*8.4%*	*NA*
2021 - 2022	*-5.6%*	*8.3%*	*NA*	*-0.5%*	*-81.0%*	*0.5%*	*NA*

3.2.4 Total N2O emissions

Table 24Error! Reference source not found. shows total N_2O emissions.

Table 24 National N2O Emissions (with LULUCF) by CRT sector from 1990 - 2022

N_2O emissions (with LULUCF)	TOTAL CH4 (with LULUCF)	1 Energy	2 IPPU	3 Agriculture	4 Land use, LULUCF	5 Waste	6 Other
kt							
1990	0.41	0.04	NE	0.315	0.008	0.04	NO
1991	0.40	0.04	NE	0.312	0.006	0.04	NO
1992	0.38	0.03	NE	0.293	0.011	0.04	NO
1993	0.36	0.03	NE	0.277	0.011	0.04	NO
1994	0.36	0.03	NE	0.283	0.007	0.04	NO
1995	0.37	0.02	NE	0.301	0.011	0.04	NO
1996	0.39	0.04	NE	0.304	0.012	0.04	NO
1997	0.38	0.04	NE	0.298	0.006	0.04	NO
1998	0.40	0.05	NE	0.296	0.013	0.04	NO
1999	0.39	0.05	NE	0.293	0.005	0.04	NO
2000	0.43	0.05	NE	0.296	0.043	0.04	NO
2001	0.39	0.04	NE	0.299	0.007	0.04	NO
2002	0.40	0.05	NE	0.305	0.007	0.04	NO
2003	0.40	0.05	NE	0.289	0.025	0.04	NO
2004	0.40	0.05	NE	0.306	0.012	0.04	NO

2005	0.31	0.04	NE	0.222	0.005	0.04	NO
2006	0.30	0.05	NE	0.210	0.006	0.04	NO
2007	0.37	0.04	NE	0.193	0.099	0.04	NO
2008	0.30	0.05	NE	0.185	0.024	0.04	NO
2009	0.26	0.04	NE	0.176	0.006	0.04	NO
2010	0.28	0.05	NE	0.176	0.009	0.04	NO
2011	0.51	0.05	NE	0.156	0.258	0.05	NO
2012	0.28	0.04	NE	0.161	0.034	0.04	NO
2013	0.26	0.04	NE	0.165	0.007	0.05	NO
2014	0.27	0.04	NE	0.174	0.007	0.04	NO
2015	0.29	0.04	NE	0.176	0.023	0.05	NO
2016	0.28	0.04	NE	0.176	0.013	0.05	NO
2017	0.38	0.04	NE	0.172	0.117	0.05	NO
2018	0.29	0.05	NE	0.165	0.026	0.05	NO
2019	0.27	0.05	NE	0.161	0.015	0.05	NO
2020	0.28	0.05	NE	0.153	0.033	0.05	NO
2021	0.35	0.05	NE	0.151	0.097	0.05	NO
2022	0.28	0.05	NE	0.150	0.026	0.05	NO
Trend							
1990 - 2022	*-30.4%*	*22.2%*	*NA*	*-51.2%*	*222.0%*	*25.1%*	*NA*
2005 - 2022	*-8.2%*	*19.2%*	*NA*	*-30.6%*	*425.2%*	*35.2%*	*NA*
2021 - 2022	*-18.9%*	*3.3%*	*NA*	*2.2%*	*-72.9%*	*0.0%*	*NA*

3.2.5 Total PFC, SF6 and HFC emissions

Table 25 National SF6, HFC and PFC Emissions (without LULUCF) from 1990 - 2022

F-gas emissions	TOTAL F-gases	TOTAL SF6	TOTAL HFC	TOTAL PFC
	kt $_{CO2\ equivalent}$			
1990	1,345.67	5.19	NA	1 340.48
1991	1,801.68	5.19	0.01	1 796.49
1992	1,124.75	5.19	0.11	1 119.45
1993	414.22	5.19	0.31	408.72
1994	88.09	5.19	0.81	82.10
1995	316.85	5.19	1.37	310.30
1996	799.40	5.19	2.07	792.14
1997	1,227.65	5.19	2.88	1 219.58

1998	898.91	5.19	3.80	889.92
1999	940.75	5.19	4.78	930.78
2000	1,235.51	5.19	5.77	1 224.54
2001	1,277.69	5.19	6.76	1 265.73
2002	1,222.10	5.19	9.43	1 207.48
2003	1,005.35	5.19	10.38	989.78
2004	892.58	5.19	11.33	876.05
2005	799.56	5.19	12.62	781.75
2006	891.24	5.19	15.18	870.87
2007	988.24	5.19	18.76	964.30
2008	1,130.08	5.19	23.15	1 101.74
2009	338.98	5.19	28.16	305.63
2010	486.04	5.19	33.76	447.09
2011	425.36	5.19	39.73	380.44
2012	252.39	5.19	46.48	200.72
2013	165.52	5.19	56.57	103.76
2014	149.96	5.19	66.89	77.88
2015	144.83	5.19	74.95	64.69
2016	127.30	5.19	81.12	40.99
2017	142.96	5.19	97.18	40.59
2018	143.99	5.19	105.24	33.56
2019	158.75	5.19	122.96	30.60
2020	183.54	5.19	146.44	31.92
2021	159.85	5.19	136.77	17.89
2022	145.59	5.19	138.74	1.66
Trend				
1990 - 2022	-89.2%	0%	NA	-99.9%
2005 - 2022	-81.8%	0%	999.2%	-99.8%
2021 - 2022	-8.9%	0%	1.4%	-90.7%

3.3 Analysis of key categories and inventory completeness

The analysis of key sources and completeness of the inventory was done on the basis of the IPCC methodology, using the Tier-1 approach – Trend assessment and Tier-2 approach – Level assessment. **Table 26** and **Table 27** give an assessment of the trends for key emission sources for 1990 and 2022 and the levels of key categories for 2022.

Table 26 Trend Assessment: Key categories without LULUCF 1990-2022

Trend Assessment		GHG	Base Year (1990) Estimate $E_{x,0}$	Latest Year (2022) Estimate $E_{x,t}$	Trend Assessment $L_{x,t}$	% Contribution to the trend	Cumulative Total of $L_{x,t}$
CRT Code	CRT Category		Gg CO_2-equivalent		$L_{x,t}$		
2 C 3	Aluminium production	PFC	1,340	2	195.886	92.3%	92.3%
1 A 2 b liquid	Non-ferrous metals	CO2	113	0	9.758	4.6%	96.9%

Table 27 Trend Assessment: Key categories including LULUCF 1990-2022

Trend Assessment		GHG	Base Year (1990) Estimate $E_{x,0}$	Latest Year (2022) Estimate $E_{x,t}$	Trend Assessment $L_{x,t}$	% Contribution to the trend	Cumulative Total of $L_{x,t}$
CRT category Code	CRT Category		Gg CO_2-equivalent		$L_{x,t}$		
2 C 3	Aluminium production	PFC	1,340	2	572.77	96.3%	96.3%

3.4 Greenhouse gas emissions by sector

3.4.1 Energy sector

In the Energy Sector, emissions originating from, fuel combustion activities in road traffic, in the energy and manufacturing industry and in the commercial, agricultural and residential sector (Category 1.A) as well as fugitive emissions from fuels (Category 1.B) are considered.

Box 1 Data sources for the estimation of the GHG emissions inventory for the energy sector

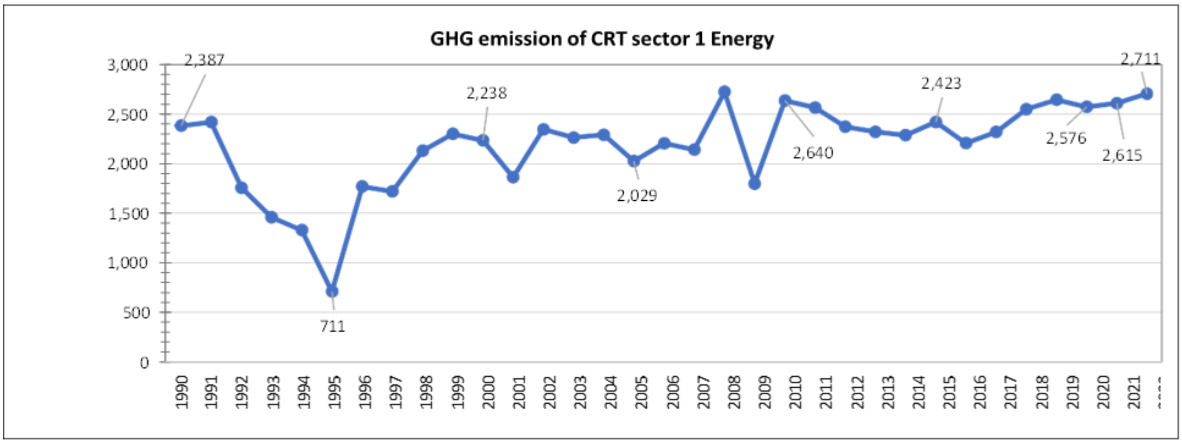
Data related to the consumption, import, and distribution of fuels in Montenegro is reported by the National Statistics Office – MONSTAT. The data is processed and systematized as an energy balance, which is the basis for calculating GHG emissions from the energy sector. Data on consumption fuels was used from the Joint Questionnaire from MONSTAT. Recalculation of estimates for the whole period between 1990 – 2017 was made. According to the expert recommendation, an oxidation factor of 0.98 was used in the estimation. For most of the liquid fuels distributed and consumed in Montenegro, MONSTAT provided information on lower calorific values that are close to the recommended values from the IPCCC 2006 methodology. For lignite, a lower calorific value was used in accordance with the IPCC 2006 recommendations. For verification of the inventory, the records of fossil fuel consumption in large industrial facilities were used, which were made available to the Environment Protection Agency (EPA).

In 2022, greenhouse gas emissions from CRT sector 1 Energy amounted to 2,710.95 kt CO_2 equivalents which corresponds to 74.6% of the total national emissions (without LULUCF). 99.55% of the emissions from this sector originate from fuel combustion (1.A) while fugitive emissions from fuels (1.B) contribute with about 0.5%. the main subcategories within 1.A fuel combustion are 1.A.1. Energy industries and 1.A.3. Transport (here road transport).
The overall trend in GHG emissions from the sector Energy shows increasing emissions with a increase of 13.6% from 1990 to 2022, 33.62% from 2005 to 2022, and 3.69% from 1990 to 2022. The GHG emissions disaggregated by greenhouse gas are included in Annex A4.
Fugitive emissions slightly increased by 0.8% since 1990 due to slightly increasing mining and post-mining activities. Fluctuation of emissions in CRT sector 1 Energy are due to stopped/shut-down electricity and industrial production and/or limited public life during the time of

- break-up of Yugoslavia (1992);
- overall economic downturn in the country;
- break-up of the union with Serbia (2006);
- world economic crisis (2009);
- break-down (1995) and reconstruction of the power plant (2009/2010);
- shut-down of alumina plant (2009) and shutdown of one electrolysis line (2016);
- forest and wild fires (2000, 2003, 2011, 2017);
- agricultural activities;
- growing population;
- increasing road transport;
- worldwide COVID pandemic and the lockdown.

The CRT category 1.C. Carbon capture and storage (CCS) does not exist in Montenegro.

Figure 15 Trend of GHG emissions from CRT sector 1 Energy: 1990 – 2022



Emissions trends

The estimation of direct GHG emissions from the energy sector was carried out according to the IPCC 2006 Methodology. In accordance with the available national data (lower calorific values and specific fossil carbon emissions), a combined Tier-1 and Tier-2 approach was used to estimate emissions from solid and liquid fuels in energy production (1.A.1., 1.A.4, and 1.A.2). The estimated emissions from different energy subsectors over the reporting period are shown in **Table 28**.

Table 28 GHG emissions from CRT subcategory 1 Energy by subcategories for period 1990-2022

GHG emissions	1 Energy	1.A Fuel Combustion Activities	1.A.1 Energy Industries	1.A.2 Manufacturing Industries and Construction	1.A.3 Transport	1.A.4 Other Sectors	1.A.5 Non-Specified	1.B Fugitive emissions from fuels
kt CO_2 equivalent								
1990	**2 386.90**	2 374.02	1 531.83	294.87	351.62	195.70	NE	12.88
1991	**2 422.46**	2 409.65	1 441.09	394.62	403.78	170.17	NE	12.81
1992	**1 759.24**	1 747.09	1 119.32	258.07	254.36	115.35	NE	12.14
1993	**1 460.91**	1 450.42	962.68	191.32	196.82	99.60	NE	10.49
1994	**1 331.42**	1 322.43	801.48	202.90	219.52	98.53	NE	8.99
1995	**711.17**	705.95	159.58	198.44	235.95	111.99	NE	5.22
1996	**1 772.78**	1 762.23	1 127.33	231.58	291.13	112.20	NE	10.55

1997	**1 722.51**	1 712.71	1 074.92	182.12	307.84	147.83	NE	9.80
1998	**2 133.03**	2 120.85	1 358.44	174.47	431.07	156.87	NE	12.18
1999	**2 304.56**	2 292.93	1 425.00	175.18	528.32	164.42	NE	11.63
2000	**2 237.67**	2 225.58	1 398.35	171.98	523.66	131.59	NE	12.08
2001	**1 866.09**	1 856.84	1 098.94	180.32	451.23	126.35	NE	9.25
2002	**2 349.15**	2 335.21	1 642.67	177.86	360.88	153.79	NE	13.94
2003	**2 266.79**	2 254.22	1 560.92	159.53	377.31	156.46	NE	12.58
2004	**2 295.00**	2 283.17	1 529.68	167.78	442.75	142.96	NE	11.83
2005	**2 028.79**	2 018.69	1 124.69	371.72	487.14	35.13	NE	10.10
2006	**2 209.36**	2 197.66	1 276.95	374.23	480.72	65.75	NE	11.69
2007	**2 144.71**	2 135.47	998.58	474.38	623.00	39.51	NE	9.24
2008	**2 727.53**	2 714.03	1 531.97	525.01	623.69	33.36	NE	13.49
2009	**1 801.86**	1 794.44	819.23	287.60	646.16	41.45	NE	7.42
2010	**2 639.71**	2 624.65	1 735.61	138.80	709.71	40.52	NE	15.06
2011	**2 570.17**	2 554.87	1 774.84	105.62	653.85	20.55	NE	15.30
2012	**2 375.21**	2 361.39	1 583.35	129.60	621.51	26.93	NE	13.83
2013	**2 325.29**	2 312.14	1 539.44	219.74	509.88	43.07	NE	13.16
2014	**2 290.30**	2 277.44	1 491.80	214.60	499.37	71.66	NE	12.86
2015	**2 423.49**	2 409.76	1 558.13	195.05	572.73	83.85	NE	13.73
2016	**2 210.29**	2 199.46	1 256.27	188.75	675.08	79.36	NE	10.83
2017	**2 323.28**	2 311.95	1 292.80	223.83	725.70	69.62	NE	11.33
2018	**2 553.74**	2 541.34	1 485.54	201.63	780.31	73.85	NE	12.40
2019	**2 648.55**	2 636.24	1 532.39	208.61	820.44	74.80	NE	12.31
2020	**2 576.22**	2 563.37	1 599.03	201.35	699.26	63.73	NE	12.85
2021	**2 614.52**	2 602.72	1 389.89	226.07	911.66	75.09	NE	11.80
2022	**2 710.95**	2 697.97	1 492.29	205.36	927.67	72.65	NE	12.98
Trend								
1990 - 2022	*13.6%*	*13.6%*	*-2.6%*	*-30.4%*	*163.8%*	*-62.9%*	*NA*	*0.8%*
2005 - 2022	*33.6%*	*33.6%*	*32.7%*	*-44.8%*	*90.4%*	*106.8%*	*NA*	*28.5%*
2021 - 2022	*3.7%*	*3.7%*	*7.4%*	*-9.2%*	*1.8%*	*-3.2%*	*NA*	*9.9%*

Total GHG emissions expressed as CO_2eq from the energy sector categories 1.A, 1.B and 1.C for the period from 1990 - 2022 are shown in **Figure 16**, while **Figure 17** shows CO_2eq emissions by energy subsectors.

Figure 16 Trend of GHG emissions of CRT category 1.A Fuel combustion and 1.B Fugitive emissions for the period 1990 - 2022

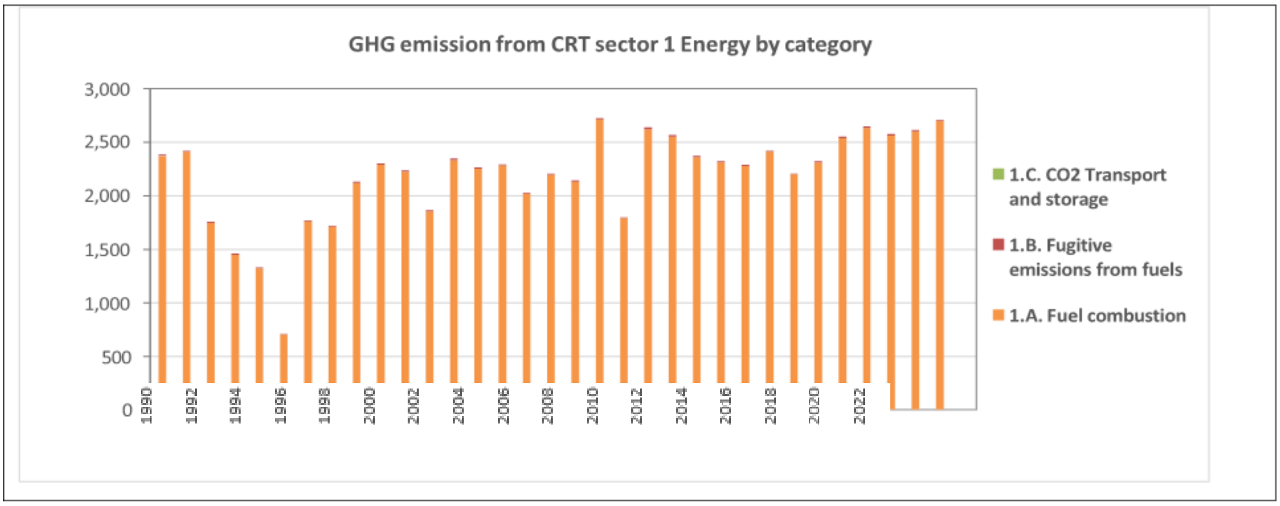


Figure 17 Trend of GHG emissions of CRT sector 1 Energy by category for the period 1990 – 2022

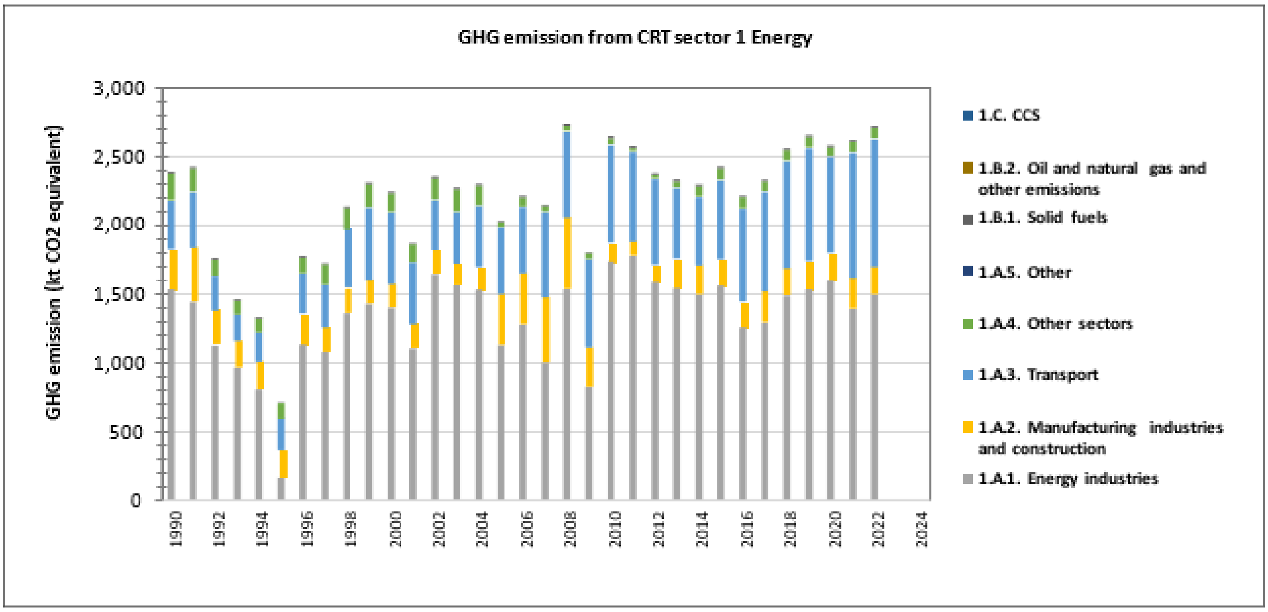
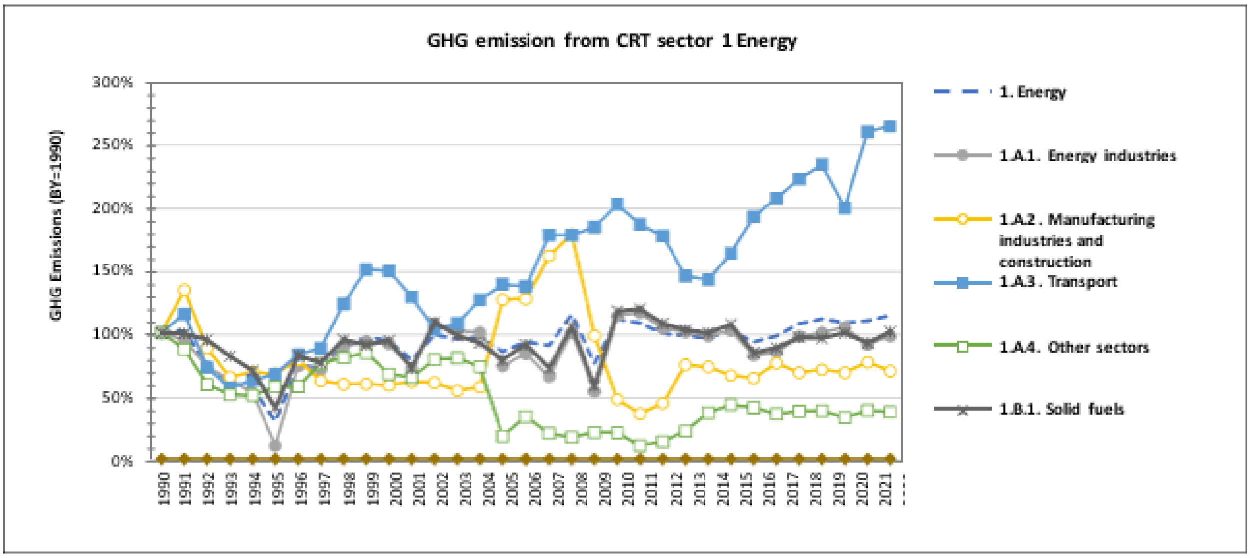


Figure 18 Trend of emissions from CRT sector 1 Energy in index form (base year = 100) by category for the period 1990



GHG emissions expressed as CO_2eq

The largest share within the total energy sector emissions is accounted for by activities related to power and heat generation. The reported drop in emissions from 1992 to –1995 and in 2009 was a result of reduced output from the TPP in Pljevlja "Pljevlja", reduced production at the energy facility of the KAP, as well as an overall economic downturn in the country.

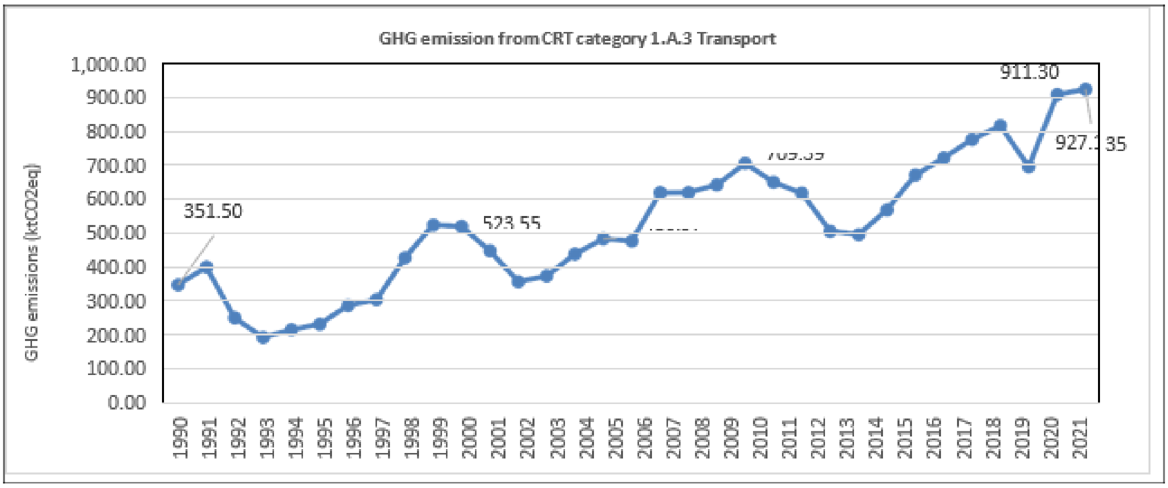
Emissions from the transport subsector record slowed but saw a steady increase commensurate with the increase in the number of motor vehicles in the country. The need to align the methodology for developing planned and effectuated energy balances with reporting requirements to EUROSTAT and IEA encouraged MONSTAT to create a new reporting format. The most prominent difference relatefers to biomass consumption. It includes the consumption of firewood and woodchips, pellet, charcoal, and other primary solid biomass types. It is also noteworthy that the definition "jet kerosene" was introduced into aviation fuel, whereas until 2013 the term "jet fuel" had been used.

Emissions from transport

An overview of the GHG emission from fuel combustion in CRT category 1.A.3 Transport is provided in the following figures and tables:

- annual GHG emissions;
- trend of the periods 1990 – 2022 , 2005 – 2022, 2021 – 2022.

Figure 19 GHG Emissions from CRT category 1.A.3 Transport



The greenhouse gas emissions from CRT category 1.A.3 Transport amounted to 351.50 kt CO_2 equivalents in 1990, 486.97 kt CO_2 equivalents in 2005 and 927.135 kt CO2 equivalents in 2022.

The overall trend in GHG emissions from the CRT category 1.A.3 Transport shows an increase by 163.8% from 1990 to 2022, and 90.40% from 2005 to 2022 and by 1.7% from 2021 to 2022.
Fluctuation of emissions are due to overall situation in the country:

- breakup of Yugoslavia;
- overall economic downturn in the country;
- break-up of the union with Serbia;
- worldwide pandemic (2020).

In 2022, the CRT category 1.A.3 Transport contribute with 27.1% to National Total GHG emissions. In 2005, the CRT category 1.A.3 Transport contribute with 24.0% to National Total GHG emissions. In 1990, the CRT category 1.A.3 Transport contribute with 14.7% to National Total GHG emissions.

The most important fuels are gas/diesel oil and motor gasoline. But also LPG is becoming more important. In 2022, these three fuels combined to contribute to 100% of emissions to CRT category 1.A.3 Transport – sub-category 1.A.3.b Road Transportation

No emissions occur from CRT category 1.A.3.c Railways since 2014 as the railway was electrified.

No emissions are reported for all years from 1.A.3.d Domestic Waterborne Navigation as these emissions are reported in 1.A.3.b Road Transportation.

No emissions from CRT category 1.A.3.e Other Transportation – pipeline transport, as this category does not exist in Montenegro.

Figure 20 GHG Emissions from CRT category 1.A.3 Transport by category

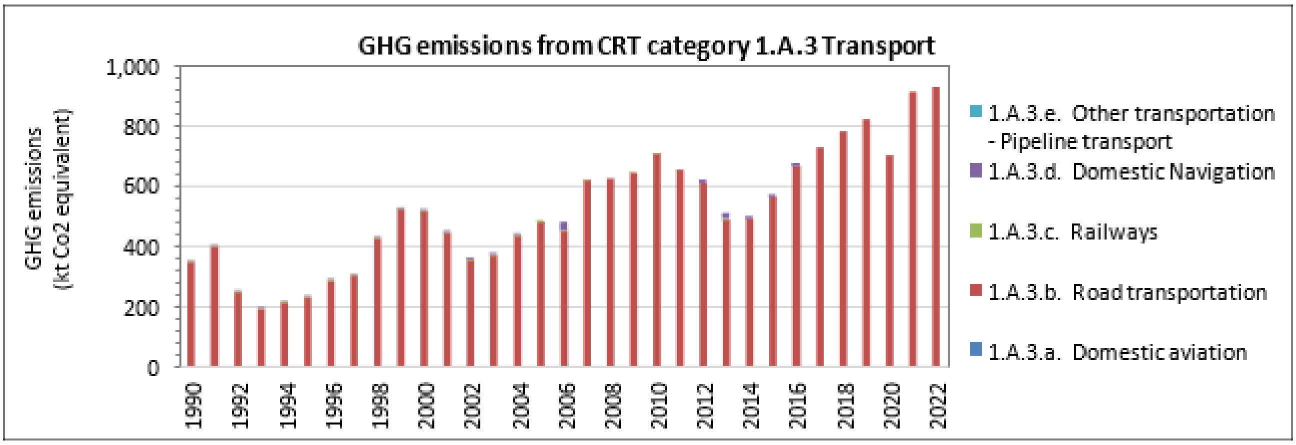
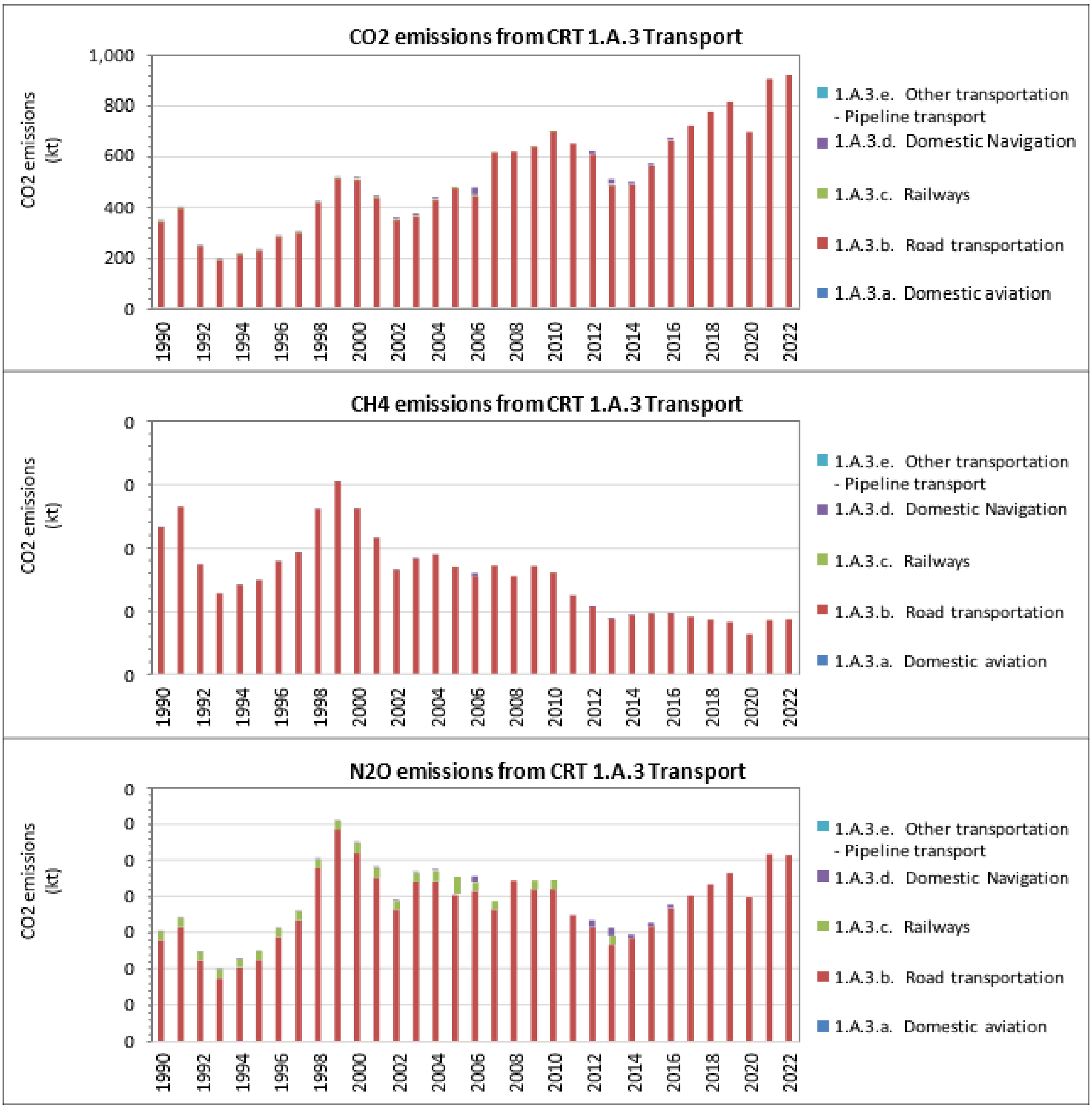


Figure 21 Emissions of CO_2, CH_4 and N_2O from CRT category 1.A.3 Transport by category



3.4.1.1 International bunker fuels

International bunkers are relevant for

- International aviation: international airports Podgorica and Tivat;
- International navigation on Adriatic Sea (Mediterranean Sea) and Lake Skadar

Montenegro has two airports, both for national and international flights. The number of passengers carried by international aviation but also the international freight transport increased. The drop in 2020 is due to worldwide pandemic. GHG emissions from combustion of fuel in *international aviation* amounted to

- 10.54 kt CO_2eq in the year 1990,
- 15.11 kt CO_2eq in the year 2005.
- 48.00 kt CO_2eq in the year 2022.

GHG emissions from *international aviation* increased by 356.0% in the period 1990 – 2022, which is mainly caused by increasing activities in passenger and freight transport.

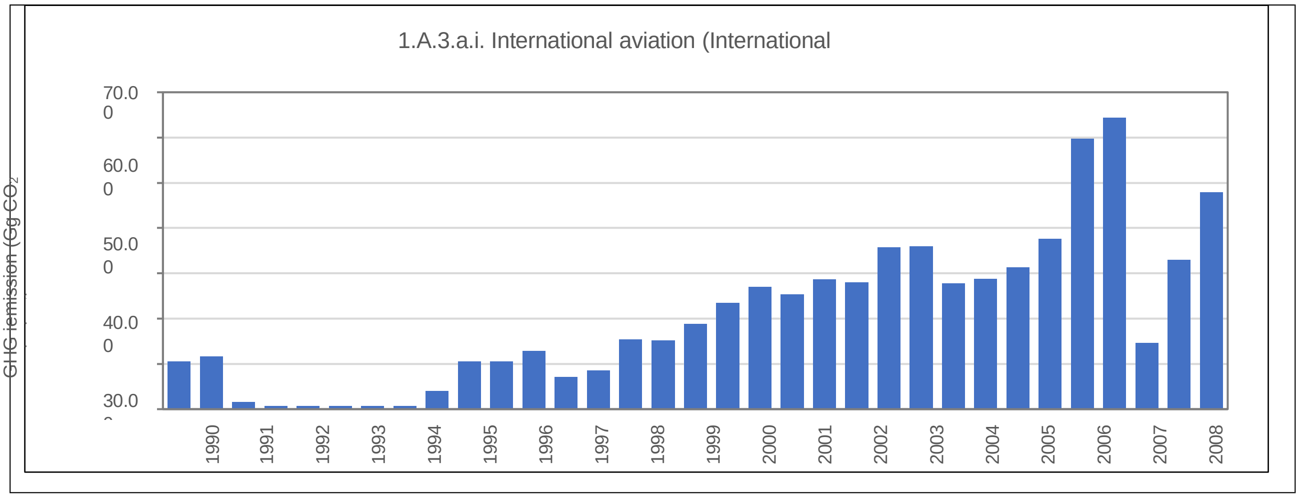


Figure 22 GHG emissions from International Bunkers: International aviation

For international navigation, Montenegro stretches for 294 km along the coastline including 5 commercial ports, mainly used in the touristic sector:

- Port of Bar
- Port of Tivat
- Port of Bijela
- Port of Kotor
- Port of Risan
-

GHG emissions from international shipping are not well reported due to allocation of the fuel in the Energy balance. **The emissions of fuels used in International navigation is included in Road transport**.

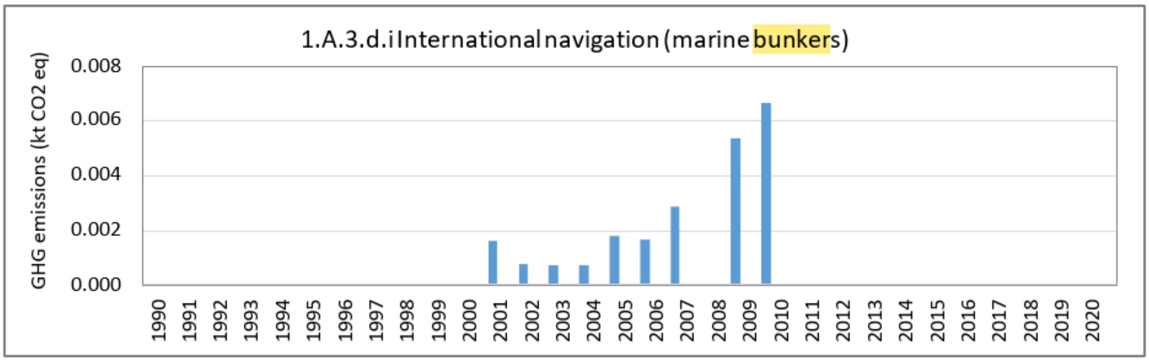


Figure 24 GHG emissions from International Bunkers - International Navigation

3.4.2 Industry sector

In the Sector IPPU, emissions originating from industrial processes, from the use of greenhouse gases in products, and from non-energy uses of fossil fuel carbon are considered. Emissions from this sector comprise emissions from the following sub-categories:

- 2.A Mineral Industry
- 2.B Chemical Industry
- 2.C Metal Industry
- 2.D Other Production
- 2.E Production of HFC/PFC and SF6
- 2.F Consumption of HFC/PFC and SF6
- 2.G Other product manufacture and use
- 2H Other Greenhouse gas emissions are produced from a wide variety of industrial activities.

The main emission sources are releases from industrial processes that chemically or physically transform materials like:

- Lime industry in category 2.A Mineral Industry,
- Iron and steel from scraps and Aluminium industry in category 2.C Metal Industry,
- Refrigeration and Stationary Air Conditioning in category 2.F Consumption of HFC/PFC and SF6,

- Use of Electrical Equipment 2.G Other product manufacture and use.

In the following table, an overview of the IPCC subcategories included in this chapter is given and is provided information on the status of emission estimates of all subcategories. A „✓" indicates that emissions from this subcategory have been estimated. None of the subcategories in the IPPU sections are a key category.

Table 29 Overview of categories of CRT sector 2 IPPU and status of emission estimates of all subcategories

IPCC Code	IPCC category	CO_2	CH_4	N_2O	HFC	PFC	SF6	NF3
2.A	**Mineral Industry**	NA	NA	NA	NA	NA	NA	NA
2.B	**Chemical Industry**	✓	NA	NA	NA	NA	NA	NA
2.C	**Metal Industry**	✓	✓	NO	NO	✓	NO	NA
2.D	**Other Production**	NE	NA	NA	NA	NA	NA	NA
2.E	**Production of HFC/PFC and SF6**	✓	NA	NA	NO	NO	NO	NO
2.F	**Consumption of HFC/PFC and SF6**	NE	NA	NA	✓*	NE	NE	NE
2.G	**Other Product Manufacture and Use**	✓	NO	NE	NA	NA	✓	NA
2.H	**Other**	NA	NO	NA	NA	NA	NA	NA

*Only 2.G.1.b Refrigeration and Stationary Air Conditioning

Other Industries of the CRT sector IPPU, such as primary iron and steel industry, Electronic industries (e.g. semiconductor), or production of Electrical Equipment are not existing in Montenegro. During these processes, different greenhouse gases, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), can be produced. The so-called F-gases hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), sulphur hexafluoride (SF6) and Other halogenated gases are oftentimes used in products such as refrigerators, foams or aerosol cans as well as Electrical equipment. Due to lack of data and resources GHG emissions from the use of greenhouse gases (HFC, PFC) and Other halogenated gases used in products these were not estimated for all subcategories in this inventory cycle (2.F Consumption of HFC/PFC and SF6) - except for subcategory 2.G.1.b Refrigeration and Stationary Air Conditioning where data was available.

Emissions trends

In 2022 GHG emissions from sector IPPU amounted to 153.03 kt CO_2 equivalent, which correspond to 7.3% of total national emissions.

Box 2 Data source for the GHG emissions inventory in the industry sector

Data related to industrial production was reported by: MONSTAT, the Electric Power Industry of Montenegro, the Electricity Transmission System of Montenegro, the Agency for Nature and Environmental Protection, Podgorica Aluminum Plant Podgorica, Zeljezara Nikšić Steel Factory and Pljevlja Coal Mines Pljevlja. Official MONSTAT statistics were used to estimate emissions from this sector, while industrial inventory records were used to verify the inventory.

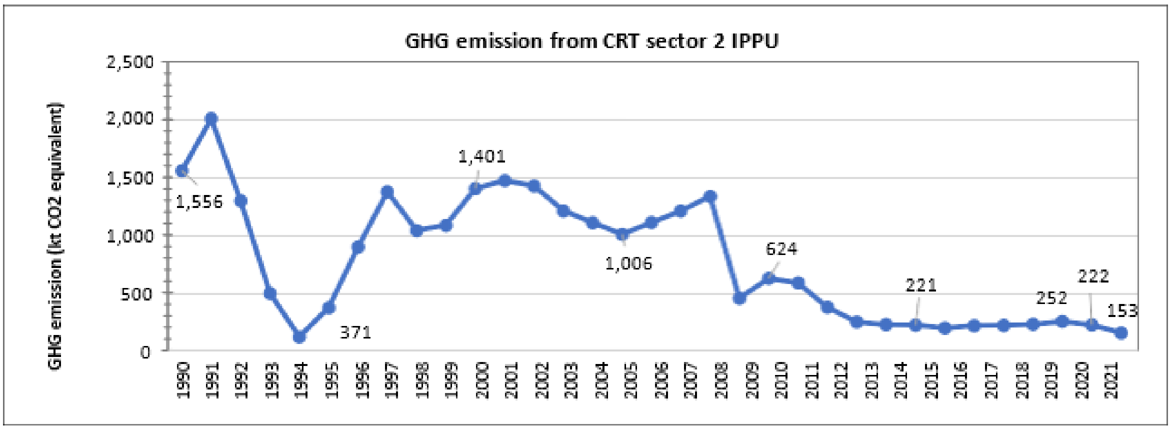
The most important subcategories of this sector until 2022 was 2.C Metal industry (mainly metal/aluminium production). During 2022 production in this sector (Electrolysis unit) was significantly reduced emission of PFCs contribute with 1.08%. Emissions from the use of SF6 contribute with 3.39% to this sector, CO2 with 2.97%, N2O does not occur from sector IPPU. In 2022 use of HFC's generated 92.56% of emissions from IPPU sector.

In 2005 GHG emissions from sector IPPU amounted to 1 012.38 kt CO_2 equivalent, which correspond to 27.0% of total national emissions. The overall trend in GHG emissions from IPPU is an decrease of -84.8% from 2005 to 2022 due to reduced aluminium production, in the same time increased emissions of HFC.

In 1990 GHG From Sector IPPU Amounted To 1,555.86 Kt CO_2 Equivalent, Which Correspond To 32.5% Of Total National Emissions

The most important subcategory of this sector is 2.C Metal industry (aluminium production). Important greenhouse gases of this sector are CO2 with a contribution of 11.9% and PFCs with a contribution of 86.2% to this sector.

Figure 23 Trend of GHG emissions from CRT sector 2 IPPU: 1990 – 2022



GHG emissions expressed as CO2eq

The estimated CO2eq emissions from industrial processes for the reporting period are shown in **Figure 24, Figure 25, Figure 26**, and **Table 30**. In all the industrial subsectors, it is observed that the GHG emission level strictly monitors the level of production volume during the period 1990-–2022, as well as technological improvements in the electrolysis plant in Podgorica the Aluminium Plantmill in Podgorici.

The share of CO2eq emissions from aluminium production in the total emissions from the industry sector in the reporting period ranges from over 90% (1990) to less than 10% (2022). Starting from 2009, due to a significant reduction in the volume of aluminium production, but also due to technological improvements in the Electrolysis Plant, PFC emissions have fallen and thus the dominant share of the aluminium industry within total CO2eq has also reduced. With the increase in the number of refrigeration units, especially air conditioners in households, the PFC emissions from these activities are increasing, and thus the share of total emissions from the industry sector is also increasing. However, the value of this emission is low compared to the total value of emissions from all sectors.

Figure 24 Trend of GHG emissions of CRT sector 2 IPPU by category for the period 1990 – 2022

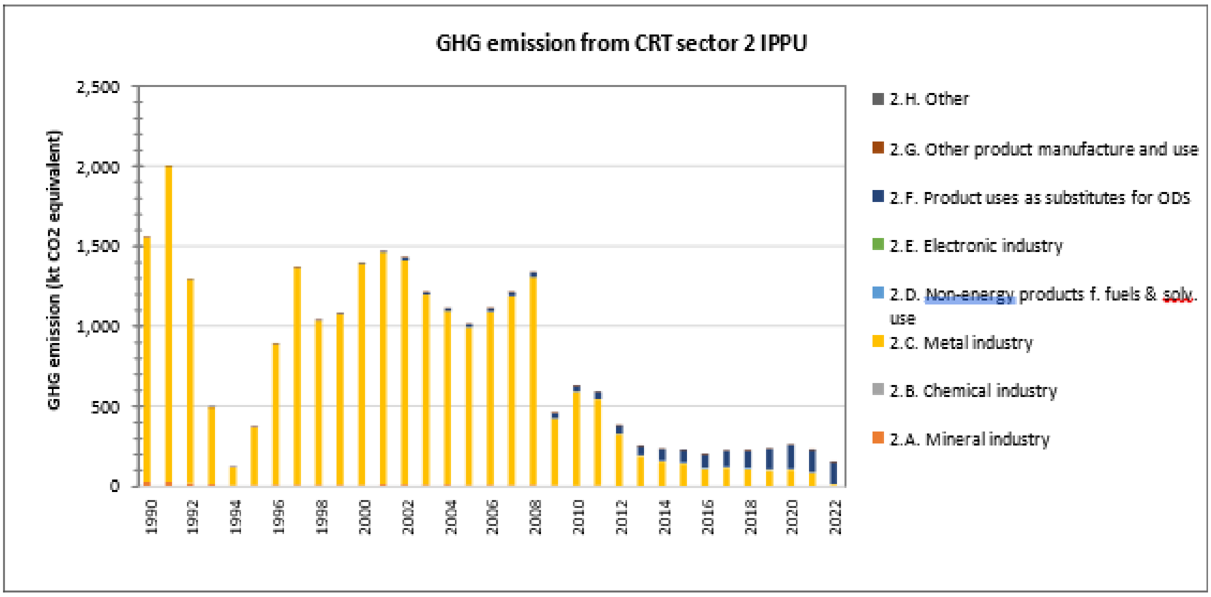


Figure 25 Trend and share GHG emissions of CRT sector 2 IPPU by category for the period 1990 – 2022

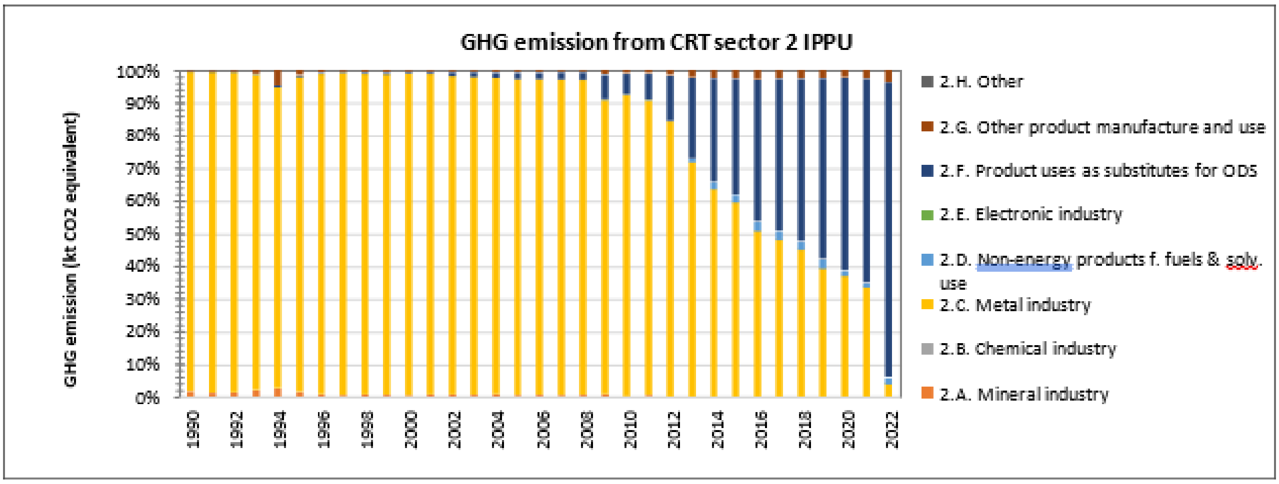


Figure 26 Trend of emissions from CRT sector 2 IPPU in index form (base year = 100) by category

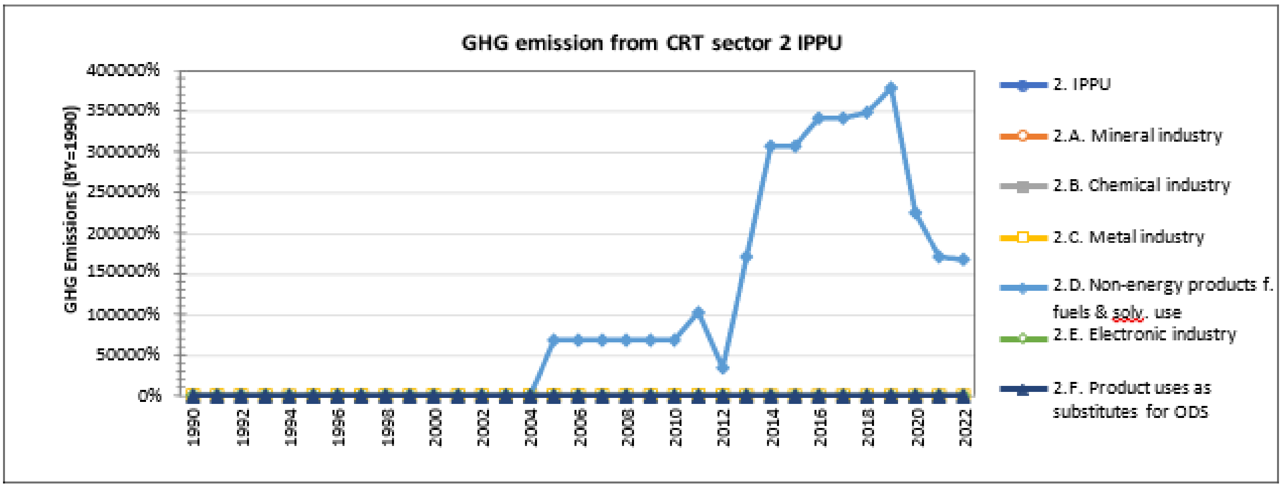


Table 30 GHG Emissions from CRT subcategory 2 IPPU (the entire Industry Industrial Processes and Product Use sector) by subcategories for the period 1990-2022

GHG emissions	2 IPPU	2.A Mineral industry	2.B Chemical industry	2.C Metal industry	2.D Non-energy products from fuels and solvent use	2.E Electronic industry	2.F Product uses as substitutes for ODS	2.G Other product manufacture and use	2.H Other
kt CO_2 equivalent									
1990	1 555.86	24.85	NO	1 525.82	0.00	NA	NA	5.19	NO
1991	2 004.52	23.34	NO	1 975.98	0.00	NA	0.01	5.19	NO
1992	1 295.44	16.57	NO	1 273.57	0.00	NA	0.11	5.19	NO
1993	494.23	9.79	NO	478.94	0.00	NA	0.31	5.19	NO
1994	118.48	3.01	NO	109.47	0.00	NA	0.81	5.19	NO
1995	370.95	5.27	NO	359.12	0.00	NA	1.37	5.19	NO
1996	895.38	6.02	NO	882.09	0.00	NA	2.07	5.19	NO
1997	1 373.26	6.02	NO	1 359.17	0.00	NA	2.88	5.19	NO
1998	1 038.78	6.02	NO	1 023.77	0.00	NA	3.80	5.19	NO
1999	1 083.31	6.02	NO	1 067.31	0.00	NA	4.78	5.19	NO
2000	1 400.51	5.36	NO	1 384.19	0.00	NA	5.77	5.19	NO
2001	1 469.28	9.78	NO	1 447.54	0.00	NA	6.76	5.19	NO
2002	1 423.50	8.38	NO	1 400.50	0.00	NA	9.43	5.19	NO
2003	1 208.56	6.13	NO	1 186.86	0.00	NA	10.38	5.19	NO
2004	1 105.89	7.98	NO	1 081.38	0.00	NA	11.33	5.19	NO
2005	1 006.08	4.52	NO	982.56	1.18	NA	12.62	5.19	NO
2006	1 106.36	6.11	NO	1 078.70	1.18	NA	15.18	5.19	NO
2007	1 207.49	5.34	NO	1 177.03	1.18	NA	18.76	5.19	NO
2008	1 333.02	7.41	NO	1 296.08	1.18	NA	23.15	5.19	NO
2009	453.26	3.39	NO	415.35	1.18	NA	28.16	5.19	NO
2010	623.83	0.63	NO	583.07	1.18	NA	33.76	5.19	NO
2011	583.82	2.60	NO	534.54	1.77	NA	39.73	5.19	NO
2012	374.10	NO	NO	321.84	0.59	NA	46.48	5.19	NO
2013	247.37	NO	NO	182.66	2.95	NA	56.57	5.19	NO
2014	224.85	NO	NO	147.46	5.31	NA	66.89	5.19	NO
2015	221.07	NO	NO	135.62	5.31	NA	74.95	5.19	NO

2016	194.70	NO	NO	102.50	5.90	NA	81.12	5.19	NO
2017	215.44	NO	NO	107.17	5.90	NA	97.18	5.19	NO
2018	217.82	NO	NO	101.38	6.01	NA	105.24	5.19	NO
2019	226.55	NO	NO	91.86	6.54	NA	122.96	5.19	NO
2020	251.76	NO	NO	96.24	3.89	NA	146.44	5.19	NO
2021	221.97	NO	NO	77.06	2.95	NA	136.77	5.19	NO
2022	153.03	NO	NO	6.21	2.89	NA	138.74	5.19	NO
Trend									
1990 - 2022	*-90.2%*	*NA*	*NA*	*-99.6%*	*166851.2%*	*NA*	*NA*	*0.0%*	*NA*
2005 - 2022	*-84.8%*	*NA*	*NA*	*-99.4%*	*144.8%*	*NA*	*999.2%*	*0.0%*	*NA*
2021 - 2022	*-31.1%*	*NA*	*NA*	*-91.9%*	*-2.0%*	*NA*	*1.4%*	*0.0%*	*NA*

PFC, SF6 and HFC emissions

For the reporting period 1990-2022, the estimated PFCs, SF6, and HFCs emissions from industrial subsectors are shown in the table below with the full table of all years included in Annex A4. The total estimated emissions of PFC substances from this sector come from the aluminium industry (electrolysis plants). The entire PFC emissions time series have been recalculated from the SBUR (2019) in accordance with the findings and recommendations of the UNFCCC Secretariat Expert Mission. The recalculated emissions show a significantly lower level due to the information being thoroughly analyszed information regarding the number and duration of anode effects and consequently the application of the Tier- 2 approach in the calculation. The decline in PFC emissions in the 1990s is related solely to the fall in production volume, while in the period 2009 - 2017, the fall in emission levels is related not only to the evident decline in the volume of aluminium produced, but also to technological improvements in terms of reducing the number and duration of anode effects in electrolytic cells.

Table 31 Emissions of HFCs, PFCs and SF6 from CRT subcategory 2 IPPU by subcategories for select years

GHG emissions (kt CO_2 eq)	2	2.A	2.B	2.C	2.D	2.E	2.F	2.G	2.H
	IPPU	Mineral industry	Chemical industry	Metal industry	Non-energy products from fuels and solvent use	Electronic industry	Product uses as substitutes for ODS	Other product manufacture and use	Other
	GHG			**PFCs**			**HFCs**	**SF6**	
1990	**1,345.67**	NA	NO	1,340.48	NA	NO	NA	5.19	NA

1995	**316.85**	NA	NO	310.30	NA	NO	1.37	5.19	NA
2000	**1,235.51**	NA	NO	1,224.54	NA	NO	5.77	5.19	NA
2005	**799.56**	NA	NO	781.75	NA	NO	12.62	5.19	NA
2010	**486.04**	NA	NO	447.09	NA	NO	33.76	5.19	NA
2015	**144.83**	NA	NO	64.69	NA	NO	74.95	5.19	NA
2020	**183.54**	NA	NO	31.92	NA	NO	146.44	5.19	NA
2021	**159.85**	NA	NO	17.89	NA	NO	136.77	5.19	NA
2022	**145.59**	NA	NO	1.66	NA	NO	138.74	5.19	NA
Trend									
1990 - 2022	*-89.2%*	*NA*	*NA*	*-99.9%*	*NA*	*NA*	*NA*	*0.0%*	*NA*
2005 - 2022	*-81.8%*	*NA*	*NA*	*-99.8%*	*NA*	*NA*	*999.2%*	*0.0%*	*NA*
2021 - 2022	*-8.9%*	*NA*	*NA*	*-90.7%*	*NA*	*NA*	*1.4%*	*0.0%*	*NA*

3.4.3 Agriculture

This chapter includes information on, and description of, methodologies used for estimating GHG emissions as well as references to activity data and emission factors reported under CRT sector 3 Agriculture for the period 1990 to 2022.

Box 3 Data source for the GHG emissions inventory in the agriculture sector

The original data provider for the national and international agricultural data is the Ministry of Agriculture, Forestry and Water Management and MONSTAT. The agricultural data used and presented in this inventory are taken from the following national and international sources: **Census of Agriculture -** In 2010 the Agricultural Census was conducted at the whole territory of the country, using the "door-to-door" approach, and was the first independent Agricultural Census in Montenegro. It was conducted by Statistical Office of Montenegro MONSTAT in cooperation with the Food and Agriculture Organization of the United Nations (FAO) consultants.* **Statistical yearbook -** The official statistics (several years) of MONSTAT provides information on: • usable land area and cultivated land area • crop production, crop yield of agricultural products • fruit and vegetable cultivated land area • fruit area and production by province • area and production of wheat, barley, maize etc • annual livestock numbers • livestock production by type FAO agricultural data base - The FAO agricultural data base (FAOSTAT) provides worldwide harmonized data (FAO AGRICULTURE STATISTICAL SYSTEM 2001).The FAO data base provides data for the entire time series 1990 – 2022, even some data are based on estimates done by FAO. *Available (3. January 2021) on http://www.fao.org/faostat/en/#data

Emission trends

In **2022**, GHG emissions from CRT sector 3 *Agriculture* amounted to 250.79 kt CO_2 equivalent, which correspond to 7.8% of total national emissions.

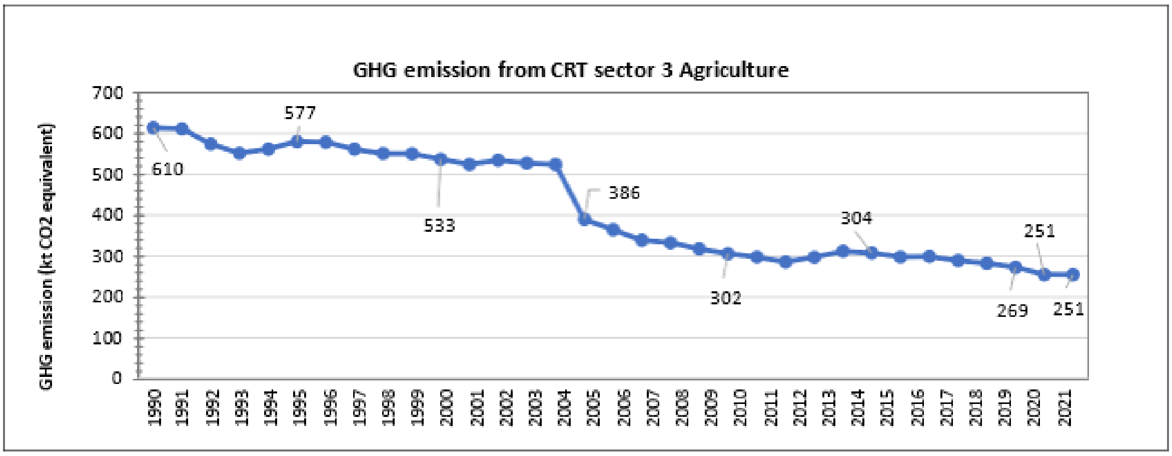
In **2005**, GHG emissions from CRT sector 3 *Agriculture* amounted to 386.03 kt CO_2 equivalent, which correspond to 10.3% of total national emissions.

In **1990**, GHG emissions from CRT sector 3 *Agriculture* amounted to 610.32 kt CO_2 equivalent, which correspond to 12.7 of total national emissions.

The most important subcategories of this sector are *3.A Enteric fermentation* and *3.B Manure Management*. CRT sector 3 *Agriculture* is the largest source of national N_2O and CH_4 emissions because they produce the highest quantity of emissions.

The overall trend in GHG emissions from *Agriculture* shows a decrease of -58.59% from 1990 to 2022 and - 35.0% from 2005 to 2022. The main drivers for this trend are decreasing livestock.

Figure 27 Trend of GHG emission of CRT sector 3 Agriculture for the period 1990 – 2022



During the reporting period (1990-–2017), GHG emissions from the agricultural sector in almost all segments has decreased, due to reduced crop and livestock production (by about 60%) and the total animal population. **Table 29** and **Figure 29** show the sources and sinks of GHG emissions from the agriculture and land use sectors, expressed as CO_2eq.

Figure 28 Trend of GHG emission of CRT sector 3 Agriculture by category for the period 1990 – 2022

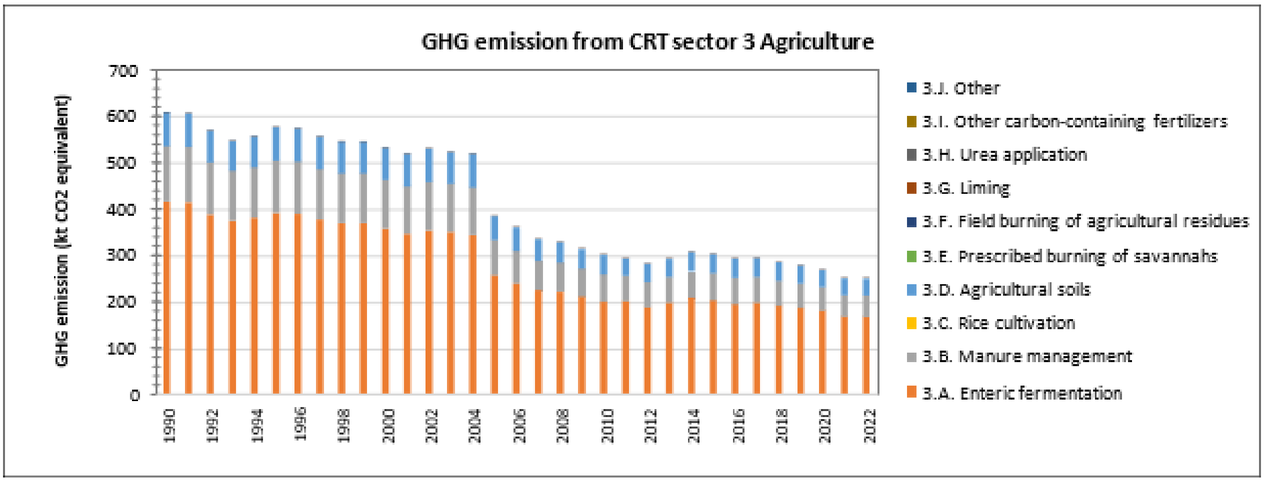


Figure 29 Trend of emissions from CRT sector 3 Agriculture in index form (base year = 100) by category for the period 1990 – 2022

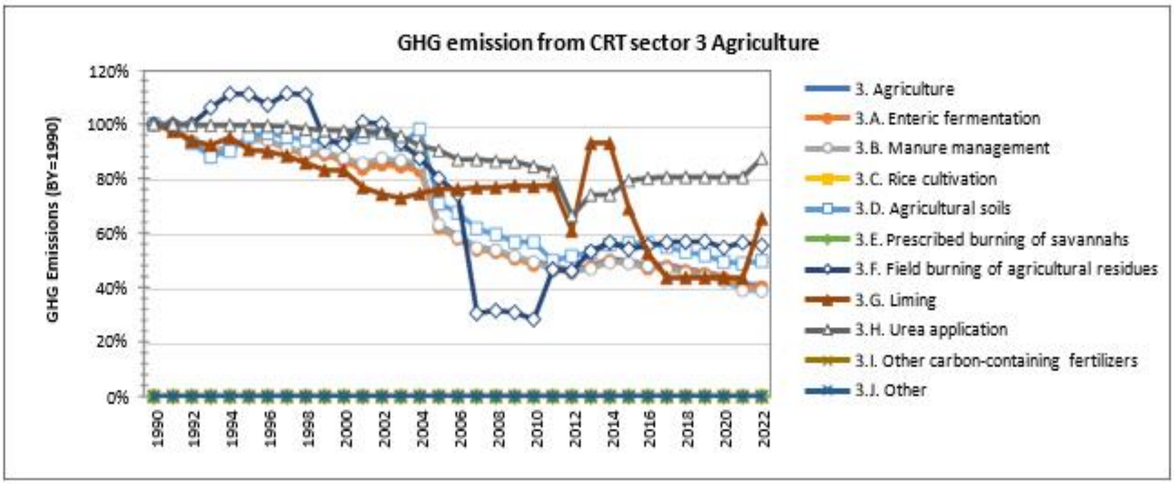


Table 32 GHG Emissions from CRT subcategory 3 Agriculture by subcategories for the period 1990-2022

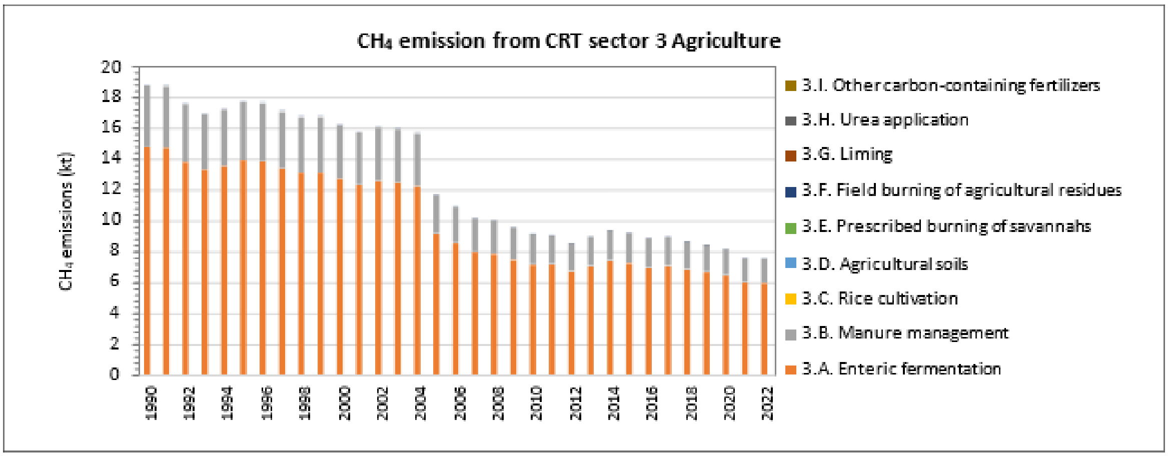
GHG emissions	3	3.A	3.B	3.C	3.D	3.E	3.F	3.	3.H	3.I	3.J
	Agriculture	Enteric Fermentation	Manure Management	Rice Cultivation	Agricultural soils	Prescribed burning of	Field burning of agricultural	Liming	Urea application	Other carbon-containing	Other
	kt CO_2 equivalent										
1990	610.32	414.43	120.91	NA	74.44	NA	0.05	0.06	0.00	NA	NA
1991	607.90	413.28	120.43	NA	73.65	NA	0.05	0.06	0.42	NA	NA
1992	570.34	387.46	113.14	NA	69.21	NA	0.05	0.06	0.42	NA	NA
1993	548.28	373.41	108.78	NA	65.55	NA	0.06	0.06	0.42	NA	NA
1994	558.11	379.77	110.72	NA	67.09	NA	0.06	0.06	0.42	NA	NA
1995	576.67	390.83	114.06	NA	71.24	NA	0.06	0.06	0.42	NA	NA
1996	575.08	388.83	113.70	NA	72.01	NA	0.06	0.06	0.42	NA	NA
1997	557.76	375.97	110.33	NA	70.93	NA	0.06	0.06	0.42	NA	NA
1998	547.03	367.83	108.51	NA	70.16	NA	0.06	0.06	0.42	NA	NA
1999	546.78	368.01	108.64	NA	69.60	NA	0.05	0.05	0.42	NA	NA
2000	533.22	356.85	105.92	NA	69.93	NA	0.05	0.05	0.42	NA	NA
2001	520.36	345.51	103.45	NA	70.88	NA	0.05	0.05	0.41	NA	NA
2002	530.85	352.44	105.76	NA	72.15	NA	0.05	0.05	0.41	NA	NA
2003	523.59	349.66	104.70	NA	68.72	NA	0.05	0.05	0.41	NA	NA
2004	520.33	343.26	103.52	NA	73.07	NA	0.05	0.05	0.39	NA	NA

2005	386.03	256.63	76.23	NA	52.69	NA	0.04	0.05	0.38	NA	NA
2006	360.80	239.44	70.66	NA	50.24	NA	0.04	0.05	0.37	NA	NA
2007	335.21	222.95	65.96	NA	45.86	NA	0.02	0.05	0.37	NA	NA
2008	328.99	219.26	65.06	NA	44.23	NA	0.02	0.05	0.37	NA	NA
2009	313.76	208.99	62.19	NA	42.14	NA	0.02	0.05	0.37	NA	NA
2010	302.06	199.77	59.68	NA	42.19	NA	0.01	0.05	0.36	NA	NA
2011	293.92	200.60	55.84	NA	37.06	NA	0.02	0.05	0.35	NA	NA
2012	281.78	187.83	55.22	NA	38.39	NA	0.02	0.04	0.28	NA	NA
2013	293.73	197.41	56.63	NA	39.28	NA	0.03	0.06	0.31	NA	NA
2014	308.27	206.93	59.48	NA	41.46	NA	0.03	0.06	0.31	NA	NA
2015	303.95	202.62	59.11	NA	41.81	NA	0.03	0.04	0.34	NA	NA
2016	294.44	194.18	57.91	NA	41.95	NA	0.03	0.03	0.34	NA	NA
2017	295.31	197.58	56.47	NA	40.86	NA	0.03	0.03	0.34	NA	NA
2018	285.60	191.07	54.67	NA	39.47	NA	0.03	0.03	0.34	NA	NA
2019	278.70	186.53	53.22	NA	38.56	NA	0.03	0.03	0.34	NA	NA

CH_4 emissions

Figure 30 shows CH_4 emissions from the agriculture subsectors. The share of emissions from enteric fermentation in the livestock subsector is the most significant followed by manure management.

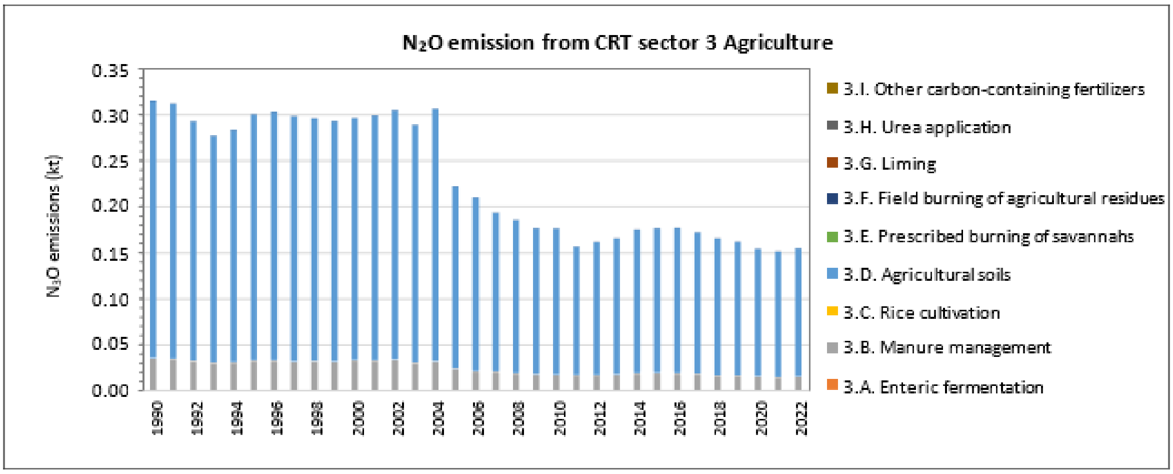
Figure 30 Trend of CH_4 emission of CRT sector 3 Agriculture by category for the period 1990 – 2022



N_2O emissions

Figure 31 shows the N_2O emissions from the agriculture and land use subsectors. The share of emissions from agricultural soils is the most significant.

Figure 31 Trend of N_2O emission of CRT sector 3 Agriculture by category for the period 1990 – 2022

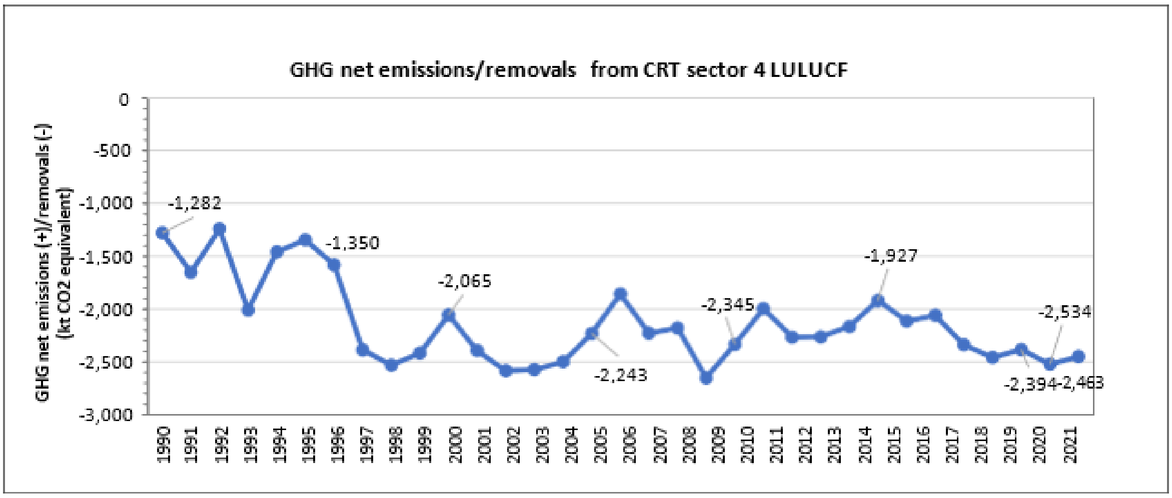


3.4.4 LULUFC

This chapter describes the GHG emissions and removals arising from land use, land use change and forestry (LULUCF). LULUCF is a significant sector in the Montenegrin GHG balance with total sector net GHG removals ranging from -1,244.47 to -2,276.56 kt CO_2eq. The sector is dominated by fluxes of CO_2, with emissions of CH_4 and N_2O contributing only marginally to the sector's total GHG balance. The sector is driven by the net removals from Forest land, which dwarf the net emission/removals of the other subcategories of the sector. In 2022, Forest land contributed net removals of -2,513.04 kt CO_2eq. The next most significant subcategories are Harvested Wood Products and Settlements, which In 2022 contributed removals of -11.66 kt CO_2eq and emissions of 62.64 kt CO_2eq, respectively.

In 2022, net removals from sector LULUCF amounted to -2,462.58 kt CO_2 equivalent, which is an increased by 92.1% compared to 1990. In 2005, net removals from sector LULUCF amounted to -2 242.86 kt CO_2 equivalent. In the period 2005-2021, GHG net removals increased by 9.8%, In 1990, net removals from sector LULUCF amounted to -1,281.65 kt CO_2 equivalent.

Figure 32 Trend of GHG net removals of CRT sector 4 LULUCF for the period 1990 – 2022



Box 4 Data source for the GHG emissions inventory in the LULUCF sector

The methodology used to create a complete land use and land use change time series for Montenegro from 1970 to 2022 involved synthesizing data from various sources, primarily relying on the National Forestry Inventory for some emission factors, and CORINE Land Cover (CLC) product from the EU's Copernicus Land Monitoring Service. Key steps include:

1. **Land Use Classification**: The CLC data was classified according to IPCC land use categories. National experts used 2018 CLC data to split cropland into annual and perennial types, applying this ratio across the time series.

2. **Land Use Change Calculation**: Land use changes were tracked using CLC-change layers for 2000-2006, 2006-2012, and 2012-2018, with annual changes calculated by dividing total changes over six-year intervals. Data for 1990-2000 was deemed unreliable, so changes from 2000-2006 were extrapolated back to 1970.

3. **Forest Land Estimation**: The forest land area was estimated starting with the national forest inventory in 2010, then calculating yearly changes to forest land, both forward (2011 onwards) and backward (1970-2010).

4. **Non-Forest Land Categories**: For Cropland, Grassland, Wetlands, Settlements, and Other lands, the time series was built by first determining the 2018 non-forest area and distributing it proportionally. Changes for earlier years were calculated by subtracting the respective land use change data.

5. **Extrapolation for Recent Years**: For 2019-2021, no new CLC data was available, so land use changes from the 2012-2018 CLC change layer were extrapolated.

The approach ensures consistency with national expert judgment and CLC data, while addressing gaps in earlier data through extrapolation.

The calculations for LULUCF emissions and removals follow the IPCC 2006 Guidelines (Vol. 4). The inventory largely relies on these guidelines for carbon stock, carbon stock changes, and emission factors to compile the GHG balance. In some categories, Tier 2 approaches were used in the current submission.

Emissions trends

With regard to the overall trend of net removals from LULUCF, the removals increased by 92.1% over the observed period. The main driver for this trend is the net removals from Forest land, which dwarf the net emission/removals of the other subcategories of the sector. The next most significant subcategories are Harvested Wood Products and Settlements. Generally, land use has been rather stable in Montenegro, with only a small proportion of the total territory undergoing land use change. Nevertheless, significant dynamics in Forest land remaining forest land have driven the aforementioned substantial long-term trend as well as considerable inter-annual variability. Principally, this variation has been driven by year-to-year changes in total drain due to timber harvest and biomass losses due to forest fires.

Figure 33 Net emissions/ removals in CRT sector LULUCF from 1990 – 2022

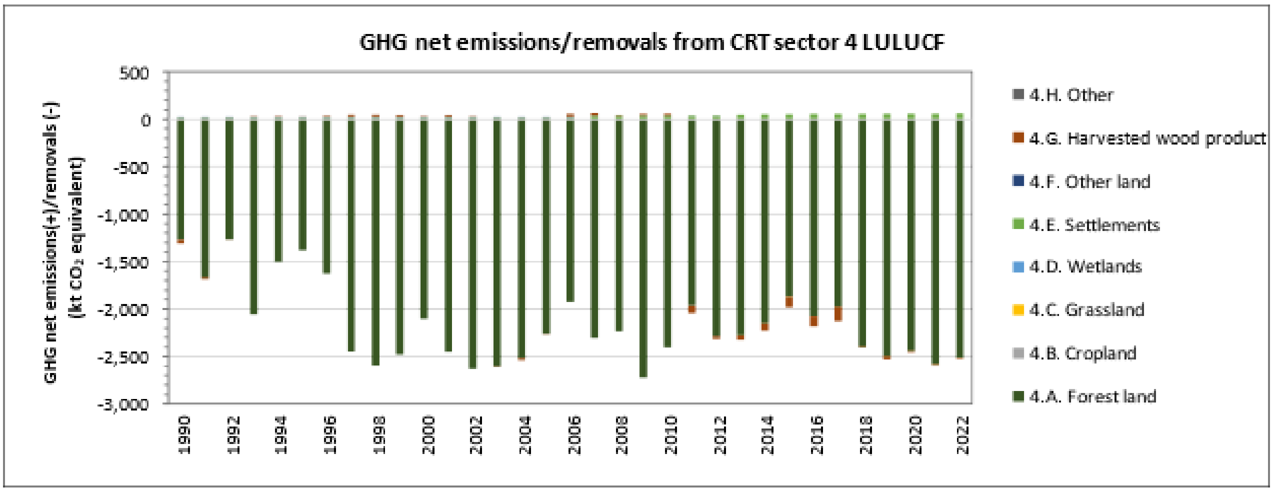


Figure 34 Trend of emissions and removals from CRT sector 4 LULUCF by greenhouse gas for the period 1990 – 2022

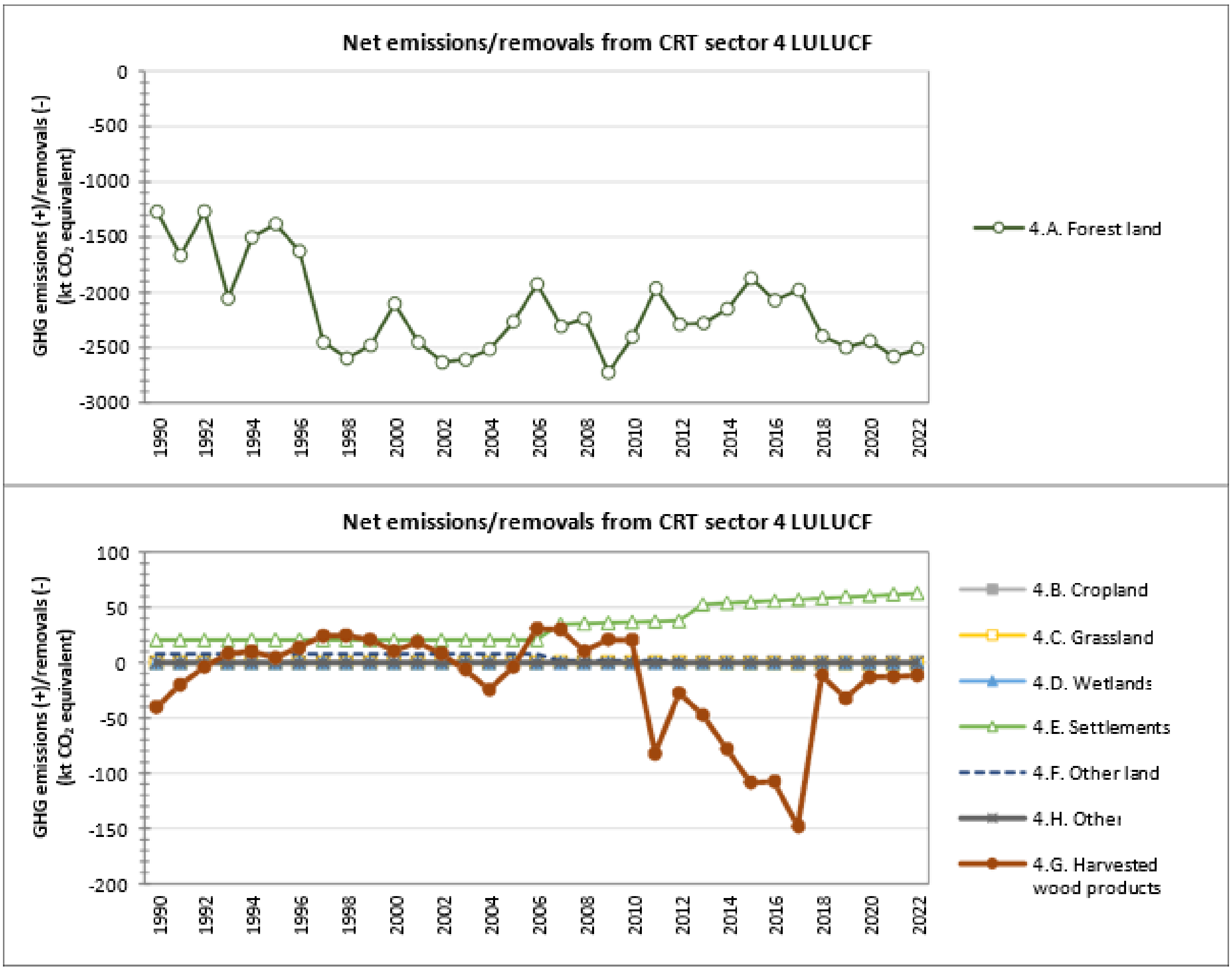
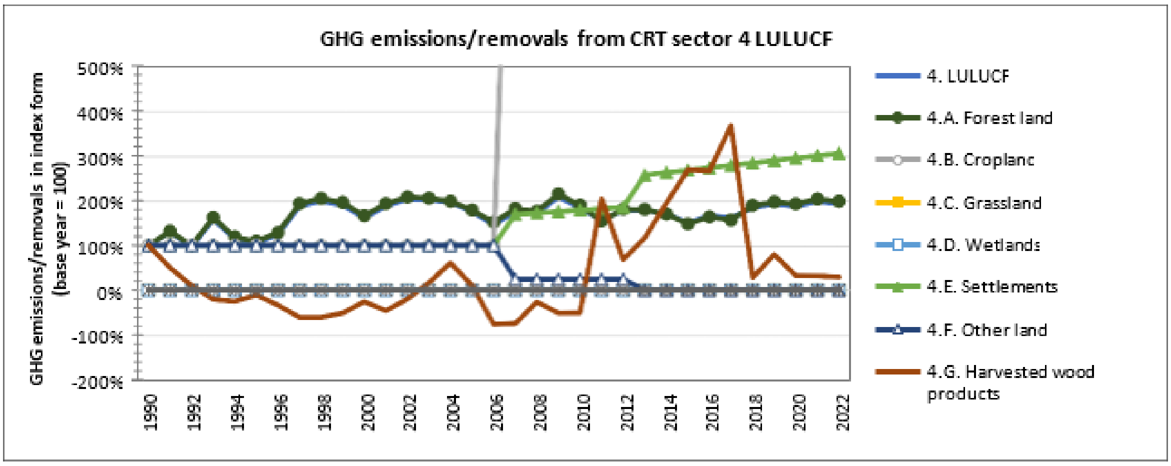


Figure 35 Trend of emissions from CRT sector 4 LULUCF in index form (base year = 100) by category for the period 1990 – 2022



Additional data on GHGs disaggregated according to specific gases is included in Annex A4.

3.4.5 Waste

This chapter includes information on and description of methodologies used for estimating GHG emissions, as well as references to activity data and emission factors reported under CRT sector 5 – Waste for the period 1990 to 2022. In the Waste sector emissions of CO_2, CH_4 and N_2O originate from the IPCC categories:

- 5.A Solid waste disposal,
- 5.B Biological treatment of solid waste,
- 5.C Incineration and open burning of waste,
- 5.D Wastewater treatment and discharge.

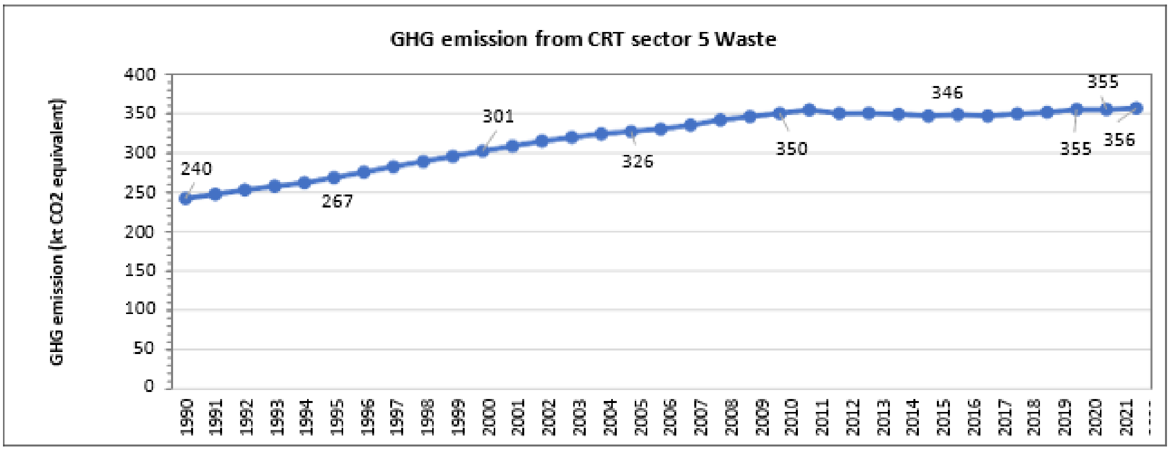
Emission trends

In 2022, GHG emissions from CRT sector 5 Waste amounted to 356.17 kt CO_2 equivalent, which correspond to 33.5% of total national emissions. In the period 1990 to 2022 GHG emissions from the CRT sector 5 Waste increased by 48.4% from 240.07 kt CO_2 eq in 1990 due to increasing landfilling activities (CRT category 5.A Solid waste disposal) as a result of increasing population and growing waste generation rates. Also, the reduction of illegal disposal (sites) or open burning results in increasing landfilling. In the same period GHG emissions from the CRT category 5.D Wastewater treatment and discharge increased slightly due to increasing number of population connected to sewage systems and wastewater treatment plants and due to growing population and higher protein consumption per capita.

The most important categories of Waste are solid waste disposal followed by wastewater treatment and discharge. The most important greenhouse gas is CH_4.

Emissions from the categories 5.B Biological Treatment of Solid Waste and 5.C Incineration and Open Burning of Waste were not estimated due to lack of data.

Figure 36 Trend of GHG emission of CRT sector 5 Waste for the period 1990 – 2022



GHG emissions expressed in CO2eq

Table 33 and **Figure 37** show and the estimation of the annual GHG emissions from the activities of waste management are estimated CO_2eq, for the period 1990 – 2022. Data for specific gases is included in Annex A4.

Table 33 Total GHG Emissions from CRT sector Waste for the period 1990 - 2022

GHG emissions	5 TOTAL Waste	5.A Solid Waste Disposal	5.B Biological Treatment of Solid Waste	5.C Incineration and Open Burning of Waste	5.D Wastewater Treatment and Discharge
	kt CO_2 equivalent				
1990	240.07	172.01	NA	0.000	68.06
1991	245.30	176.64	NA	0.000	68.66
1992	250.93	181.41	NA	0.000	69.52
1993	255.66	186.32	NA	0.000	69.35
1994	260.11	191.32	NA	0.000	68.79
1995	266.89	197.12	NA	0.000	69.77
1996	273.68	203.62	NA	0.000	70.06
1997	280.76	210.75	NA	0.000	70.01
1998	287.50	218.05	NA	0.000	69.45
1999	293.95	225.53	NA	0.000	68.43
2000	300.90	233.17	NA	0.000	67.74
2001	307.25	239.77	NA	0.000	67.48

2002	313.65	245.38	NA	0.000	68.27
2003	318.48	250.12	NA	0.000	68.37
2004	323.14	253.98	NA	0.000	69.16
2005	326.06	256.92	NA	0.000	69.14
2006	329.22	259.15	NA	0.000	70.07
2007	334.35	263.41	NA	0.000	70.94
2008	341.10	269.28	NA	0.000	71.82
2009	345.37	273.32	NA	0.000	72.05
2010	349.56	277.03	NA	0.000	72.54
2011	353.86	280.79	NA	0.000	73.07
2012	349.30	276.33	NA	0.000	72.96
2013	349.64	276.29	NA	0.000	73.35
2014	348.39	275.22	NA	0.000	73.17
2015	346.13	272.62	NA	0.000	73.51
2016	347.80	273.12	NA	0.000	74.68
2017	346.28	270.81	NA	0.000	75.47
2018	348.96	272.65	NA	0.000	76.30
2019	350.74	273.75	NA	0.000	77.00
2020	354.50	276.79	NA	0.000	77.72
2021	354.55	276.68	NA	0.000	77.87
2022	356.17	278.40	NA	0.000	77.77
Trend					
1990 - 2022	*48.4%*	*61.9%*	*NA*	*NA*	*14.3%*
2005 - 2022	*9.2%*	*8.4%*	*NA*	*NA*	*12.5%*
2021 - 2022	*0.5%*	*0.6%*	*NA*	*NA*	*-0.1%*

Figure 37 Trend of GHG emission of CRT sector 5 Waste by category for the period 1990 – 2022

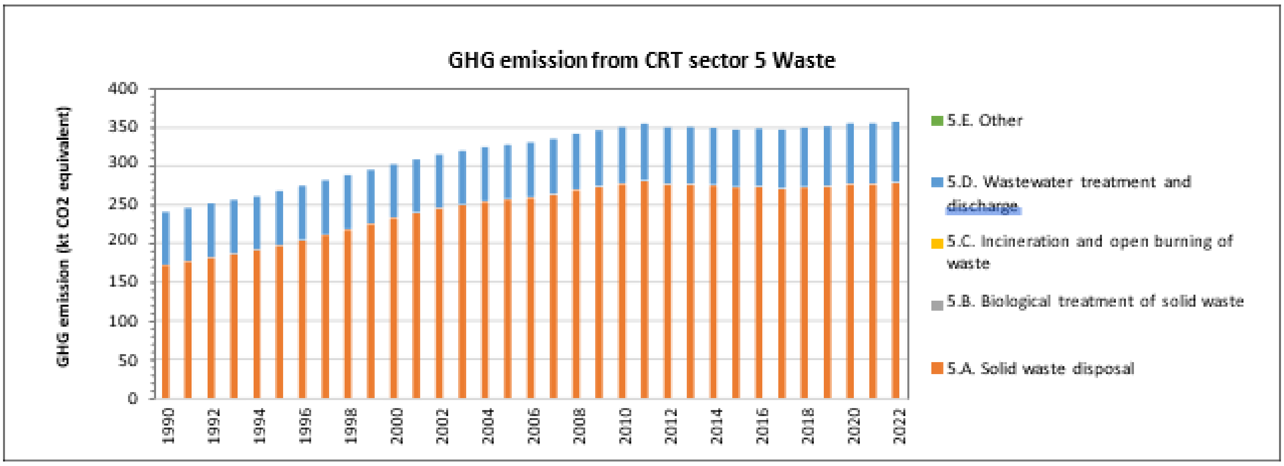
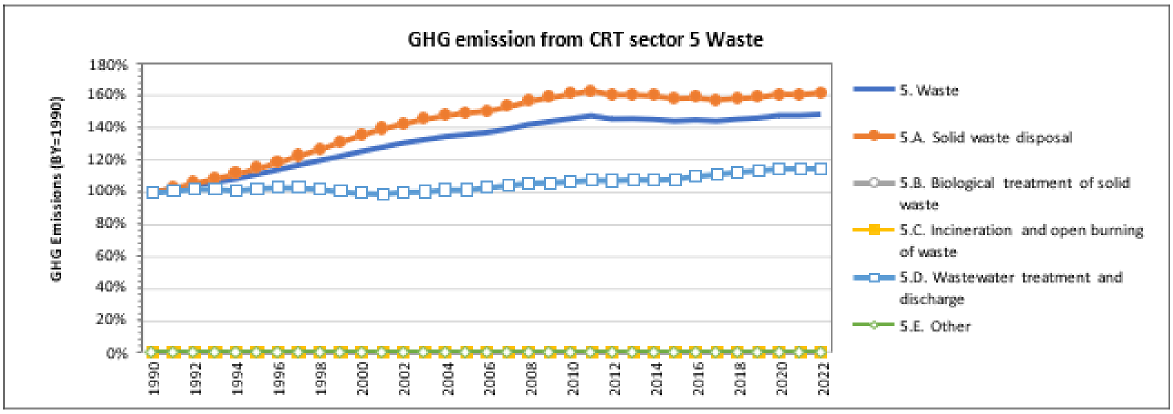
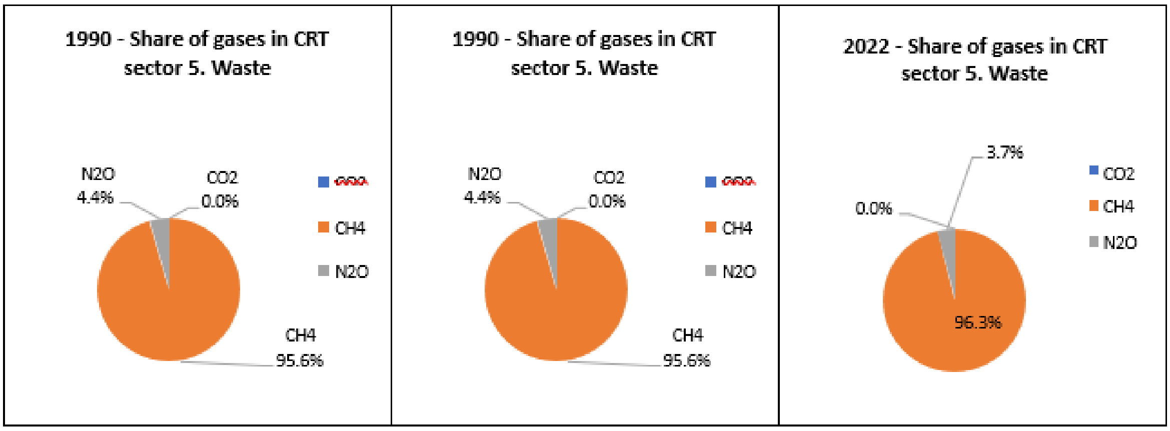


Figure 38 GHG emissions from CRT sector 5 waste by category in index form



Note: base year = 100% and all other years are gauged against that year in percentage terms)

Figure 39 Share of gases in from CRT sector 5 waste



3.5 Uncertainty calculations for the period 1990-2022

A general uncertainty assessment is not performed for this inventory cycle (i.e. the combined impact of all specific uncertainties was not assessed). However, for all sources uncertainties for activity data and emission factors used are provided in the sectoral chapters within the National Inventory. The provided information on uncertainties is mainly based on default uncertainties provided in the 2006 IPCC Guidelines.

Uncertainty estimates are an essential element of a complete inventory of greenhouse gas emissions and removals, and require a detailed understanding of the uncertainties of the respective input parameters. They should be derived for both the national level and the trend estimate, as well as for the component parts such as emission factors, activity data and other estimation parameters for each category.

As presented in the 2019 refinement to the 2006 IPCC Guidelines, two approaches for the estimation of combined uncertainties can be applied:

- Approach 1 uses simple error propagation equations and is used to estimate uncertainty in individual categories, in the inventory as a whole, and in trends between a year of interest and a base year.
- Approach 2 uses Monte Carlo or similar techniques.

However, the GHG inventory for 1990 – 2022 is prepared mainly applying TIER 1 methodology including TIER 1 emission factor of the 2006 IPCC guidelines and the 2019 Refinement to the 2006 IPCC Guidelines. Therefore, the default uncertainties associated with the activity data and emission factors were selected.

TIER 1 should be implemented using Table 3.2 of the 2019 Refinement to the 2006 IPCC GL.

- The excel based tool '19R_V1_Ch03_Ad_IPCC_Tool_for_Approach_1_Uncertainty_Analysis.xlsx' provided with the 2019 Refinement to the 2006 IPCC GL31 was applied.

- The uncertainty calculation was performed applying TIER 1 of the 2019 Refinements to the IPCC 2006 GL, for all sectors excluding LULUCF.

As a result of the uncertainty analysis, the following tables show a total uncertainty of 6.1% for 2022 (excluding LULUCF) and a total trend uncertainty of 2.7% for 1990 – 2022.

Table 34 Summary report of uncertainties analysis

Sector	Emissions / removals in base year (1990)	Emissions / removals in year t (2022)	Contribution to total uncertainty by sector in year t	Contribution to total trend uncertainty by sector
	kt CO_2 equivalent	kt CO_2 equivalent	%	%
Energy	2385.46	2612.98	10.7	14.5
IPPU	1629.37	221.97	14.8	33.3
Agriculture	564.35	233.37	17.0	10.2
LULUCF	0.00	0.00	0.0	0.0
Waste	216.82	319.65	57.5	42.0
Other	0.00	0.00	0.0	0.0
Total	4796.00	3387.98	100.0	100.0
Uncertainty in total inventory			6.1	2.7

Detailed information on the Approach 1 uncertainty analysis is provided in Annex A1.6.

4.

DESCRIPTION OF MONTENEGRO'S
NATIONALLY DETERMINED CONTRIBUTION UNDER ARTICLE 4 OF THE PARIS AGREEMENT, INCLUDING UPDATES

4.1 Montenegro's 2021 updated NDC

In its updated NDC submitted in 2021, Montenegro provides a quantified mitigation target, expressed as clear numerical target, covering all sectors defined in the 2006 IPCC Guidelines except LULUCF, strengthening its 2015 NDC commitment to reducing or limiting GHG emissions by 2030 and demonstrating increased ambition to address climate change.

The target is an economy-wide absolute GHG emissions reduction target for 2030 compared to 1990 level excluding the LULUCF sector.

The revised NDC, adopted by the Government of Montenegro and submitted to the UNFCCC Secretariat in June 2021, represents the country's increased political commitment to cut GHG emissions. In line with the revised NDC, Montenegro's target aims to reducing its GHG emissions by 35% by 2030, compared to 1990 level (excluding LULUCF).

The starting date for the revised NDC of Montenegro is 1st January 2021 with an implementation period until 31st December 2030.

The reference point is total GHG emissions (excluding LULUCF) in 1990 (base year) in kt CO_2 equivalent as reported in the National GHG inventory.

IPCC sectors included are Energy, Industrial Processes and Product Use, Agriculture and Waste and the gases included are Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Perfluorocarbons (PFCs), Hydrofluorocarbons (HFCs), Sulphur hexafluoride (SF_6) and Nitrogen trifluoride (NF_3).

All source and sink categories have been included. Notation keys have been used in accordance with the IPCC 2006 Guidelines.

To quantify the target:

- Montenegro updated the GHG inventory and recalculated the time series including the base year 1990 for the time series 1990-2018 as the basis for defining the target and has shifted from the use of GWP values of AR2 to AR4 from the previous inventory used for the 2015 INDC. Although such updates lead to higher-quality NDC, the GHG inventory recalculations performed based on improvements in GHG data and the change of GWP values led to small increase in the estimated emission levels for the whole time series.

- Montenegro performed projections of Activity Data based on GDP and population projections, including a 'business as usual' and a NDC scenario. The NDC scenario only took into account the planned policies with high chances to be implemented or in place policies and measures adopted in official strategic documents.

The updated NDC has been prepared during 2020 and its target is based on analysis of historic GHG emission trends, and an impact assessment of mainly existing climate mitigation measures. The measures were shared and largely discussed and agreed with the relevant stakeholders. These measures were approved by the government, and streamlined with the integrated National Energy and Climate Plan.

Economic measures, such as the introduction of an emission trading scheme, have also been set. Montenegro adopted a by-law allowing the country to participate in the EU ETS from 2025 onwards.

The updated NDC target for 2030 will be fulfilled by Montenegro and is not currently part of a regional joint agreement. However, Montenegro is a candidate country to the EU and is currently implementing negotiation chapter 27 on 'Environment and Climate Change'. The chapter has been opened in December 2018. Further efforts are being implemented to align with the EU 2030 climate and energy policy framework. In fact, in 2007, Montenegro accessed the Energy Community Treaty (ECT), which allows the country to be an active member of the Regional and European Energy Market, obliging the state to align its national energy related legislation with the community acquis. Currently, work on preparing an Integrated National Energy and Climate Plan, as required by the EU Governance Regulation (EU 2018/1999) has started and is in its finalisation phase.

The accounting rules for international carbon markets under Article 6 of the Paris Agreement have not been set yet. Montenegro has not made any national decision on this issue yet but is striving to participate in the EU emission trading scheme (ETS) from 2025 onwards.

The accounting guidance included in Annex II of decision 4/CMA.1 is used for accounting of anthropogenic emissions and removals.

Mitigation policies and measures already implemented or with a realistic chance to be implemented in the coming years were identified and assessed. For the implementation of the revised NDC, 18 mitigation policies and measures were selected: 12 in the energy sector; 2 in the transport sector; 2 in the sector of industrial processes and product use; and 2 in the waste sector.

Although LULUCF was not included in the target, it was estimated in the GHG inventory as follows:

- Emissions and removals are estimated using 2006 IPCC Guidelines without any special approach to exclude emissions or removals due to natural disturbances.
- Harvested Wood Products are estimated based on the production approach (or approach B) of the 2006 IPCC Guidelines. Activity data have been derived from the FAOStat database on forestry production and trade statistics.
- Variations on the carbon stock in forest is estimated based on the information of the Montenegro's National Forest Inventory (NFI). Living biomass increase has been estimated using increment data from the NFI. While there has only been one inventory cycle so far, increment estimates were derived based on increment borer measurements of sample trees. Age classes are taken into account implicitly in the estimation of the growth rates of the different species.

4.2 Updates performed for improving Montenegro's 2021 updated NDC

The following table summarizes the methodological updates in the estimation of the progress of the updated NDC of Montenegro.

Table 35 Methodological updates in the estimation of the progress of the updated NDC of Montenegro.

Metrics and methodologies used for updating the NDC 2021	Updates performed for tracking the revised NDC 2021
The GHG emission inventory used to set the updated NDC is in compliance with the IPCC 2006 Guidelines. Consistent methodologies have been applied throughout the reported period (1990-2018), efforts have been made to apply country specific data and moving to higher Tier methods, and accuracy and completeness was increased – especially in the LULUCF sector.	Methodological improvements have been performed to the GHG inventory including the use of the 2019 Refinement in addition to the IPCC 2006 Guidelines to better reflect national circumstances and increase the accuracy of the GHG estimates. Recalculations are presented in this section.
The GWP values (for a 100-year time horizon) used were the ones presented in the IPCC 4th Assessment Report.	The GWP values (for a 100-year time horizon) used are the ones presented in the IPCC 5th Assessment Report.
For the revision of the NDC and using the 1990-2018 GHG inventory, total GHG emission levels excluding LULUCF in the Business-as-usual scenario were projected to be 4 046 kt $CO_{2\text{-eq}}$ in 2030 which is about 24% lower than in 1990 levels of the inventory used as a reference.	Using a recalculated 1990-2022 GHG inventory and improving the approach to perform projections, total GHG emission levels excluding LULUCF in the without measures scenario were projected to be 4927.21 kt CO2 eq in 2030, representing a 2.80% increase from the recalculated 1990 levels.
Total GHG emission levels resulting from implementation of the adopted policies and measures in the energy, IPPU and waste sectors were projected to be around 3 301 kt CO2 eq in 2030, which is about 39% lower than the 1990 emission levels (the target being 35%).	Using the 1990-2022 GHG inventory and improving the approach to perform the projections, total GHG emission levels excluding LULUCF in the with measures scenario were projected to be 3 140 kt $CO_{2\text{-eq}}$ in 2030 which is 34.49% lower than the recalculated 1990 levels.

According to the IPCC Guidelines, the quality of the National Greenhouse Gas Inventory will be continuously improved. This implies an increase of the completeness, accuracy (e.g. use of higher tier methods), consistency, comparability, and transparency. For this reason, Montenegro performs updates and recalculations to the national GHG inventory based on methodological improvements and information on recalculations are presented here after.

Even though a QA/QC system gives assistance so that potential error sources are minimized it is sometimes necessary to make some revisions (called recalculations) under the following circumstances:

- An emission source was not considered in the previous inventory.
- A source/data supplier has delivered new data. The causes might be: Previous data were preliminary data only (by estimation, extrapolation), improvements in methodology.
- Occurrence of errors in data transfer or processing: wrong data, unit-conversion, software errors, etc.
- Methodological changes: a new methodology must be applied to fulfil the reporting obligations caused by one of the following reasons:
    - to decrease uncertainties.
    - an emission source becomes a key source.
    - consistent input data needed for applying the methodology is no longer accessible.
    - input data for more detailed methodology is now available.
    - the methodology is no longer appropriate.

Detailed information on recalculations and their justifications of emissions with respect to the previous submission are listed:

Table 36 Recalculations including explanatory information and justifications

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
1.A.1.a	Revision of NCV	AD	Accuracy
1.A.1.a.iii	Revision of NCV	AD	Accuracy
1.A.2	Revision of NCV	AD	Accuracy
1.3.1.a.i 1.3.1.a.ii	Application of 2006 IPCC Guidelines methodology and estimation of GHG emissions	EMI	Comparability Completeness
1.A.3.b	Fuel consumption data (activity data) was revised due to revised assumption regarding vehicle fleet distribution	AD	Accuracy Transparency
1.A.3.b	Tier 2 approach and COPERT model was applied Expert judgment and assumptions were applied	AD	Accuracy
1.A.3.b	Revision of NCV	AD	Accuracy
1.A.3.c	Application of 2006 IPCC Guidelines methodology and estimation of GHG emissions	EF	Comparability
1.A.3.c	Revision of NCV	AD	Accuracy
1.A.3.d.i 1.A.3.d.ii	Application of 2006 IPCC Guidelines methodology and estimation of GHG emissions	EF	Comparability
1.A.3.d	Revision of NCV	AD	Accuracy

2D1 Lubricants	Recalculation due updated Energy balance data (2005-2022)	AD	Accuracy
3.A	Correction of technical mistakes	AD, EF	Accuracy
3.B (N2O)	Application of 2019 refinements to the 2006 IPCC Guidelines, and EMEP/EEA air pollutant emission inventory guidebook 2023	AD EF EMI	Accuracy
3.D	Application of 2019 refinements to the 2006 IPCC Guidelines, and EMEP/EEA air pollutant emission inventory guidebook 2023	AD EF EMI	Accuracy
5.A.	Waste statistics revised by MONSTAT	AD	Accuracy
5.A.1.	Amount of Methane Recovered from SWDS data update due to information from Landfills,, Možura" i „Livade"	AD	Accuracy
5.D	Correction of average protein supply using data from 2nd BUR, FAO and expert judgment	AD	Accuracy

5.

INFORMATION NECESSARY TO TRACK PROGRESS OF THE NDC

5.1 Accounting of progress in the implementation of the revised NDC

To assess the progress of implementation of the revised NDC, Montenegro:

- has selected an indicator.
- has updated the GHG inventory and recalculated the time series including the base year 1990 for the time series 1990-2022 and has shifted from the use of GWP values of AR4 to AR5 from the previous inventory used for establishing the target of the revised NDC as presented in the previous section B.
- Has updated the mitigation potential of policies and measures using the latest and more complete information available as presented in section D and
- has performed projections using the latest GHG inventory available as presented in section F of the current FNC/1BTR.

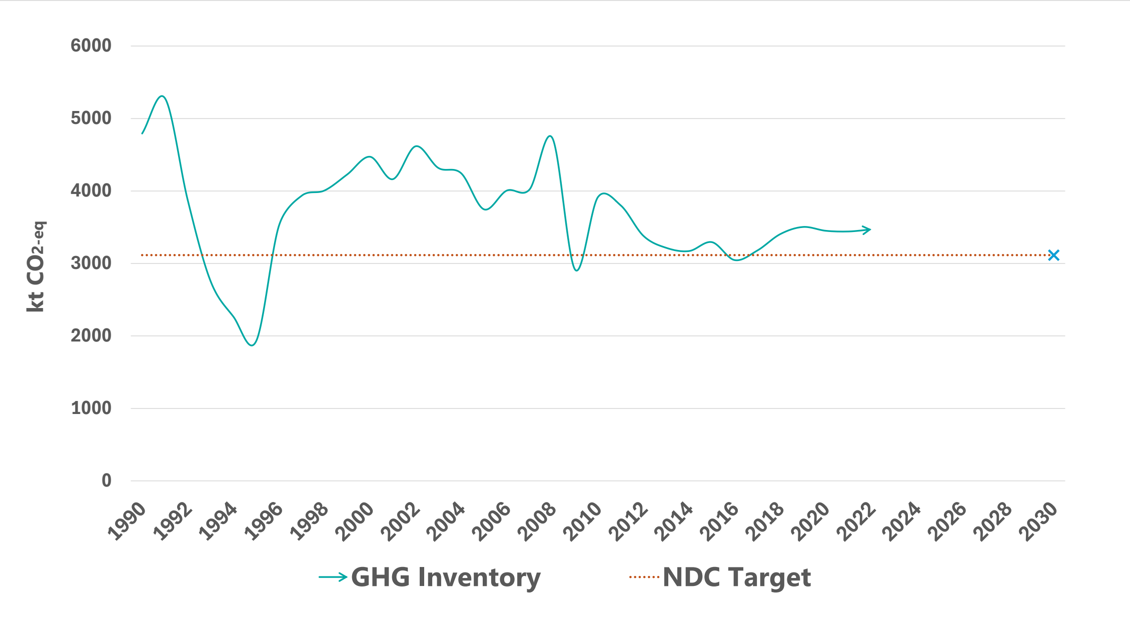
5.2 Indicator selected to track progress in the implementation of the revised NDC

The indicator selected to track progress in the implementation of the revised NDC is total GHG emissions in CO_{2eq} using the latest GHG inventory available without LULUCF in the last year compared to 1990 level.

5.3 Progress made in the implementation and achievement of the revised NDC

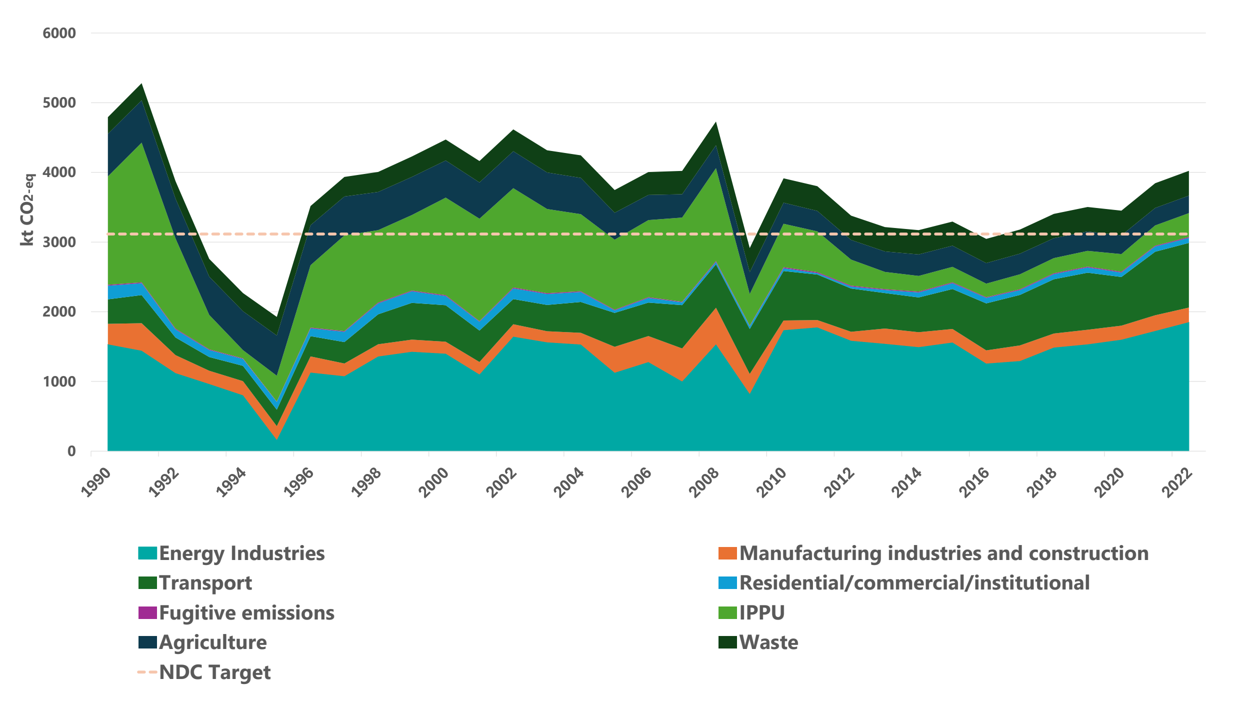
The national GHG inventory reports an emission level of 3 470 kt CO_{2-eq} for 2022 (excluding LULUCF), representing a **27.60% reduction from 1990 levels**. While this reflects a significant decrease in emissions, further reductions are necessary to meet the NDC target of a 35% reduction by 2030. The following figure illustrates the aggregated GHG emission trend from the national inventory compared to the NDC target.

Figure 40 Progress made - GHG emissions against the NDC target



The analysis by sector reveals that energy industries and transport are the primary contributors to Montenegro's national GHG emissions in 2022, accounting for 43% and 27% of total emissions, respectively. Transport and waste have shown significant increases since 1990, largely driven by overall population and GDP growth. In contrast, other sectors have experienced substantial emission reductions due to various factors, such as changes in industrial activity and sectoral efficiencies. The following figure illustrates the evolution of these main emission sources in the country compared to the NDC target.

Figure 41 Progress made – Sectoral GHG emissions against the NDC target



6.

MITIGATION POLICIES AND MEASURES INCLUDED IN THE REVISED NDC

This section presents the overarching policy framework on mitigation, a description of the mechanisms, instruments and mitigation actions by sector considered in the revised NDC, the long-term impacts of the PAMs included in the revised NDC and the economic and social impacts of the PAMs included in the revised NDC.

6.1 Overarching policy framework on mitigation in Montenegro

6.1.1 The process of accession to the European Union

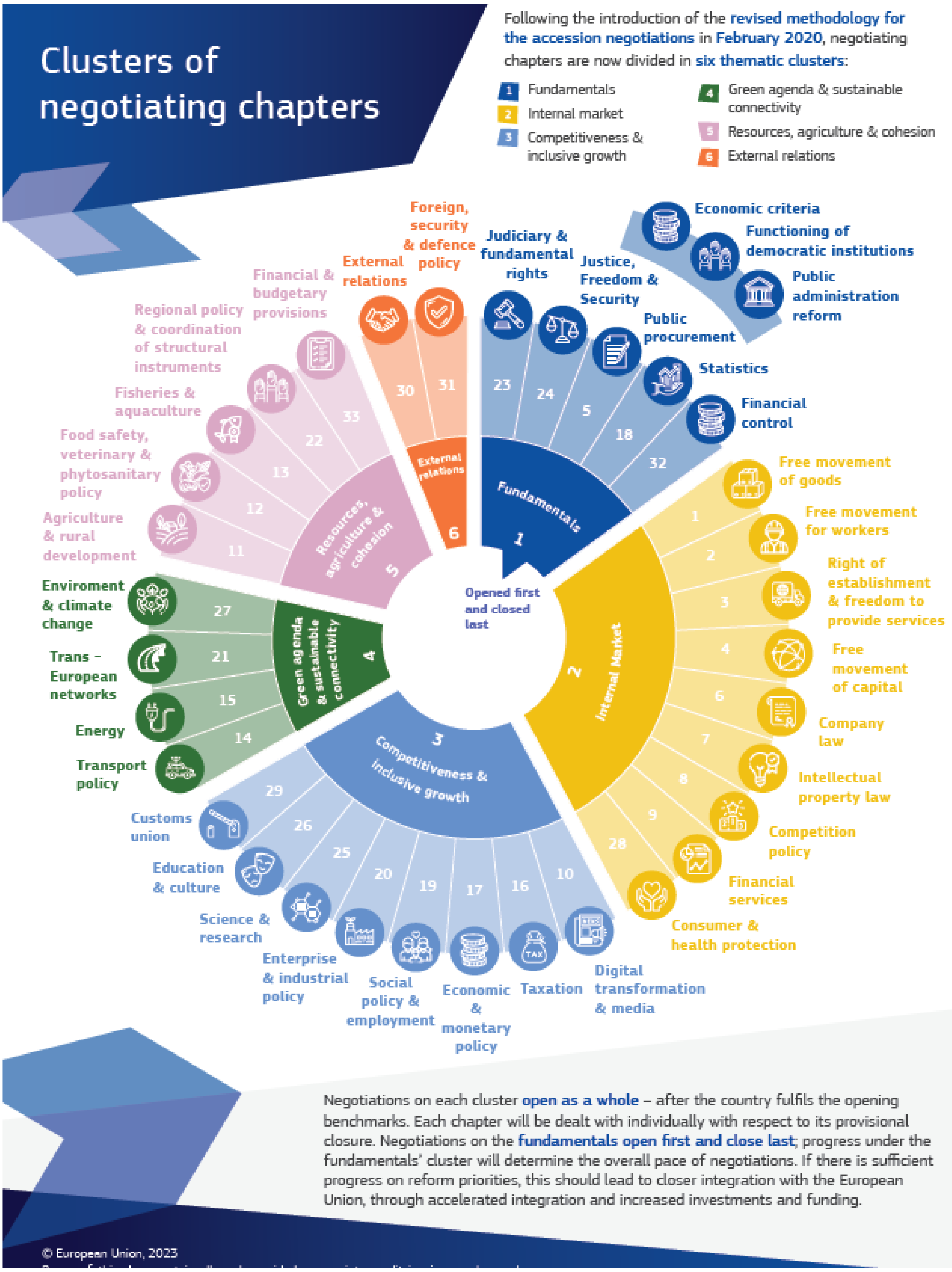
As an EU candidate country and actively committed Party to the UNFCCC and the Paris Agreement, Montenegro aspires to comply with EU acquis and the EU legislation, standards and regulations, including those related to environmental protection and climate change mitigation, through the Stabilisation and Association Agreement with the European Union which entered into force on 1st May 2010.

By adopting the National Strategy with Action Plan for transposition, implementation and enforcement of the EU acquis on Environment and Climate Change 2016-2020 at the Government session held on 28 July 2016, Montenegro expressed its strategic approach in taking over and enforcing the EU acquis in this field.

Negotiations between EU and candidate countries are used to help in the implementation of EU laws and standards. Once negotiations are finalised and approved by EU Member States and the European Parliament, all EU Member States and the candidate country sign and ratify an Accession Treaty which enables the country to become an EU Member State.

Accession negotiations are structured according to 6 thematic clusters and 33 chapters as illustrated in the figure below. Environment and climate change are included in chapter 27 under the cluster "Green agenda and sustainable connectivity".

Figure 42 EU clusters of negotiating chapters



The EU accession process thus requires candidate countries to implement complex reforms in many areas such as the rule of law and the economy and to align their legislation with the EU acquis. At the same time, candidate countries are expected to develop their administrative structures. Reconciliation, good neighbourly relations and regional cooperation are of utmost importance.

Every year, the Commission provides an Enlargement Communication, which outlines its recommendations regarding the Enlargement process, and dedicated reports, which provide a detailed assessment of the state of play and the progress made by the candidates' countries on their respective paths towards the European Union. This assessment focuses on the implementation of fundamental reforms, and also contains clear guidance on the reform priorities ahead. The Communication and the reports together constitute the "Enlargement Package".

In previous "enlargement" report and in relation to the area of climate change of chapter 27, the EU highlighted the need for Montenegro to continue its work on strengthening administrative capacity and inter-institutional cooperation i) to integrate climate change policy into all the relevant policies and strategies; ii) enhance inter-sectoral cooperation for efficient implementation of climate change policy; iii) enhance administrative capacity, human resource capacity; and technical capacity and knowledge of national institutions to carry out tasks stemming out of the Montenegrin legislation and the relevant EU acquis.

On 23rd of December 2019, the Parliament of Montenegro adopted the Law on Protection against the Negative Impacts of Climate Change. This Law represents the basis for the establishment of the National System for Monitoring, Reporting and Verification of Greenhouse Gases, the operation of the Emissions Trading System, and as well as a system that will ensure the sectoral distribution of efforts to reduce emissions outside the EU ETS System, Effort Sharing System. Moreover, with this Law it was enhanced the regulation of issues dealing with the use of ozone-depleting substances and fluorinated gases. This Law is being amended and a new proposal is expected to be adopted by the end of 2024.

Recommendations from the last European Commission "enlargement" report of October 2024 which has been submitted with the enlargement communication to the European Parliament, the Council, the European Economic and Social Committee and the Committee of Regions concerning chapter 27 – area of climate change, can be summarised as follows:

Montenegro needs to step up its efforts to implement commitments under the Energy Community's Decarbonisation Roadmap, particularly to finalise and adopt the NECP in line with the 2050 climate neutrality target.

Montenegro is also urged to fully implement the Monitoring, Reporting, Verification and Accreditation (MRVA) of greenhouse gas emissions by December 2025 as well as take decisive steps for improving its current and/or establishing new carbon pricing mechanisms, to facilitate a future alignment with the EU Emission Trading Scheme.

Montenegro is asked to finalise the development of a low emissions development strategy.

Montenegro is also set to adopt its draft Law on the protection from negative impacts of climate change and ozone layer protection to align with EU acquis on Ozone Depleting substances[77].

Energy Community Treaty

The Energy Community is an international organisation bringing together the EU and 9 neighbouring EU candidate or potential candidate countries (Albania, Bosnia and Herzegovina, Georgia, the Republic of North Macedonia, Kosovo, Moldova, Montenegro, Serbia, and Ukraine), known as the contracting parties. The Energy Community aims to extend the EU's internal energy market to South-Eastern Europe and the Black Sea region and create an integrated regional energy market based on a legally binding framework.

The Treaty establishing the Energy Community entered into force in July 2006. Montenegro is a contracting party to the Energy Community since 2007 and is thereby obligated to implement the energy regulations outlined in the treaty and to implement the EU acquis communautaire on energy, environment, competition and renewables, upon proposals by the Commission. This has been continuously extended or updated to incorporate new directives and regulations covering electricity, gas, oil, infrastructure, renewable energy, energy efficiency, competition and state aid, environment, statistics, climate and cybersecurity.

At the 20th Ministerial meeting of the Energy Community held in 2022, the Contracting Parties agreed to implement the EU electricity market rules. Once this is achieved, they will be able to fully access the EU electricity markets, and therefore to freely trade electricity with the EU.

At the 20th Ministerial Council meeting, the Contracting Parties also agreed on a set of ambitious 2030 targets for greenhouse gas emission reduction (60,9% net Greenhouse Gas Emissions reduction compared to 1990 levels), energy efficiency (129,88% maximum share of primary energy consumption and 79,06% maximum share of final energy consumption in 2030) and renewable energy (31% share of energy from renewable sources in gross final consumption of energy in 2030) for the Energy Community as a whole. The targets will constitute the benchmark for the transformation of Contracting Parties economies in line with their national energy and climate plans and their commitments to achieve climate neutrality by 2050.

In line with this, Montenegro's target for GHG emission reduction is 55% compared to 1990 level without the LULUCF sector, its target share of energy from renewable sources in gross final consumption of energy by 2030 is 50% and the country's target energy efficiency contributions in 2030 are 0.92% maximum share of primary energy consumption and 0.73% maximum share of final energy consumption.

77. SWD (2024) 694 final. Brussels, 30.10.2024. COMMISSION STAFF WORKING DOCUMENT. Montenegro 2024 Report. Accompanying the document COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF REGIONS. 2024. Communication on EU enlargement policy. Available at https://neighbourhood-enlargement.ec.europa.eu/document/download/a41cf419-5473-4659-a3f3-af4bc8ed243b_en?filename=Montenegro%20Report%202024.pdf

However, the collective greenhouse gas emissions reduction achievement of all Contracting Parties is indicative, as not all Contracting Parties' individual targets are expressed in equivalent terms[78].

During the preparation of this report, the National Energy and Climate Plan (NECP) of the country was under elaboration.

National Strategy for Sustainable Development by 2030

Montenegro has adopted the National Strategy for Climate Change by 2030 (NSCC) in 2015, which represents the horizontal policy document for climate change in the country. The Strategy is closely linked to a number of other sectoral strategies, as well as other documents reoffering to climate change issues and has been developed taking into account the identified effects of climate change, current socio-economic development and future development scenarios based on existing information.

The NSSD outlines a comprehensive approach to sustainable development. The NSSD is a key national strategic document drawing the pathway for economic and human development in Montenegro under the premise of sustainable and equitable development considerations.

The NSSD promotes leveraging international funds and regional cooperation for climate change mitigation. The NSSD outlines six priority themes to be accomplished by 2030 which includes measures related to the construction of energy efficient building, reducing GHG emissions through low-carbon technologies in the areas of energy, industry, agriculture, forestry and waste management, and increasing the share of renewable energy sources and promoting the rational use of energy. Its target defines that by 2030 GHG emissions levels are reduced by 30% compared to baseline 1990 as established in the Intended National Determined Contribution (INDC) of Montenegro which became the first NDC upon ratification of the Paris Agreement.

National Climate Change Strategy (NCCS) by 2030

Overall, the National Climate Change Strategy (NCCS) is committed to creating a competitive, safe, and sustainable energy sector through coordinated efforts at the national and EU levels, ensuring regulatory certainty, and fostering green growth and job creation through early investments in a low-carbon economy.

The National Strategy on Climate Change provides a concise overview of the GHG emissions trends in the emitting sectors and includes projections for key emission sector based on the identification of mitigation policies and measures. Sectoral projections were formulated for two scenarios: with existing measures (WM) and with additional measures (WAM). Additionally, the strategic document outlines

78 DECISION OF THE MINISTERIAL COUNCIL OF THE ENERGY COMMUNITY No 2022/02/MC-EnC on amending Ministerial Council Decision No 2021/14/MC- EnC amending Annex I to the Treaty Establishing the Energy Community and incorporating Directive (EU) 2018/2001, Directive (EU) 2018/2002, Regulation (EU) 2018/1999, Delegated Regulation (EU) 2020/1044, and Implementing Regulation (EU) 2020/1208 in the Energy Community acquis communautaire

potential GHG saving measures and their associated costs, adaptation measures to climate change with corresponding costs, compliance with EU climate change legislation, action plans, investment planning, and financing strategy implementation.

The strategy projects a reduction in GHG emissions by 40-44% by 2030 compared to 1990 levels, with a target of 79-82% by 2050. Specific to the energy sector, emissions are expected to decrease by 54-68% by 2030 and reach 93-99% by 2050.

In the energy sector, the NCCS by 2030 aims to comprehensively address energy sectoral emissions and enhance energy efficiency across key sectors such as buildings and transport. To achieve the national ambitious targets, the NCCS outlines a multifaceted approach focusing on increasing the share of renewable energy to at least 27%. The strategy emphasises the importance of a stable regulatory framework to attract investments in low-carbon technologies and infrastructure. This includes doubling investments in low-carbon energy generation and expanding the capacity of existing electricity networks. Furthermore, the construction of new and improved transmission networks is deemed crucial for balancing a decarbonised electricity system and integrating it into the energy market.

In buildings, the NCCS promotes significant energy efficiency improvements through initiatives such as the Energy Efficiency Directive, which targets a 30% energy savings by 2030. Similarly, the transport sector aims to reduce GHG emissions by 20% by 2030, leveraging cleaner technologies and alternative fuels, such as hybrid and electric vehicles, and promoting multimodal transport systems. The strategy also supports innovations in green technologies and expects the share of clean technologies to increase from 45% in 2011 to 60% by 2020, and up to 100% by 2050.

For the IPPU sector, the actions identified are revolving exclusively around the KAP electrolysis plant, which as of 2024 has halted primary aluminium production.

The NCCS also identifies potential GHG-saving measures for the waste sector, encompassing both existing policies and measures (PAMs), as well as additional PAMs to further increase the waste management ambition. There are three existing PAMs, namely: (1) constructing six regional sanitary landfills with recycling centres, (2) reducing waste disposal rates by increasing recycling rates to 25% by 2014 and 50% by 2020, and (3) reducing the share of biowaste in the total waste generated in Montenegro from 63% in 2010, to 47% in 2015, and 22% by 2025, such that the amount of biowaste disposed of by 2017, 2020, and 2025 is respectively reduced to 75%, 50%, and 35% of 2010 levels. There are two additional PAMs, proposed, namely: (1) installing a system for collecting and burning landfill gas in the new landfill sites for energy production, and (2) installing Combined Heat-Power (CHP) waste-to-energy facilities using the biodegradable waste that is not sent to landfills.

Law on the Protection against Adverse Impacts of Climate Change (2019)

In 2019, the Parliament of Montenegro approved the Law on the Protection against the Negative Effects of Climate Change[79] (OG 73/19).
This Law regulates the provisions and rules aimed at setting the protection against negative effects of the climate change, including the aim of reduction of greenhouse gas emissions, ozone layer protection and other issues related to the protection against known negative effects of climate change in general.
The Law on the Protection against Adverse Impacts of Climate Change, adopted at the end of 2019, addresses all climate issues relevant to Montenegro and incorporates elements of the EU's Clean Energy Transition policy. It establishes national systems for GHG inventories and projections, carbon storage, and ozone layer protection, and outlines obligations for stationary plants and aircraft operators. The law also includes provisions for the Low Carbon Development Strategy (LCDS) and National Adaptation Plan (NAP).
The Law lays the groundwork for the National Monitoring, Reporting and Verification of GHG System and the operation of the Emissions Trading System (ETS). Additionally, this law addresses the use of ozone-depleting substances and fluorinated gases. After adopting the Law, the then Ministry of Ecology, Spatial Planning and Urbanism established a working group to draft bylaws and adopted several rulebooks:

- Rulebook on the manner of preparation and content of the inventory of greenhouse gas emissions (OG 55/20);
- Rulebook on the manner of determining the mandatory targets for reducing greenhouse gas emissions (OG 57/20);
- Rulebook on the detailed manner and necessary documentation for issuing a permit for import and/or export of ozone-depleting substances and alternative substances (OG 69/20);
- Rulebook on the content of the plan for monitoring the emission of greenhouse gases from a plant (OG 92/20);
- Rulebook on the plan for monitoring greenhouse gas emissions from aircraft (OG 102/20);
- Rulebook on the detailed content of labels, guides, posters, displays and promotional literature and materials on fuel consumption and carbon dioxide emissions from new passenger vehicles (OG 113/20);
- Rulebook on the form of the permit for the emission of gases with the effect of greenhouses and the manner of keeping records (OG 13/21);
- Rulebook on the form, content and manner of verification of the report on greenhouse gas emissions (OG 13/21);
- Rulebook on detailed conditions of access to the carbon dioxide transport network, procedure and criteria for acceptance of carbon dioxide flows (OG 12/21);

79 Chapters of this Law are as follows: I. Basic provisions; II. Documents for the protection against climate change negative impacts; III. Achieving low carbon development; IV. Emission reporting and report verification; V. Geological storage; VI. Ozone layer; VII. Supervision; VIII. Penalty provisions; and IX. Transitional and final provisions.

- Rulebook on conditions regarding personnel and equipment for a legal entity that verifies the report on greenhouse gas emissions (OG 12/21).

Draft Law on Protection from the Negative Impacts of Climate Change and Protection of the Ozone Layer

The draft Law on Protection from the Negative Impacts of Climate Change and Protection of the Ozone Layer was put up for public discussion in March 2023 for 30 days.
Among other things, the draft Law:

- improves the procedure for issuing permits for the emission of greenhouse gases in the emissions trading system (ETS) in terms of issuing permits, revision of permits, validity periods, permit changes (deadlines for processing and submitting requests), termination of permit validity;
- improves the process of creating, submitting and evaluating the emissions monitoring plan for both stationary plants and aircraft, as well as the simplified monitoring plan;
- improves reporting and verification of emissions reports, conservative estimates of emissions, control of fulfilment of requirements for verifiers;
- more fully regulates the GHG emissions trading system in terms of allocation methods and conditions for exclusion from the ETS system, as well as the circumstances under which free credits can be allocated (preventing the displacement of energy-intensive industries), as well as the management and control of emissions data in the ETS;
- establishes a national inventory system of gases with a greenhouse effect;
- establishes a national reporting system on policies and measures to mitigate climate change, measures to adapt to climate change, as well as reporting on GHG emission projections in terms of defining clear responsibilities and deadlines for reporting, obligations and responsibilities for the collection and quality of data relevant for reporting
- establishes a financing system for protection against the negative impact of climate change and the use of funds collected in the emission trading system, as well as reporting on the use of income.

In the Draft Law, the following acts were transferred:

- Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ("European Climate Law");
- Commission Implementing Regulation (EU) 2020/2085 of 14 December 2020 amending and correcting Implementing Regulation (EU) 2018/2066 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council;
- Commission Implementing Regulation (EU) 2020/2084 of 14 December 2020 amending and correcting Implementing Regulation (EU) 2018/2067 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council;
- Commission Implementing Regulation (EU) 2020/1208 of 7 August 2020 on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) 2018/1999 of the European Parliament and of the Council and repealing Commission Implementing Regulation (EU) No 749/2014;

- Commission Delegated Regulation (EU) 2020/1044 of 8 May 2020 supplementing Regulation (EU) 2018/1999 of the European Parliament and of the Council with regard to values for global warming potentials and the inventory guidelines and with regard to the Union inventory system and repealing Commission Delegated Regulation (EU) No 666/2014;
- Commission Implementing Regulation (EU) 2018/2067 of 19 December 2018 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council;
- Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012;
- Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council;
- Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement;
- Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework;
- Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006;
- Regulation (EC) No 1005/2009 of the European Parliament and of the Council of 16 September 2009 on substances that deplete the ozone layer;
- Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006;
- Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC;
- Directive 1999/94/EC of the European Parliament and of the Council of 13 December 1999 relating to the availability of consumer information on fuel economy and CO2 emissions in respect of the marketing of new passenger cars.

In March 2024, the Ministry responsible for proposing the Law organized another public hearing and submitted the draft for compliance assessment, which is now being finalized.

6.1.2 PAMs included in the revised NDC by sector

This section presents the mechanisms and instruments in the policy landscape and summary information on the PAMs included in the revised NDC of Montenegro by sector.

6.1.3 Energy Sector

Mechanisms and instruments focusing on mitigation in the energy sector

Energy
• State Aid and Market Instruments, Decree on activities that emit greenhouse gases for which a permit for the emission of greenhouse gases is issued and additional by-laws • Law on Energy • Law on the use of energy from renewable sources • Law on Efficient Use of Energy • Law on Exploration and Production of Hydrocarbons • Law on Cross-border Exchange of Electricity and Natural Gas

State Aid and Market Instruments

Montenegro's national climate change policies utilise market instruments such as subsidies, including tax incentives, feed-in tariffs, preferential financing, and credit guarantees; taxes on carbon dioxide emissions and eco taxes; and participation in the EU Emissions Trading System (EU ETS). Recently, the government introduced support schemes for renewable energy through several regulations. These include rules for acquiring privileged electricity producer status, managing guarantees of origin for renewable and high-efficiency cogeneration, and setting incentive tariffs for electricity from these sources.
There is a feed-in tariff for electricity from renewable sources in Montenegro from 2020. The operators of plants that generate electricity from renewable energy sources can obtain the status of a "Privileged Producer/Generator". Then they acquire the right to a price support for the generated electricity under the legal requirements. Based on Art. 73 § 2 Energy Law the Government adopted the Tariff System Decree, that determines the amount of the feed-in tariff. The prices are revised annually in accordance with the inflation indexes reported during the previous year (Art. 8 § 2 Tariff System Decree).

Decree on Activities for which a GHG Permit is Issued (Official Gazette of Montenegro, No. 08/20)

The Government of Montenegro in February 2020 adopted the Decree on activities or operations that emit greenhouse gases for which a greenhouse gas emissions permit is issued. The Decree is in force and regulates free allocation and auctioning, and establishes national registry for Greenhouse Gases (GHG) emission trading. This bylaw determines sectoral coverage and inclusion thresholds, rules governing trading of allowances, allocation rules, and a market stabilization reserve.

Recently, the government adopted regulations for emission allowances for stationary plants and is preparing additional bylaws in line with the draft law on the Protection against Adverse Impacts of Climate Change. There are some additional set of by-laws which are relevant for the energy sector since 2011:

- Rulebook on the contents of the annual operational plan for improving energy efficiency and reports on the implementation of the plan ("Official Gazette of Montenegro", No. 08/16 of 05 February 2016) which closer regulates manner of EE planning at the level of the central government;
- Decree on reconstruction of official buildings ("Official Gazette of Montenegro" No. 09/16 of 11 February 2016) defines the dynamics of reconstruction of administrative buildings at the annual level (1%), defines buildings that are excluded from the obligation of reconstruction and gives priority to buildings with lowest energy performance;
- Rulebook on the methodology for determining energy savings ("Official Gazette of Montenegro", No. 22/16 of 31 March 2016) defines TD and BU methods of energy savings monitoring in accordance to EU best practice ;
- Rulebook on methodology for determining the level of energy efficiency in the public procurement procedure ("Official Gazette of Montenegro", No. 09/16 of 11 February 2016);
- Rulebook on the type of energy related product for which energy efficiency labelling is mandatory ("Official Gazette of Montenegro" No. 75/15 of December 25, 2015) establishing a general framework for energy labelling and creating a legal basis for the adoption of rulebooks which regulates energy efficiency labelling of specific group of products as follows:
  - Rulebook on energy efficiency labelling of household washing machines ("Official Gazette of Montenegro" No. 75/15 of December 25, 2015);
  - Regulation on energy efficiency labelling of air-conditioners ("Official Gazette of Montenegro" No. 75/15 of December 25, 2015);
  - Rulebook energy efficiency labelling of household refrigeration appliances ("Official Gazette of Montenegro" No. 74/16 of 1 December 2016);
  - Rulebook on energy efficiency labelling of televisions ("Official Gazette of Montenegro" No. 74/16 of 1 December 2016);
  - Rulebook on energy efficiency labelling of household dishwashers ("Official Gazette of Montenegro" No. 74/16 of 1 December 2016);
  - Rulebook on energy efficiency labelling of electric lamps and luminaries ("Official Gazette of Montenegro" No. 74/16 of 1 December 2016).
  - Regulation on the eco-design of energy related products ("Official Gazette of Montenegro" No. 09/16 of 11 February 2016) establishing a general framework for ecodesign and creating a legal basis for the adoption of rulebooks which regulates ecodesign requirements for specific group of products as follows:
  - Rulebook on ecodesign requirements for electric motors ("Official Gazette of Montenegro" No. 39/2017 of 22 June 2017);
  - Rulebook on ecodesign requirements for non-directional lamps ("Official Gazette of Montenegro" No. 39/2017 of 22 June 2017);

    - Rulebook on ecodesign requirements for fluorescent lamps, high intensity discharge lamps, and for ballasts and luminaires able to operate such lamps ("Official Gazette of Montenegro" No. 39/2017 of 22 June 2017).
    - Rulebook on the amount of the incentive fee for promoting electricity production from renewable energy sources and cogeneration (Official Gazette of Montenegro no 18/14).
    - Rulebook on criteria for issuance of energy permit, content of a request and registry of energy permits (Official Gazette of Montenegro no 49/10, 38/13).
    - Rulebook on types and classification of power plants for electricity generation from renewable energy sources and high efficiency cogeneration plants (Official Gazette of Montenegro no 28/11).
- Decree on acquiring the status and accomplishing entitlements of the privileged producer of electricity (Official Gazette of Montenegro no 37/11).
- Decree on manner of issuance, transfer and cancellation of guarantees of origin for energy produced from renewable energy sources and high efficiency cogeneration (Official Gazette of Montenegro no 37/11).
- Decree on tariff system for determining incentive prices for electricity produced from renewable energy sources and high efficiency cogeneration (Official Gazette of Montenegro no 52/11).
- Rulebook on more detailed requirements legal entity should meet in order to perform measurement and survey of renewable energy sources potential (Official Gazette of Montenegro no 28/11).
- Decree on incentive fees for promoting electricity production from renewable energy sources and cogeneration (Official Gazette of Montenegro no 08/14).

Also, the main requirements of the Energy Efficiency Directive related to energy efficiency on the supply side are transposed through the Energy Law ("Official Gazette of Montenegro", No. 5/16 of 20 January 2016) while further harmonization is planned through bylaws that will be adopted pursuant to this Law.

Law on Energy (Official Gazette of Montenegro no 005/16, 051/17, 082/20, 029/22, 152/22)

The Law establishes principles and regulations for energy-related activities to ensure quality and sustainability in energy production and consumption. It promoted renewable energy and high efficiency cogeneration, and organises the management of electricity and gas markets. Regulated activities include electricity generation, transmission, distribution, and supply; gas storage, transfer, distribution, and supply; transport and storage of petroleum, petroleum products, and liquid natural gas; production and supply of heat energy; combined production of electrical and thermal energy; and biofuel production, storage, and trade. Currently, activities on transposition of the Regulation (EU) 2019/942, Regulation (EU) 2019/943, Regulation (EU) 2017/2196 and Regulation (EU) 2017/1485, which were incorporated into the acquis of the Energy Community by Decision D/2022/03/MC, into Law on Energy is ongoing and it is expected they will be adopted by the end of 2024.

Law on the use of energy from renewable sources (Official Gazette of Montenegro no 82/24)

In August of 2024, Montenegro adopted the Law on the use of energy from renewable sources. With this law, Montenegro fulfils its obligation towards the Energy Community to transpose and implement Directive

(EU) 2018/2001 on the promotion of the use of energy from renewable sources. In order to promote, produce and use energy from renewable sources, this Law regulates the determination of the share of energy from renewable sources, incentives for the production of energy from renewable sources, conditions and procedure for acquiring the status of temporary privileged producer and privileged producer, issuing guarantees of origin for energy produced from renewable sources, the status of buyers-producers and communities of renewable energy sources, the use of renewable energy sources in the heating and cooling sector and in the transport sector, sustainability and criteria for saving greenhouse gases, regional cooperation, as well as other issues of importance for energy use from renewable sources. The Law also introduces communities of renewable energy sources. This Law envisages comprehensive set of bylaws to be adopted in order to complete the renewable energy acquis.

Law on Efficient Use of Energy (Official Gazette of Montenegro no 29/10)

This Law governs methods for efficient energy use, measures to improve energy efficiency, and other related issues. It excludes energy efficiency regulations for facilities involved in energy production, transmission, and distribution. The December 2022 amendments incorporated changes from the Energy Efficiency Directive, including provisions for 2030 target setting and integrated planning.

Law on Exploration and Production of Hydrocarbons (Official Gazette of Montenegro no 41/10, 62/13)

This Law governs the conditions, the manner of and the procedure for the exploration and production of hydrocarbons, as well as other matters important for the exploration and production of oil and gas.

Law on Cross-border Exchange of Electricity and Natural Gas (Official Gazette of Montenegro, No. 42/2016)

This law regulates the conditions for access to transmission systems for the cross-border exchange of electricity and natural energy of gas and the way to ensure the security of gas supply and the transparency of the electricity and gas market.

Currently, activities on transposition of the Regulation (EU) 2016/1719, Regulation (EU) 2017/2195, and Regulation (EU) 2015/1222, which were incorporated into the acquis of the Energy Community by Decision D/2022/03/MC, into Law on Cross-border Exchange of Electricity and Natural Gas is ongoing and it is expected they will be adopted by the end of 2024.

Mitigation actions of the energy sector included in the revised NDC

This subsection provides a description of the 12 PAMs included in the revised NDC of Montenegro in the energy sector with a summary of the emissions reductions achieved in 2022 and expected in 2030.

Table 37 Mitigation actions in the energy sector included in the revised NDC.

<table>
<tr><th colspan="2">Number of mitigation actions</th><th colspan="3">13</th></tr>
<tr><td colspan="2">Total estimated GHG emission reductions in 2022</td><td colspan="3">812.17 ktCO2e/yr</td></tr>
<tr><td colspan="2">Name and NDC code of mitigation action</td><td>Status (planned, adopted, implemented)</td><td>Estimated GHG emission reductions achieved in 2022</td><td>Estimated GHG emission reductions expected in 2030</td></tr>
<tr><td colspan="4">Energy industry and residential/commercial sector</td><td></td></tr>
<tr><td>1E</td><td>Ecological refurbishment of Pljevlja Thermoelectric Power Plant (TPP)</td><td>Adopted</td><td>0</td><td>0</td></tr>
<tr><td>2E</td><td>Carbon pricing for TPP</td><td>Adopted</td><td>556.88</td><td>876.53</td></tr>
<tr><td>3E</td><td>NDC renewable power plants</td><td>Adopted</td><td>99.74</td><td>214.40</td></tr>
<tr><td>NA*</td><td>New renewable capacity</td><td>Adopted</td><td>0.00</td><td>313.48</td></tr>
<tr><td>4E</td><td>District Heating in Pljevlja</td><td>Adopted</td><td>0.00</td><td>5.47</td></tr>
<tr><td>5E</td><td>Development and Implementation of Energy Efficiency Regulatory Framework in Buildings</td><td>Adopted</td><td rowspan="6">151.13</td><td rowspan="6">245.43</td></tr>
<tr><td>6E</td><td>Increased Energy Efficiency in Public Buildings</td><td>Adopted</td></tr>
<tr><td>7E</td><td>Financial Incentives for Citizens/Private Households (for Energy Efficiency Investments)</td><td>Adopted</td></tr>
<tr><td>8E</td><td>Energy Labelling and Eco-Design Requirements for Energy-Related Products</td><td>Adopted</td></tr>
<tr><td>9E</td><td>Establishment and Implementation of Energy Efficiency Criteria in Public Tendering</td><td>Adopted</td></tr>
<tr><td>10E</td><td>Implementation of Energy Efficiency Measures in Public Municipal Companies, Utilities and Services</td><td>Adopted</td></tr>
<tr><td>11E</td><td>Development of Transmission and Distribution Power Network (decrease in losses)</td><td>Adopted</td><td>0.00</td><td>22.86</td></tr>
<tr><td>12E</td><td>Refurbishment of Small Hydroelectric Power Plants (increased Energy Efficiency)</td><td>Adopted</td><td>4.42</td><td>3.75</td></tr>
</table>

*This PAM was not included in the NDC submission

Ecological refurbishment of Pljevlja Thermoelectric Power Plant

The Pljevlja Thermoelectric Power Plant (TPP) ecological refurbishment includes the construction of a de-sulphurisation (FGD) and de-nitrification (SCR) installation, upgrade of the electro-filtering plant, construction of a wastewater treatment facility, and reconstruction of the internal system for transporting by-products, as well as building a heating station, as a part of the district heating system (see PAM 4E).

The objective of the refurbishment is to ensure that flue gas treatment installations result in sulphur oxide (SOx) emissions ≤ 130 mg/Nm3 and nitrogen oxide (NOx) emissions ≤ 150 mg/Nm3 in accordance with the EU Decision 2017/1442 establishing the best available techniques (BAT) for large combustion plants and the Montenegrin Law on Industrial Emissions which transposed the EU Industrial Emissions Directive – IED (Official Gazette 17/19).

The planned ecological reconstruction of the TTP Pljevlja includes, among other things, the installation of a waste gas desulphurization system, which can reduce emissions from SOx by up to 80%, improving air quality in Pljevlja not only because sulfur dioxide (SO2) concentrations have sporadically increased, but also because SO2 can be a precursor of secondary suspended particles, i.e. accelerate their generation.

In addition, as part of the ecological reconstruction of the TTP Pljevlja, a system for denitrification of waste gases is planned, which will reduce NOx by up to 70% and eliminate elevated nitrogen oxides concentrations in Pljevlja.

However, ecological reconstruction will not result in lower CO2 emissions.

The TPP Pljevlja contributes between 40% and 45% of the annual electricity production in Montenegro under normal conditions (higher in periods in which hydroelectrical plants cannot work) and it is estimated that during the planned 7 months of shutdown for refurbishment in 2025 there will be a deficit of around 700 GWh of electricity with the corresponding GHG emissions avoided.

As this action will not result in mitigating GHG emissions, it will not be longer reported in the next BTRs.

Carbon Pricing for Pljevlja Thermoelectric Power Plant

The Decree on Activities which Emit Greenhouse Gases and for which a Permit for GHG Emission is issued has been in force since February 2020. With this decree the emissions of industrial and energy plants are limited by the introduction of a national emissions trading system.

In this cap-and-trade scheme the minimum price of CO2 was set at EUR 24 per tonne. Free emissions allowances were allowed for energy intensive industries and coal power plants, which included all three relevant plants in Montenegro: the Pljevlja coal plant, the KAP aluminium plant and the Toščelik steel mill.

Free allowances for TPP Pljevlja were to be reduced by 5 per cent per year and phased out by 2025, but for KAP and Tosčelik they were to be reduced by 15 per cent per year until they reached the level of the emissions factor laid out in annex 3 of the Decree setting up the scheme.

The funds collected (once auctions finally started) were to be paid into the Eco Fund and used for renewable energy, environmental protection or innovation in line with Montenegro's smart specialisation strategy.

The cap was planned to decrease only by 1,5 per annum until 2030.

The scheme enabled a transfer of around EUR 17 million from state-owned electricity company EPCG to the KAP aluminium plant in February 2021.

The way the allowances were estimated presented several shortcomings:

Knowing that the Pljevlja plant would be offline for some time during its refurbishment, there was a danger of a surplus of credits accumulating if the number of allocated credits was not reduced sufficiently.

Allocating free credits for KAP was also questionable in state aid terms, because it has been subject to bankruptcy proceedings since 2013.

The baseline emissions for deciding on the number of free allowances for KAP and Tosčelik had been set according to the production levels of 2005-2008, which were 2-3 times the levels in 2020-2021. The European Commission Decision in force when Montenegro set up its scheme did indeed set 2005-2008 as the reference years for baseline data. However it also clearly said in Article 7 that where production levels had significantly changed, data on the changed operation should be used as the baseline but Montenegro Decree did not include this article.

In the meantime, the scheme has become even more pointless due to the fact that both Tosčelik and KAP have virtually shut down production or getting under the ETS thresholds.

For these reasons, the carbon pricing policy for the TPP Pljevlja did not achieve the expected outcomes during the period 2020–2022. However, electricity prices have risen in recent years, leading to reductions in electricity consumption across several end-use sectors. This, combined with the indirect effects of carbon pricing and the prospects of EU accession and further integration into the EU Emission Trading Scheme, has contributed to significant GHG reductions. When comparing emissions from energy industries in 2021–2022 with the higher levels observed in previous years, a noticeable decline is evident.

In mid-2021 the government set up a working group to carry out changes in the Decree governing the scheme, but this initiative is still being finalised by the inclusion of improvements in the draft law on Protection from the Negative Impacts of Climate Change and Protection of the Ozone Layer. These improvements are related to ensuring that the cap on emissions is tight enough and decreases in line with the 2030 ambitions needed to tackle climate change; defining more clearly the end of free allowances and rules around trading and setting realistic baseline year for emissions.

NDC renewable power plants

During the period 2021–2024, Montenegro has made several investments in renewable energy projects, adopting key initiatives to increase its capacity for clean electricity generation. Among these, the modernization and expansion of HPP Perućica will add a new turbine-generator unit (G8), increasing the plant's capacity by 58.5 MW, from 307 MW to 365.5 MW, with an expected completion date by the end of 2027[80] as well as the reconstruction and modernization of HPP Piva, which has a capacity of 342 MW,..

As for HPP Komarnica, the project is controversial, having not obtained environmental permission.

The public power utility EPCG has planned to invest in several photovoltaic power plants, hydropower plants (Kruševo and Ćehotina) as well as projects aimed at prosumers (projects Solari 500+, 3000+ and 5000+). So far, EPCG Solar-Gradnja has installed cca. 0.003 GW rooftop PV through Solari project. Additional 0.004 GW are expected to be installed in the next 2 years, within the next generation of Solari 10000+ project.

With adoption of the Law on use of energy from renewable energy sources, private investment, mainly in solar power is expected in next period, which is evident from the number of contracts for the construction of connection infrastructure and connection with TSO. Beside these projects, TSO and DSO have substantial number of requests for connection of new Renewable Energy Sources projects, but considering the grid constraints, they are highly unlikely to materialise until 2030.

In the wind energy sector, the Gvozd wind farm, with a capacity of 54.6 MW, is under development and is expected to become operational by mid-2026[81], producing approximately 150 GWh annually. Furthermore, in solar energy, the Velje Brdo solar photovoltaic (PV) project, along with prosumer installations, will contribute an additional 40 MW of capacity by the end of 2024, with a further 60 MW planned for 2025–2026. Together, these solar initiatives are projected to generate around 72 GWh annually. In the meantime, Government of Montenegro has abandoned WPP Briska Gora, as well as WPP Velje Brdo. The WPP Brajici is also uncertain at the moment, due to opponents from civil sector and local population[82].

New renewable power plants

Aligned with Montenegro's green energy transition goals, additional renewable energy capacity is being installed by 2030, as outlined in the Spatial Plan 2040 drafted in 2022. This plan, currently under

80 https://balkangreenenergynews.com/montenegros-epcg-secures-loan-for-new-unit-in-hpp-perucica/
81 https://www.epcg.com/media-centar/saopstenja-za-javnost/ozvanicen-pocetak-izgradnje-ve-gvozd
82 https://www.vijesti.me/vijesti/ekonomija/725368/velja-bajka-o-veljem-brdu-plan-vlade-suprotan-zakonima-planskim-rjesenjima-i-tehnickim-mogucnostima ; https://adria.tv/vijesti/ekonomija/drzava-formirala-koordinaciono-tijelo-za-velje-brdo-do-kraja-godine-bice-zavrsene-izmjene-pup-a-podgorice/

review and integration into the National Energy and Climate Plan, identifies several key projects aimed at expanding the country's renewable energy portfolio. EPCG signed memorandum of understanding with EDF for developing HPP Kruševo with installed capacity of 0.082 GW and HPP Ćehotina[83].

In December 2023, the first solar power plant on ground in Montenegro Čevo Solar with an installed capacity of 0.004 GW was put into operation.

Five new renewable energy plants have been identified for commissioning by 2030, based on the Spatial Plan and expert judgment. With the solar power plant project at the HPP Perucica - Vrtac, Slano and Krupac hydroelectric dams, EPCG has started the construction of about 0.005 GW of total power and the Zeljezara Solar Power Plant, located at the steel mill site, with a capacity of 0.005 GW. EPCG has also started the construction of a small hydroelectric power plant at the Otilovići reservoir at the existing Otilovići dam with an installed capacity of 0.003 GW. This small hydropower plant will be in operation until the end of 2026.

Additionally, Bijela Wind Power Plant, with a capacity of 0.118 GW is currently being developed, expected to be online by 2027.

Montenegro recently adopted the Law on the Use of Energy from Renewable Sources, thus taking a step towards improving the sustainability of the energy sector. The first such law in the country brings with it a new framework for encouraging investments in the field of renewable energy sources, with the aim of reducing carbon dioxide emissions and increasing energy production from clean sources. The new law replaces the previous incentive model, where the state had the obligation to purchase energy produced from renewable sources. Instead, market premiums have now been introduced that will enable the placement of energy on the free market, with lower costs for citizens. One of the key provisions of the law refers to the introduction of an auction system for renewable energy projects, which is expected by 2025. These auctions will open the door for new investments in energy from renewable sources, enabling a better integration of these sources into the energy system of Montenegro.

The projects that have concluded the Contract for the construction of connection infrastructure and connection with TSO are listed below:

Name of the power plant	Installed capacity (MW)	Type of power plant
SPP Montečevo	400	Solar power plant
WPP Bijela	119	Wind power plant
SPP Vraćenovići	87.5	Solar power plant

[83] https://balkangreenenergynews.com/montenegros-epcg-edf-sign-memorandum-of-understanding/

SPP Ubli	506	Solar power plant
SPP Sunrise	195	Solar power plant
SPP Korita	240	Solar power plant
SPP Solar Power (Velestovo)	170	Solar power plant
SPP Prediš	240	Solar power plant
Total planned capacity (MW)	**1957.5**	

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District Heating in Pljevlja

The district heating development in Pljevlja town will follow after TPP Pljevlja eco-refurbishment, while during the refurbishment, all the heating system connection related preparatory works are to be completed.

The heating project shall solve the long-lasting air pollution problem and other urgent environmental and public health issues in Pljevlja and its surroundings. The citizen of Pljevlja for heating purposes fire around 80% of the total coal used in residential sector in the country. So, the air in Pljevlja during the winter season is heavily loaded primarily with air pollutants (SO2, NOx, PM2.5, PM10, ash and dust), which are mostly the by-products of lignite combustion in individual mostly inefficient furnaces in around 5,000 local households.

The main objective of this project is to supply Pljevlja town with the heat energy via modern centralized heat supply system, from central heat source, that will close down the households' coal furnaces. It is assumed that this project will eliminate lignite as a fuel used for heating purpose in Pljevlja latest by 2030.

The phasing out of lignite used in Pljevlja municipality residential sector will result in GHG emission reduction.

Development and Implementation of Energy Efficiency Regulatory Framework in Buildings

The implementation of legislation on the minimum requirements for the energy efficiency of buildings, certification of building energy performance and regular energy audits for heating and air-conditioning systems are already generating results in reduced building energy consumption.

This measure has a major impact on the refurbishment of existing buildings and new buildings, as all fully refurbished buildings and new buildings must meet the minimum requirements.

The implementation of a regulatory framework for the building's energy performance is a measure ensuring compliance with the standards relevant to the minimum requirements of buildings energy performance.

The development of energy efficiency regulations for buildings is closely linked to meeting the requirements of Directive 2012/27/EU on energy efficiency (EED) and Directive 2010/31/EU on the energy performance of buildings (EPBD), both transposed to the national Law on efficient energy use and activities based on the requirements of these directives will continue to be implemented.

Implementation mechanisms include control of the minimum energy efficiency requirements, control of the certification obligation of both new and reconstructed buildings prior to their use, control of the energy performance certificates correctness, as well as inspection controls.

This measure has a major impact on the existing buildings refurbishment, as all retrofitted buildings must meet the minimum requirements. This multiplies the effect estimated for new buildings.

Increased Energy Efficiency in Public Buildings

Energy efficiency programs in public buildings are an effective driving mechanism to motivate authorities at the state and local levels to implement their own energy efficiency programs. The goal of this measure is to improve energy efficiency and comfort conditions in selected public sector buildings. The implementation of the measure is expected to initiate the development of the services market in the construction sector and cause a positive impact on the overall socio-economic environment. It is also expected to achieve remarkable results in the area of environmental conservation.

In Montenegro, several years of investments in increasing energy efficiency in public buildings (healthcare, education, cultural and administrative buildings) has occurred through two programs: Energy Efficiency in Montenegro (MEEP) and Energy Efficiency Program in Public Buildings (EEPPB)), implemented since 2010 and 2012, respectively. These programs have already resulted in big savings and emission reductions. The two programs have covered 48 public buildings so far, reducing annual energy consumption by 49% and emissions by 7.5 ktCO2.

The programs implemented in public buildings sector are as follows:

- Montenegro Second Energy Efficiency Project (MEEP 2) development objective is to improve energy efficiency in health sector buildings, and to develop and demonstrate a sustainable financing model. The MEEP 2 was implemented and financed by an International Bank for reconstruction and Development (IBRD) loan of EUR 6 million and contra-part funding (from captured energy cost savings and in kind contribution of the Government of Montenegro). It consists of :
    - Energy Efficiency (EE) investments in health sector buildings to support energy efficiency investments in selected health sector buildings, for which achieved energy cost savings captured are reinvested using an energy savings capture model. Related technical services, including energy audits, designs, technical revision, works supervision, technical and social monitoring before and after the EE building renovations, and issuance of energy performance certificates for all retrofitted

facilities, and Installation of energy consumption monitoring equipment in health buildings. These investments reduce energy consumption and associated CO2 emissions, help lower recurrent energy expenditures, and improve comfort levels in the retrofitted health sector facilities.

- Technical assistance, Capacity building and Communication and awareness. Technical assistance to enhance local EE capacity related to the development of a long-term sustainable EE investment framework. Capacity building activities on an as-needed basis to key project stakeholders, including local energy service providers (e.g. energy audit, design, construction and building certification companies), energy managers of retrofitted facilities, government representatives, and other key stakeholders. Targeted support includes training and technical assistance related to the issuance of building certificates, monitoring and verification of achieved energy and cost savings, improved operational and maintenance practices in retrofitted facilities, and/or other EE capacity building aspects. Communication and awareness activities by showcasing EE benefits (e.g. through promotion and dissemination of results achieved under the MEEP2) and supporting information activities on how to improve EE, including through behaviour changes.

- Project implementation support for the effective implementation and management of the project and its reflows from captured energy cost savings, including a Project Implementation Unit and a Government's Technical Service Unit (TSU) responsible for procurement and financial management functions; Project-related operating costs and financial audits.

- A Regional Energy Efficiency Programme for the Western Balkans (REEP PLUS). The Government of Montenegro has received a loan in the amount of EUR 45 million from the KfW bank, the grant from EU, through the Regional Energy Efficiency Programme for the Western Balkans (REEP PLUS), and ca. EUR 10 million from state budget for financing of the Project: "Promotion of Energy Efficiency in Public Buildings (EEPPB) – Greening Public Infrastructure in Montenegro". The Project predominantly concerns (1) the promotion of energy efficient rehabilitation and modernization of selected public buildings in the administrative, social care and educational sector, (2) the new construction of the highly efficient new ministerial complex (Nearly-Zero (NZEB) or Plus-Energy House) and (3) Energy Management (energy monitoring, optimization of operations) as well as related services in Montenegro. The Project focus on public buildings that were mainly constructed shortly after World War II and became very obsolete. Chronic problems are missing heaters or heating systems which are not working, badly insulated and leaky roofs, single-glazed windows and thermal bridges all leading to mold in and many other defects. The energy consumption is correspondingly high, the user-friendliness (indoor climate, comfort) is severely restricted, and many buildings have almost reached the end of their useful economic and technical life. After the implementation of the energy efficiency measures the terms of use shall be improved and the operating costs shall be decreased significantly. High visibility of the investments in the public sector shall also serve as an example for private households and private sector. The objective of the Project is to improve energy efficiency in selected public buildings and to ensure a reliable energy supply from renewable energy. It is also intended to contribute to reducing greenhouse gas emissions. The overarching development policy objective is that the population and the environment benefit from a sustainable, efficient and reliable energy supply. In addition, renewable energy (e.g. photovoltaic or solar thermal energy or biomass) should be used where possible.

Financial Incentives for Citizens/Private Households (for Energy Efficiency Investments)

The aim of this measure is to provide financial support mechanisms available to individuals for investing in energy efficiency and renewable energy systems (RES). It includes an introduction of dedicated state and local government subsidizing programs for energy savings in private households and RES use. Measures that contribute to reducing energy needs, as well as use of solar energy and modern forms of biomass (pellets, briquettes, wood chips) should be primarily encouraged. Some of the programs include:

- interest free loans for the installation of modern biomass heating systems
- installation of photovoltaic solar systems in remote rural areas (off-grid PV systems)
- interest-free loans for improving the energy performance of the building envelope
- subsidy program for the installation of solar systems in new buildings, through the reduction of local communal taxes.

The Ministry of Economy has launched the "Energy Efficient Home" program, which aims to reduce heating costs and increase comfort in households, achieve a significant reduction in CO_2 emissions in the household sector and develop the market for biomass heating systems in Montenegro.

The program implies an attractive and sustainable financial mechanism in order to implement energy efficiency measures in households. For the purposes of this Program, the Ministry of Economy has provided EUR 100,000 to subsidise interest and loan processing fees for:

- purchase and installation of heating systems on modern forms of biomass (pellets, briquettes), which include boilers / furnaces, piping and / or radiators;
- installation of thermal insulation on the façade of a residential building and
- installation of energy efficient façade joinery.

Citizens have the opportunity to apply for interest-free loans up to a maximum of EUR 10,000, with a repayment period of up to six (6) years, to implement the aforementioned energy efficiency measures in their households, while the Ministry of Economy will subsidize loan processing and interest for the entire loan repayment period.

Energy Labelling and Eco-Design Requirements for Energy-Related Products

The Regulation for energy labelling and eco-design requirements for energy-related products, covering a wide range of consumer goods used both in households and in the commercial and public sectors, contribute to substantial additional energy savings.

The energy labelling and eco-design requirements reflect the approximation of the EU's directives / regulations for energy related products. The energy labelling legal provisions require that economic operators provide customers with information about the energy consumption of the devices.

The eco-design requirements set minimum energy efficiency standards (and in some cases pollution standards) for a number of products, meaning that if they do not meet these standards they cannot be put on the market. These two areas of regulatory intervention choices depending on the energy efficiency of the devices available on the market.

In order to provide conditions and practices for the labelling and eco-design requirements of devices, an appropriate legal framework is already in place obliging market players (suppliers and distributors) to comply with a number of legal requirements for products. Furthermore, training has been carried out for market inspectors to ensure market compliance with the regulations.

During 2021-2022, Montenegro progressed with amendments of the Energy Efficiency Law and new labelling regulations. In 2022 Montenegro finalized the adoption of a complete package of updated energy labelling rulebooks.

Rulebooks for energy labelling adopted cover the following energy-related products: washing machines, TV sets, dishwashers, air-conditioning, refrigerators, electric light bulbs and lamps and car tires, while the eco-design rulebooks cover the following energy-related products: non-directional light bulbs for households, fluorescent lamps without integrated dimmer switches, high intensity discharge lamps and accompanying dimmers switches and luminaires, electric motors, receivers converting digital to analogue signals, water pumps, non-seal circulation pumps, domestic washing machines, domestic clothes dryers, domestic dishwashers, external power supply devices, fans, domestic refrigerators, room air-conditioning and fans, TV sets, standby and off-mode electric power consumption for electric and electronic office equipment and domestic appliances, directional light bulbs, LED lights and the associated equipment.

Establishment and Implementation of Energy Efficiency Criteria in Public Tendering

The implementation of this measure is one of the preconditions for meeting the requirements of the EU's Energy Efficiency Directive.

The main objective of this measure is to establish systematic mechanisms for introducing energy efficiency criteria into the public procurement process, in order to achieve significant energy savings as well as financial and other benefits.

Considering that the public sector is a very important contracting authority for goods and services relevant to the energy consumption aspect, successful implementation of this measure can significantly transform the market towards more energy efficient solutions, reducing the price of new technologies and promoting their wider use.

Implementation of Energy Efficiency Measures in Public Municipal Companies, Utilities and Services

In accordance with the Law on Efficient Energy Use, local governments are obliged to prepare Programmes for improving local government energy efficiency for a period of three years. The programmes shall contain a proposal of energy efficiency measures for the local governments, which includes a plan for adaptation and maintenance of buildings used by local government bodies to perform activities and public services founded by local government, with the aim of improving energy efficiency; plans for the improvement of the communal services system (public lighting, water supply, waste management, etc.) and transport to improve energy efficiency; specific energy efficiency measures in buildings that are protected as cultural property, etc.; other energy efficiency measures to be implemented in the area of local self-government.

Based on adopted local EE programs, several municipalities have already implemented various EE measures. So far, public lighting has already been replaced in some municipalities. All local energy-efficiency programs envisage this action, since it is easy to implement and cost-effective.

This measure accounts for the improvement of condition, monitoring and maintenance, as well as investments to improve energy efficiency related to: public lighting, water supply and sewerage and other utilities.

Development of Transmission and Distribution Power Network

The transmission and distribution network operators have the obligation to provide enough network capacities to enable a reliable electricity supply for all network users (generators and consumers). However, there are electricity losses where the network is not well dimensioned. Therefore, network operators invest in capacities and the network control in order to improve its operation and efficiency. Network operators are investing in the grid in order to accommodate new consumers and power plants. This will result in the electricity losses decrease. Decrease of losses will directly affect the electricity deficit or the amount of electricity available for export. Currently, based on the 2024 energy balance published by Monstat, transmission and distribution losses amount to 12.4% of total electricity produced in the country.

Refurbishment of Small Hydroelectric Power Plants

The operating life of all hydro power plants owned by EPCG: HE Piva and HE Perućica, as well as small hydro power plants: Rijeka Crnojevića, Podgor, Šavnik, Mušovića rijeka and Lijeva Rijeka are over 50 years. In order to extend their operations, there is need for their thorough revitalization; increase operational reliability and increase the energy efficiency i.e. increase the utilization of the hydropower plant as a whole. Small hydro power plants Rijeka Crnojevica and Podgor have been reconstructed/refurbished and completed in mid-2024.

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Small hydro power plants have a total installed capacity of 2.8 MW. As part of this revitalization, reconstruction / replacement and modernization of equipment and facilities will be performed. The group of small hydropower plants covered by this measure has been in operation for many years without serious investments that would accompany technological innovations, so they are characterized by low energy efficiency in terms of using the available hydro potential in relation to today's solutions. The planned reconstruction is comprehensive with an emphasis on the electro-mechanical part. Improving the efficiency of power plants, maximum utilization of water potential as well as bringing power plants to a higher technical and technological level of automation and remote control are the general goal, and the individual expected effects of the project are: Extension of the working life of the power plant; Ensuring high operational readiness and safety of the power plant; Automation of control of aggregates, plants and power plant as a whole; Enabling the power plant for possible remote control from the superior control center; High reliability of power supply of the power plant; Reduction of operating costs and maintenance costs; Raising the safety level of the plant and plant personnel.

The electricity savings corresponding to this measure are achieved by replacing existing, outdated electrical and mechanical equipment which is operating outside the factory characteristics that are far from modern solutions available on the market. Direct savings are realized through three aspects: Conversion of primary energy into electricity, which is achieved by replacing the unit (turbine and generator of modern production); Replacement of transformers, plants and control systems - reduction of energy losses in the plant itself; Replacement of the own consumption system - reduction of energy losses in relation to the existing solution of the own power supply system.

Also, an important indirect impact due to the installation of modern technical and technological solutions for aggregate management (better regulation of the power plant in terms of electricity production and voltage) is the reduction of electricity losses in the distribution network.

6.1.4 Transport Sector

Mechanisms and instruments focusing on mitigation in the transport sector

Transport
• Transport Development Strategy of Montenegro for 2019-2035 • Roadmap for the Decarbonisation of Traffic in Montenegro

Transport Development Strategy of Montenegro for 2019-2035

Montenegro's Transport Development Strategy for 2019-2035 outlines a plan for developing the country's transport sector, emphasising balanced infrastructure investment and service quality across road, rail, air, and water modes.

Key Priorities:

- Enhanced Connectivity: Strengthening regional connectivity within the Western Balkans to support EU accession, stimulate economic growth, and attract investment.
- EU Harmonisation: Aligning transport regulations with EU standards, focusing on infrastructure, technical specifications, safety, security, and environmental protection, and integrating with the Trans-European Transport Network (TEN-T).

Strategic Goals:

- Economic Efficiency & Sustainability: Financially sustainable practices supporting economic development.
- Accessibility & Quality: High accessibility and quality transport services.
- Safety & Security: Enhancing the safety and security of transport.
- EU Compatibility: Full alignment with EU transport network and policies.
- Environmental Sustainability: Reducing carbon footprint and environmental impact.

In conclusion, Montenegro's Transport Development Strategy offers a well-structured framework for balanced and sustainable development of the transport sector. By focusing on infrastructure investment, service quality, EU alignment, and environmental considerations, the strategy aims to support economic growth, improve connectivity, and ensure a safe and efficient transport system for Montenegro.

Roadmap for the Decarbonisation of Traffic in Montenegro

Montenegro aims to reduce its GHG emissions by 35% by 2030, but projections indicate a slight increase in total emissions by that time. The transport sector is a significant contributor, accounting for over 23% of CO_2 emissions in 2020, with a projected increase to 30% by 2030. Road transport, primarily due to private car use and road freight traffic, is the main source of these emissions. To address this, Montenegro has defined several policy objectives, including shifting transportation modes to more environmentally friendly options, renewing the fleet of cars and buses, transitioning freight transport from road to rail, decarbonizing freight transport vehicles, and improving the efficiency of the road transport sector.

The proposed measures include establishing a gender-responsive public bus transport system in Podgorica, improving urban public bus services, developing comprehensive plans for intercity transport, and expanding electric vehicle infrastructure. Additionally, the plan involves restricting the import of used vehicles, revising the taxation system to focus on CO_2 reduction, and introducing low emission zones. For freight transport, measures include establishing multimodal terminals and providing financial incentives for fleet renewal. These efforts are expected to achieve a 32.3% reduction in traffic emissions, close to the 35% target, with a significant potential for further reductions by focusing on changing passenger transportation modes.

Mitigation actions of the transport sector included in the revised NDC

This subsection provides a description of the 2 PAMs included in the revised NDC of Montenegro in the transport sector with a summary of the emissions reductions achieved in 2022 and expected in 2030.

Table 38 Mitigation actions in the transport sector included in the revised NDC.

Number of mitigation actions		2		
Total estimated GHG emission reductions in 2022		7.37 ktCO_2e/yr		
Name and NDC code of mitigation action		Status (planned, adopted, implemented)	Estimated GHG emission reductions achieved in 2022	Estimated GHG emission reductions expected in 2030
Transport sector				
1T	Electric Cars	No longer in place	7.37	36.88
2T	Financial Incentives for Electric, Plug-In Hybrid and Full Hybrid Vehicles, for Both Citizens and Companies/Entrepreneurs	Adopted		

Electric Cars

This PAM was considered for its inclusion in the NDC of Montenegro. However, this PAM has not been adopted for implementation.

Financial Incentives for Electric, Plug-In Hybrid and Full Hybrid Vehicles, for Both Citizens and Companies/Entrepreneurs

The financial framework to encourage e-mobility typically includes investment incentives to purchase e-vehicles and/or to build the e-charging infrastructure or tax policy measures that favour e-vehicles.

The tax on motor vehicles use is paid annually according to the engine capacity for passenger motor vehicles. This tax is paid by legal and natural persons who are owners of registered passenger cars according to the prescribed tariff. This tax is not paid for e-vehicles, so this tax relief is the only financial incentive for e-vehicles and e-mobility in general that currently exists in Montenegro.

An important step in starting incentives for e-mobility is the establishment of the Environmental Protection Fund (hereinafter: Eco-Fund). It was determined that the Eco-Fund funds, among other things, are to be used to encourage cleaner traffic and the use of alternative fuels in traffic. The very first financial incentives from the Eco-Fund were established for e-mobility.

The Eco-Fund has implemented a programme for subsidizing electric, plug-in hybrid and full hybrid vehicles, for both citizens and companies/entrepreneurs.

The total value of the grants for the purchase of electric and hybrid vehicles (category M1) is €100 000, of which €50 000 is intended for the purchase of electric vehicles, and the remaining €50 000 for the purchase of hybrid vehicles.

The aim of the grant is to directly encourage the procurement of environmentally friendly modes of transport, within the implementation of measures to improve air quality and improve the quality of the environment.

In order to preserve, sustainably use, protect and improve the environment, energy efficiency and the use of renewable sources and energy, it is important to encourage the procurement of green vehicles. By co-financing the procurement of electric and hybrid vehicles, this programme directly influence the improvement of air quality, as well as the reduction of air pollution sources and the reduction of greenhouse gas emissions in road traffic on the territory of Montenegro.

The Eco-Fund awards grants (subsidies) per vehicle in the following amounts:

- Electric vehicles – €5 000
- Plug-in hybrid electric vehicles – €2 500
- “Full hybrid” vehicles – €2 500

The Eco-Fund may allocate funds to natural persons for the purchase of only one vehicle, and to legal entities and entrepreneurs for the purchase of a maximum of two vehicles.

The subsidy programs awarded by the Eco-Fund have not only encouraged the purchase of "green vehicles" but have also significantly supported local vendors, which is the result of a strategy that combines environmental responsibility with economic growth.

Eco-Fund subsidy program for the purchase of vehicles was implemented in the period from 2021 to 2024. In this period, the Eco-Fund subsidized the purchase of a total of 261 vehicles, allocating €897.500,00, while the total value of the vehicles was €9.408.671,00.

During 2021, 2022 and 2023, the Eco-Fund subsidized vehicles in the amount of €90.000,00, €175.000, and €202.500 respectively. The largest amount of subsidies was recorded in 2024, when Ecofund allocated €429.500.

The total number of subsidized electric vehicles is 116, while the number of hybrid vehicles is 145. The value of electric vehicles is €3.483.279, and hybrid vehicles are €5.528.879.

Ecofund subsidized 255 vehicles purchased from local sellers, setting aside €844.500, while the total value of these vehicles was €8.615.645. Ecofund also subsidized 6 vehicles purchased from foreign sellers, with a subsidy amount of €37.500, and the value of those vehicles was €396.513.

Beyond the direct impact of subsidies provided by the Ecofund, the UNDP study "Cost–Benefit Analysis of the E-Mobility Concept in Montenegro" estimated that by 2030, the number of electric vehicles would reach 12,674, accounting for 5% of the total vehicle fleet.

6.1.5 Industrial Processes and Product Use Sector

Mechanisms and instruments focusing on mitigation in the Industrial Processes and Product Use Sector

The national greenhouse gas emissions profile of the Industrial Processes and Product-use Sector (IPPU) has seen a drastic decrease between 1990 and 2022 with sectoral emission levels decreasing more than 90%. While this decrease is compounded by various factors such as diminishing production in the GHG emitting processes of the metal and to a lesser extent mineral industry, the tourism sector is expected to contribute to an increase in the use of refrigeration and air-conditioning equipment.

Steering these trends, Montenegro has developed sector specific policies and strategic directives such as the ones presented in this section, which underscore both the observed trends and the objectives for industrial development and the reduction of GHG emissions from the consumption of fluorinated gases in the country.

Industry
• Industrial policy of Montenegro 2024-2028 with the Action Plan for implementation for 2024 • Law on Industrial Emissions • Decree on activities that emit greenhouse gases for which a permit for the emission of greenhouse gases is issued (2020)
Consumption of fluorinated gases

- Legislation and Strategies in Relation to the Montreal Protocol
- Tourism Development Strategy 2022-2025

Industrial policy of Montenegro 2024-2028 with the Action Plan for implementation for 2024

The Government of Montenegro adopted the Industrial Policy 2024-2028 with the Action Plan for implementation for 2024, as a comprehensive strategic document for further improvement and strengthening of the industry's competitiveness. The additional importance of the adoption of the strategic document is at the same time from the aspect of fulfilling the prerequisites for the temporary closure of Negotiating Chapter 20 Entrepreneurship and Industrial Policy.

Based on the findings of the independent external evaluation of the Industrial Policy in the previous implementation cycle, following the goals and priorities of the EU industrial policy framework, as well as the recommendations of the European Commission for Montenegro in the field of entrepreneurship and industrial policy, the new Industrial Policy is aimed at digital transformation and improvement of innovative performance companies, as well as their transformations towards green and sustainable business, which will enable an increase in the competitiveness of the Montenegrin industry for faster integration with the EU single market.

The document was created in the process of continuous consultations with all interested parties with the aim of looking at different perspectives, needs and initiatives for the development of the industry in a smart and sustainable way, in accordance with the EU guidelines for industrial development. Through the Ministry of Economic Development and the Coordinating Body for the Development and Implementation of the Industrial Policy, a series of individual meetings and consultations were held at the level of line ministries, public sector institutions, business associations, the academic community, as well as other relevant stakeholders who provided adequate inputs for the creation of priorities, visions, goals and programs for policy implementation.

The strategic priorities of the new Industrial Policy are conceived through four basic strategic goals:

- Improving the environment for the digital and green transition of the industry;
- Growth of investments and financing models for the long-term competitiveness of the industry;
- Encouraging innovation based on the principles of smart and sustainable industry development;
- Improving access to the EU single market and strengthening regional economic cooperation.

The financial framework for implementation includes financial resources for the implementation of the Industrial Policy 2024-2028 through the implementation of the Action Plan for 2024, as well as an indicative budget for the implementation of two two-year Action Plans 2025-2026. and 2027-2028.

For the successful implementation of the policy, it is extremely important to further strengthen the dialogue between the private and public sectors and to consult with the academic community and relevant stakeholders in all areas of Industrial Policy, which will contribute to the creation of various incentive mechanisms to stimulate economic activity in the industry and product manufacturing sector that create greater added value, and thus a more competitive industrial base for better access to the common regional and EU market.

Law on Industrial Emissions (2019, 2023, 2024)

The law was published in the "Official Gazette of Montenegro", no. 17/2019, 3/2023 and 34/2024. This law regulates measures for the prevention and control of emissions arising from industrial plants (hereinafter: plant), which may have negative effects on human health, the environment or material goods and other issues of importance for the integrated prevention and control of environmental pollution. This law does not apply to facilities where activities are carried out that are used for research, development and testing of new products and procedures.

The principles of integrated prevention and control of environmental pollution are:

- precautionary principle:
    - every activity must be carried out in such a way that: no pollution is caused; prevent or reduce emissions at the very source of pollution that lead to air, water, sea or land pollution; reduce the use of non-renewable natural resources and energy; prevent or reduce the generation of waste and minimize the risk to human health, the environment and material goods;
    - in order to avoid risks and dangers to the environment, all established preventive environmental protection measures should be applied, i.e. the use of the best available techniques, as well as the use of products, equipment and devices and the application of production procedures and maintenance systems of the designed plant parameters, which are the most favourable for life and the environment;
- principle of integrated approach:
    - the permit must take into account the entire operation of the plant, including emissions to air, water and land, waste production, use of natural raw materials, energy efficiency, noise, accident prevention and site remediation after the plant ceases to operate;

    - an integrated approach to issuing permits is a coordinated procedure for issuing permits in which more than one competent authority participates and takes measures for an efficient and integrated approach to this procedure;

- the principle of sustainable development - in order to achieve sustainable development, the environmental protection requirements established by this law and special regulations must be included in the preparation and implementation of established policies and activities in all areas of economic and social development through the permitting process;

- principle of hierarchy of waste management: the hierarchy of waste management represents the order of priorities in the practice of waste management, which consists of: 1. prevention of waste generation and reduction, i.e. reduction of the use of resources and the amount and/or hazardous characteristics of the generated waste; 2. reuse, that is, using the product for the same or a different purpose; 3. recycling, that is, treatment of waste in order to obtain raw materials for the production of the same or another product; 4. recovery, i.e. material recovery through composting, energy recovery trough the use of waste as energy;

- the "polluter pays" principle - a legal and natural person who has caused damage to the environment or an immediate risk of damage is obliged to compensate the costs incurred by polluting the environment as a result of their activities, which include costs for endangering and risking the environment and the costs of removing the damage caused to the environment, i.e. returning the location to a satisfactory condition;

- the principle of access to information and public participation - the public must have access to information related to the request for the issuance of a facility permit, drafting of the permit, the decision on the issuance of the permit and the revision of the permit, as well as relevant data obtained through monitoring, in order to inform the public about plant operation and their possible impact on the environment, in order to ensure the transparency of the permit issuing process.

Decree on activities that emit greenhouse gases for which a permit for the emission of greenhouse gases is issued (2020)

This Decree, based on the provisions of the Montenegrin Law on the protection from negative impacts of climate change, determines and lists all activities that emit gases and that need greenhouse gas emission licenses. This text also indicates the total amount of emission credits granted in relation to the initial state of greenhouse gas emissions, the manner of conducting the auction for allocation of such emission credits, minimum price of emission credits offered at the auction, issues on funds raised on the basis of those auctions, and the manner of recording granted emission credits, including their transfers and use.

Providing further guidance, the Decree sets minimum thresholds or rules for different industries to at which companies are required to obtain a license:

- Cement Industry > 500 tons/day production, 50 tons/day capacity of rotary kilns and other type of furnaces.
- Glass Manufacturing > 20 tons/day melting capacity
- Ceramic Products > 75 tons/day and or furnace capacity bigger that 4 m3 and density of material > 300kg/m3
- Baking and sintering ores
- Steel and Metal Industry > 2.5 tons/hour
- Production of non-ferrous metals using chemical processes and electrolysis
- Production of paper pulp from wood or non-fibrous materials
- Paper and cardboard production capacity > 20 tons/day

Legislation and Strategies in Relation to the Montreal Protocol

The Montreal Protocol (1987) and Kigali Amendment (2016) are international agreements aiming to phase out Ozone-depleting Substances (ODS) and reduce Hydrofluorocarbons (HFCs) and Perfluorinated Compounds (PFCs) which are GHGs with a very high global warming potential. These chemicals are used in certain products related to air-conditioning, cooling as well as for fire extinguishers.

As such, in the context of IPPU sector GHG emissions stemming from air-conditioning and refrigeration as well as other products containing fluorinated gases, Montenegro, next to signing the Montreal Protocol and Kigali Amendment, has enacted the following interrelated legislations, regulations, strategies, and actions.

- Law and draft Law on Protection Against Negative Impacts of Climate Change
- Decree on Substances that Deplete the Ozone Layer and Alternative Substances (F-Gases)
- Decision on the Control List for Export and Import of Goods
- HCFC Phase Out Management Plan

Tourism Development Strategy 2022-2025 (2022)

The national Tourism Development Strategy (TDS) 2022-2025 represents another important national strategy as the tourism sector is the fastest growing economic sector in Montenegro with already visible effects on greenhouse gas emissions. In fact, in the context of the IPPU sector, GHG emissions from air-conditioning and refrigeration, since 2018, is the biggest emissions source of the sector. The TDS 2022-2025, while containing wider strategic objectives for the tourism industry, addresses the need for taking into account environmental, specifically climate change relevant measures as the tourism industry is scaled.

Mitigation actions of the IPPU sector included in the revised NDC

In the following, a description of the mitigation PAM implemented by Montenegro as per the NDC (2021) in the IPPU sector with a summary of the emissions reductions achieved in 2022 and expected in 2030 is presented.

Table 39 Mitigation actions in the IPPU sector included in the revised NDC

Number of mitigation actions		2		
Total estimated GHG emission reductions in 2022		0 ktCO2e/yr		
Name and NDC code of mitigation action		Status (planned, adopted, implemented)	Estimated GHG emission reductions achieved in 2022	Estimated GHG emission reductions expected in 2030
1I	Uniprom KAP: electrolysis cell replacement and overhaul (2020–2024) and ETS (2025–2030)	Implemented (no longer applicable)	NA	NA
2I	Reduction of HFCs in line with the Law Acknowledging Amendments to the Montreal Protocol on Substances that Deplete the Ozone Layer	Adopted	0	12.48

Uniprom KAP: electrolysis cell replacement and overhaul (2020–2024)

Production of primary aluminium began in 1971. The KAP produced its own alumina, extracting it via the Bayer process out of the bauxite shipped from the Nikšić bauxite mine. The factory also had its own production of pre-baked anodes. The smelter had an installed capacity of 120,000 tons of liquid aluminium per year. KAP was connected by railway with bauxite mines near Nikšić.

The plant had its most difficult times during UN-imposed economic sanctions on Former Republic of Yugoslavia in the nineties. During the sanctions, the production was reduced to 13% of capacity.

In the period 1997–1999 KAP participated with 8.2–6.7% in GDP of Montenegro, and 65–67% in export for the same period. Most of the time, the KAP acquired necessary raw materials and spare parts from Glencore. The entire export was also conducted by Glencore. The company was one of the few Montenegrin companies to recover quickly after the breakup of Yugoslavia.

As of 2008, the KAP has struggled to survive the impact of ongoing economic crisis. The low trading price of aluminium, and expensive production inputs, primarily the electricity and alumina production, resulted in KAP generating daily losses of up to €200,000. The company has been unable to survive ever since without the constant Government subsidies, primarily in writing off the debt for electricity.

In 2009, the financial situation at the company had not improved, leaving KAP in danger of being closed. KAP entered bankruptcy proceedings in 2013 and was sold by Montenegro's government to Uniprom in 2014.

Since the end of 2015, the outdated A-series assembly line in the electrolysis plant has been out of operation, which is reflected in a reduction in the PFC emission from the electrolysis plant, starting from 2016. Only the operating B-series assembly line in the electrolysis plant has installed automatized control of the number and duration of anode effects on the cells, so the duration is several times shorter (less than a minute) and the number of anode effects per cell per day is more than 10 times smaller, compared to the dismantled A-series assembly line. Furthermore, 24 of the 264 cells in the B-series assembly line are ADG type with spot dosing of alumina that results in decreased F-gas emissions.

In 2020, 155 of the 264 cells were in operation, while the remaining cells were planned to be either overhauled or replaced by 2024.

Most of the electrolysis cells were shut down in December 2021, when power utility Elektroprivreda Crne Gore (EPCG) refused to supply the plant with electricity at the previous prices of 44 euro ($48) per MWh due to a hike in prices on the power exchanges.

In 2023, Montenegro's Uniprom has shut down the last 12 remaining electrolysis cells at aluminium smelter KAP, discontinuing aluminium production at the plant after 52 years of operation. The facilities for the production of aluminium logs and alloys will remain in operation, but the plant will import the metal to manufacture them.

So far, €36 million have been invested in the general overhaul and replacement of the cells, the gasification project, the equipment and infrastructure, as well as in dismantling the outdated plants.

Montreal Protocol on Substances that Deplete the Ozone Layer

In April 2019, Montenegro officially became a member of the Kigali Amendment. The obligations arising from the Amendment is to reduce the consumption of HFC substances according to the following commitments: A freeze of HFCs consumption levels in 2024 keeping it as the baseline (average HFC consumption levels for 2020-2022 + 65% of HCFC baseline):

- 10% reduction by 2029;
- 30% reduction by 2035;
- 50% reduction by 2040;
- 80% reduction by 2045.

These are the reduction targets and deadlines set for the countries of Article 5 (Group I) of the Montreal Protocol, to which Montenegro belongs.

6.1.6 Waste Sector

Mechanisms and instruments focusing on mitigation in the waste sector

Solid Waste and Wastewater Management
• Economic Reform Programme (ERP) 2022-2024 • Draft State Waste Management Plan (SWMP) 2023-2028 • Waste Management Strategy (WMS) until 2030 • National Strategy for Circular Transition by 2030 with an Action Plan from 2023 to 2024 • Municipal Wastewater Management Master Plan (MWMMP) 2020-2035 • Tourism Development Strategy 2022-2025 • Smart Specialization Strategy (S3) 2019-2024 • National Integrated Coastal Zone Management (ICZM) Strategy 2015-2030 • Energy Development Strategy until 2030 • Transposition of EU Waste Standards • Law on Waste Management (2024)

For the waste sector as a whole, the Ministry of Sustainable Development and Tourism is the overarching entity responsible for setting the strategic direction for waste management in the country, whereas municipalities are responsible for operating waste management services within their respective territories.

Montenegro has established several crucial national and waste sector-specific policy and planning documents, delineating the transformational change envisioned for the waste sector in the upcoming years. Moreover, waste management objectives have also been mainstreamed into other sectoral planning frameworks.

A summary of national and waste sector-specific policy and planning documents is presented hereafter.

Economic Reform Programme 2022-2024

The Economic Reform Programme (ERP) states the country´s economic and fiscal policy measures, as well as 22 structural reforms needed to achieve smart, sustainable, green, resilient, and inclusive economic growth in alignment with Montenegro´s EU accession. Measure 21 includes reforms for the waste sector to (1) reduce the use of lightweight carrier plastic bags from 600-700 pieces per person in 2021 to 300 pieces by 2024, and 40 pieces by 2030, (2) increase the recycling rate from 10% in 2021, to 20% by 2024, and 50% by 2030, and (3) reduce the average annual rate of growth of total waste generation in settlements with an expanding population from 2% in 2021, to 1.8% by 2024, and 1.5% by 2030.

Economic Reform Programme 2024-2026 (2024)

The Economic Reform Programme (EFP) of Montenegro detail the overarching economic strategy of the country. The Programmes are formulated biannually, reflecting the successive and up to date implementation of economic measures envisioned for the country. In the EFP 2024 -2026, reform measure 3 calls for the incentivising of innovation to realise the national Green Agenda and to support the transition to a circular economy, which is expected to increase the resource efficiency and have a dampening effect on product uses with its consequently avoided generation of waste, thus contributing to further cut GHG emissions. The EFP 2024-2026 moreover reiterates the urgent need to develop the National Energy and Climate Plan (NECP) for the period 2024-2030 to provide the country with stringent strategic guidance in regard to climate action as well as to further align with the EU strategic energy and climate change framework.

Draft State Waste Management Plan 2023-2028

The vision of the Draft State Waste Management Plan (SWMP) 2023-2028 is to ensure the transition of Montenegro to an ecologically sustainable circular economy by 2028 and provide its citizens with exemplary waste management services. Built on the principles of waste hierarchy, circular economy, sustainable development, and extended producer responsibility, it seeks to transition to a society of zero dumpsites by reducing waste generation rates and reducing waste disposal rates through strengthening recycling rates, enhancing alternative treatments for bio-waste management, promoting procurement of secondary materials, and introducing waste as alternative energy sources. This is enabled by the establishment of three regional waste management systems seeking the separate collection and processing of different waste streams, while fortifying monitoring and reporting of waste flows. The Draft SWMP sets the following key quantitative objectives:

Reuse and recycling rates:

- At least 30% and 50% of household waste materials is prepared for reuse and recycling by 2028 and 2030.
- 25% of total packaging waste is recycled by 2028, broken down by packaging type (30% of the mass of glass, 30% of paper and cardboard, 40% of metal, 15% of plastic, and 5% of wood).
- 35% of total packaging waste is recycled by 2030, broken down by packaging type (40% of the mass of glass, 40% of paper and cardboard, 50% of metal, 22.5% of plastic, and 10% of wood).
- A minimum of 4% of biowaste is composted inside households by 2025.

Separate waste collection rates:

- 100% coverage of organized waste collection services by 2024.
- 15%, 25%, and 40% of recyclable materials are collected separately by 2025, 2028, and 2030.
- 35% and 50% of packaging waste is collected separately for processing, including energy recovery, by 2028 and 2030.
- 50% and 60% of green waste, 17% and 27% of biowaste, 10% and 20% of textiles, 15% and 25% of bulky waste is collected separately by 2025 and 2030.

Waste disposal rates:

- The maximum amount of biowaste disposed of by 2025, 2029 and 2033 is 75%, 50% and 35% of the amount generated in 2010.
- 45%, 72% and 100% of the remaining waste is treated before disposal by 2025, 2029 and 2033.

Waste management facilities:

- A network of mixed material recycling facilities is established by 2028 (~70,000 t/y capacity).
- A network of biowaste composting facilities is established by 2028 (~25,000 t/y capacity).
- A network of MBT facilities (~170,000 t/y capacity) is established by 2028 where residual fractions are used as alternative fuels or as compost.
- The existing landfills in Podgorica and Ulcinj are supplemented by 2028 with an additional landfill that will serve the northern part of the country (~205,000 t/y capacity).

- New dumpsites banned, and all existing dumpsites rehabilitated by 2028.
- Tariffs increased from 0.062 EUR/ m2 to 0.132 EUR per/m2 until 2034.

Waste Management Strategy until 2030

The overall goal of the Waste Management Strategy (WMS) 2030 is to establish a successful, functional, and sustainable waste management system in the country and its constant improvement through (1) accelerated and intensive development of public and state participation in integrated waste management, (2) introduction of circular economy principles, (3) intensive primary and secondary waste selection to collect recyclable materials for reuse and repurposing, (4) high degree of separation and utilization of biowaste, (5) high degree of separation and adequate recycling and disposal of construction and demolition waste, (6) sewage sludge treatment, (7) reduced waste deposition at landfills, (8) development of a system for generating energy from waste and/or thermal treatment of waste, and (9) rehabilitating unorganized dumpsites. The Strategy is built upon five key waste management principles aligned with those of the EU, namely the sustainable development principle, the precautionary principle, the polluters pay principle, the proximity principle, and the waste hierarchy principle which states the priority methods for waste management from (1) preventing waste generation, to (2) preparation for the reuse of product for same or different purpose, to (3) recycling so as to use waste as a secondary raw material, to (4) repurpose of waste through energy generation or marketable product such as compost, and finally to (5) safe disposal of waste that could not otherwise be processed.

Strategy for Circular Transition by 2030 with an Action Plan from 2023 to 2024

This Strategy aims to foster growth and competitiveness of the Montenegrin economy through diversification, innovation, and resource efficiency based on the principles for circular transition by 2030. Its 2023-2024 Action Plan sets out the following operational objectives for improving waste management practices using a circular economy concept: (1) establish a reporting and information system to monitor waste streams against set targets, (3) enforce extended producer responsibility, (4) establish waste management systems for tires, electrical and electronic, and construction wastes, (5) eliminate single-use plastics, (5) improve infrastructure for receiving and separating waste, and (6) establish a centre for product reuse and implement a “repair café” workshop programme.

Municipal Wastewater Management Master Plan (MWMMP) 2020-2035

This Plan sets out the series of infrastructure investments as well as regulatory and legal reforms required to meet a complete coverage of wastewater collection and treatment in all urban agglomerations in Montenegro greater than 2,000 people by 2025, that is, 93% of the total population of Montenegro. The master plan prioritizes the rehabilitation and the construction of sewerage networks and treatment plants based on agglomeration sizes and delineation of sensitive areas in compliance with the Law on Municipal Wastewater Management and its implementing rulebooks.

Tourism Development Strategy 2022-2025 with Action Plan

The goal of this Strategy is to manage tourist destinations in a sustainable, innovative, green and inclusive manner in order to improve the living standards of the local population and tourists. The tourism development strategy of Montenegro 2022-2025 with the Action Plan defines the directions of tourism development, along with the development of competitiveness and better positioning of Montenegro on the global tourism map. The action plan defines key measures and activities, as well as their holders, scheduled deadlines and the financial framework for their implementation.

Tourism Development Strategy of Montenegro 2022-2025 with the Action Plan is correlated with strategic national and EU documents. The key recommendations for formulating the Strategy stem from the process of creating a comprehensive development policy of Montenegro and harmonizing it with the strategic principles of the EU. They refer to the selection of measures, the application of which would effectively influence the increase in the competitiveness of Montenegro on the international tourist market. The strategic goal of tourism development in Montenegro is defined as "Through investments and the formalization of tourist traffic, Montenegro is asserting itself as a globally recognized tourist destination, with reduced seasonality of business, moderate regional imbalance and prioritization of tourism in development policies". The realization of this strategic goal implies seven (7) key operational goals in tourism, namely:

- Operational objective 1 – Improved regulatory framework in tourism with formalization of tourist traffic;
- Operational objective 2 – Improved touristic and supporting infra and supra structure;
- Operational objective 3 – Improved quality and quantity of accommodation capacities;
- Operational objective 4 – Improved quality of the diversified tourist product;
- Operational objective 5 – Improved human resources, knowledge and skills in tourism;
- Operational objective 6 – Development of digital, innovative solutions and new technologies in tourism;
- Operational objective 7 - Montenegro - a globally recognized tourist destination.

Smart Specialization Strategy 2019-2024

The Smart Specialization Strategy (S3) seeks to build Montenegro as a modernised and competitive state that is healthy, sustainable, and digitalised whilst fulfilling the constitutional provision of Montenegro as an ecological state by 2024. Under the Energy and Sustainable Environment Priority area, the S3 seeks the adequate reuse of waste under the principles of economic circularity, including using food waste as a resource and incorporating smart waste management practices. It sets the goal of increasing innovative activities in waste recycling and utilisation by implementing a procedure for industrial waste management in line with the circular economy principles such that enhances the potential of industrial waste for reuse. It envisions the implementation of a circular economy programme as the flagship initiative seeking solve the issue of industrial waste and to strengthen the industrial competitiveness of Montenegro by recycling industrial waste and extracting residual raw materials of high economic value and / or transforming them into new materials suitable for industrial use.

National Integrated Coastal Zone Management (ICZM) Strategy 2015-2030

This Strategy envisions the coastal zone of Montenegro as resilient and healthy, recognizing the multi-sectoral nature of ICZM calling for coordinated harmonisation between sectoral policies. Nevertheless, this Strategy places a great emphasis on communal waste and wastewater management since entire spatial, economic and social development of the coast zone depends on the extent to which they are prioritised and successfully resolved. Among the key measures and targets included in the Strategy´s action plan to 2030, the following are explicitly related to the Waste Sector: (1) remove and remediate decommissioned/illegal sewer outfalls and transition from combined to separated sewers, (2) conduct spatial planning for the optimal construction of wastewater treatment plants using best available EU practices, (3) establish the system for reception and treatment of port waste and wastewater and reduce the quantity of marine litter, (4) remediate unregulated municipal dumps in priority coastal locations using best available EU practices, (5) improve the local separate collection, transport, and treatment of municipal waste, using innovative and clean technologies, improving infrastructure, and raising public awareness, including in rural areas, (6) prevent packaging and bulky waste generation and increase local waste recycling rates, and (7) improve monitoring of waste flows and improve the application of penalties.

Energy Development Strategy until 2030

This Strategy recognizes the unused potential of waste for energy purposes and strongly supports the use of waste and wastewater sludge for cogeneration and for electricity production through (1) the installation of biogas capturing technologies at landfills and wastewater treatment plans, and (2) the installation of incineration facilities for mixed biowaste and sewage sludge.

Transposition of EU Waste Standards

In 2006, Montenegro began the process of accession to the European Union (EU) by agreeing to a Stabilisation and Association Agreement with the EU, which officially came into force on 1 May 2010. The agreement requires Montenegro to align its legislation with EU standards and regulations, including those related to environmental protection and climate change mitigation. By doing so, Montenegro commits to implementing measures that contribute to reducing greenhouse gas (GHG) emissions, promoting renewable energy, and enhancing energy efficiency. Furthermore, the agreement includes provisions for monitoring Montenegro's progress in fulfilling its commitments related to climate change and environmental protection. As such, Montenegro is required to report regularly to the EU on its efforts and achievements in implementing relevant policies, ensuring transparency and accountability in its actions.

As an EU candidate country and actively committed Party to the UNFCCC and the Paris Agreement, Montenegro aspires to comply with EU Acquis Chapter 27: Environment and climate change and the EU climate change law and aims to increase its climate ambition to a 55% GHG emission reduction target by 2030 compared to 1990 levels. Montenegro therefore also has the obligation to establish a functional Integrated Waste Management System (IWMS) and, according to the European Commission, this goal is considered one of the priorities on the accession path.

Legislative Framework

On September 20, 1990, Montenegro became the first country to enshrine the "Ecological State" in its Constitution, which, under Article 1, establishes Montenegro is a civil, democratic, ecological and the state of social justice, based on the rule of law.

Law on Waste Management (2024)

This law regulates the types and classification of waste, planning, conditions and methods of waste management, as well as other issues of importance for waste management.

Waste management

1. Waste management includes the collection, transport, processing, sorting and removal of waste, control over these procedures, subsequent maintenance of landfills, as well as the activities of waste dealers and brokers and rehabilitation of unorganized landfills.

2. Waste management is an activity of public interest.

3. In accordance with the "polluter pays" principle, waste management costs, as well as costs for the necessary infrastructure (determined by waste management plans) and its operation, are borne by every person whose activity generates waste, the existing or previous owner of waste.

4. The costs of waste management are fully borne by the producers of the products from which the waste originates.

Principles of waste management

Waste management is based on the following principles:

1. sustainable development, which ensures more efficient use of resources, reduction of the amount of waste and handling of waste in a way that contributes to reducing negative impacts on the environment and improving the efficiency of resource use, in order to improve the circular economy and guarantee long-term competitiveness;

2. proximity and regional waste management, in order to process waste as close as possible to the place of generation in accordance with the economic justification of the choice of location, while regional waste management is ensured by the development and application of strategic plans based on national policy;

3. precautionary measures, i.e. preventive action, by taking measures to prevent negative impacts on the environment and human health even in the absence of scientific and expert data;

4. "polluter pays" according to which the waste producer bears the costs of waste management, as well as costs for the necessary infrastructure and its operation, costs of preventive actions and costs of remedial measures due to negative impacts on the environment and human health;

5. waste hierarchy that ensures respect for the order of priorities in waste management, namely:

    - prevention of waste generation;
    - preparations for reuse;
    - recycling;
    - another method of processing (energy processing); and
    - waste removal;

6. separate collection of waste and prohibition of mixing with other waste or other materials when necessary to comply with the goals and principles of this law and the waste hierarchy, as well as to facilitate and improve preparation for reuse, recycling or other processing procedures;

7. that the waste or materials obtained from it do not represent a greater potential danger in case of recycling than comparable primary raw materials or products from primary raw materials;

8. extended responsibility of the producer according to which every natural or legal person who professionally develops, produces, processes, processes, sells or imports products bears the responsibility for the management of the waste that remains after the use of these products, as well as the financial responsibility for these activities.

Waste management plans and programs

1. Waste management is carried out in accordance with the state waste management plan (hereinafter: State Plan) and local municipal and non-hazardous construction waste management plans (hereinafter: local plan).

2. The owner of the waste is obliged to manage the waste in accordance with the State Plan and the local plan.

State plan

1. The state plan is the basic document that determines the long-term goals of waste management and establishes the conditions for rational and sustainable waste management in Montenegro.

2. The state plan provides an overview of the current state of waste management, with measures to be taken to ensure the best conditions for waste preparation for reuse, recycling and other processing and disposal procedures, in a manner acceptable for environmental protection and human health.

3. The state plan in particular contains:

    - type, quantity (mass) and origin of waste produced on the territory of Montenegro and assessment of the type and quantity (mass) of waste that will be produced by years from the planning period referred to in paragraph 5 of this article;

    - the percentage amount of reuse and recycling of the entire amount (mass) of waste estimated by years, in order to achieve the percentages referred to in Article 21 of this law, including the method of establishing and supporting the network for reuse and separate collection and economic instruments;

    - review of the current state and organization of waste collection operations and larger facilities for processing and disposal, including special procedures for hazardous waste and special types of waste;

    - assessment of the need for the establishment of additional organizational structures for waste collection, closure of existing facilities, establishment of additional capacities for waste processing (respecting the principle of proximity), as well as the necessary financial resources;

    - general waste management policy, including planned waste management technologies and methods or policy for waste for which there are specific problems in the application of usual waste management procedures;

    - organizational aspects of waste management, including division of tasks and responsibilities between public and private entities dealing with waste management;

    - assessment of the usefulness and applicability of the use of economic and other instruments in solving various problems related to waste, taking into account the need to maintain the smooth functioning of the market;

- the method of raising awareness and providing information to the public or special consumer groups about waste management and the method of implementing the campaign;

- information on unorganized waste disposal sites and measures for their rehabilitation or recultivation and ways to prevent further waste disposal at these locations;

- information on measures to achieve the goals established by the program for disposal of biologically degradable waste;

- evaluation of the functioning of existing waste collection systems, measures for improvement, as well as the need for new collection systems;

- assessment of investments and other financial resources, including at the local level;

- measures to prevent the creation of waste packaging and reduce the impact of waste packaging on the environment and measures of extended producer responsibility to reduce the impact of packaging waste on the environment and encourage the use of returnable packaging;

- measures for the establishment of facilities for adequate waste management, respecting the principle of proximity and a high level of protection of the environment and human health, i.e. facilities for waste removal and facilities for the processing of mixed municipal waste collected from households, as well as waste from other sources;

- measures to prevent improper disposal of waste and measures to clean untidy landfills;

- quantitative indicators and goals, which refer to the amount of waste generation and its processing and to communal waste that is disposed of or energy processed;

- action plan and financing dynamics and sources of financial resources necessary for the implementation of the State Plan;

- biodegradable waste disposal program, waste prevention program, medical, veterinary and sewage sludge management plans.

4. The state plan refers to waste that will be shipped from or on the territory of Montenegro and for the purpose of preventing improper disposal of waste and is harmonized with the program of measures for the protection of the marine environment and the coastal area in accordance with the law governing the protection of the marine environment and with a

water management plan in the water area of the river basin or on its part in accordance with the law regulating water management.

5. The Ministry informs the public about the drafting of the State Plan through at least one electronic media that is broadcast on the territory of Montenegro and a printed media that is distributed on the territory of Montenegro.

6. The Government of Montenegro shall adopt the national plan, on the proposal of the Ministry, for a period of up to six years.

7. The national plan is published in the "Official Gazette of Montenegro".

Biodegradable waste disposal program

The Biodegradable Waste Disposal Program specifically establishes measures to reduce the amount of biodegradable waste that is disposed of, including measures for recycling, composting, biogas production and material and/or energy processing, in order to ensure that the amount of biodegradable municipal waste that is disposed of at the landfill, reach the level of 35% of the total mass of biodegradable waste produced in 2010 in the following percentages and deadlines:

1. 75% of the total mass of biodegradable waste produced in 2010 must be reached no later than December 31, 2025;

2. 50% of the total mass of biodegradable waste produced in 2010 must be reached no later than December 31, 2029;

3. 35% of the total mass of biodegradable waste produced in 2010 must be reached no later than December 31, 2033.

Waste prevention program

1. The waste prevention program establishes goals and measures for the prevention of waste, as well as indicators for monitoring and evaluating the progress achieved by applying those measures.

2. The waste prevention program in particular contains and encompasses measures that:

    - promote and support sustainable models of production and consumption;

    - encourage the design, production and use of products that are repairable, reusable and upgradeable, in order to efficiently use resources;

    - are directed towards products containing certain raw materials in order to prevent these materials from becoming waste;

- encourage the reuse of products and the establishment of a system to promote repair and reuse activities, especially for electrical and electronic equipment, textiles and furniture, as well as for packaging and construction materials and products;

- encourage the availability of spare parts, instructions, technical information or other instruments, equipment or software that enable the repair and reuse of products without jeopardizing their quality and safety, in accordance with laws regulating intellectual property rights;

- reduce the generation of waste in the processes of industrial production, mineral extraction, production, construction and demolition of buildings, taking into account the best available techniques;

- reduce the creation of food waste in primary production, processing and production, retail and other distribution of food, in restaurants, food services, as well as in households, as a contribution to the sustainable development goal of the United Nations to reduce global food waste by 50% by 2030 . year;

- encourage food donation and other redistribution for human consumption, prioritizing human use over animal feed and processing into food products;

- promote the reduction of the content of hazardous substances in materials and products;

- reduce the generation of waste, especially waste that is not suitable for preparation for reuse or recycling;

- identify products that represent the main sources of ignition, especially in the natural and marine environment, and take appropriate measures to prevent and reduce unregulated landfills of such products;

- aim to stop the generation of waste in the sea as a contribution to the goal of sustainable development of the United Nations in order to prevent and significantly reduce the pollution of all types of marine waters;

- develop and support information campaigns to raise awareness about preventing and disposing of waste.

3. Methodology and quality requirements for measuring food waste generation are prescribed by the Ministry.

Medical, veterinary and sewage sludge management plans

1. In the process of preparing the medical waste management plan, the Ministry is obliged to obtain the consent of the state administration body responsible for health affairs, and for

the veterinary waste management plan, the consent of the state administration body responsible for veterinary affairs.

2. The management plan for medical, veterinary and sewage sludge in particular contains:

    - produced and expected type, quantity (mass) and origin of medical and veterinary waste in the territory of Montenegro, that is sewage sludge in the territory of the local self-government unit;

    - review of the current state and organization of medical and veterinary waste collection, i.e. sewage sludge and processing and disposal facilities, including special procedures for medical and veterinary waste, i.e. sewage sludge;

    - medical or veterinary waste or sewage sludge management policy, including planned technologies and methods of medical or veterinary waste or sewage sludge management or policies for medical or veterinary waste or sewage sludge for which there are specific problems in the application of usual procedures management of medical, veterinary waste and sewage sludge;

    - assessment of the need for the establishment of additional organizational structures for the collection of medical and veterinary waste and sewage sludge, the closure of existing facilities required in waste management procedures, for the establishment of additional capacities for the treatment of medical and veterinary waste and sewage sludge in accordance with the principle of proximity , as well as the necessary financial resources;

    - criteria for determining the location and capacity of future facilities for the removal of medical and veterinary waste and sewage sludge and/or processing facilities;

    - action plan and financing dynamics and sources of financial resources necessary for the realization of these plans.

3. The state administration body responsible for health affairs provides the conditions and takes care of the implementation of the medical waste management plan.

4. The state administration body responsible for veterinary affairs provides the conditions and takes care of the implementation of the veterinary waste management plan.

5. The Ministry provides the conditions and takes care of the implementation of the sewage sludge management plan.

Local plan

1. The local plan is adopted by the assembly of the Capital City, the Capital City and the municipality (hereinafter: local self-government unit), for the period for which the National Plan was adopted.

2. The local plan must be harmonized with the National Plan.

3. The local plan is submitted to the Ministry for approval before it is adopted at the assembly of the local self-government unit in order to assess compliance with the State Plan.

4. The local plan especially contains:

    - type, quantity (mass) and origin of municipal waste produced on the territory of the local self-government unit and assessment of the type and quantity (mass) of municipal waste that will be produced by year from the planning period referred to in paragraph 1 of this article and its origin;

    - locations of existing facilities and facilities for the treatment of municipal waste, that is, for local self-government units that do not have a landfill, in accordance with the law, the locations and period where they will temporarily store municipal waste from Article 94 of this law;

    - information on unorganized waste disposal sites and measures for their rehabilitation or recultivation and the way to prevent further waste disposal at these locations, as well as rehabilitation and recultivation of temporary communal waste storage facilities;

    - locations of existing facilities for the processing of non-hazardous construction waste and facilities for the removal of non-hazardous construction waste and/or landfills for inert waste, i.e. for local self-government units that do not have facilities for the processing of construction waste and facilities for the removal of non-hazardous construction waste and/or a landfill for inert waste in accordance with the law, location and term for temporary storage of non-hazardous construction waste;

    - the way of organizing and performing waste management operations from the part of the territory of the local self-government unit that is a protected area or an area of marine property;

    - the method and program of separate collection and transportation of municipal and construction waste from households and from producers who are not subject to the obligation to adopt a waste management plan, including trash and other municipal and construction waste that cannot be disposed of in places designated for the disposal of municipal and construction waste;

- description of activities that take place within recycling yards and transfer stations and recycling centers for the purpose of temporary storage of municipal waste, or processing;
- measures to prevent or reduce the amount of municipal waste and negative impacts on the environment and human health, ensuring proper management of municipal waste;
- method of separate collection, method of processing and measures to reduce the amount of biodegradable waste contained in municipal waste that is disposed of in landfills;
- method of separate collection of fractions of hazardous waste generated in households;
- dynamics of implementation of selected methods and procedures for managing municipal waste and non-hazardous construction waste;
- method of sewage sludge management;
- action plan and financing dynamics and sources of financial resources for the implementation of the local plan;
- a way to increase awareness of proper handling of municipal waste.

5. (5) The competent body of the local administration informs the public about the drafting of the local plan through at least one electronic media that is broadcast on the territory of the local self-government unit and a printed media that is distributed on the territory of Montenegro.
6. (6) The draft of the local plan of the local self-government units on the territory of which a part of the protected areas or the marine property area are located shall be submitted for an opinion to the legal entity that manages that area.

Joint management of municipal and non-hazardous construction waste

Two or more local self-government units can jointly provide for the management of communal and non-hazardous construction waste, in accordance with the law regulating communal activities.

Concerning wastewater, Montenegro´s Law on Municipal Wastewater Management (2017) sets out the governance and operational framework for establishing a functional integrated wastewater management system in compliance with EU regulation, seeking to achieve universal sewerage connection and treatment of wastewater in all agglomerations (settlements) of more than 2,000 people by 2025-2029, depending on the population size and type of water body receiving effluent.

However, based on the most recent negotiations between Montenegro and the EY, it is most likely that the aforesaid implementation schedule will be substantially extended for full compliance by 2035.

This Law is supported by:

Rulebook on criteria for definition of sensitive and vulnerable areas for protection of waters from pollution.

Rulebook on delineation, number, and capacities of agglomerations.

Rulebook on the specific conditions that municipal sewage sludge must meet, quantity, volume, frequency, and methods of analysis of municipal sewage sludge.

Mitigation actions of the waste sector included in the revised NDC

This subsection provides a description of the 2 PAMs included in the revised NDC of Montenegro in the waste sector with a summary of the emissions reductions achieved in 2022 and expected in 2030.

Table 40 Mitigation actions in the waste sector included in the revised NDC.

Number of mitigation actions		2		
Total estimated GHG emission reductions in 2022		0 ktCO2e/yr		
Name and NDC code of mitigation action		Status (planned, adopted, implemented)	Estimated GHG emission reductions achieved in 2022	Estimated GHG emission reductions expected in 2030
W1	Reduction of Bio-Waste in Municipal Waste	Adopted	0	19.44
W2	Increase in Connection Rate to Sewerage System (target 93% by 2035)	Adopted	0	36.41

Reduction of Bio-Waste in Municipal Waste

The implementation of the Landfill Directive (1999/31/EC) requires the reduction of biodegradable waste to be landfilled. Therefore, it is planned to increase the separate collection of municipal waste and achieving hereby a decrease of organic waste being disposed to landfills. This is to be achieved by a system of primary separation (2 bins – dry and wet), network of waste collection in rural areas, construction of recycling yards in municipalities, equipment for waste collection, as well as educational and awareness raising activities.

The implementation of these measures is already ongoing, and will be continued to achieve the following targets, as set in the negotiation Chapter 27:

- By 2025: share of biodegradable municipal waste disposed to landfills will be reduced to 75% of total amount (per weight) of biodegradable municipal waste produced in 2010 (146.000 t).

- By 2029: share of biodegradable municipal waste disposed to landfills will be reduced to 50% of total amount (by weight) of biodegradable municipal waste produced in 2010 (146.000 t).

By 2033: share of biodegradable municipal waste disposed to landfills will be reduced to 35% of total amount (by weight) of biodegradable municipal waste produced in 2010 (146.000 t).

Increase in Connection Rate to Sewerage System

The construction of sewage connection systems and wastewater treatment plants in recent years which led to decreased amount of wastewater collected in septic tanks and released untreated to aquatic environment.

According to the Negotiation Chapter 27, Montenegro, sets the target that 93% of the population will be connected to sewage systems by 2035 except of agglomerations of less than 2000 population equivalent (PE) which are not obliged to comply with the Urban Wastewater Treatment Directive (UWWTD).

Remaining percentage of population, which is not possible to be connected to the network for technical reasons, will be achieved with the individual systems according to UWWTD.

With this approach, until the end of 2035, wastewater management in all agglomerations will be provided, according to the UWWTD.

The decrease of CH4 emissions is mostly related to the decrease of CH4 emissions resulting from septic tanks.

Untreated wastewater released to aquatic environment causes minor CH4 emissions due to the mostly aerobic nature of sea, rivers and lakes. However, the treatment has an environmental benefit by decreasing eutrophication of natural waters and less pollution by harmful substances.

6.1.7 PAMs on International Transport

This section provides the planned actions of Montenegro that influence GHG emissions from international civil aviation.

Montenegro became the 189th member of the International Civil Aviation Organization (ICAO) on 13 March 2007.

Montenegro became a member of EUROCONTROL on 1 July 2007.

Montenegro signed on 9 June 2006 a Multilateral Agreement between the European Community and its Member States and the Republic of Albania, Bosnia and Herzegovina, the Republic of Bulgaria, the Republic of Croatia, the former Yugoslav Republic of Macedonia, the Republic of Iceland, the Republic of Montenegro, the Kingdom of Norway, Romania, The Republic of Serbia and the United Nations Interim Administration Mission in Kosovo on the establishment of European common aviation area - European Common Aviation Area (ECAA) Agreement. The Parliament of Montenegro ratified this Agreement on 9 October 2007 and it has entered into force on 26 October 2007. After 11 years of its signing and finally concluded long ratification procedures of all the EU member states, and internal procedures in the European Council and Parliament, the ECAA entered into force on 1 December 2017.

On 7 July 2009 Montenegro has signed a Working arrangement with EASA. The basis for this arrangement was Regulation (EU) No. 216/2008 (so called Basic regulation). The new regulation adopted after 2009 brought some changes, so EASA considered it necessary to replace the existing outdated Working Arrangement with a new one, subsequently signed by the Director of the Civil Aviation Agency of Montenegro with the Executive Director of EASA in Cologne on 25 February 2015.

Montenegro is a candidate country for European Union membership. Through the ECAA Agreement, Montenegro has accepted to align its national aviation legislation to the complete aviation acquis of the European Community.

Montenegro is also member of the European Civil Aviation Conference (ECAC) since June 2008.

ECAC is an intergovernmental organisation covering the widest grouping of Member States of any European organisation dealing with civil aviation. It is currently composed of 44 Member States and was created in 1955.

ECAC States share the view that the environmental impacts of the aviation sector must be mitigated, if aviation is to continue to be successful as an important facilitator of economic growth and prosperity, being an urgent need to achieve the ICAO goal of Carbon Neutral Growth from 2020 onwards (CNG2020), and to strive for further emissions reductions.

Together, they fully support ICAO's on-going efforts to address the full range of those impacts, including the key strategic challenge posed by climate change, for the sustainable development of international air transport.

All ECAC States, in application of their commitment in the 2016 Bratislava Declaration, support CORSIA implementation and have notified ICAO of their decision to voluntarily participate in CORSIA from the start of its pilot phase and have effectively engaged in its implementation.

Montenegro like all of ECAC's 44 States, is fully committed to and involved in the fight against climate change and works towards a resource-efficient, competitive and sustainable multimodal transport system.

Montenegro recognises the value of each State preparing and submitting to ICAO an updated "State Action Plan for CO2 emissions reductions" as an important step towards the achievement of the global collective goals agreed since the 38th Session of the ICAO Assembly in 2013.

In that context, it is the intention that all ECAC States submit to ICAO an action plan and Montenegro strongly supports the ICAO basket of measures as the key means to achieve

ICAO's CNG2020 target and shares the view of all ECAC States that a comprehensive approach to reducing aviation CO2 emissions is necessary, and that this should include:

i. emission reductions at source, including European support to CAEP work in this matter (standard setting process);

ii. research and development on emission reductions technologies, including public-private partnerships;

iii. development and deployment of sustainable aviation fuels, including research and operational initiatives undertaken jointly with stakeholders;

iv. improvement and optimisation of Air Traffic Management and infrastructure use within Europe, in particular through the Single European Sky ATM Research (SESAR), and also beyond European borders through participation in international cooperation initiatives; and CO2 emissions, which is a task different in nature and purpose to that of action plans, strategic in their nature. Also this requirement is subject to different deadlines for submission and updates as annual updates are expected. For that reason, the reporting to ICAO of international aviation CO2 emissions may be provided separately, as part of routine provision of data to ICAO, or in future updates of the action plan.

v. Market Based Measures, which allow the sector to continue to grow in a sustainable and efficient manner, recognizing that the measures at (i) to (iv) above cannot, even in aggregate, deliver in time the emissions reductions necessary to meet the ICAO 2020 CNG global goal.

In Europe, many of the actions which are undertaken within the framework of this comprehensive approach are in practice taken collectively, most of them led by the European Union. In this context, the extent of participation will vary from one State to another, reflecting the priorities and circumstances of each State (economic situation, size of its aviation market, historical and institutional context, such as EU/non EU).

The ECAC States are thus involved in different degrees and on different timelines in the delivery of these common actions. When an additional State joins a collective action, including at a later stage, this broadens the effect of the measure, thus increasing the European contribution to meeting the global goals.

Acting together, the ECAC States have undertaken measures to reduce the region's emissions through a comprehensive approach. Some of the measures, although implemented by some, but not all of ECAC's 44 States, nonetheless yield emission reduction benefits across the whole of the region (for example research, SAF promotion or ETS).

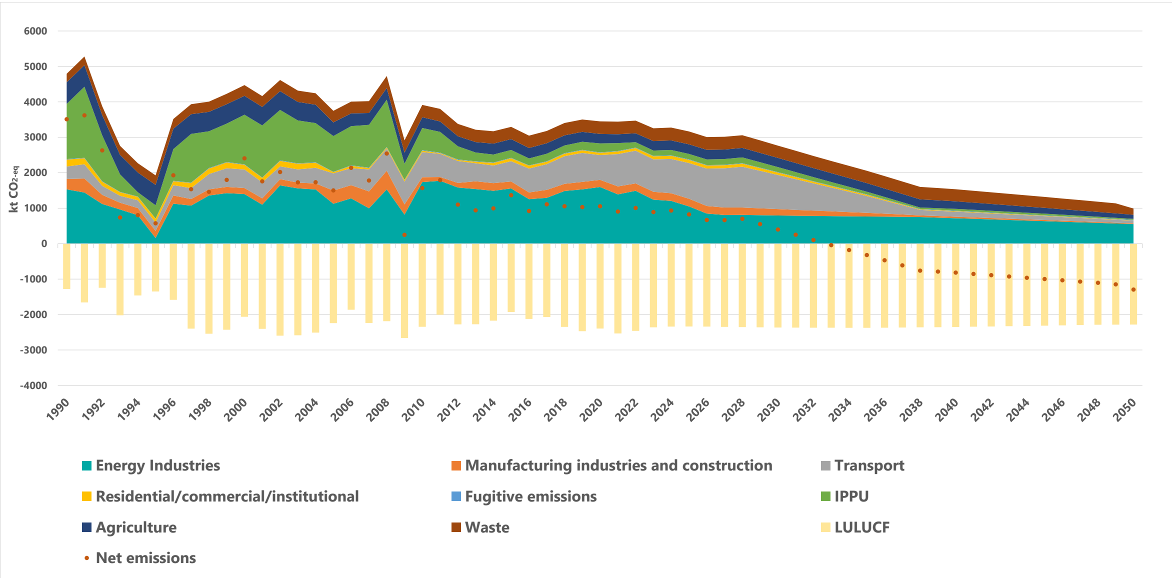
Further information can be found in the following link: https://www.ecac-ceac.org/images/activities/environment/Montenegro_Action_Plan_on_CO2_Emission_Reduction_2021.pdf

6.1.8 Long term impact of PAMs

The PAMs described in this chapter have an impact on national GHG emissions extending beyond 2040. Montenegro's projections take into account the evolution of emissions beyond 2040, supporting the country's long-term climate change planning. In this context, PAMs continue to shape the national emissions profile well into the future.

The following graph illustrates the WAM scenario emissions up to 2050, reflecting the effects of ongoing, adopted, and planned PAMs. These projections extend the trends identified in projections, demonstrating the sustained impact of these measures on Montenegro's emission trajectory.

Figure 43 Impact of PAMs in long term GHG scenarios.



6.1.9 Economic and social impact of response measures

The Powering Past Coal Alliance (PPCA) is a coalition of national and subnational governments, businesses and organisations working to advance the transition from unabated (ie without carbon capture and storage) coal power generation to clean energy. Government members commit to phasing out existing unabated coal power generation and to a moratorium on any new coal power stations without operational carbon capture and storage, within their jurisdictions.

Montenegro joined the PPCA on 30 June 2021 with a plan to phase out coal by 2035. However, Montenegro does not need to meet the PPCA's 2030 Declaration date because Montenegro is a non OECD country. PCCA members commended Montenegro for the cancelation of the construction of a new coal plant in Pljevlja II and the plans to retrofit its existing Pljevlja I coal plant and connect it to a district heating network.

Nevertheless, this section provides an overview of the economic and social consequences of the decarbonization process of the energy sector in Montenegro through a gradual reduction in the use of coal in the production of electricity and as a source of heat for heating in homes and businesses. It includes the potential effects of the energy transition on the workers, businesses, and communities most impacted by the reduction and eventual elimination of coal exploitation in Montenegro.

The information presented here comes from a diagnostic analysis of socio-economic situation published in 2023 by the United Nations Development Program (UNDP) in the framework of the development of the Montenegro Roadmap for Just Transition project funded by Slovak Aid84.

Coal Mine AD Pljevlja (hereinafter: Coal Mine) and Thermoelectric Power Plant "Pljevlja" (hereinafter: TPP Pljevlja) as a subsidiary of Elektroprivreda Crne Gore AD Nikšić (hereinafter: EPCG) are the most important economic companies in Pljevlja, affecting the entire economic activity and, in particular, the income of its residents.

The frequent occurrence of temperature inversions, particularly in the Pljevlja basin, prevents the dispersion of emissions and causes the retention of pollutants produced by the combustion of fossil fuels, emissions from traffic, and other similar sources, directly above the ground, resulting in high concentrations of pollutants in the ground layer of the atmosphere.

The mining process and coal combustion in the TPP Pljevlja have a significant impact on the state of the environment as well as people's health and quality of life in Pljevlja and the region. This has an impact on water pollution, soil contamination, and the production of industrial waste. The greatest

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84 DIAGNOSTICS OF SOCIO-ECONOMIC SITUATION OF COAL REGION PLJEVLJA available in https://www.undp.org/montenegro/publications/diagnostics-socio-economic-situation-coal-region-pljevlja

impact, however, is on air quality due to the emission of particle matter (PM), sulfur dioxide (SO_2), and nitrogen oxides (NO_x).

Sulfur oxides combined with solid microparticles and fog have the greatest impact on respiratory organ damage. Sulfur dioxide causes coughing, bronchial contraction, and increased secretion of bronchial secretions due to its irritating effect. The most serious air pollution issue in Pljevlja is suspended particles (PM10 and PM2.5). The presence of fine particles (PM2.5 particles with a diameter of less than 2.5 μm) in the ambient air causes the emergence and progression of cardiovascular diseases, as well as an increase in their mortality. They have also been shown to cause cancer in humans. PM10 coarse fractions (particles with a diameter of less than 10 μm) increase the incidence of respiratory diseases and contribute to increased mortality.

High levels of suspended particles (PM10 and PM2.5), are most common during the winter months. The permitted concentration of PM10 particles is up to 50g/m3. In the period from January to the end of November 2022, the specified concentration was exceeded on 102 days in Pljevlja, 64 days in Bijelo Polje, 43 days in Podgorica, and 41 days in Nikšić[85]. The number of days with PM10 particle concentrations exceeding the limit in 2021 was 114, accounting for nearly a third of the year.

The process of producing electricity from coal has a significant environmental impact, primarily on the quality of air, soil, and water, as well as the generation of industrial waste. This impact is significant during the company's operations, but it will also be felt after the mining process in the Pljevlja ore-bearing basin is completed. The surface mine's proximity to Pljevlja's city center has an impact on the outside air during the summer months. This influence is amplified on windy summer days when marl dust rises from the surface mine. Aside from the air, there is an impact on water courses, particularly the Ćehotina river, because the water pumped out of the surface mine flows into it. The negative effects of using coal are especially pronounced during the winter months due to the use of this energy source for household heating in individual fireplaces. For these reasons, the PAM on ecological refurbishment of TPP Pljevlja has been included in the NDC even if it does not have a GHG emissions mitigation potential.

The Coal Mine and TPP Pljevlja form the "heart" of the coal value chain, which has an average annual value of 69,647,603 euros, which is calculated by applying the price of 45EUR/MWh. Around 55 companies are directly or indirectly dependent on these two companies, 14 of which are headquartered in Pljevlja (excluding TPP Pljevlja, which is a subsidiary of EPCG with headquarters in Nikšić). The total number of employees in the coal value chain is 7103, with 2100 (29.6%) residing in Pljevlja. Almost 75% of employees in the municipality of Pljevlja work in directly dependent companies, which account for 23% of all employees in the municipality of Pljevlja in 2022[86].

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85 Data published by the Montenegrin Environmental Protection Agency.

86 Cunningham W, Schmillen A. Te Coal Transition: mitigating Social and Labor Impacts, Discussion paper, May 2021

The vast majority of employees rely on their earnings from the Coal Mine, or the TPP Pljevlja. Own earnings are the primary source of household income in 83.1% of cases (personal income).

Employees at Coal Mine and TPP Pljevlja (9 out of 10 or 92.4%) have no desire to change jobs, even if offered a job similar to their current one in a different company. Respondents in 4.2% of cases would accept a second job right away, while the rest were undecided or stated that it depends on the working conditions and earnings. Despite their desire to stay with their current employer, more than half of the respondents (54.3%) are eager to participate in the adult education process by securing a new early position (retraining, professional development).

The operation of the coal mine has a significant impact on the budget of Pljevlja municipality through various types of income. The Coal Mine and EPCG generate the majority of the Municipality's budget revenues, including real estate tax, personal income tax, and tax surcharge, as well as the concession fee for mineral raw materials and income from the fee for environmental protection and improvement.

In the previous four years, coal mines and EPCG contributed nearly 41% of the municipality of Pljevlja's current revenues on average. Every year, the Coal Mine donates approximately 870 tons of coal to associations of pensioners and socially vulnerable families.

In Montenegro, the gradual reduction in the use of coal in the production of electricity and as a source for heating will primarily affect the municipality of Pljevlja and its inhabitants, given the municipality's decades-long production of coal and electricity from coal.

The Coal Mine Pljevlja and the TPP Pljevlja represent a unique coal-based electricity production system that is important not only for Pljevlja because of the employment and added value it provides, but also for the entire country because it is Montenegro's sole basic source of energy.

TPP's annual planned electricity production is approximately 1,300 GWh, which accounts for approximately 45% of the energy produced in the Montenegrin electricity balance. Renewable energy sources are still insufficient to ensure the necessary electricity supply stability.

In the face of a bad hydrological situation, TPP Pljevlja's participation in 2022 exceeded 70% and even 80% on a monthly basis, making TPP Pljevlja connected to the Coal Mine Montenegro's only stable source of energy production.

Considering the estimated reserves given in the concession to the Coal Mine of 54.9 million tons and the annual exploitation of coal of 1.65 million tons, of which 85% is supplied to the TPP Pljevlja, and other unchanged circumstances (the capacities of the Coal Mine and TE Pljevlja, without new concessions), the existing reserves would be exhausted in approximately 35 years. However, the future operations of the Coal Mine and TPP Pljevlja will be determined by the current energy transition processes and the reduction of electricity production from fossil fuels until its abolition. Because the local economy is so heavily reliant on the coal value chain, it is critical that any policy changes that affect coal exploitation and production at the TPP Pljevlja take into account the social, ecological, and economic implications.

Given the environmental and health impacts of the coal value chain in Pljevlja, the energy transition brings with it social, economic, and environmental benefits, though it is certain that they will not be distributed evenly throughout society. Reducing reliance on coal will imply the mining sector's restructuring which has an impact on population's well-being in several ways, including the loss of employment in the coal industry and the impact of migration caused by the reduction of activities in the coal value chain.

According to companies executives, the fact that Montenegro has yet to begin the construction of new energy sources that would provide the necessary supply security and stability, as well as desired energy independence, leads to the conclusion that all moves on the path of energy transition must be carefully planned, with realistic implementation deadlines.

Reduced coal-fired electricity production, if not accompanied by diversification of economic activities in the local community, but also by diversification of energy production from renewable sources, can thus have a significant impact on population living standards and encourage economic migration. Additionally, rising expenditures will primarily affect the poorest and most vulnerable populations, owing to potential increases in energy costs.

Based on the results of the analysis, reducing coal-fired electricity production as well as for the heating needs necessitates timely planning including support for the diversification of economic activity in the municipality of Pljevlja, training of those whose jobs are threatened for employment in new sectors, and the development of support programs for those who decide to start their own business or retire.

The economic diversification will also depend on the road connectivity of Pljevlja, which is currently poor, given that Pljevlja is not connected by a railway line, nor is it in the corridor of the planned highway. Improved road infrastructure on the municipality's territory is required for agricultural development, particularly due to unfavorable winter conditions that cut off individual villages from urban areas. Poor road infrastructure not only impedes agricultural product marketing, but also discourages people from staying in rural areas due to a lack of social and cultural resources. To encourage entrepreneurial activity among the residents, it is necessary to improve the educational process and to provide content in places where young people congregate that will allow the development of missing skills, creativity, and innovation.

7.

PROJECTIONS OF GHG EMISSIONS AND REMOVALS

Projections of GHG emissions and removals are based on the national inventory for 1990–2022, as presented in earlier chapters of this FNC/1BTR. Projections are developed under different scenarios, each reflecting a specific set of policies and measures (PAMs). By comparing mitigation scenarios, Montenegro can assess the variations in its national emissions profile resulting from policy implementation and evaluate progress toward achieving its defined NDC targets. In alignment with the Modalities, Procedures, and Guidelines (MPGs), Montenegro defines the following three scenarios:

- **Without Measures (WOM) Scenario**: Excludes all PAMs implemented, adopted, or planned after 2020.
- **With Measures (WM) Scenario**: Includes PAMs under Montenegro's Revised NDC, reflecting all measures currently being implemented to meet NDC targets.
- **With Additional Measures (WAM) Scenario**: Incorporates additional PAMs beyond those in the current NDC, planned for future implementation.

The emission projections demonstrate the influence of mitigation measures on Montenegro's future GHG emissions levels. These projections focus specifically on PAMs that directly support the implementation and achievement of the NDC targets, ensuring they provide a clear basis for tracking progress.

The projections cover the time period from 2023 to 2040, using the 1990–2022 inventory as a reference.

7.1 Approaches used and key underlying assumptions and parameters used in projections

The tools and assumptions used for projecting GHG emissions and removals are explored, detailing the software programmes, models, and frameworks employed to create these projections, along with the assumptions regarding key economic and sectoral variables.

Methodological Framework and Tool

Montenegro has applied the Mitigation-Inventory Tool for Integrated Climate Action (MITICA)[87] to develop its national projections of GHG emissions and removals of all scenarios. The Long-range Energy Alternative Planning software (LEAP)[88] was also employed to estimate the impact of the energy efficiency PAMs considered in the WM scenario.

MITICA provides a standardised framework to formulate specific bottom-up mitigation models at the CRT category level, linked to Montenegro's national GHG inventory, and combined with a top-down specification of the national economy. As such, MITICA serves both as a framework and a tool to create consistent mitigation scenarios that can be tracked against historical GHG emission trends.

MITICA develops mitigation scenarios starting with the estimation of a WOM scenario, which represents the future national GHG emissions based on the historical GHG dynamics of each emission source and sink, using a macroeconomic framework as a reference. The macroeconomic framework is built from the evolution of the main socioeconomic and demographic variables, considering that the technology mix, consumer behaviour, and GHG accounting methodologies remain the same as in the latest historical year, changing only due to the implementation of PAMs.

Macroeconomic and sectoral trends are crucial in developing GHG emissions projections, as they define the drivers of emissions which ultimately derive in emissions and removals. Proxies or drivers are variables that are believed to impact the variable of interest (in this case, GHG emissions). An essential added value from MITICA is that it considers the historical evolution of both CRT emissions and its drivers to build best-fit models by category. Through machine learning techniques, MITICA tests all possible statistical models to *explain* the emission levels of each CRT category, defining the one showing better statistical results in each case. The granularity level used for performing the estimations is the most disaggregated level available at the GHG inventory, and therefore, one specific model is designed for each CRT activity. This allows to capture the behaviour of each emission source individually, learning from the historical period to project future emissions.

[87] Martín-Ortega, J.L., Chornet, J., Sebos I., Akkermans, S., Lopez Blanco, M.J. (2024). Enhancing Transparency of Climate Efforts: MITICA's Integrated Approach to Greenhouse Gas Mitigation. Sustainability 2024, 16(10), 4219. https://doi.org/10.3390/su16104219
[88] SEI. LEAP; Stockholm Environment Institute: Stockholm, Sweden, 2024

MITICA uses the WOM scenario as a benchmark for developing WM and WAM scenarios. In these scenarios, the only differences are the PAMs implemented and their impact on GHG emissions.

To estimate the WOM scenario, MITICA requires national GHG emission inventory data and a set of projected proxies that define the macroeconomic framework. These proxies include national-level proxies for developing GHG projections and sector-specific proxies for refining sectoral model specifications.

While the forecasting approach is common across sectors and categories, different sectoral proxies enable MITICA to define category-specific models for projecting WOM emissions. The results of the WOM were validated by the projections technical team to ensure the WOM results are consistent with the historical trends, confirming that there are no structural breaks in the trends and there are no outliers or unjustified values in the projected period.

Starting from the initial WOM projection, MITICA implements methodologies to estimate the impact of relevant PAMs on main emission sources and sinks, consistently with the WOM. The WM and WAM scenarios are then constructed by considering the impact of the selected PAMs. The consistency between the national inventory, PAMs and projections is ensured by using the latest inventory methodologies to estimate PAMs, while integrating the estimation in a common projection framework.

Macroeconomic Framework

The forecasting modelling approach applies a nationally defined macroeconomic framework considering the evolution of several proxies (parameters in the wording of the MPGs) that determine the composition of the national economy, demography and main sectoral characteristics.

Proxies are first identified based on available data from national planning processes and national prospects available. This notably includes the population projection up to 2050 developed by Monstat[89], and the GDP projections of the Ministry of Finance of Montenegro[90]. This was complemented by historical statistics from Monstat, and data available in the Shared Socioeconomic Pathways (SSP) database[91] for Montenegro. The following table provide the time series of the main parameters considered in the macroeconomic framework.

Table 41 Main parameters of the Projections Macroeconomic Framework.

Parameter	2020	2021	2022	2025	2030	2035	2040
Population Total Medium Fertility (inhabitants)	620 739	617 683	616 695	618 105	620 455	622 806	625 156

89 https://www.monstat.org/eng/page.php?id=47&pageid=47
90 https://wapi.gov.me/download-preview/e5286401-6770-4635-8cd2-d348a6c5e83a?version=1.0
91 https://iiasa.ac.at/models-tools-data/ssp

Electricity demand (Gigawatt-Hours)	3 037	3 428	3 636	3 653	3 736	3 834	3 935
Final energy consumption (Thousand TOE)	702	809	771	864	1 001	1 121	1 215
GDP Forecast (chained linked volumes 2015)							
Total GDP	3 214	3 629	3 848	4 315	4 998	5 592	6 066
Agriculture, forestry and fishing	*303*	*302*	*293*	*289*	*273*	*237*	*182*
Industry (except construction)	*414*	*434*	*432*	*452*	*416*	*345*	*243*
Manufacturing	*155*	*170*	*176*	*176*	*204*	*228*	*248*
Construction	*231*	*220*	*186*	*194*	*225*	*251*	*273*
Wholesale and retail trade, transport, accommodation and food service activities	*680*	*1009*	*1 173*	*1 403*	*1 667*	*1 911*	*2 123*
Information and communication	*153*	*161*	*209*	*244*	*305*	*366*	*425*
Financial and insurance activities	*187*	*193*	*198*	*228*	*293*	*360*	*425*
Real estate activities	*255*	*258*	*262*	*280*	*325*	*363*	*394*
Professional, scientific and technical activities; administrative and support service activities	*175*	*191*	*203*	*244*	*321*	*403*	*485*
Public administration, defence, education, human health and social work activities	*573*	*603*	*610*	*671*	*784*	*886*	*971*
Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organizations and bodies	*88*	*88*	*106*	*133*	*186*	*244*	*303*

The GDP time series was constructed using historical data from the Eurostat database and interannual GDP growth rates provided by the Ministry of Finance for 2024–2027 (3.8%, 3.1%, 3.2%, and 3.2%, respectively). From 2028 to 2040, the interannual growth rates of the SSP2 scenario for Montenegro were applied.

The working team ensured consistency across all proxies defining the macroeconomic framework, resulting in a coherent basis for building GHG projections by scenario. This consistency was validated through cross-checking the evolution of proxies to ensure robust results. For example, one validation check used the Solow Growth Model Framework to analyse GDP and population time series. In this framework, GDP growth is influenced by population growth and total factor productivity. The analysis revealed that, while annual GDP growth is significantly higher than population growth during the projected period, its trajectory can be explained by productivity growth. Importantly, the required productivity levels remained within the historical ranges available.

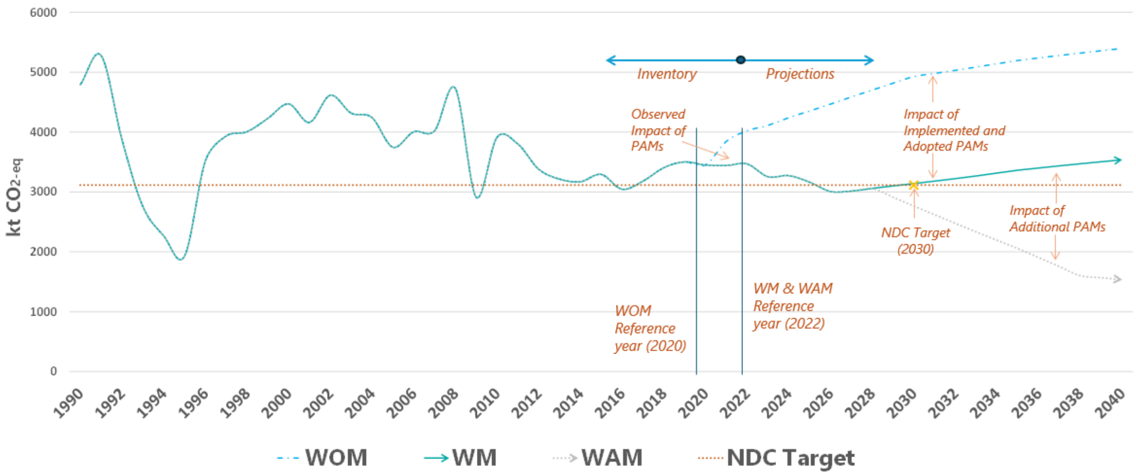
The composition of the economy (i.e. GDP branches) and the population series are common in all scenarios, and the differences between scenarios are only explained by the impact of PAMs.

7.2 Projections for NDC tracking

Projections of GHG emissions and removals are based on the national inventory for 1990–2022, as presented in earlier chapters of this FMC/1BTR. **All projections provided in this chapter exclude the emissions of the LULUCF sector to allow the tracking of the NDC objectives**.

The figure below illustrates the results for the WOM, WM, and WAM scenarios in relation to the NDC target.

Figure 44 Summary of results of GHG projections.



The projections indicate that Montenegro is on track to achieve its NDC target by 2030. While emissions under the WM scenario are slightly above the target, the results demonstrate that the country's efforts are closely aligned with the goal of reducing national GHG emissions (excluding LULUCF) by 35% by 2030 compared to based year (1990).

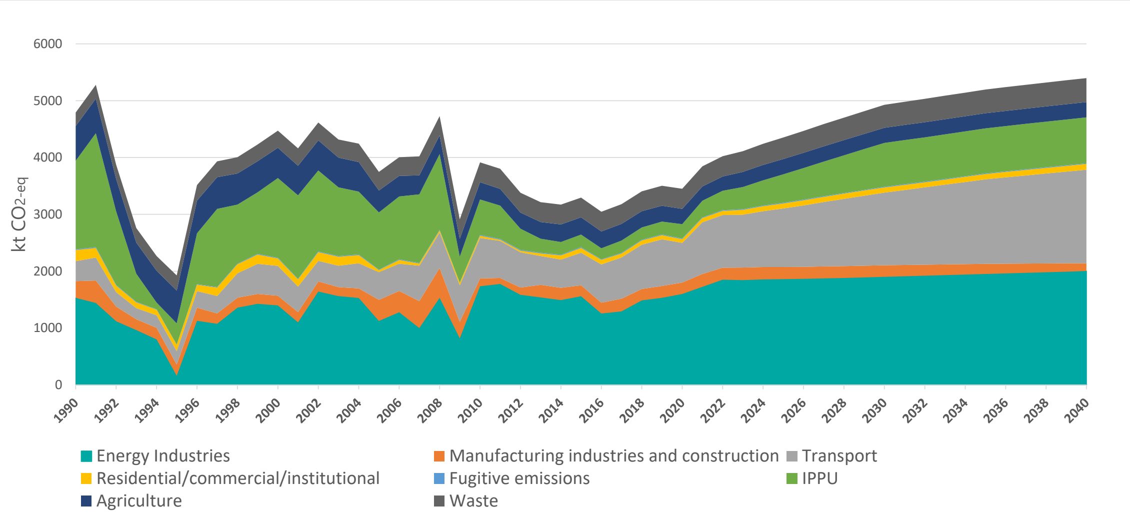
The WOM scenario serves as the baseline for projections, representing Montenegro's GHG emission profile if no NDC PAMs were implemented. Notably, the implementation of NDC PAMs began primarily in 2020–2021, and their impact is already observed in these inventoried years.

The WAM scenario explores the potential impact of Montenegro's accession to the EU, assumed to occur in 2028. Although Montenegro is making significant efforts to adopt the EU legislative acquis, the projections show that by 2030, the influence of EU PAMs and targets remains limited.

7.2.1 Scenario Without Measures (WoM)

The Without Measures (WoM) scenario depicts the evolution of national GHG emissions in the absence of policies and measures (PAMs). The following figure illustrates how emissions are projected to evolve under this scenario.

Figure 45 WoM projections



The WOM scenario shows an overall increasing trend in national GHG emissions from the latest inventory year (2022). From 2023 to 2040, emissions are projected to grow at an average annual rate of 1.65%. However, the growth rate differs significantly between the periods 2022–2030 and 2030–2040. Between 2022 and 2030, emissions are projected to increase at an annual average rate of 2.40%, while from 2030 to 2040, the growth slows to an annual average of 1.04%.

In terms of categories, the IPPU sector shows the greatest GHG growth by 2030, primarily driven by significant increases in refrigeration and air conditioning emissions. Other sectors contributing to this growth include transport, residential/commercial/institutional, and waste. In contrast, manufacturing industries and fugitive emissions show negative growth, reflecting shifts in the country's economic evolution. From 2030 to 2040, these trends moderate, with smaller increases in GHG emissions across sectors.

Table 42 GHG growth estimated in the WOM scenario.

CRT Categories	GHG Emissions Change (%)	
	2030 vs 2022	2040 vs 2030
1.A.1. Energy Industries	2.8%	5.3%
1.A.2. Manufacturing industries and construction	-3.6%	-32.0%
1.A.3. Transport	37.9%	28.5%

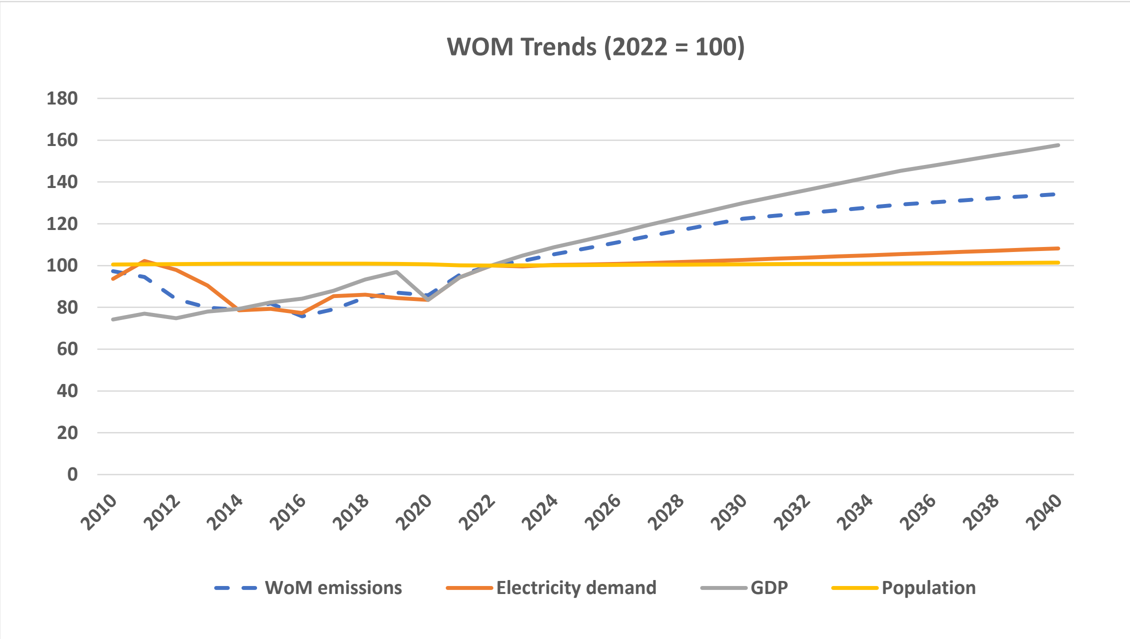
1.A.4. Residential/commercial/institutional	24.7%	13.4%
1.B. Fugitive emissions	-8.5%	2.8%
2. IPPU	125.2%	4.7%
3. Agriculture	6.4%	0.3%
5. Waste	13.3%	5.0%

*Negative figures represent a decrease in emissions.

The reference year for the WOM scenario is set at 2020 to facilitate the estimation of the impact of most PAMs considered in the NDC implementation, which are included into the WM scenario. This ensures a consistent analysis of the effects of PAMs and the projections based on the most recent GHG inventory.

Examining the evolution of key drivers in relation to the WOM results reveals that GHG emissions are projected to grow at a slower pace than GDP. This indicates that, even in the absence of PAMs, the Montenegrin economy shows a slight decoupling of GHG emissions from economic growth.

Figure 46 Trends observed in the WOM scenario.



7.2.2 Scenario With Measures (WM)

The scenario With Measures considers the impact of the PAMs adopted or implemented to achieve the NDC objectives. A summary of the impact of PAMs considered in the WM scenario is provided in the following table.

Table 43 Summary of PAMs included in the WM scenario.

NDC code	Name of the Measure	GHG Impact in 2030 (kt CO2-eq)
1E	Ecological refurbishment of Pljevlja Thermoelectric Power Plant (TPP)	0
2E	Carbon pricing for TPP	876.53
3E	NDC renewable power plants	214.40
NA*	New renewable capacity	313.48
4E	District Heating in Pljevlja	5.47
5E	Development and Implementation of Energy Efficiency Regulatory Framework in Buildings	245.43
6E	Increased Energy Efficiency in Public Buildings	
7E	Financial Incentives for Citizens/Private Households (for Energy Efficiency Investments)	
8E	Energy Labelling and Eco-Design Requirements for Energy-Related Products	
9E	Establishment and Implementation of EE Criteria in Public Tendering	
10E	Implementation of Energy Efficiency Measures in Public Municipal Companies, Utilities and Services	
11E	Development of Transmission and Distribution Power Network (decrease in losses)	22.86
12E	Refurbishment of Small Hydroelectric Power Plants (increased EE)	3.75
1T	Electric Cars	36.88
2T	Financial Incentives for Electric, Plug-In Hybrid and Full Hybrid Vehicles, for Both Citizens and Companies/Entrepreneurs	
1E	Reduction of HFCs in line with the Law Acknowledging Amendments to the Montreal Protocol on Substances that Deplete the Ozone Layer	12.48
W1	Reduction of Bio-Waste in Municipal Waste	19.44
W2	Increase in Connection Rate to Sewerage System (target 93% by 2035)	36.41

*PAM not mentioned in the NDC submission

The impact of the PAMs listed in the previous table is estimated relative to the WOM scenario, which begins in 2020. By 2030, the PAMs with the greatest impact are carbon pricing and those related to the integration of new renewable capacity into the electricity mix, followed by energy efficiency measures. While the remaining PAMs have a smaller individual impact, they still contribute to the overall reduction of GHG emissions under the WM scenario.

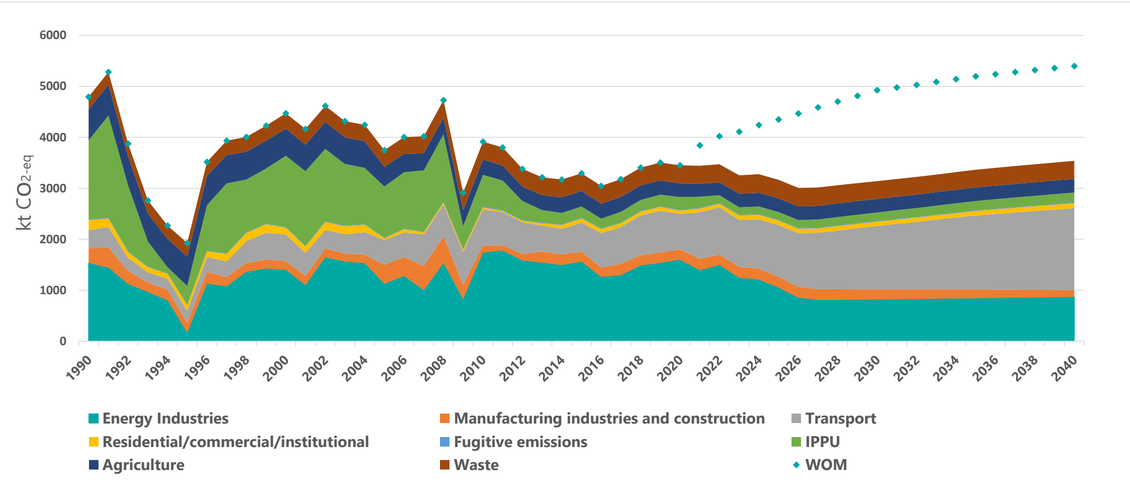
The methodologies used to estimate the impact of these PAMs are based on the default MITICA methodologies, which have been extended and adapted to Montenegro's national circumstances. Impact estimation begins with an ex-post approach, utilizing data from the national inventory and other sources to assess the observed impact of PAMs compared to a hypothetical scenario where the PAMs were not implemented. Inventory years 2021 and 2022 are part of the WM scenario and are used to calculate the ex-post impact of PAMs for these years.

From 2023 to 2040, the impact estimation is conducted ex-ante, projecting the influence of PAMs across the various CTF categories within the WOM scenario. Although there is a distinction between ex-post and ex-ante estimates, the methodologies applied to calculate the GHG impact of PAMs remain consistent throughout the period. The primary difference lies in the use of observed data (ex-post) versus projected data (ex-ante).

PAMs are integrated into the WM scenario calculations according to their annual implementation schedules. Additional details on the methodologies used to estimate the impact of PAMs can be found in Annex 2 of this FMC/1BTR.

The following figure illustrates the emissions estimated in the WM scenario up to 2040 considering the impact of PAMs implemented and adopted.

Figure 47 WM projections.



By 2030, WM emissions are projected to decrease by 9.51% compared to the most recent inventory year, dropping from 3 470 to 3 140 kt of CO_2-eq. This represents a 34.49% reduction from 1990 levels, bringing Montenegro close to achieving its NDC target for 2030. These results emphasize the country's ongoing commitment to reducing national GHG emissions and demonstrate that it is on track to meet its target.

Sectoral analysis under the WM scenario shows that the largest emission reductions by 2030 occur in energy industries (1.A.1), with a 45% decrease compared to 2022 levels. This is followed by an

8.52% reduction in fugitive emissions (1.B), a 2.41% reduction in waste (5), and a 1.59% reduction in manufacturing industries and construction (1.A.2). However, some sectors are projected to see increases in emissions relative to 2022 levels. Emissions in the transport sector are expected to rise by 33.97%, while those in the residential, commercial, and institutional sectors increase by 17.14%. Additionally, emissions from agriculture and IPPU sectors are projected to grow by 11.06% and 6.39%, respectively. These increases highlight priority areas for further mitigation efforts, particularly in the transport and residential sectors, which present significant opportunities for emission reductions.

Looking ahead to 2040, WM projections indicate that total GHG emissions will increase slightly by 7.15% compared to 2030 levels, reflecting overall growth in activity levels.

7.2.3 Scenario With Additional Measures (WAM)

While the WM scenario demonstrates that Montenegro is on track to meet its NDC target by 2030, the country remains committed to further advancing climate action and decarbonizing its economy. This effort seeks to foster economic growth, reduce inequalities, and improve the living conditions of its population. In this context, Montenegro's potential accession to the European Union represents a critical opportunity to strengthen its regulatory framework, particularly in the area of climate change mitigation.

The WAM scenario builds upon the WM projections by incorporating the implementation of additional key EU policies aimed at addressing Montenegro’s major emission sources. It starts from the emission levels achieved under the WM scenario and accounts for the incremental impact of WAM Policy and Mitigation Actions (PAMs).

A summary of the impact of the PAMs included in the WAM scenario is presented in the following table.

Table 44 PAMs considered in the WAM scenario.

Name of the PAM	Main EU legislation associated	GHG Impact in 2030 (kt CO2-eq)
Industrial Decarbonization	EU ETS and Industrial Emissions Directive	42.56
Sustainable Transport	CO_2 Emission Standards for Vehicles; Fit for 55 Package; Alternative Fuels Infrastructure Regulation	277.83
Green Buildings and enhanced energy efficiency	Energy Efficiency Directive (EED); Energy Performance of Buildings Directive (EPBD); Renewable Energy Directive (RED)	7.09

Sustainable Agriculture	Effort Sharing Regulation (ESR); Common Agricultural Policy (CAP)	15.80
Low-Carbon Refrigerants	EU F-Gas Regulation	30.82
Enhanced Waste Management and Circular Economy	Landfill Directive; EU Waste Framework Directive; Circular Economy Action Plan	0.00*

*The PAMs of the WM scenario impacting the waste sector emissions, partially consider the impact of EU PAMs for the waste sector. For this reason, the observed impact of this PAM is zero by 2030 (the impact of this PAM reaches 40.10 kt by 2040).

By 2030, the impact of the PAMs considered in the WAM scenario is expected to have limited effect on Montenegro's national GHG emissions. This is primarily due to the anticipated timeline for Montenegro's accession to the European Union, which is targeted for 2028. By this year, the country will be required to meet the EU convergence criteria and implement the full legislative acquis, which includes significant regulatory and institutional adjustments.

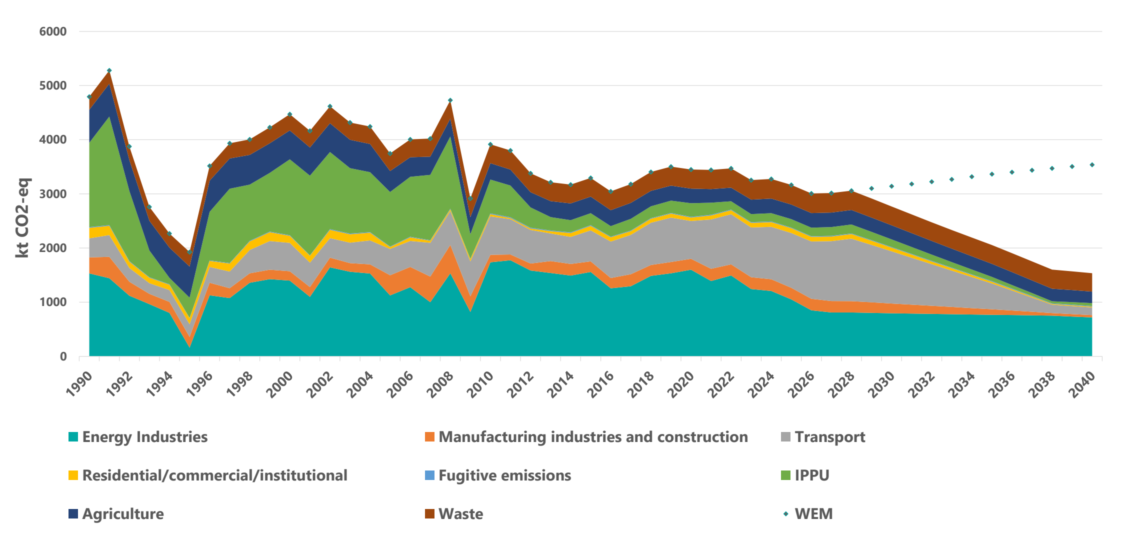
However, the accession year is not yet certain, and besides, historical experience from previous EU enlargements indicates that the full impact of EU Policies typically requires a significant timeframe to materialize[92,93]. This delay is due to the complexities of integrating EU legislation into national policies, coupled with the infrastructure investments, administrative capacity building, and behavioural changes required to achieve compliance.

Based on these precedents and recognizing the scale of transformation required in Montenegro's key sectors, the GHG impact of PAMs in the WAM is estimated assuming an average period of 10 years post-accession for the country to achieve the full impact of EU policies and measures. This would be represented in the achievement of main EU 2030 targets by sector after 10 years of accession, without considering the LULUCF sector[94]. Further information on the methodologies and assumptions made for estimating PAMs in the WAM scenario is available in the Annex 3 to the FMC/1BTR.

The following figure illustrates the emissions estimated in the WAM scenario up to 2040 considering the impact of the described additional PAMs.

[92] https://www.consilium.europa.eu/en/documents-publications/library/library-blog/posts/library-guide-to-eu-enlargement/
[93] https://www.europarl.europa.eu/factsheets/en/sheet/167/die-erweiterung-der-europaischen-union
[94] Since the current NDC target excludes the LULUCF sector, the WAM estimates presented in this BTR similarly do not account for emissions or removals from the LULUCF sector.

Figure 48 WAM projections.



By 2030, WAM projections indicate a 13.5% reduction from WM levels, decreasing emissions from 3 140 kt CO_2-eq to 2 765 kt CO_2-eq. This reduction becomes even more pronounced by 2040, with national total GHG emissions projected to reach 1 534 kt CO_2-eq. In terms of the NDC target metrics, the 2040 WAM emissions represent a 68% reduction from 1990 levels, marking a significant milestone in GHG emission reductions.

By sector, all sources experience substantial reductions under the WAM scenario. Emissions from the energy industry stabilize between 800–700 kt CO_2-eq, reflecting significant decarbonization progress, while retaining the Pljevlja TPP as an auxiliary technology to address the variability of renewable energy sources[95]. Transport emissions decrease to very low levels, consistent with EU policies aimed at phasing out fossil fuel-based transportation. Emissions from other sources are also drastically reduced, achieving very low emission levels by 2040.

[95] The integration into the EU and the integration of energy markets could allow the further reduction of emissions in energy industries. Furthermore, the use of the small nuclear reactors: https://www.iaea.org/newscenter/news/what-are-small-modular-reactors-smrs could be explored in the future in view of the potential replacement of the installed Capacity of Pljevlja TPP.

7.2.4 Sensitivity Analysis

Two sensitivity analyses were conducted to evaluate the potential uncertainties in the estimated projections, with a focus on the WM scenario.

First, a sensitivity analysis assessed the impact of varying GDP growth trends. Unrealistic GDP assumptions could lead to biased results, driven by unfeasible economic projections.

Second, a sensitivity analysis examined the capacity factors (CF) of renewable energy sources (RES). Variability in renewable capacity, combined with the challenge of balancing electricity supply and demand, introduces uncertainty about the actual capacity that will be available to meet demand. Although this uncertainty is expected to diminish as Montenegro integrates into the EU's energy market, it remains a critical factor for this assessment.

Sensitivity Analysis – GDP

In Montenegro's case, the GDP trend used for projections aligns with historical patterns. To assess the sensitivity of the results, two alternative scenarios were developed: one assuming an annual average GDP growth of 4% and another with 1%. These scenarios illustrate two distinct economic pathways that could significantly influence GHG emissions projections.

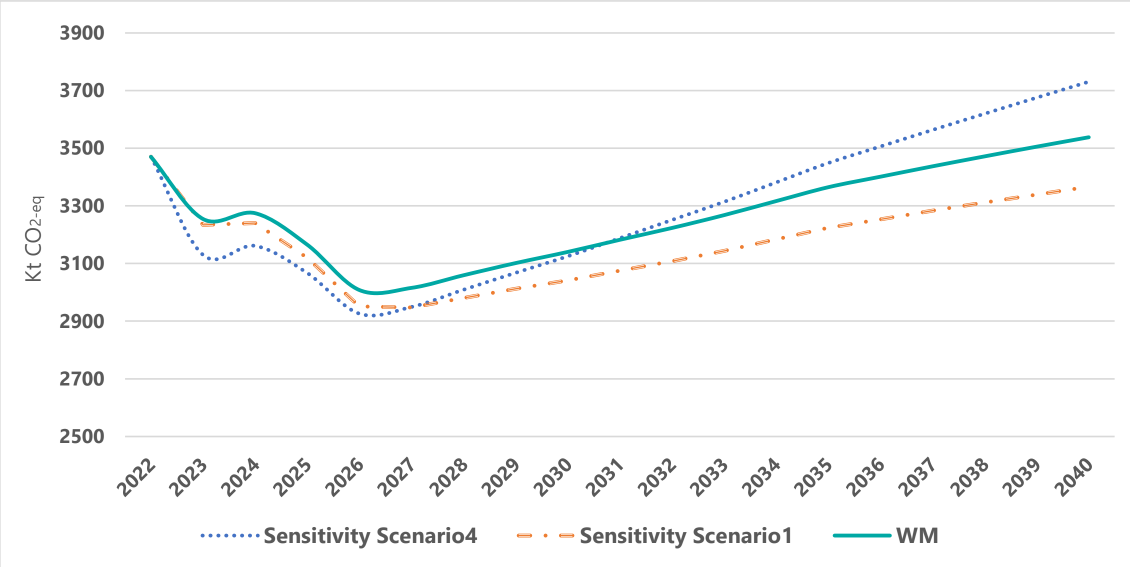
The projections for the sensitivity scenarios were simplified by using GDP as the sole proxy in the MITICA software and updating the estimates for PAMs that use the GDP trend in any form. However, it is important to note that depending on the CRT category, this does not necessarily mean that GDP drives the projected trend. The influence of GDP on each category depends on how it has historically impacted that category.

Table 45 GDP trends – Sensitivity scenarios

Scenario	2024	2025	2026	2027	2028	2029	2030	2040
Sensitivity scenario 4	4%	4%	4%	4%	4%	4%	4%	4%
WM GDP	3.8%	3.1%	3.2%	3.2%	2.9%	2.8%	2.8%	1.6%
Sensitivity scenario 1	1%	1%	1%	1%	1%	1%	1%	1%

The results of the sensitivity analysis indicate that, up to 2030, variations in the GDP trend have a minimal impact on the projection outcomes. However, in the long term, up to 2040, the GDP trend significantly influences the final results. The following figure illustrates the differences observed in the WM scenario projections, excluding LULUCF.

Figure 49 Sensitivity scenarios related to GDP.



Sensitivity Analysis – Capacity Factors of RES.

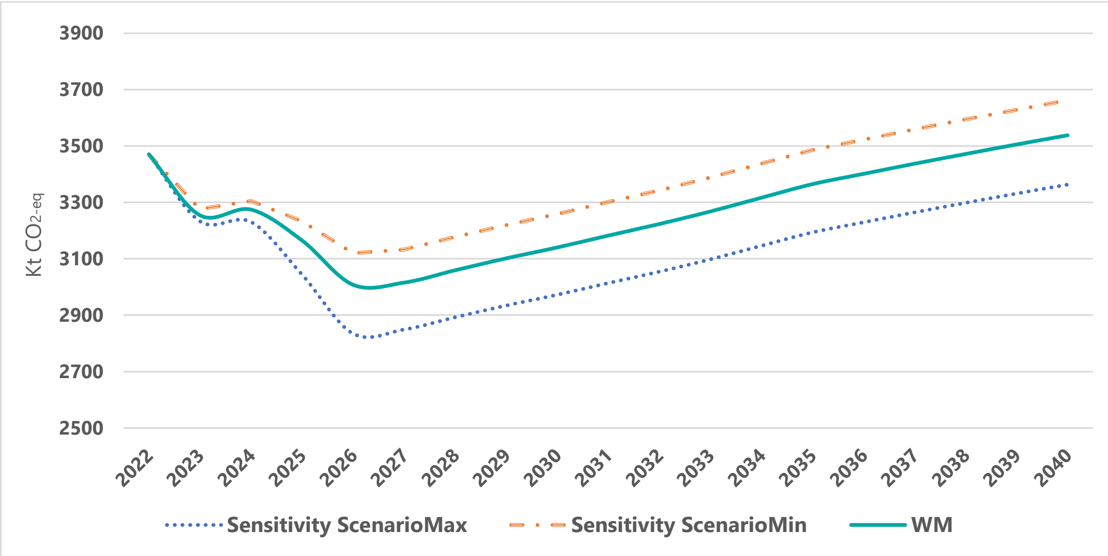
The PAMs associated with renewable energy sources are estimated using capacity factors specific to each technology. The capacity factor reflects both how often a plant operates at maximum capacity and how effectively supply meets demand. Generally, CFs depend on the type of RES and the operational dynamics of the electricity grid. For the estimation of PAMs, the following CF assumptions were used: 20% for photovoltaic (PV), 35% for wind, and 40% for hydropower.

To assess the sensitivity of WM results, two alternative scenarios were developed:

- High CF scenario: 35% for PV, 45% for wind, and 50% for hydropower.
- Low CF scenario: 15% for PV, 25% for wind, and 30% for hydropower.

The results of these scenarios reveal the following differences in the WM outcomes:

Figure 50 Sensitivity scenarios related to CF.



7.2.5 Projections of the key indicator used to track the progress of the implementation of the NDC target

The projections presented in this chapter, derived from the latest inventory available, enable the calculation of the key indicator used to track progress toward Montenegro's NDC target: the percentage reduction in emissions compared to 1990 levels. The following table provides the projected values of this indicator from 2022 to 2030 (the target year) and 2040 (the latest projected year).

Table 46 Projection of indicator used to track progress of NDC: % reduction in total national GHG emissions (excl. LULUCF) compared to 1990

2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
27.60	32.10	31.68	33.96	37.25	37.09	36.18	35.29	34.49	29.80	26.18

The indicator is calculated using data from the national inventory (2022) and the WM projections for 2023–2040. The table demonstrates that Montenegro is on track to meet its target of reducing emissions by at least 35% by 2030 compared to 1990 levels. Between 2026 and 2029, Montenegro is projected to exceed the target, achieving a maximum reduction of 37.25%.

Considering the uncertainties highlighted in the sensitivity analysis, it is evident that Montenegro remains on track to achieve its 2030 target. Furthermore, under the WAM scenario, Montenegro is projected to achieve a 42.29% reduction from 1990 levels by 2030, 57.12% by 2035, and 67.98% by 2040.

7.3 Projections including LULUCF

The projections presented in the previous section are provided without the LULUCF sector to ease the tracking of progress toward the NDC target, which does not account for the emissions of LULUCF. However, Montenegro developed projections including LULUCF, in order to meet the provisions of the MPG and to enhance the transparency of the FNC/1BTR. This section provides the results of projections including the LULUCF sector for illustrative purposes. The CTF tables provided in the Annex include the emission by sector, gas and totals with and without LULUCF.

It should be noted that these projections do not include PAMs targeting LULUCF sector emissions, as such actions are excluded from Montenegro's current NDC. LULUCF projections are estimated at the category level, covering CRT categories 4A1, 4A2, 4B2, 4C2, 4E2, 4F2, and 4G. Sectoral emissions remain steady throughout the projected period, as the land-use distribution is stable and significant economic changes in land-intensive activities are not anticipated, even in the WOM scenario.

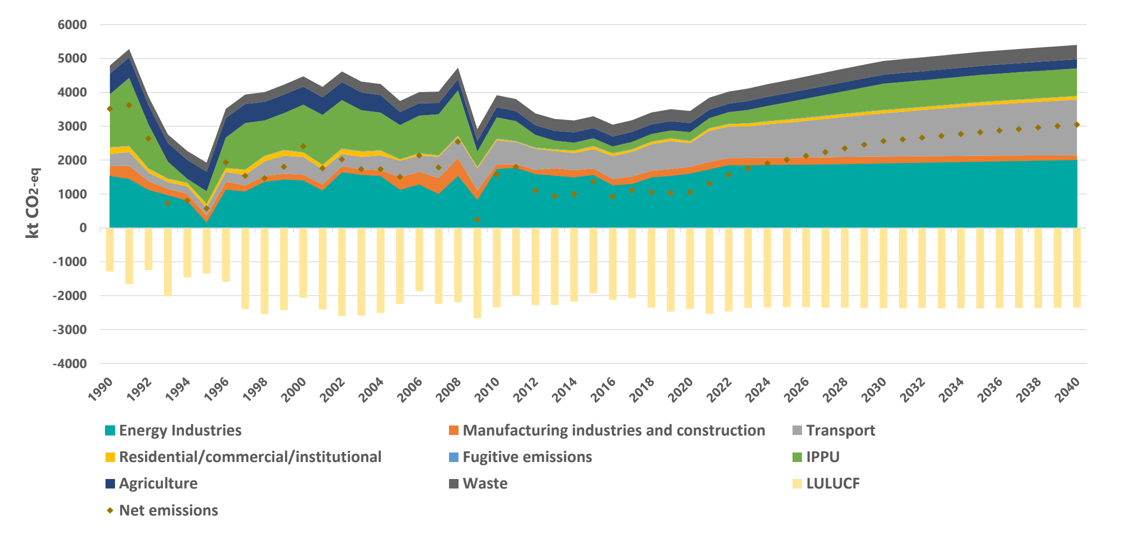
Since no PAMs are identified for the LULUCF sector under the NDC implementation, LULUCF net emissions remain the same across all mitigation scenarios.

The following provides information on the results obtained by scenario when LULUCF is considered.

Scenario Without Measures (WOM) with LULUCF

From 1 007 kt of CO2-eq in the latest inventory year, net GHG emissions in the WOM reach 2 559 kt CO2-eq in 2030, and 3 046 kt CO2-eq in 2040. LULUCF removals remain stable throughout the projected period, ranging between -2 200 and -2 400 kt CO_2-eq. The following figure illustrates net GHG emissions in the WOM scenario including the contributions from the LULUCF sector.

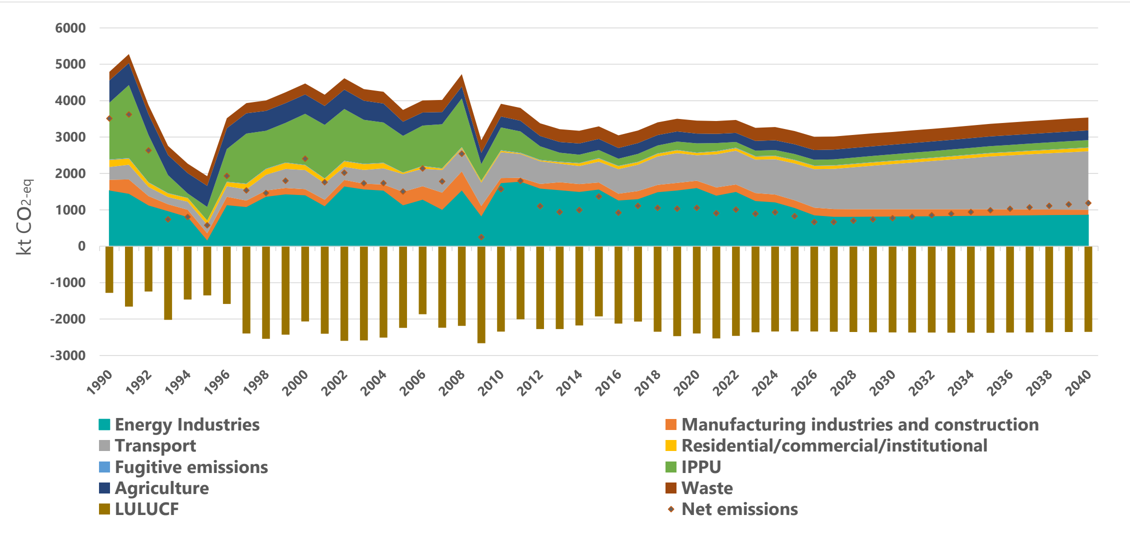
Figure 51 WOM projections including LULUCF.



Scenario With Measures (WM) with LULUCF

In the WM scenario, emissions are projected to reach 772 kt CO_2-eq by 2030, representing a 23.32% reduction from the latest inventory year. By 2040, emissions are expected to rise to 1,187 kt CO_2-eq.

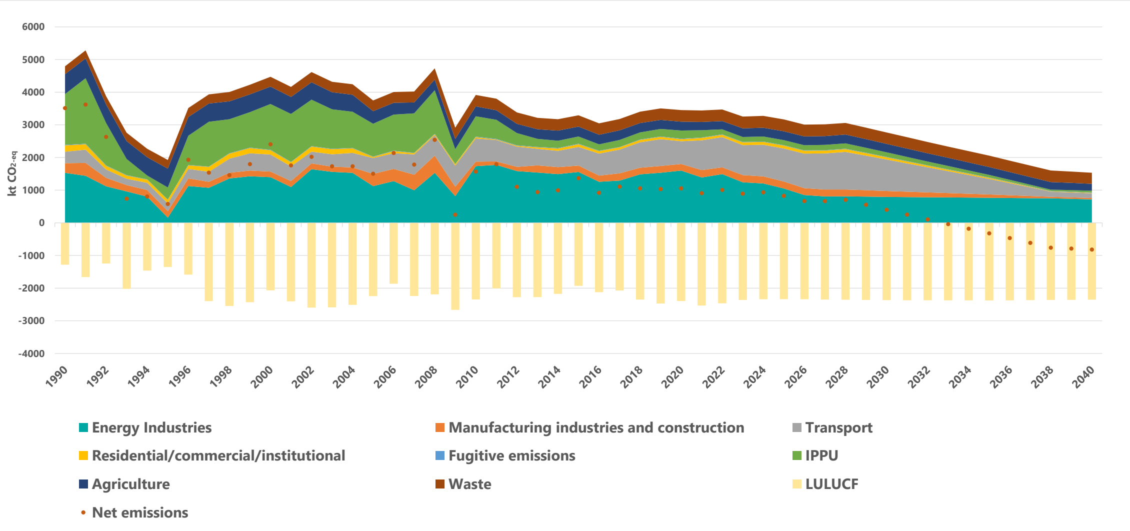
Figure 52 WM projections including LULUCF.



Scenario With Additional Measures (WAM) with LULUCF

In the WAM scenario, net emissions are projected to reach 399 kt CO_2-eq by 2030, with further reductions beyond that point. The combined effect of emission reductions achieved through the implementation of WM and WAM PAMs, along with the removals from the LULUCF sector, positions Montenegro to achieve carbon neutrality starting in 2033.

Figure 53 WAM projections including LULUCF.



8.

VULNERABILITY AND RISK ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

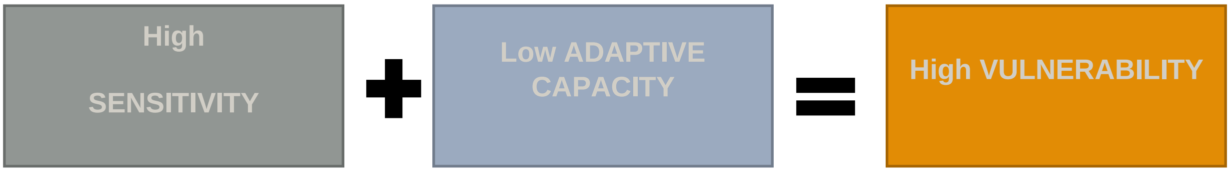
Montenegro is a country that is particularly vulnerable to the impacts of climate change due to its geographical location, its topography, and its socio-economic characteristics. Climate change impacts have already manifested themselves in the country and are expected to result in more impacts for key sectors, such as water availability and agricultural production. Therefore, adaptation actions and strategies are necessary and urgent. Montenegro recognises that adaptation is a fundamental component in the long-term global response to the impacts of climate change, and has promoted the importance of the adaptation component through its participation in the UN negotiation processes and in the development of instruments that link international agreements with national policy.

8.1 Conceptual framework for climate adaptation in Montenegro

Montenegro has adopted the conceptual approach of the IPCC, which defined that the level of vulnerability of human and natural systems to climate-related impacts is a result of the level of sensitivity and adaptive capacity to cope with climate change (IPCC, 2014). Both changes in the climate system and socio-economic processes are drivers of vulnerability.

To understand how to adapt to climate change, it is necessary to define and understand the concept of vulnerability, defined by the IPCC as the "propensity or willingness to be adversely affected". This term comprises a number of concepts, such as sensitivity or susceptibility to damage and lack of responsiveness and adaptability" (**Figure 55**) (Agard et al., 2014). This means that a system will be more vulnerable the more it is affected by climatic variables (sensitivity) and that it has little or insufficient ability to adjust to them (adaptive capacity).

Figure 54 Vulnerability and its components



Adaptation actions are oriented towards reducing the vulnerability of the people and nature system affected by climate events. Adaptation to the effects of climate change refers to adjustments in social, ecological, or economic systems as a response to the current or expected impacts of climate change. It refers to adjustments in processes, practices, and structures to moderate potential damage or to take advantage of opportunities.

Adaptation processes must start by knowing who the most vulnerable people are and what should be protected, which is why Montenegro has conducted a vulnerability analysis to determine the sectors most vulnerable to climate change.

8.2 Climate change profile for Montenegro

8.2.1 Basic climate characteristics and climate change trends

The climate of Montenegro is very heterogeneous, which is a consequence of its geographical location. Montenegro is located in a zone where the bar and frontal systems intensively mix air masses with extremely different physical and meteorological properties: cold masses from the north and warm masses from the south. The complex orography, layout and orientation of mountains and valleys, proximity to the Adriatic and Mediterranean Seas, and proximity to a large land area to the north further affect weather and climate.

The sharp changes of altitude over a small distance and the prevailing mountainous regions over 1,000 m in altitude shape a highly variable climate. The mountain chains of Orijen, Lovćen, Rumija, and Sutorman reduce the influence of the Adriatic Sea on the littoral part. On the other hand, the River Bojana, Podgorica, the Skadar Basin, the valley of the Rivers Morača and Zeta, and Nikšić Valley are influenced by the Mediterranean climate. That area acts as a border zone between the Mediterranean and continental-mountainous climate. It consists of the mountains: Golija, Vojnik, Lola, Kapa Moračka, Babin Zub, Crkvine, Komovi, and Prokletije. Beyond that zone there are high mountain chains with a severe sub-alpine climate and moderate mountainous climate in the valleys up to the north of the country.

The main climate types represented in Montenegro are: maritime, continental and mountainous. However, in continental and mountainous areas, the basic climate types are very often intertwined and modified to form subtypes within the primary climate types. The maritime type of climate penetrates deep into the continental part, modifying the continental and mountain types. As a consequence, the continental type modified by the mountain or maritime type, as well as the mountain type modified by the maritime type, occur.

The coast is characterised by a maritime type of climate, with long and warm summers and mild winters with a large amount of precipitation. The Zeta-Bjelopavlić plain has long, hot dry summers and relatively mild and rainy winters. The Zeta Valley is particularly notable for its warm summers, where the highest temperatures in Montenegro have been recorded, as well as the largest number of tropical days.

The central part of the country has a temperate-continental climate, while the northern part has some characteristics of a mountainous climate, but with a marked influence of the proximity of the Mediterranean Sea that modifies the precipitation regime and mitigates winters. The far north of Montenegro has a continental type of climate, with a large daily and annual temperature amplitude and a small annual amount of precipitation that is evenly distributed throughout the months. In the mountainous areas of northern Montenegro, summers are relatively cold and wet, and winters are long and harsh, with frequent frosts and low temperatures.

The average annual air temperature in the climatic period 1991-2000 ranged from 5.9°C in Žabljak to 16.8°C in Budva. The hottest month is July, with an average air temperature of 15.7· C in Žabljak to

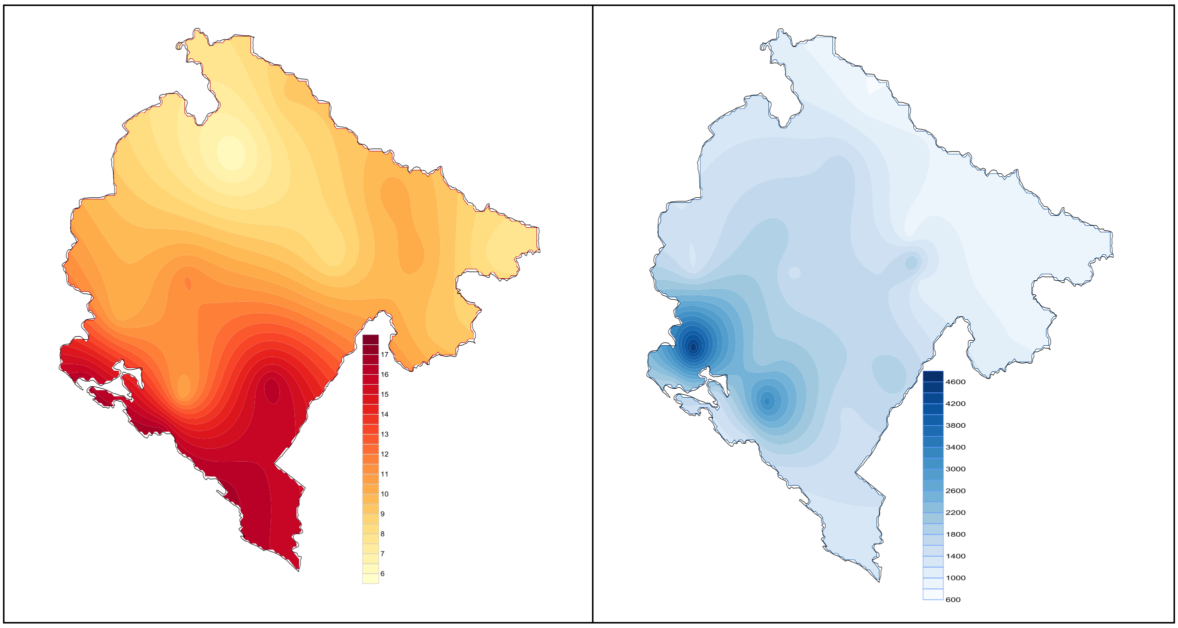
27.8°C in Podgorica. The coldest month is January with an average temperature of -3.2°C in Žabljak to 8.8°C in Bar and Budva. The highest daily air temperature was measured on August 24, 2007 in Podgorica and amounted to 44.8 °C, while the lowest temperature in this period was measured in Rožaje on January 26, 2006 and amounted to -30.5 °C.

The highest number of tropical days (a day with a maximum daily temperature greater than or equal to 30°C) was recorded in Podgorica, an average of 90.3 days per year, and the least in Žabljak 1.1 days. On the coast and in the Zeta-Bjelopavlić plain, tropical days occur from April to October. The average number of tropical nights (a day with a minimum daily temperature lower than or equal to 20°C) ranges from 0.1 in Žabljak to 64.4 days per year in Podgorica, while no tropical nights were recorded in Kolašin, Plav and Rožaje. The average number of frosty days (a day with a minimum daily air temperature below 0°C) ranges from 3.5 days in Bar and Budva to 151.7 days in Žabljak, where frosty days, as well as in other areas with high altitudes, are not recorded only in July and August.

The average annual precipitation in Montenegro is very heterogeneous, with a pronounced rainy and less rainy area. Most of the country has Mediterranean and modified Mediterranean precipitation, with the highest precipitation in late autumn and early spring. In the north, the continental type of precipitation is represented, with a maximum in early summer. The average annual precipitation in the period 1991-2000 ranged from about 800 mm in the far north to about 4600 mm in the far southwest. The highest annual precipitation was recorded in 2010 in Crkvice and amounted to 9079 mm. The average annual number of days with precipitation is from 110 days in Berane, about 115-127 in Pirmorje and up to 182 in Žabljak. The average annual number of days with snow cover ranged from 0.4 days in Bar to 182 days in Žabljak, while in Budva and Herceg Novi during this climatic period no days with snow cover were recorded.

The mean annual air temperature and the mean annual precipitation for the climatic period 1991-2000 are shown in **Figure 56**.

Figure 55 Mean annual air temperature (left) and mean annual precipitation (right) in Montenegro for the climatic period 1991-2000.



Compared to the climatic period 1961-1990, the period 1991-2000 is warmer by an average of 1.1°C, with deviations in mean annual temperatures ranging from 0.8°C in Herceg Novi and Cetinje to 1.6° in Bijelo Polje. In the same period, the largest increase in the average annual precipitation was recorded in Cetinje (3.5%), while the largest decrease was observed in Herceg Novi (-6.3°C). Changes in mean annual temperature and precipitation for the period 1991-2000 compared to 1961-1990 at the main meteorological stations are shown in **Table 47**.

Table 47 Deviation of mean annual temperature (°C) and mean annual precipitation (%) in the period 1991-2000 compared to 1961-1990

Station	Temperature deviation	Precipitation deviation
Žabljak	1.3	2.3
Pljevlja	1.0	-0.7
Herceg Novi	0.8	-6.3
Nikšić	0.9	-3.7
Bar	1.2	-2.2
Podgorica	1.1	2.5
Kolašin	1.1	-3.9
Berane	1.5	-2.8
Bijelo Polje	1.6	1.0
Cetinje	0.8	3.5

The average annual cloud cover in Montenegro ranges from in Tivat to 6.5 tenths in Bijelo Polje. Average cloudiness is highest during winter, when there is the most precipitation, while it is lowest in July and August, which are also the driest months. The average number of clear days ranges from 38 in Pljevlja to 163 days in Tivat, while the average number of cloudy days ranges from 89 in Tivat to 228 in Bijelo Polje. The average annual number of hours of sunshine ranges from 1693 hours in Kolašin to 2660 hours in Ulcinj.

The prevailing winds in Montenegro are north to northeast and south. On the coast, the bora, as a waterfall wind, and the wind from the sea (during the day) and the wind from the land (at night), as daily periodic winds, are represented. In the central and coastal areas, gusts of north and northeast winds very often reach storm strength (over 17 m/s), while higher areas in the north and the coast have stormy gusts of southern winds, which reach speeds of more than 100 km/h.

8.2.2 Observed climate change trends

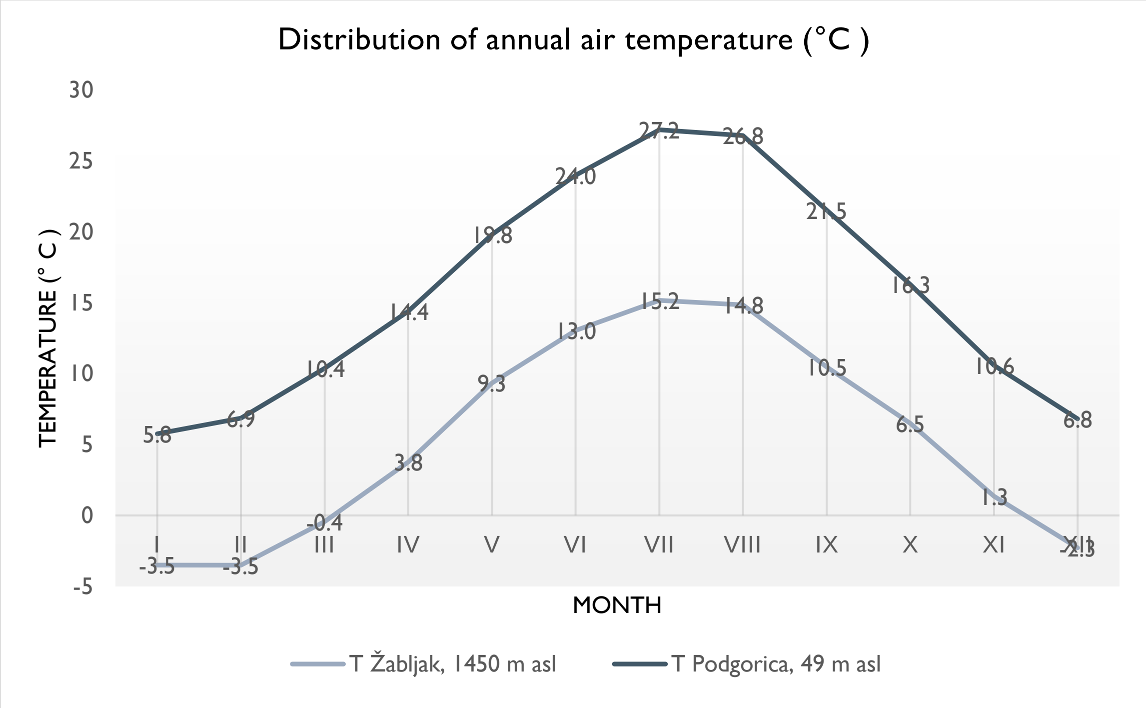
According to geographical position, Montenegro is in the central part of the moderate warm belt of the northern hemisphere. Additionally, the vicinity of the sea, morphological profiles, and atmospheric circulations form complex climatic characteristics in terms of high variability in space and time.

The country's relief has an important role in modifying the climate. The sharp changes of altitude over a small distance and the prevailing mountainous regions over 1,000 m in altitude shape a highly variable climate. The mountain chains of Orjen, Lovćen, Rumija, and Sutorman reduce the influence of the Adriatic Sea on the littoral part. On the other hand, the River Bojana, Podgorica, the Skadar Basin, the valley of the Rivers Morača and Zeta, and Nikšić Valley are influenced by the Mediterranean climate. That area acts as a border zone between the Mediterranean and continental-mountainous climate. It consists of the mountains: Golija, Vojnik, Lola, Kapa Moračka, Babin Zub, Crkvine, Komovi, and Prokletije. Beyond that zone there are high mountain chains with a severe sub-alpine climate and moderate mountainous climate in the valleys up to the north of the country.

Historic trends for temperature

The valley of the River Zeta River has the hottest summers in Montenegro, mainly due to having the highest number of clear days. The highest mean summer temperature is in Podgorica, 29.2 C with the highest maximum daily temperature of up to 44.8 C recorded in August 2007. The lowest minimum daily temperature was -32 C, recorded in Rožaje in January 1985. **Figure 57** shows the mean annual temperature in Montenegro recorded by the two monitoring stations – Podgorica and Žabljak.

Figure 56 Distribution of annual mean temperature in Montenegro



Climate monitoring and assessments show that Montenegro's climate is changing as a result of global climate change and variability. The clearest indicators are: a significant increase in air temperature, an increase in sea surface temperature and soil temperature at depths, changes in extreme weather and climatic events.

The deviation of the mean annual air temperature from the climatological normal 1961-1990 is shown graphically and tabularly, and the results at the level of Montenegro show:

- the air temperature has changed statistically significantly and has an upward trend;
- since 1981, each decade has been warmer than the last;
- the warmest is the last decade 2011-2020 at +1.7 0C. As stated in the report of the World Meteorological Organisation (WMO), the decade 2001-2010 was a decade of extremes at the global level, and according to the data of the IHMS also at the level of Montenegro;
- the warmest year so far is 2023 with a deviation of +2.37 0C from the climatological normal.

Figure 57 Deviation of mean annual air temperature from the climatological normal 1961-1990 in Montenegro and the trend of decadal temperature changes.

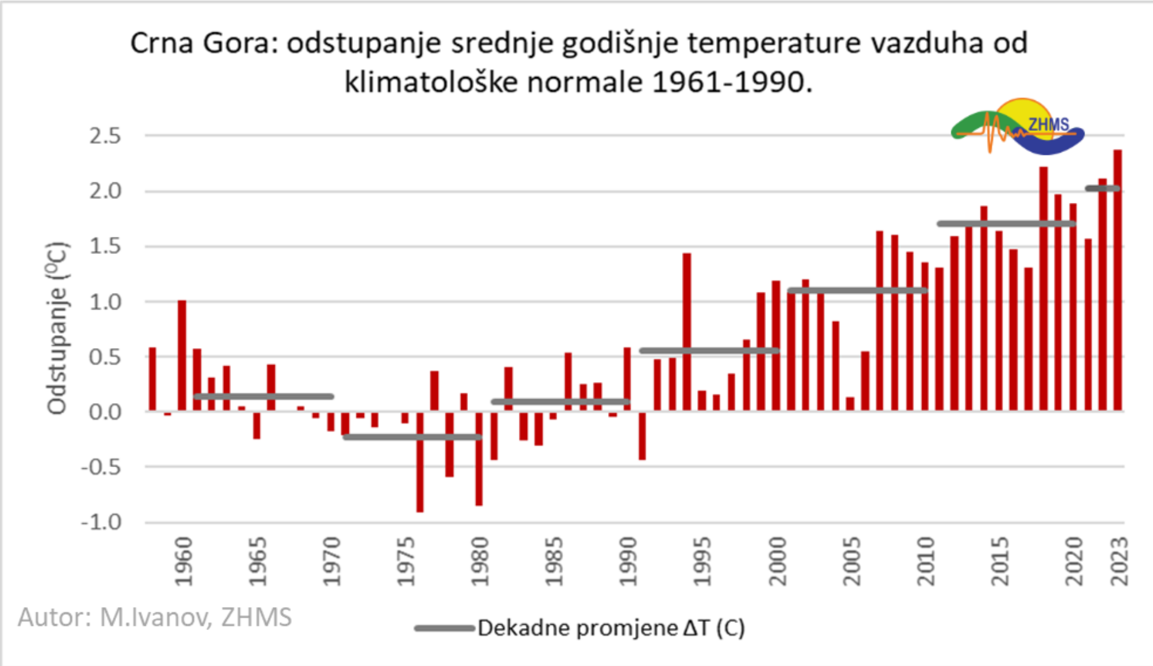


Table 48 Mean decadal deviation of air temperature (°C) from climatological normal

	Climatological normal	Mean decadal deviation of air temperature from climatological normal.						
Montenegro	**'61-'90.**[96]	**61-70**	**71-80**	**81-90**	**91-00**	**01-10**	**11-20**	**21-23**
	10,42	+0,14	-0,23	+0,09	+0,56	+1,10	+1,70	+2,02

Table 49 The mean decimal deviation of air temperature (°C) from the climatological normal by region

	Climatology normal	Mean decadal deviation of air temperature from climatological normal							
REGIONS	**61-90**	**51-60**	**61-70**	**71-80**	**81-90**	**91-00**	**01-10**	**11-20**	**21-23**
North (Žabljak, 1450 m	4.6	/	+0.09	-0.18	+0.09	+0.79	+1.4	+1.75	+1.81

[96] The period 1961-1990 is the climatological normal against which climate change is observed. The period was chosen by WMO and refers to the climate, which is described by the mean values of meteorological elements obtained from a 30-year measurement period. At the end of 2020, the 1991-2020 period will be used as the next reference period for the analysis of climate characteristics, but will continue to use the 1961-1990 climatological normal for the analysis of climate change. More information on the WMO website: http://www.wmo.int/pages/themes/climate/statistical_depictions_of_climate.php

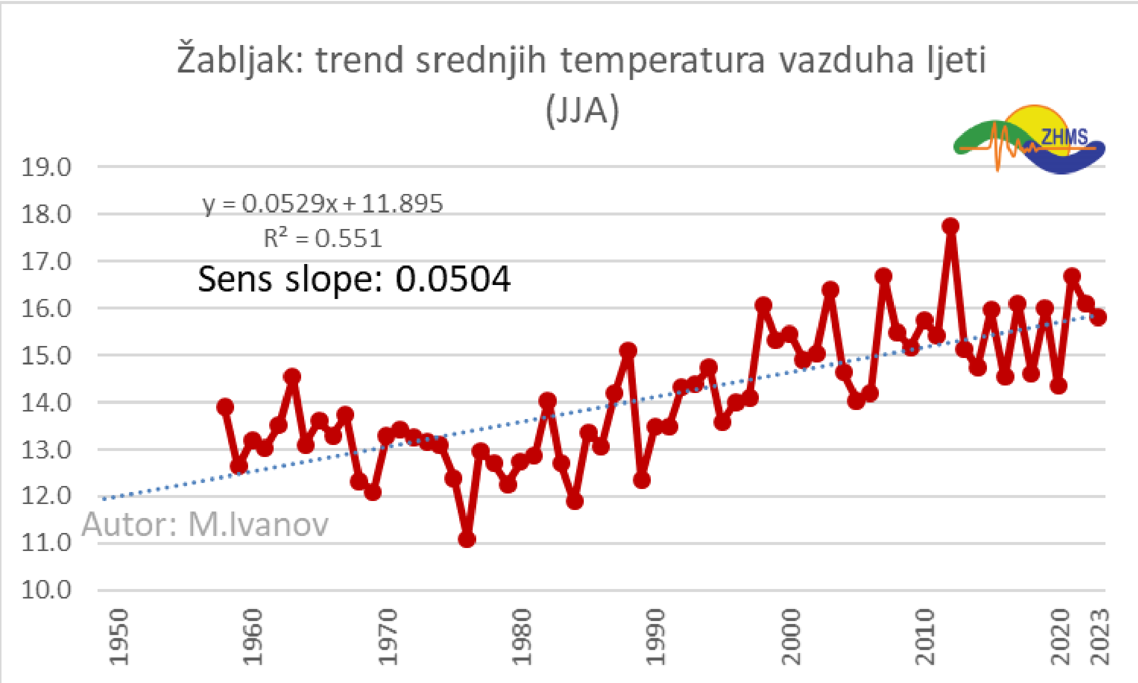
above sea level)									
Central (Podgorica, 49 m above sea level)	15.3	+0.19	+0.11	-0.26	+0.15	+0.59	+1.06	+1.76	+2.14
South (Bar, 4 m above sea level)	15.5	+0.12	+0.17	-0.22	+0.05	+0.39	+1.23	+1.83	+2.03

A seasonal analysis by region shows:

- The growth trend in Žabljak, Podgorica and Bar is such that the greatest positive changes in air temperature are in summer, then in spring, then in winter, and finally in autumn;
- The changes are statistically significant in all seasons.

For the sake of visual effect, the trend of average air temperature during the summer season of JJA on Žabljak is graphically shown (**Figure 58**). This part of the northern mountainous region at an altitude of about 1450 m above sea level, was interesting for the selection and presentation of climate change due to the snow-forest climate and the existence of Debelo Namet, i.e. It is located in the Durmitor National Park. From the figure, it can be seen that the slope of the trend line is positive (i.e. it has an uptrend) indicating climate change.

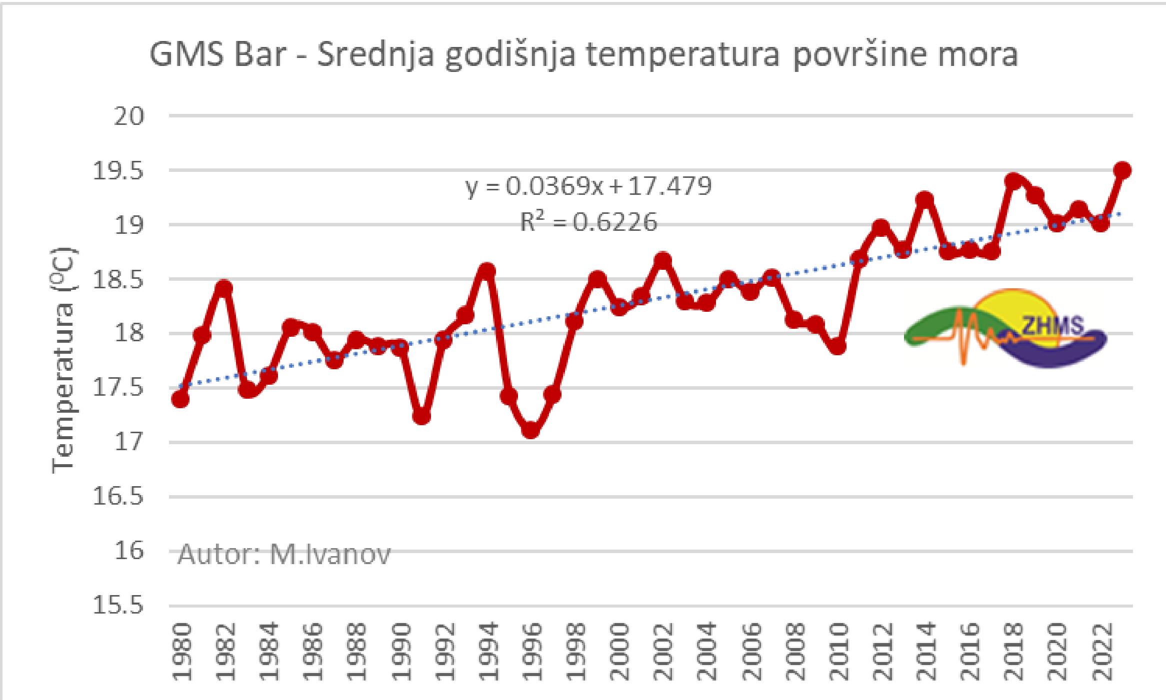
Figure 58 Average summer temperature (Žabljak)



According to the analysis of IHMS data from 1980-2023, the sea surface temperature according to data from the main meteorological station in Bar:

- the average annual sea temperature has an upward trend;
- from 1980 to 2023, the total increase in the mean annual sea surface temperature is + 1.7 C (graph below);
- From 2018 to 2023, its values were equal to or greater than 19 C;
- during the decade 2011-2020. The average annual sea surface temperature was the highest and its value was 19 C.

Figure 59 Average annual sea surface temperature



According to the sea surface temperature projections carried out within the framework of the T, the change in the mean annual sea surface temperature in the coastal area of Montenegro for scenario RCP8.5[97] are as follows:

- for the period 2011-2040: from +0.5 to +1.5 °C;

[97] Under scenario RCP8.5, fossil fuels would remain widely used until the end of this century. The corresponding energy imbalance in the climate system conditioned by this concentration would be about 8.5 W/m2.

- for the period 2041-2070: +1 to +2 °C;
- For the period 2071-2100: +2.5 to +3.5 °C in relation to the mean for the period 1971-2000.

A more detailed analysis of the change in sea surface temperature and its level due to climatic changes and variability was carried out within the project CAMP (Integrated Management Program for the Coastal Area of Montenegro). In this segment of the project, it was recognised as a very serious problem:

- quality of meteorological and hydrographic data;
- the availability of a set of data, and
- a rare network of observations in the coastal area, which provide a weak basis for assessing current and future sea level changes.

Climate change and variability are also reflected in the frequency and severity of many types of extreme events such as heat waves, droughts, storms, floods, and through it many other non-temporal hazards (e.g. landslides, forest fires). Extreme weather and climate events have been particularly frequent and intense globally in the last decade of the 21st century. The World Meteorological Organisation (WMO) has declared the period 2001-2010 as the Decade of Climate Extremes (WMO-No.1119, 2013).

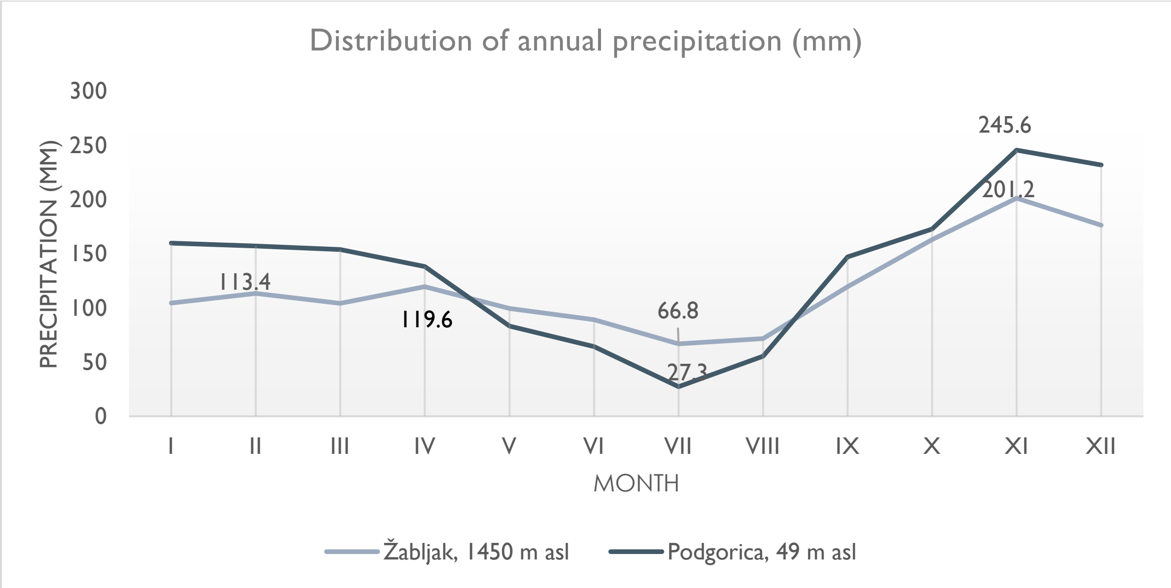
Many of the events and trends of the past decade are thought to be explained by natural climate variability and rising concentrations of GHGs, and that the main challenge is to find the individual roles played by climate variability and anthropogenic factors in climate change.

Historic trends for precipitation

Annual precipitation in Montenegro is very uneven, ranging from about 800 mm in the north to about 5,000 mm in the southwest. On the slopes of Mt. Orjen, in the village of Crkvice (940 m above sea level), precipitation may even reach 7,000 mm.

Figure 60 shows the annual distribution of air temperature and precipitation for the period 1981-–2010 on at the two stations (Podgorica and Žabljak) on at different altitudes and in different climatic zones.

Figure 60 Annual distribution of air temperature and precipitation for the period 1981–2010 at the two stations (Podgorica and Žabljak) at different altitudes and in different climatic zones

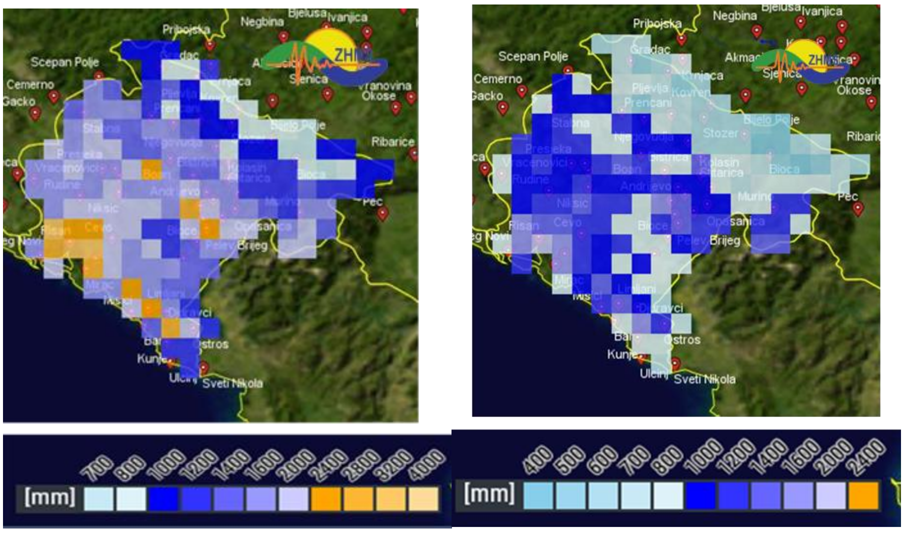


Analyses of the ISHM show:

- in the area of the northern region, an area with a lower mean annual precipitation (from 400-800 mm) compared to the climatological normal of 1961-1990 (from 400-1200 mm) is expanding;
- the trend is also decreasing in the Zeta-Bjelopavlić plain, then in the coastal region where there is no more precipitation from 2000 to 2400 mm in their mountain belt as it was during 1961-1990 (**Figure 62**);

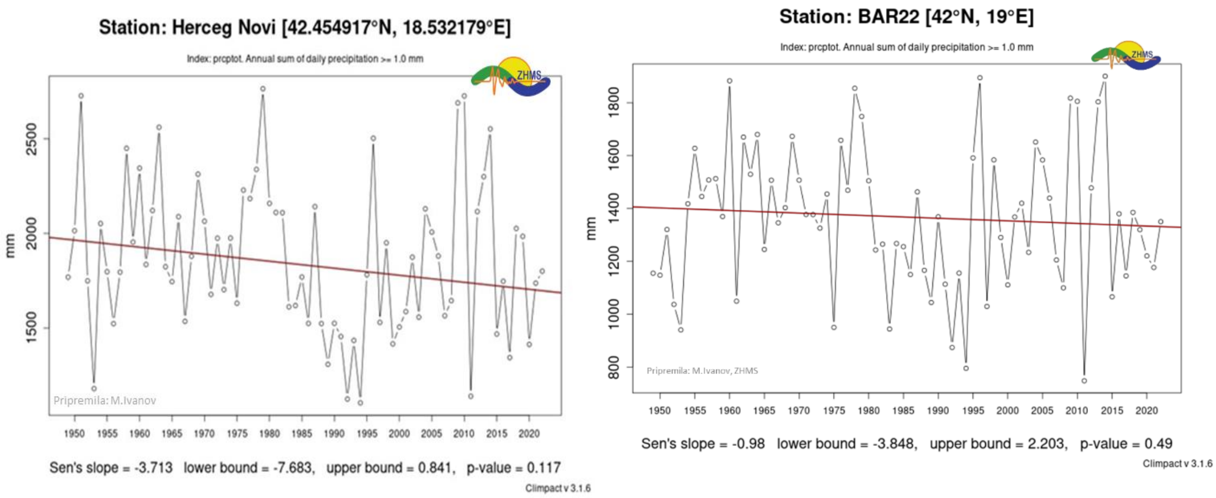
However, these changes are within normal limits.

Figure 61 Spatial and temporal distribution of mean annual precipitation (period 1961-1990 left and period 1981-2010 right) (Source: DANUBECLIM Project)



An example of this is the total annual precipitation >=1mm in Herceg Novi and Bar, which has a decreasing trend.

Figure 62 Annual daily precipitation, Herceg Novi and Bar



- The mean decadal decrease in relation to the climatological normal shows that the downward trend on the coast is from 1981 to 1990 until the last decade;
- slightly higher amounts of precipitation were registered in 1971-1980 in the northern mountainous region;
- The decade 2001-2010 is a record for average annual precipitation after a continuous 20-year deficit.

Table 50 Mean decimal deviation of precipitation (mm) from the climatological normal 1961-1990 by region

	Climatological normal	Mean decimal deviation of precipitation (mm) from climatological normal.							
REGIONS	61-90	51-60	61-70	71-80	81-90	91-00	01-10	11-20	21-23
North (Žabljak, 1450 m above sea level)	1455.4		+1.2	+104.2	-172.6	-72.1	+150.9	+42.3	+249.8
Central (Podgorica, 49 m above sea level)	1657.9	-18.2	+97.5	+40.1	-137.6	-64.7	+136	+38.2	+69.4
South (Bar, 4 m above sea level)	1390.9	-19.7	+82.4	+89.6	-172.0	-149.0	+73.1	-36.5	-118.2

- Observed by seasons, the decrease is greatest during the winter and then spring in the coastal region. Analyses for Podgorica show that the largest decrease is in winter and summer, and the increase in autumn and spring.

- The year 2010 was a record year for the annual amount of precipitation in the northern mountainous region over 1000 m above sea level and the Zeta-Bjelopavlić region, which coincides with a highly developed La Niño.

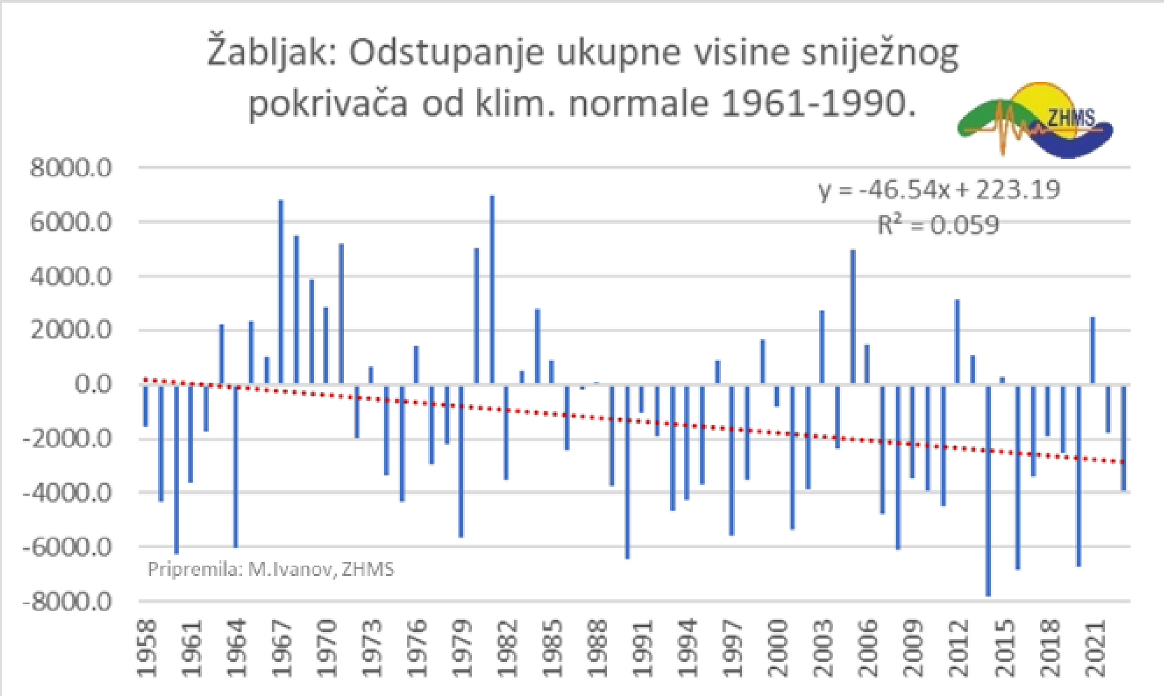
Total Snow Cover (TSC)

According to the analysis of the IHMS for the northern mountainous region, the results show:

- that the total height of the snow cover is highest in February and March, then in January, while it is lowest in December;

- There is a trend of decreasing the average annual amount of snow cover, but it is not statistically significant (**Figure 63**). Variability is expressed.

Figure 63 Žabljak: deviation of the total height of the snow cover from the climatological normal 1961-1990



- From the beginning of measurements in Žabljak from 1958 until 2023, the slope of the trend line shows that the decrease occurs faster during January and March.
- Every decade from 1991 to 2000 to 2011 to 2020 has a lower annual TSC compared to 1961-1990.
- The decade 2011-2020 has the lowest mean annual values of the TSC so far, by -34% compared to the climatological normal. It should be noted that this decade has been the hottest so far.

Table 51 Mean decadal deviation of the total annual height of snow cover on Žabljak from the climatological normal 1961-1990

	Climatological normal	Mean decadal deviation of the annual TSC from the climatological normal						
REGION	**61-90**	**51-60**	**61-70**	**71-80**	**81-90**	**91-00**	**01-10**	**11-20**
Municipality of Žabljak	8711		10034	7901	8199	6410	6646	5790
%			+15	-9	+6	-26	-24	-34

- The years with the maximum and minimum annual heights of the TSC on Žabljak are shown in **Table 52**. The lows were prevalent during the warmest decade of 2011-2020.

Table 52 Maximum and minimum annual heights of total snow cover (Žabljak)

Maximum			Minimum		
No.	Year	Annual TSC (cm)	No.	Year	Annual TSC (cm)
1	1981	15669	1	2014	915
2	1967	15527	2	2016	1891
3	2005	13681	3	2020	1958
4	2012	11867	4	1990	2283
5	1987	11495	5	2023	4814

A state of emergency was declared in Montenegro on February 11, 2012, due to a snowstorm that paralysed the country. Although this is the 4th year in a row with an extreme amount of snow, it is the first in that in February absolute maximums of snow height were reached in all regions of Montenegro. On a monthly basis, the total height of the snow cover was then 4,476 cm in Žabljak, and in Kolašin 3,817 cm.

8.2.3 Analysis of observed extreme weather and climate events

Observed extreme weather and climate events until 2022:

1. more frequent extremely high maximum and minimum temperatures;
2. more frequent and longer heat waves;
3. a greater number of very warm days and nights;
4. fewer frosty days and very cold days and nights;
5. more frequent occurrence of droughts accompanied by high temperatures and heat waves;
6. a large number of forest fires;
7. interruption of the dry period accompanied by heavy precipitation;
8. more frequent occurrence of storms (cyclones) during the colder half of the year;
9. reducing the number of consecutive wet days;
10. reducing the number of days with heavy precipitation;
11. increase in the intensity of precipitation

Temperature indicators

Table 53 shows the indicators of extreme temperatures and their definitions that were used in the analysis.

Table 53 Indicators of extreme temperatures

Indexes	Index Name	Definition	
U30	Tropical days	Annual number of tropical days - days when the	Days

		maximum daily temperature is > 30 °C	
TR20	Tropical nights	Annual number of days when the minimum daily temperature is > 20 °C	Days
HWN EHF	The number of heat waves	The number of heat waves[98] in the period from May to September	Events
HWD EHF	The length of the heat wave	The length of the longest heat wave	Days
HWF EHF	The frequency of heat waves	The total number of days that contribute to each heat wave	Days

In the northern region, the number of summer and tropical days and nights changes statistically significantly compared to the climatological normal of 1961-1990. The same applies to warm days and nights, the length of heat waves, and the number of frosty days. And while the number of frosty days is decreasing, which is why the trend is downwards, other indicators have an upward trend. Statistically significant changes in the length of the growing season were recorded only in Žabljak.

The central and southern regions also saw positive changes in the number of summer and tropical days, warm days and nights, and the length of heat waves. The trend is positive, increasing over time, while unlike the northern region there are no significant changes in the number of frosty days except in Bar. There are no significant changes in the length of the growing season.

A comparative analysis of heat waves shows that deviations from the climatological normal are positive. All three characteristics, i.e. The number, length and frequency of heat waves are increasing in all three regions. Heat waves are the longest on the coast and the largest number of days participate in it. Long-term heat waves are dominant in August, while short-term heat waves are more common in June and July. Such frequent and long heat waves have contributed to a higher frequency of temperature extremes and a shift in the temperature distribution curve towards a warmer climate.

Table 54 Comparative analysis: number of heat waves, length and frequency in the period 1961-1990 and 1991-2020

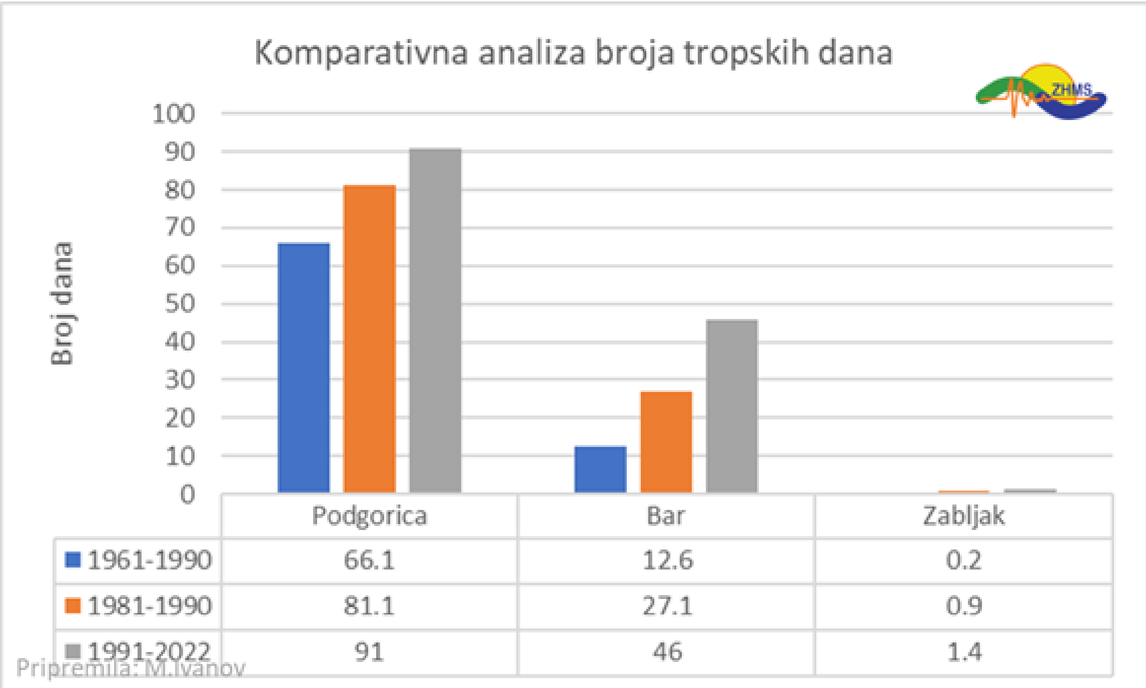
REGIONS	1961-1990	HWN EHF 1991-2022		1961-1990	HWD EHF 1991-2022		1961-1990	HWF EHF 1991-2022	
	Number (days)	Number (days)	Change (days)	Number (days)	Number (days)	Change (days)	Number (days)	Number (days)	Change (days)
North (Žabljak,	1,2	5,1	+2.9	5,4	11	+5,6	9,5	33,9	+24,4

[98] A heat wave is defined as 3 or more consecutive days when the EHF is positive. Leap days are not taken into account. EHF-Excess Heat Factor (Source: Climpact, Measurement of heatwaves J. Clim. 26 4500–17 Online: http://dx.doi.org/10.1175/JCLI-D-12-00383.1

1450 m above sea level)									
Central (Podgorica, 49 m above sea level)	1.9	5,6	+3,7	6,4	15,5	+9,1	9,7	44,5	+34,8
South (Bar, 4 m above sea level)	1,8	7	+5,2	6,5	25,7	+19.2	9,7	75,7	+66

The number of tropical days indicates their increase compared to the climatological normal 1961-1990. The maximum increase in their number is in the period 1991-2022.

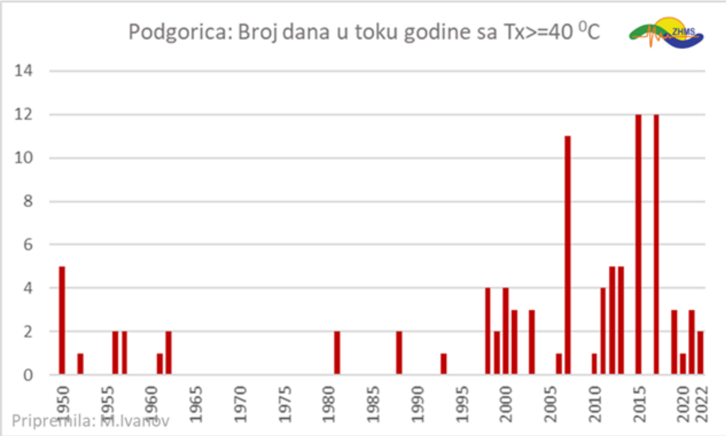
Figure 64 Comparative analysis of the number of tropical days for the periods 1961-1990, 1981-2010, 1991-2022



Prepared by: M.Ivanov, IHMS

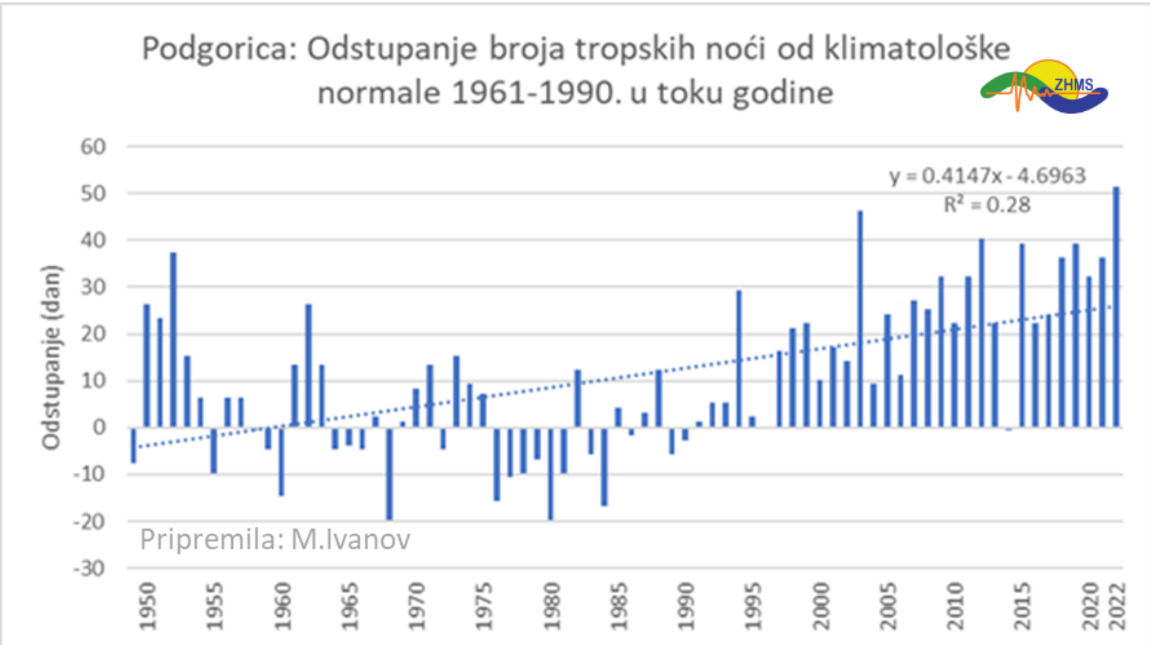
The hottest city during the summer is the capital Podgorica, where maximum daily temperatures greater than or equal to 40 °C have been more frequent since 1998. Compared to the climatological normal of 1961-1990, there are eleven times more in the period 1991-2022. By the way, such very high maximum daily temperatures are most common during August, but since 2012 they have also appeared in July. In August 2007, this city recorded Montenegro's highest maximum daily air temperature, reaching 44.8°C.

Figure 65 Podgorica: number of days in the year with T >= 40 C



The capital is also characterised by tropical nights when the minimum daily temperature is greater than or equal to 20 C. The number of tropical nights is 1.7 times higher during 1991-2022 than the climatological normal of 1961-1990. They are also characterised by a successive positive deviation from the climatological normal, **Figure 67**.

Figure 66 Podgorica: Deviation of the number of tropical nights from the climatological normal 1961-1990 during the year

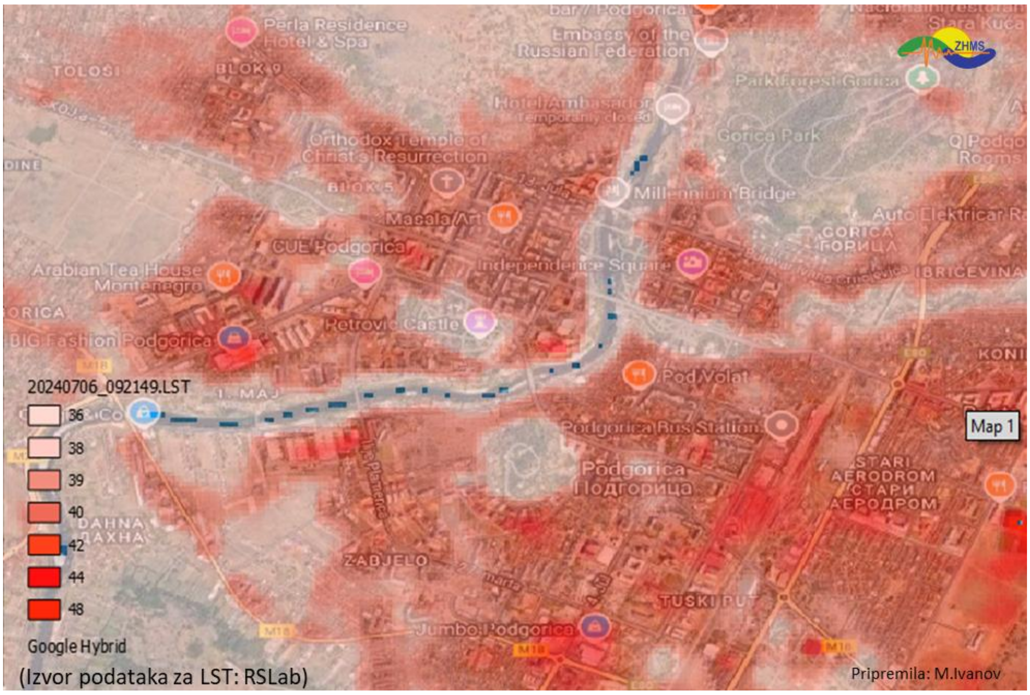


Using data from the Landsat 8 and MODIS satellites, the image below illustrates the land surface temperature (LST) in Podgorica on July 6th, 2024, as provided by RSLab. This example highlights the presence of urban heat islands within the city, driven by significant surface warming caused by solar radiation, urbanization, and the increased concentration of greenhouse gases contributing to global climate change.

The image reveals that, on July 6th , 2024, at 09:21, surface temperatures in some parts of the city reached as high as 48°C.

An assessment of vulnerability and an action plan for climate change adaptation in the capital were developed as part of the GIZ project *"Adaptation to Climate Change in the Western Balkans" (January 2012 – December 2018). Since then, the city has undergone substantial urban expansion up to 2024***.**

Image 1: Land surface temperature in Podgorica July 2024



(Source for LST: RSLab)

The capital city of Podgorica has acknowledged the negative impact of urban heat islands on public health and urban resilience by participating in the INTERREG project BeReady, scheduled for implementation from January 1st, 2024, to June 30th, 2026.

The primary objective of the project is to assist local and regional authorities in gaining a deeper understanding of urban heat islands. By collaboratively developing and testing innovative solutions, the project aims to mitigate the effects of this phenomenon, thereby enhancing the resilience of cities to climate change.

Indicators for extreme precipitation

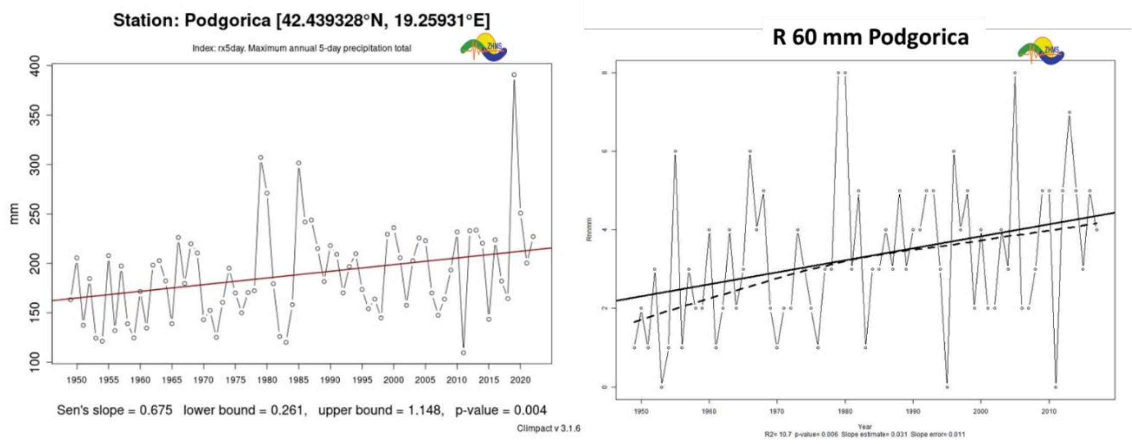
Table 55 Indicators of extreme precipitation

Index	Index Name	Definition	
R20mm	Number of days with heavy rainfall	Annual number of days with daily precipitation ≥ 20 mm	Days
R60mm	The number of days with very heavy rainfall	Annual number of days with daily precipitation ≥ 60 mm	Days
rx5day	Max 5-day precipitation	Maximum precipitation in five consecutive rainy days	Mm
SDII	Daily intensity of precipitation	Annual precipitation divided by the number of rainy days (defined as days with precipitation ≥ 1 mm) in a year	mm/day
SPEI 3	Standardised Precipitation and Evaporation Index	Cumulative precipitation and evaporation in three months	/

In the northern region , there is a statistically significant change in the daily intensity of precipitation in all three cities of the northern region (Žabljak, Pljevlja and Kolašin). In Pljevlja, the number of days with very heavy rainfall has also changed significantly.

In the central region, (Cetinje, Nikšić and Podgorica) there is a significant increase of 5% of the highest precipitation. In Nikšić and Podgorica, changes in the number of days with very heavy precipitation R60mm are evident, the daily intensity of precipitation sdii increases significantly. In Podgorica, the maximum five-day amount of precipitation rx5day is also increasing (**Figure 68**), and its change is statistically significant.

Figure 67 Maximum annual 5-day precipitation, Podgorica



In *cities of the coastal region* (Herceg Novi and Bar) there are no significant changes in extreme precipitation indicators. A negative trend has: the number of days with heavy precipitation R60mm, the maximum 5-day amount of precipitation in Herceg Novi, as well as 5% of the highest precipitation, as a result of which the daily intensity of precipitation sdii has a small upward trend.

Drought

In Montenegro, until the implementation of the IPA project "Drought Management Centre for South East Europe" (DMCSEE) in 2012, co-financed by the European Commission, permanent drought monitoring was not established.

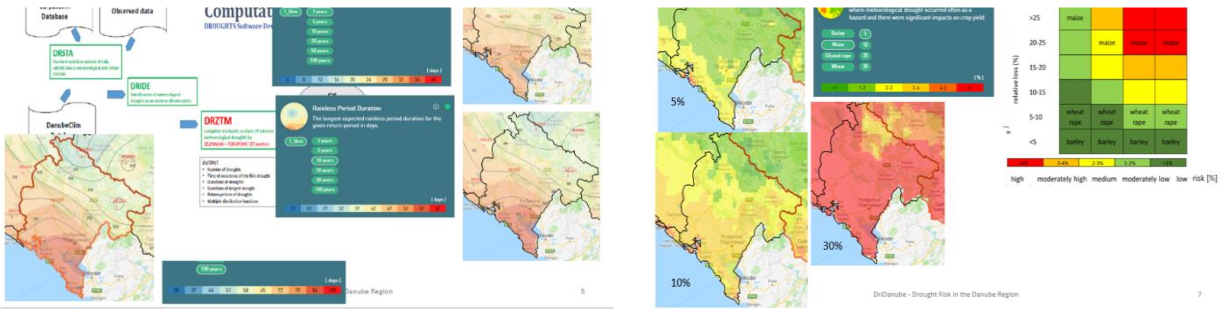
IHMS strengthened its capacities through the EU DMCSEE project and within the EU INTERREG DriDanube project (Drought risk in the Danube region):

Table 56 IHMS strengthening via EU DMCSEE and DriDanude projects

Strengthening of IHMS through the EU DMCSEE project	Strengthening IHMS through the EU DriDanube project
• Homogenisation of precipitation data has been carried out; • Archive on the impact of droughts since 2000;	• Developed Altatka DroughtWatch Tool; • Conducted in near real-time monitoring using the National Reporters Network; • Impact maps are drawn with the assistance of CzechGlobe project partners; • Drought archive updated; • developed a joint strategy for drought, i.e. for the Danube Region; • The data from this strategy are integrated into the National Drought Plan;

• constant monitoring of drought by monitoring the SPI[99] index; • tested application of the WINISAREG model for irrigation planning; • A map of Montenegro's vulnerability to drought has been made; • applied analysis of the FVC index based on data from satellites and with the assistance of the DMCSEE centre;	• Drought risk assessment according to the ZT method; • developed RED software for agricultural drought risk assessment

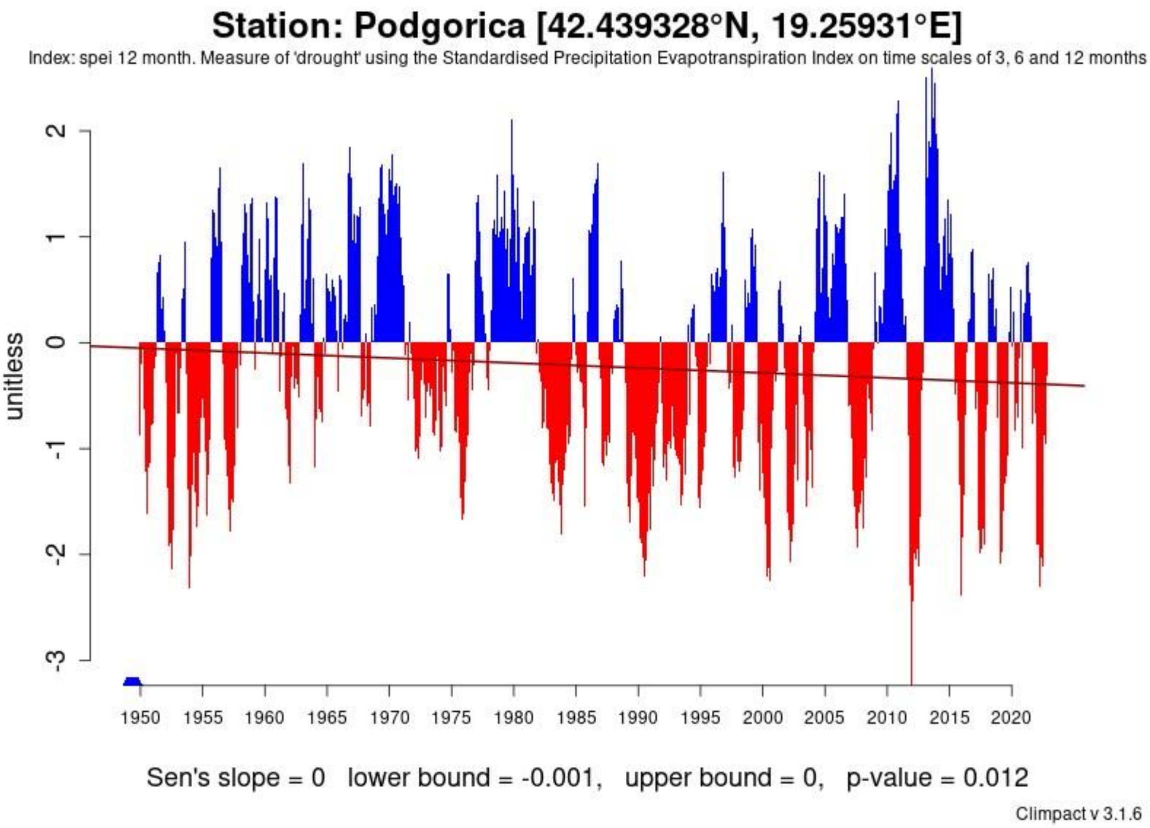
Figure 68 Risk maps according to the ZT method (left) and according to the RED software (right)



Given that the region of South-East Europe is singled out as a region vulnerable to drought and that Montenegro is therefore not exempt, typical agricultural dry years were singled out in terms of severity and decade (**Table 57**). The results of the SPEI (standard precipitation evaporation index) analysis show that from 1981 to 1990 moderate to very severe droughts occur more frequently (graph below) and that their trend is negative with age.

[99] SPI – Standardized Precipitation Index; Department of PMKP (Applied Meteorology and Climate Change)

Figure 69 Measure of drought (Podgorica)



The driest years were 2011 and 2012 when agricultural drought developed into a hydrological drought (**Figure 70**). The drought covered all parts of Montenegro, and its intensity was within the limits of very dry and extremely arid. The exception was in the far north, where the intensity of the hydrological drought was within normal limits. On the occasion of the severe drought, a round table was organised at the Montenegrin Academy of Sciences and Arts (MANU) 06/12/2011. It should be borne in mind that the consequences of droughts are intensified due to high temperatures, both individually and within a heat wave, and this characteristic has been particularly prominent since the beginning of the 21st century until now

Table 57 Agricultural droughts according to the SPI3 index classified by severity in Montenegro and by decades

DECADE						
51-60	61-70	71-80	81-90	91-00	01-10	11-20
1953	1962,1967,1969	1973	1981,1982,1983 1988, 1989	1990,1992,1993, 1994,1997, 1998,1999	2000,2001,2002, 2003,2007,2008	2011,2012,2015, 2017,2018,. 2019,

						2020,2021,2022

Analysis: Department of PMKP, IHMS

Figure 70 2011/2012 : Maps of agricultural drought (SPI3, left) and hydrological drought (SPI2, right); graphs of the FVC (vegetation) index obtained by processing satellite data for the area of AD Plantation in Podgorica. The situations of 2012, 2013, 2017 and 2018 were compared with the reference period 2007-2013.

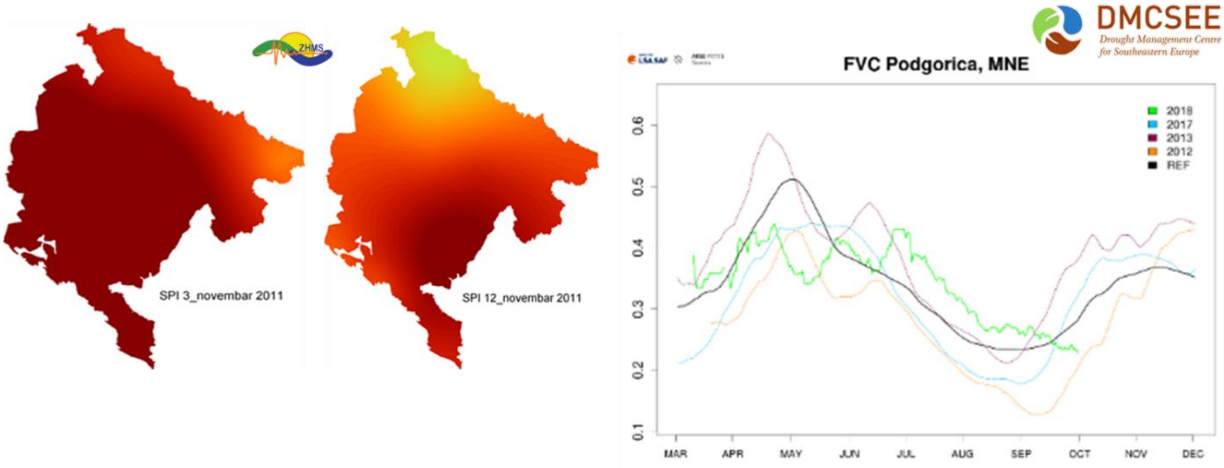
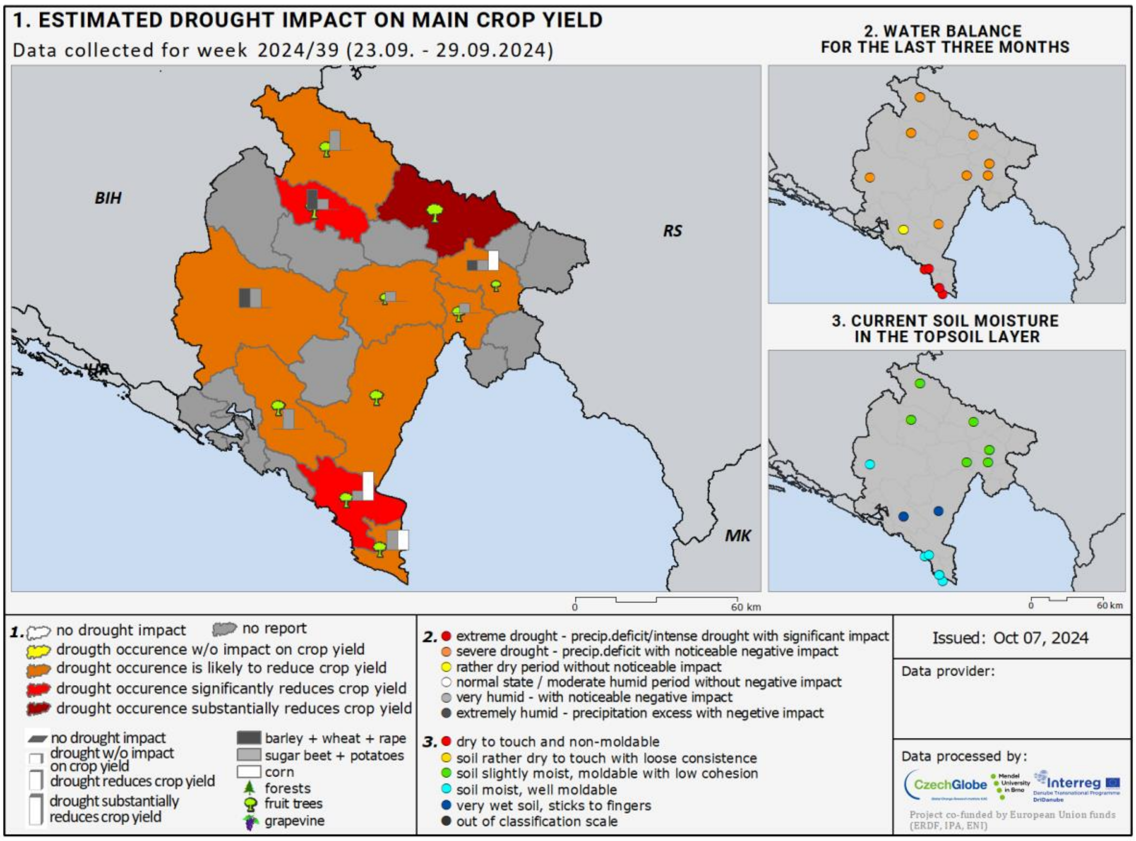


Figure 71 Estimation of the impact of drought on crop yields according to measurements and observations in approximately real time (Source: CzechGlobe and IHMS, within the DriDanube project)



Based on reporting from the National Network of Reporters, the impact of the drought that began to develop in July 2024 is such that as of September:

- probably reduces crop yields in most of the territory (**Figure 72**);
- *They are significantly reduced* in the area of Žabljak (northern mountainous region) and the area of Bar (coastal), and that
- *They are greatly reduced* in the area of Bijelo Polje (northern mountainous region).
- At the same time, the water balance for the previous three months shows that the deficit of precipitation has noticeable negative impacts on most of the territory, and that in the south of the coast its impact is significant;
- The current moisture content of the topsoil is in the category from slightly wet to very wet.

All the time, average daily air temperatures are higher than the average for the period 1961-1990, as well as higher than the maximum daily temperatures.

Heavy rains

Heavy rainfall can occur either as part of a well-developed cyclone (called a storm) or as a result of severe local air instability.

Heavy rains that lead to flooding most often affect the area of Tara and Lim in the colder season (October – March). During this period, a low air pressure field was developed in the coastal areas of Montenegro, which has been maintained for a long time and conditions maximum precipitation in the southern areas. In karst fields during the spring, floods periodically occur due to prolonged precipitation and melting of snow and water reserves in the soil. Such floods have hit the Cetinje field several times and caused extensive damage to buildings.

Through the research conducted within the CAMP project, at the level of observed data and damage caused by storms, it can be said that storms (highly developed cyclones) have occurred more often and more intensely since 1998, bringing, especially to the coast, large amounts of precipitation, stormy to hurricane-like wind gusts, high waves and flooding of a wide area along the coast.

A series of cyclones and local instabilities were recorded during the decade 2001-2010 and 2011-2020 accompanied by heavy rains, floods, snowfall and gusty winds.

The results of **Table 58** show that:

- The intensity of heavy rainfall shows a decade-long variability;
- The most intense precipitation was during 2011-2022 on the coast and the Zeta-Bjelopavlić region, and then in the northern mountainous region up to 1000 m above sea level;Long-term changes relative to the climatological normal are positive and in line with the expected qualitative changes in climate change projections.

Table 58 Average precipitation intensity on days with heavy precipitation[100]

	Climatological normal	**DECADE**						
REGIONS	**61-90**	**51-60**	**61-70**	**71-80**	**81-90**	**91-00**	**01-10**	**11-22***
Municipality of Žabljak	37.6		39.3	36.2	37.9	38.1	39	38.1
Municipality of Pljevlja	35.0	26	35.8	30.7	32.2	33.9	33.8	44.2
Municipality of Podgorica	39.8	34.6	38.1	39.7	41.6	40.1	50.6	147

[100] Heavy precipitation – precipitation with a quantity greater than 20 mm/day
• Impact of extremes in 2003, 2005 and 2006 on the total annual amount of snow cover

Opština Bar	38.8	36.7	38.6	39.3	38	37.1	63.3	157.5

Prepared by: M.Ivanov, IHMS

The WMO report considers it likely that climate change has influenced the occurrence and intensity of extreme precipitation, and the acceleration of the hydrological cycle, which is reflected in both heavy precipitation and evaporation.

8.2.4 Climate change projections

Methodology

In the analysis of future climate projections, an ensemble of eight climate models from the EURO-CORDEX project was used, the results of which were statistically corrected to eliminate systematic errors present in each model. The use of an ensemble (set) of multiple models in such studies allows for a reduction in the uncertainties associated with individual models, as well as a better estimate of natural climate variability. A list of climate models used in the analysis is given in **Table 59**.

Table 59 Climate models whose results have been used in the analysis of climate projections

No.	Climate model name
1	CLMcom-CCLM4-8-17
2	DMI-HIRHAM5
3	KNMI-RACMO22E
4	CLMcom-CCLM4-8-17
5	KNMI-RACMO22E
6	CLMcom-CCLM4-8-17
7	MPI-CSC-REMO2009/1
8	MPI-CSC-REMO2009/2

Two of the most commonly used RCPs (RCPs) were selected for the analysis. Representative Concentration Pathways (GHG) scenarios RCP4.5 and RCP8.5, which provide critical insights into the possible outcomes of climate change depending on GHG emission reduction activities. RCP4.5 shows how proactive mitigation measures could stabilise climate change, while RCP8.5 illustrates the potential consequences of continuing current greenhouse gas emission trends.

RCP4.5 presents a scenario in which greenhouse gas emissions are stabilised by the middle of the 21st century through the implementation of active policy measures to reduce emissions. In this scenario, emissions reach their maximum in 2040 and then decline, while global radiative forcing at 2100 is 4.5 W/m^2.

RCP8.5 presents a scenario with intense greenhouse gas emissions that continue to rise until the end of the 21st century, leading to a global radiative forcing of 8.5 W/m^2 by 2100. In terms of impacts, this scenario leads to significant effects on ecosystems, including biodiversity loss and habitat degradation, higher risks of extreme events, such as intense heatwaves, more frequent floods and droughts, leading to serious consequences for public health, agriculture and the economy.

The horizontal resolution of all simulations used is 11 km, while the time resolution is one day, i.e. Daily data from model simulations were used, on the basis of which changes in temperature, precipitation and derived climate indices were calculated and analysed. The reference period was 1971-2000, while the data for the future were analysed in three annual periods: 2011-2040, 2041-2070 and 2071-2100.

Changes in four basic climate variables (mean daily temperature, minimum daily temperature, maximum daily temperature and daily precipitation) on an annual and seasonal level were analysed, where the seasons were defined as follows: spring – MAM (March, April, May), summer – JJA (June, July, August), autumn – SON (September, October, November), winter – DJF (December, January, February).

In front of these quantities, changes and twelve climate indices were analysed, which were derived from the basic climate variables, temperature and precipitation, namely:

1. **Number of summer days (are):** The number of days during the year with a daily maximum temperature above 25 °C.

2. **Number of tropical days (td):** The number of days with a daily maximum temperature above 30 °C in one year.

3. **Number of Tropical Nights (tr):** The number of days during the year with a daily minimum temperature above 20 °C.

4. **Number of frost days (fd):** The number of days during the year with a daily minimum temperature below 0 °C.

5. **Length of vegetation period (5°C) (gsl5):** The duration (in days) of the growing season during the year, between the date of the beginning of the growing season and the date of end, where the date of the beginning of the growing season is defined as the sixth day, from the first occurrence of a period of six consecutive days with an average daily temperature above 5 °C from the beginning of the calendar year. The end date of the growing season is defined as the sixth day of the first occurrence of a period of six consecutive days with a mean daily temperature below 5 °C in the second half of the year. The base temperature of the growing season in this case, defined as 5 °C, is considered the biological minimum for the plant, which means that daytime temperatures must be above this base temperature to provide suitable thermal conditions for plant development.

6. **Length of vegetation period (10 °C) (gsl10):** The duration (in days) of the growing season during the year, between the start date of the growing season and the end date, where the start date of the growing season is defined as the sixth day, from the first occurrence of a period of six consecutive days with an average daily temperature above 10 °C from the beginning of the calendar year. The end date of the growing season is defined as the sixth day of the first occurrence of a period of six consecutive days with a mean daily temperature below 10 °C in

the second half of the year. The baseline temperature of the growing season in this case, defined as 10 °C, is considered the biological minimum for the plant, which means that daytime temperatures must be above this baseline temperature to provide suitable thermal conditions for plant development.

7. **Number of heatwaves (hwfi):** The number of events that have lasted for at least six consecutive days during which the maximum daily temperature has been higher than a predetermined limit value. In this case, the corresponding limit value is determined for each day of the year (365 values in total) as the 90th percentile of the data set that includes the maximum daily temperatures from the reference 30-year period, for the corresponding day of the year, but also for the days that make up the time window of 5 days around the day for which the limit value is determined.

8. **Length of heat waves (hwfid):** The total number of days that heat waves last during the year, where a heat wave is defined as an event that lasts for at least six consecutive days during which the maximum daily temperature was higher than a predetermined limit.

9. **Number of days with precipitation greater than 20 mm (yy20):** The number of days during the year with daily accumulated precipitation equal to or above 20 mm.

10. **Number of days with precipitation greater than 30 mm (yy30):** The number of days during the year with daily accumulated precipitation equal to or above 20 mm.

11. **Maximum single-day precipitation (rx1d):** The maximum one-day accumulated amount of precipitation (in mm) during the year.

12. **Maximum five-day precipitation (rx5d):** The maximum five-day accumulated precipitation (in mm) during the year.

13. **Consecutive dry days (cdd):** The longest uninterrupted period, the number of consecutive days, during the year with less than 1 mm of precipitation.

14. **Number of days with extreme precipitation (r95p):** The number of days with precipitation greater than the 95th percentile of the reference period.

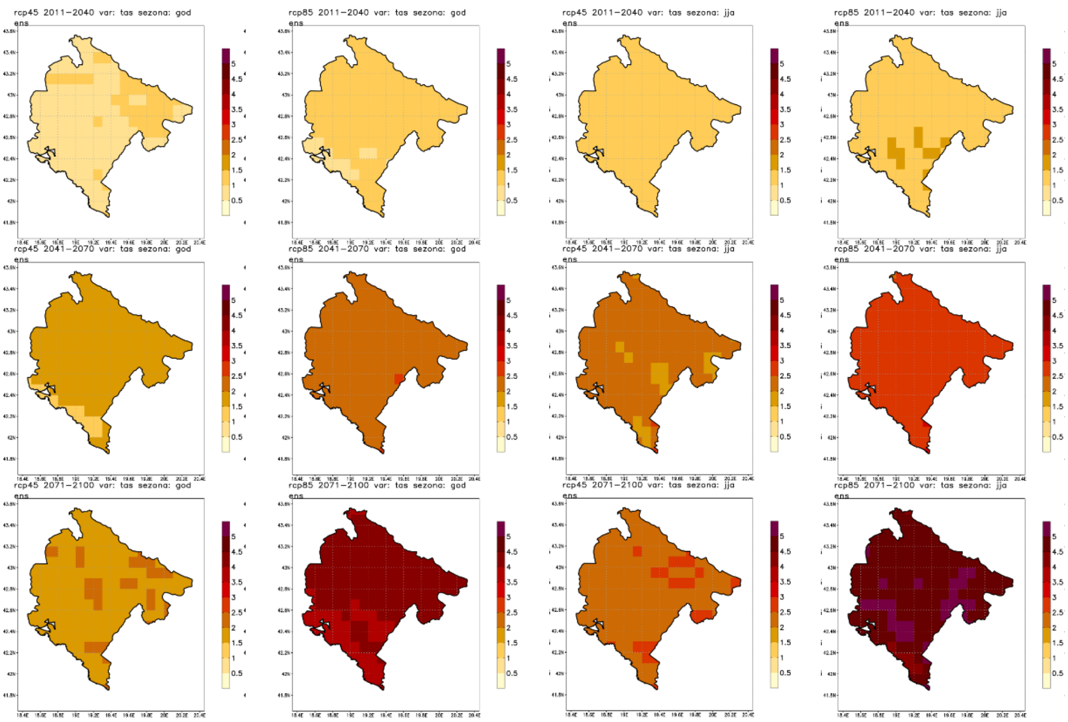
Projections for mean annual and seasonal temperatures

In the coming decades, the average annual temperature in Montenegro will increase according to both analysed scenarios. Under the RCP4.5 scenario, this increase will be less pronounced in the second half of the century, after greenhouse gas emissions stabilise. In the middle of the century, the expected increase is around 2°C compared to the reference period (1971-2000), while at the end of the century only in some parts of the country is expected to increase more than 2°C. The most intense warming is expected during the summer, up to 2.5°C by the end of the century, locally and slightly higher. The least warming is expected in the spring, up to 1.5°C in the middle of the century. The range of the most probable values for temperature changes ranges from ±0.5°C around the stated median values.

Under the RCP8.5 scenario, the expected temperature rise is higher, especially in the second half of the century. By the middle of the century, the average annual temperature is expected to increase by around 2°C, while by the end of the century an increase of more than 4°C is expected. The greatest warming is expected in the summer, up to 5°C by the end of the century, and locally a little more. The range of the most likely values for temperature changes ranges from -0.5°C to +1°C around the stated median values.

Changes in mean, minimum and maximum annual and seasonal temperatures follow the values of changes in mean temperatures in both scenarios.

Figure 72 Change in mean annual air temperature according to the scenario RCP4.5 (first column) and RCP8.5 (second column) and mean summer air temperature according to the scenario RCP4.5 (third column) and RCP8.5 (fourth column) in the period 2011-2040 (first row), 2041-2070 (second row) and 2071-2100 (third row).

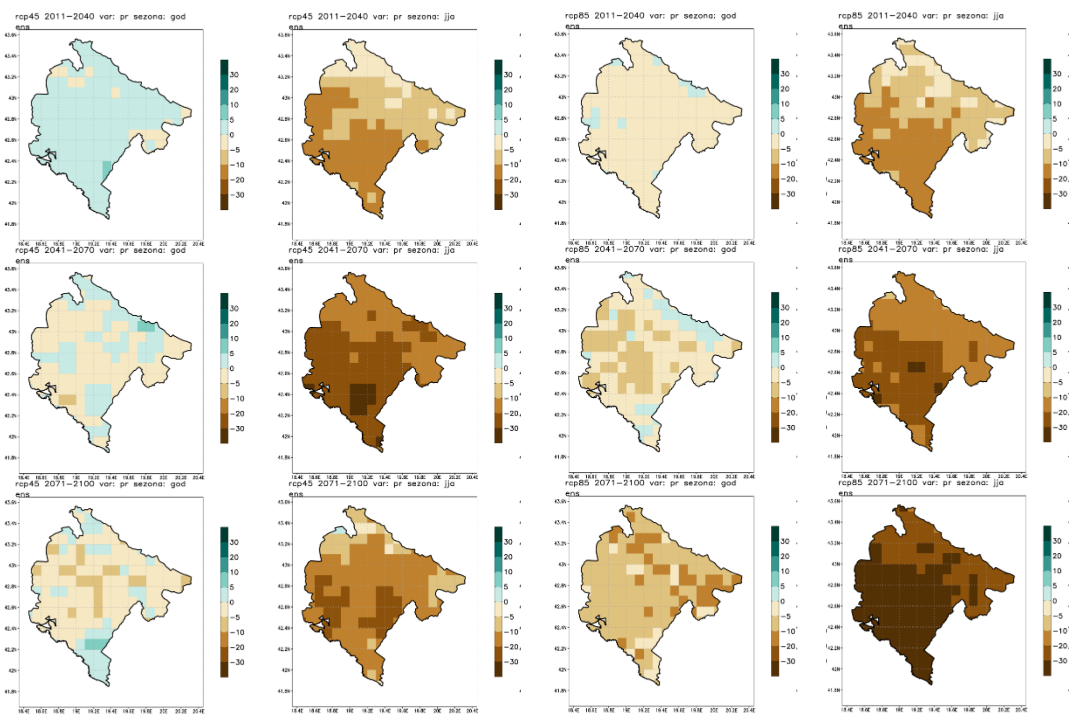


Projections for mean annual and seasonal precipitation

According to the RCP4.5 scenario, the average annual precipitation in the middle and end of the 21st century will decrease in the largest part of the territory of Montenegro, but mostly to -5% compared to the reference period. During the summer, precipitation is expected to decrease mainly to -20%, in some parts to -30%. For other seasons, the changes range from -10 to +10%, with the increase in precipitation most pronounced during the spring. The range of most likely precipitation values is higher in relation to temperatures, but summer precipitation in this range has a predominant character of decrease.

According to the RCP8.5 scenario, average annual precipitation in the middle and end of the century, most of Montenegro expects a decrease in precipitation in the amount of -5 to -10%. As in RCP4.5, the greatest loss of precipitation is expected during the summer, but in this case it is more intense, up to -30% in most of the territory. Changes in other seasons range from -10 to +5%, with a decrease in precipitation occurring over a larger area during spring and autumn compared to the RCP4.5 scenario. The range of most likely precipitation values is higher in relation to temperatures, but summer precipitation in this range has a predominant character of decrease.

Figure 73 Change in the mean annual precipitation according to the scenario RCP4.5 (first column) and RCP8.5 (second column) and mean summer precipitation according to the scenario RCP4.5 (third column) and RCP8.5 (fourth column) in the period 2011-2040 (first row), 2041-2070 (second row) and 2071-2100 (third row)



Thermal indices

Along with the increase in temperature, the number of summer days, tropical days and tropical nights is expected to continue to increase, and the number of frosty days is expected to decrease.

According to the RCP4.5 scenario, up to 25 more summer days are expected in the middle of the century, up to 20 days more at the end of the century, but in a larger territory of the country, while according to the RCP8.5 scenario, 50 to 65 days more are expected at the end of the century.

According to the RCP4.5 scenario, the number of tropical days will rise to 25 in the south of the country by mid-century, and from 5 to 10 days in the north. By the end of the century, the expected changes are similar, except that in the south they occupy a larger area. According to the RCP8.5 scenario, up to 55 more tropical days are expected in the south of the country by the end of the century.

Tropical nights occur only in the south of the country, where RCP4.5 is expected to increase by up to 20 days, and slightly more by the end of the century, while the change to RCP8.5 is predicted to be up to 55 days and covers a larger area.

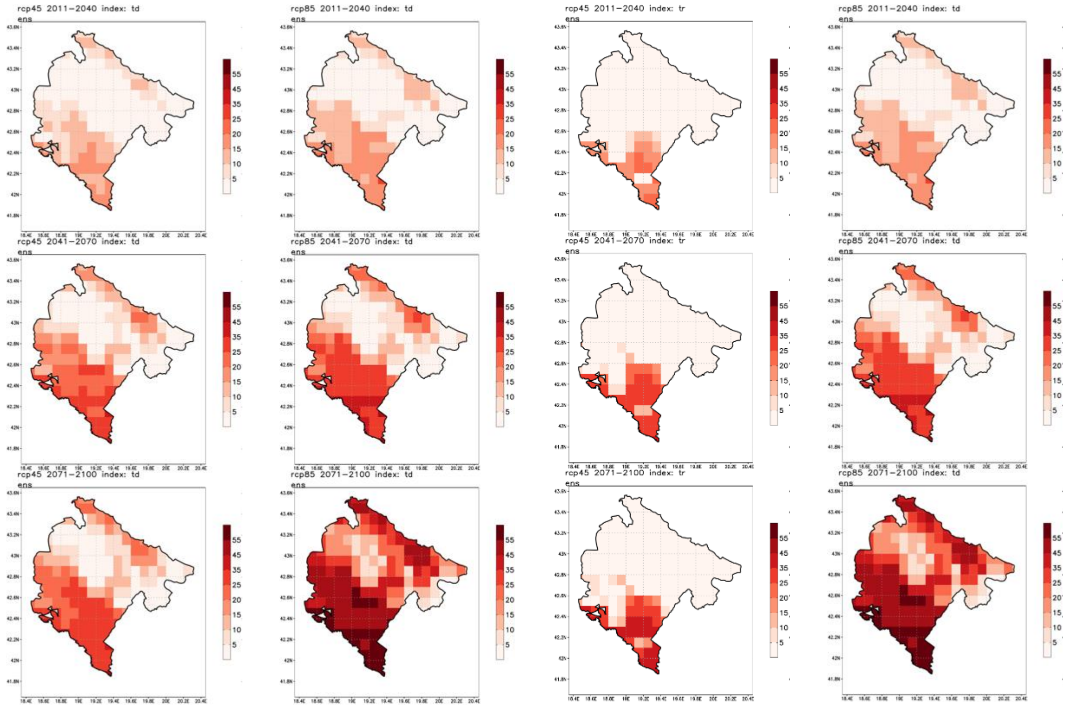
Under the RCP4.5 scenario, the number of frost days will decrease by about 25 days in the north by mid-century and by about 30 days by the end of the century, while the change to RCP8.5 is up to 60 days by the end of the century.

Due to the increase in temperature, the growing season is expected to be extended, which will start earlier and end later. By the end of the century, the growing season will be about 35 days longer under RCP4.5 and about 55 days under RCP8.5.

The number of heat waves will increase the most in the south of the country. According to the RCP4.5 scenario, up to eight more heatwaves are expected in the south and up to five more in most of the country. The expected change is more intense under the RCP8.5 scenario, according to which by the end of the century there will be up to ten more heatwaves in the south, and up to eight in the rest of the country.

According to the RCP4.5 scenario, the length of heat waves by the end of the century will increase between 36 and 48 days in most of Montenegro and up to 48 days in the south. According to the RCP8.5 scenario, this increase will be more than 96 days by the end of the century, in almost the entire territory of the country.

Figure 74 Change in the number of tropical days under scenarios RCP4.5 (first column) and RCP8.5 (second column) and the number of tropical nights under scenarios RCP4.5 (third column) and RCP8.5 (fourth column) in the period 2011-2040 (first row), 2041-2070 (second row) and 2071-2100 (third row).



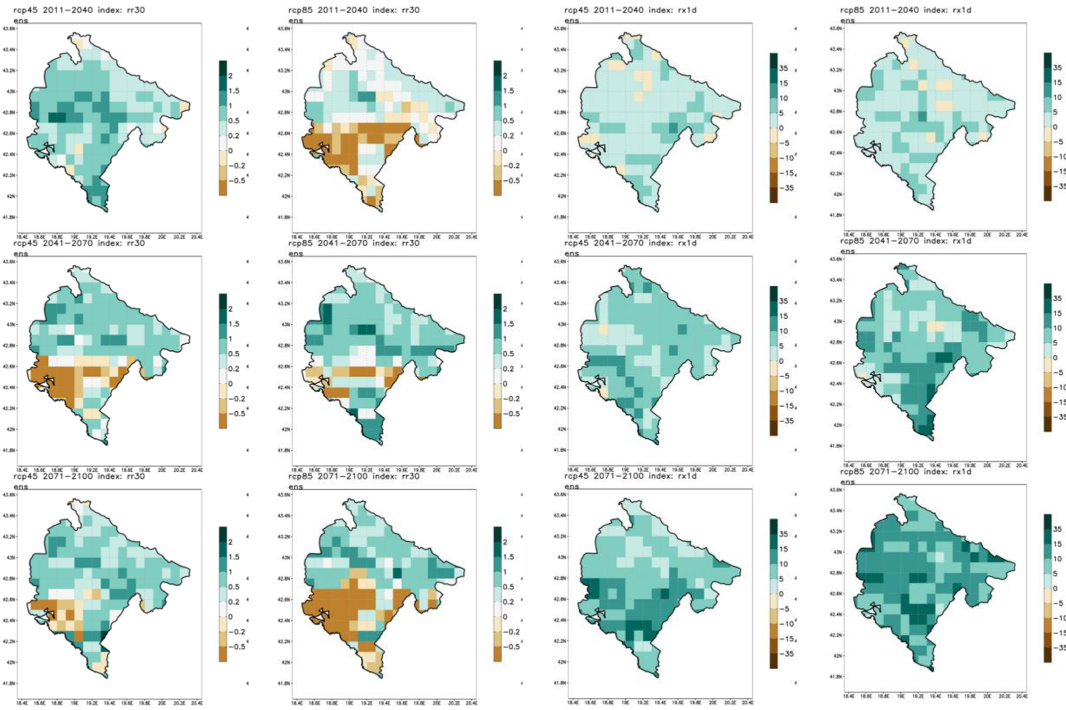
Precipitation indices

Projections in changes in the number of days with intense precipitation show great uncertainty, given that the lower part of the range of probable values of change shows a decrease, and the upper part shows an increase in the number of days. The general conclusion, according to both scenarios, is that an increase in the number of days with intense precipitation is certain in the north of Montenegro.

Maximum one-day and five-day precipitation is increasing in almost the entire territory of Montenegro and in all periods, under both scenarios. By the end of the century, the expected increase in maximum one-day fares is up to 35% and five-day maximums up to 15% under both scenarios. The number of days with precipitation above the 95th percentile is expected to increase by one in the middle to late century compared to the reference period, under both scenarios.

On the other hand, the number of consecutive days without precipitation is also expected to increase. According to the RCP4.5 scenario, the increase will be higher in the middle of the century, up to 6 days, and slightly less at the end of the century, up to 3 days in the largest part of the territory. By the end of the century, according to the RCP8.5 scenario, a longer average period without precipitation is expected in the south and southeast of the country.

Figure 75 Change in the number of days with precipitation over 30 mm according to the scenario RCP4.5 (first column) and RCP8.5 (second column) and the maximum one-day precipitation according to the scenario RCP4.5 (third column) and RCP8.5 (fourth column) in the period 2011-2040 (first row), 2041-2070 (second row) and 2071-2100 (third row).



8.3 Sector vulnerability and adaptation analysis

8.3.1 A review of the main conclusions of Montenegro's TNC to the UNFCCC

Water resources

In the previous, Third National Communication of Montenegro (TNC) under the UNFCCC, the biggest climate threats were identified as increasing temperatures, drought and intense rainfall. Increasing temperatures lead to increased water consumption, especially during the summer months, and a decrease in water quality, which can cause degradation of aquatic ecosystems. The more frequent occurrence of periods with a precipitation deficit reduces water quality, affects the operation of existing and planned hydrological systems, as well as agricultural production, and reduces the level of groundwater. Intense rainfall increases the maximum runoff on rivers, and therefore the risk of flooding, sedimentary transport, soil erosion, and has a negative impact on human health.

The recommended adaptation measures include, first of all, the improvement of coordination and cooperation between authorities and organisations, as well as the professional and scientific community, the improvement of sectoral planning, the harmonisation of data standards and their exchange, but also the definition of protocols and conditions for sanitary zones, as well as the monitoring of surface waters and the implementation of the spatial plan. Technical measures include the improvement of the network of hydrometeorological stations, the exploration of groundwater potentials and the construction of new and improvement of existing infrastructure for water supply and storage. The proposed measures include improving scientific research capacities for assessing the impact of climate change on freshwater systems, improving information systems and databases, as well as raising awareness of the link between scab and precipitation regimes, in order to improve groundwater conservation and assess their vulnerability to climate change.

Forestry

In the TNC, the main climate hazards related to the forestry sector were CO2 concentrations, increasing temperatures, changes in precipitation regimes and the intensity and frequency of extreme weather events. Increasing temperatures affect different tree species differently, and for some it can become a limiting factor, which can affect competition and succession, especially in mixed forests. The risk of insects / pests and diseases and forest fires increases, while the risk of frost decreases. Changes in the precipitation regime disrupt the hydrological balance of habitats, due to more frequent droughts, more frequent and more intense occurrence of forest fires is possible, the risk of soil erosion is increased, and all this together can have a long-term impact on the reduction of the net primary productivity of forests in Montenegro.

Separate measures relate to the improvement of forest management, the establishment of a monitoring system and the definition of indicators for monitoring changes in forest ecosystems, the promotion of afforestation, the improvement of the system for early warning and warnings of forest fires and hydrometeorological hazards, the increase in preparedness for forest fires, the improvement of cross-sectoral cooperation, as well as cooperation with the scientific community, as well as the improvement of capacities for education on sustainable forest management.

Agriculture

For the agriculture sector the most relevant climate hazards identified in the TNC are rising temperatures, decreasing precipitation, and more frequent occurrences of droughts and floods. Increasing temperatures affect the shift of vegetation periods, disrupt the phenological phases of development, affect yields, and productivity of soil and farmed animals, affect the number and development of weeds and insects, increase the risk of heat stress of plants and animals. Droughts and reduced rainfall reduce the amount of organic matter in the soil, increase the need for irrigation systems, limit plant growth, and reduce the availability of food for farm animals. Floods lead to reduced yields and loss of animals, favour the appearance of diseases and weeds, and cause damage to crops.

The proposed adaptation measures are based on strengthening cooperation between scientists, decision makers and stakeholders, improving the type and amount of agro-meteorological data collected (phenological and soil data), and increasing the availability of agro-meteorological information, in order to increase knowledge, enable better understanding and enable timely responses, promote and implement activities that support sustainable resource use and agroforestry, as well as develop a comprehensive plan for sustainable use of resources. adaptation to drought. Agro-technical measures include the improvement of irrigation systems in terms of efficient water use, drainage and water collection during wetter periods, as well as the introduction of varieties resistant to higher temperatures and the occurrence of extreme weather events.

Coastal areas

In coastal areas, the most significant climate hazards are rising temperatures, decreasing precipitation, flooding and storms with strong winds. The increase in air temperature also causes an increase in water temperature, which adversely affects coastal ecosystems, which suffer greater pressure due to tourist activities. Eutrophication is pronounced. Reducing precipitation reduces the available water and reduces its level in coastal wetlands, while on the other hand, flooding leads to significant economic damage and intensifies erosion processes. Stormy winds also contribute to soil erosion, raise sea levels and create high waves, all of which can cause material damage to infrastructure and private property and hinder maritime traffic.

Incorporating climate change impact and risk analysis into all future strategic documents related to coastal areas, improving cross-sectoral cooperation in this area, improving the protection of special nature reserves, establishing monitoring and developing adaptation plans in the tourism sector, as well as promoting sustainable tourism. A number of technical measures were also taken to protect against sea level rise and control erosion, as well as to improve the system of early warning and warnings of floods and storms. For the planning of further measures, it is necessary to continuously work on researching the impact on all sectors in the coastal area, the development of new impact models, as well as further analyses of high waters and potential for erosion control.

Human health

Rising temperatures, extreme temperatures, and flooding are recognised in TNC as having the most significant impact on human health. Rising temperatures can enable the transmission of various types of foodborne or vector-borne diseases, while extreme temperatures increase mortality due to heat waves and extremely cold temperatures. Flooding has direct physical effects on people's injuries and lives, affects mental health, and increases the risk of foodborne and waterborne diseases.

The recommended adaptation measures relate to improving the capacity of the health system to adapt to climate change and to respond to future needs, improving the public health monitoring system, developing and improving the system of early warning and warning, as well as the development of strategic sectoral documents related to climate change adaptation planning.

Urban environments

Rising temperatures, hot and cold waves, droughts, intense precipitation, floods, changes in precipitation patterns and rising sea levels affect the health and lives of people in urban areas, as well as economic sectors such as tourism and agriculture, water availability, energy production, and the environment.

The recommended adaptation measures in the TNC were related to the improvement of cooperation between regions, support to local self-government units in planning and implementation of adaptation measures, improvement of the planning process and improvement and development of water supply and sewerage system infrastructure, support for green infrastructure, but also the analysis of the quality of available precipitation data and methodological approaches for the analysis of the risk of intense precipitation in urban areas.

Energy

Montenegro's TNC does not contain a dedicated section on the energy sector's vulnerabilities despite the significant risks it faces from climate change. The report identifies water, forestry, and agriculture as the sectors most vulnerable to climate change, two of which directly impact the energy sector. The water sector's vulnerability due to reduced rainfall and snowmelt directly affects Montenegro's hydroelectric production, which is less effective during drought. The forestry sector's increased susceptibility to forest fires also poses high risks for energy infrastructure, such as transmission lines and key substations. Modernising transmission lines can help the energy sector better cope with forest fires, reducing the likelihood of fires caused by faulty transmission lines and improving energy efficiency.

The report notes that Montenegro imported 1,537 GWh of electricity, exported 416.7 GWh, and experienced 512 GWh in transmission and distribution losses. Reducing imports and losses is crucial for decreasing energy vulnerability. The TNC highlights Montenegro's efforts to lower energy consumption in line with the Energy Community Agreement and indicates that further reductions in total energy use are possible. It includes extensive information on reducing GHG emissions, such as increasing photovoltaic and wind energy production and enhancing energy efficiency, which can mitigate the energy sector's vulnerability to climate change. Additionally, the TNC covers strategies to reduce vulnerabilities in other vital sectors, indirectly benefiting the energy sector. Policies in the TNC, including the introduction of emission credits, will generate funds for the Eco Fund, which aims to develop environmental measures, support renewable energy, and finance innovation, thereby bolstering the resilience of the energy sector.

8.3.2 Agriculture

Climate change has a complex impact on Montenegro's agriculture, with significant consequences for food production, economic incomes and rural development. Changes in temperature and precipitation, as well as the availability of water for irrigation, are key factors affecting the net primary productivity of agricultural crops.

The economic consequences of climate change on agriculture can be severe, especially in Montenegro where agriculture is an important part of the economy and most soil types are quite shallow and skeletal. The need for more water leads to an increase in production costs and can reduce its profitability. This is especially true for fruit and viticulture production, which represents the greatest value in the commercial production of the agricultural sector.

An increase in costs for disease and pest control, irrigation, as well as other adaptation measures is also expected. Therefore, the need to develop capacities for better modelling of the physical and economic impacts of climate change on the agricultural sector of Montenegro was expressed. This includes the development of new models and methods that will contribute to a more accurate impact assessment and help create effective adaptation strategies and mitigate the negative effects of climate change.

Based on the available literature, the impact of climate change on the most important agricultural crops in Montenegro has been assessed.

Olive

Under the most intense scenario of rising greenhouse gas emissions, the expected increase in temperature would affect the expansion of areas in Montenegro that are suitable for olive cultivation to the north and towards higher altitudes, potentially increasing them from the current 17% to 30.2% of the total land area.

The increase in temperature affects phenological development, causing earlier flowering (up to 17 days earlier in the most extreme scenario) and accelerating the ripening of fruits, which can lead to changes in the quality of olive oil. In addition, high temperatures can increase stress in plants and reduce yields.

The water needs of olives will increase by up to 3%, while the evapotranspiration of plantings without irrigation will decrease by 5.5 to 21.7%. Net irrigation needs will increase, from 29.5 to 103.4 mm in the most extreme scenario, which at the same time predicts a relative yield loss of 16.2 ± 7.6%.

All of the above indicates that olive cultivation in Montenegro requires adaptation in cultivation methods and resource management to ensure the sustainability of production.

Vines

The increase in temperature poses multiple challenges for the production of high-quality vines. Accelerating the stages of development of vines leads to earlier ripening of grapes. This can be beneficial for some varieties in the short term, but it also carries the risks of ripening berries in the warmer period of the year, as a result of which the content of aromatic compounds in the grapes can decrease, the sugar content increases, and the acidity level decreases, which negatively affects the quality of the wine.

A decrease in the amount of precipitation and an increased frequency of dry periods can lead to water stress of the vine, which directly affects the development of fruits and reduces the yield. Adaptive measures for efficient water management, such as the implementation of drip irrigation systems, are becoming necessary.

In accordance with the projections of the future climate in the territory of Montenegro, it is expected that high temperatures will accelerate the phenophases of vine development and lead to earlier flowering and ripening of grapes by 10 to 20 days compared to the current climatic conditions. The expected decrease in precipitation during the summer months can prolong periods of drought and intensify water stress on the vine.

Potato

Potato production in Montenegro is particularly vulnerable to climate change due to the low level of technology applied in production, cultivation in long-term monoculture, fragmentation of production plots, limited use of machinery and irrigation. Due to these problems, potato yields are low, highly unstable and susceptible to the influence of weather conditions, such as high summer temperatures, long dry periods during the growing season, intense rainfall and flooding (which can damage not only crops, but also storage capacities and infrastructure).

Due to the increase in temperature, a shortening of the potato growing season by 13.6 to 29.7 days can be expected in the future, depending on the scenario. Irrigation needs would increase from 4 to 19.5 mm under the same scenarios. Yields may be reduced in coastal regions, while in mountainous regions it may be increased. Therefore, in the future, a gradual relocation of production to the northern and colder regions of the country is expected. In the future, potatoes could also be successfully grown in the Zeta and Littoral regions, while inland producers should consider applying adaptation measures, such as sowing earlier, to avoid heat stress and lack of moisture in the soil during the summer.

Cereals

Wheat and corn are staple grains that are crucial for food production in Montenegro.

Changes in climatic conditions can lead to changes in the phenophases of wheat, including earlier germination, flowering, and ripening. Such changes can shorten the growing season, potentially shortening the time available for biomass accumulation and grain development, leading to a decrease in yield. Less rainfall during critical growth phases, such as pouring grain, can lead to water stress and limit yields, especially for winter wheat.

The expected increase in temperature can prolong the growing season of maize, but also increase the risk of heat stress during critical stages of development, such as flowering and fertilisation. High temperatures can reduce the efficiency of photosynthesis, cause aborting of flowers, and reduce the percentage of fertilised grains. Frequent summer droughts directly affect the availability of water for corn, which requires advanced water conservation techniques and adaptive varieties that are better adapted to stress conditions.

The precipitation regime in Montenegro is often characterised by a period of intense precipitation followed by dry intervals. Such a distribution of precipitation makes it impossible for farmers to use water efficiently for irrigation. Water is often lost through surface runoff before it has time to infiltrate the soil to the depth of plant roots, further intensifying the challenges faced by producers. Significant changes in climatic conditions, in the event of failure to achieve the goals of the Paris Agreement, would require the application of adaptive measures in order to preserve yields. These measures include the selection of varieties that are resistant to drought and high temperatures, improved water management and changes in the cultivation system.

8.3.3 Forestry

Climate change is a limiting factor in the protection of forests and the protection of biodiversity of forest ecosystems. The most important climate hazards affecting forests are: increasing the intensity and frequency of droughts, storms with strong winds and extremely high temperatures, increasing the intensity of precipitation and evapotranspiration that affect the intensification of soil erosion, as well as increasing temperature that affects the expansion of the range of certain pests and plant diseases.

An increase in mean air temperature will result in a shift of vegetation zones towards higher latitudes and higher altitudes, at a rate of about 200-300 km towards the halves and 150-200 m upwards at 1 °C of warming. It is expected that in some areas there may be drying and degradation of forests as a result of abiotic stress or due to the attack of pests and plant diseases, there is a change in the growth rate of forest trees, and natural and artificial regeneration of the forest is difficult. Due to prolonged dry periods and high temperatures, the damage caused by forest fires and atmospheric disasters is expected to increase. Air pollution, the occurrence of acid rain, soil acidification are factors that, along with climate change, can affect the deterioration of the state of forest ecosystems. A decrease in the biological adaptability of forest trees and other forest species is also expected. The most endangered are those communities that have limited opportunities for adaptation, such as mountain, island and coastal communities, endemic species, species that inhabit specific habitats, as well as species with slow and difficult reproduction.

The genetic diversity of forest trees ensures the conservation of existing forest tree populations, as well as the preservation of the adaptive potential of trees capable of responding to environmental changes. However, migration and the transfer and selection of genes resistant to new habitat conditions are hampered by the fact that forest tree species are long-lived and have long generation cycles. Therefore, neither the natural migration of trees nor the flow of genes can keep up with the current rate of climate change.

Taking appropriate forest management measures can to some extent reduce the environmental and socio-economic consequences of possible forest degradation under the influence of climate change. Strengthening the resilience of forest ecosystems means reducing exposure to the risk of climate change, reducing the consequences that may arise and enabling the fastest and more favourable recovery of forests after the damage suffered.

After the development of the TNC in the forestry sector, a proposal for the Forest and Forestry Development Strategy of Montenegro for the period 2025-2030 was drafted. This Strategy defines the conservation and strengthening of forests' capacity for resilience and adaptation to climate change as one of the basic strategic objectives of forestry. A new Forest Act is also being prepared.

The strategic objectives defined by the proposal of the Forest and Forestry Development Strategy of Montenegro for the period 2024-2029 are:

1. Providing the basics of sustainable forest management in Montenegro, respecting the principle of polyfunctionality of forest ecosystems;

2. Preserving and strengthening the capacity of forests for resilience and adaptation and resilience to climate change;

3. Increasing the area of protected forests, protecting biodiversity and areas;

4. Fostering the sustainability and competitiveness of forest-based industries, bioenergy and the wider green industry and circular economy;

5. Institutional Strengthening and Financial Support.

These goals are aligned with the goals in the National Strategy for Sustainable Development of Montenegro until 2030.

Strategic and regulatory-legal documents in forestry, in accordance with the Law on Forests (Official Gazette of Montenegro 74/10 and 47/15) are: National Forestry Policy of Montenegro (2008), Strategy with a Plan for the Development of Forests and Forestry (2013-2023, proposal for 2024-2029), Development Plan for the Forest Area, Forest Management Program for the Management Unit, Private Forest Management Plan and Operational Criteria and Indicators for Sustainable Forest Management in Montenegro (2011).Forest management is the basic instrument that can mitigate the negative impact of climate change on the forest, and therefore the key documents that regulate the forestry sector in Montenegro have been developed in accordance with the principles of the forestry profession that take into account the existing scientific knowledge and contain measures of adaptive forest management in order to mitigate the negative impact of climate change on the forests of Montenegro.

The health status in the forests of Montenegro is monitored within the framework of the International Cooperative Program for Forests (ICP Forests). Within the framework of this program, a system with more than 7,500 bioindication points has been established in Europe distributed on a network of 16 x 16 km. Within this network, according to the established methodology, the health status of forests, their spatial distribution and damage that occurs in forests is monitored. The assessment of the condition of forest tree crowns is carried out once a year and is the best indicator of the positive and negative effects of biotic and abiotic influences on the state of forests. In Montenegro, monitoring of the health status of forests according to this program started in 1988. Until 2003, the collection of data at bioindicative points was carried out intermittently, and since 2003, the collection has been carried out continuously and the data is sent to the International Center for the ICP Forest Program, which packages and publishes the data for all European countries. Monitoring of the health status of forests in Montenegro is carried out at 49 biodication points.

The National Forestry Policy (2008) envisages monitoring of the health status of forests as the basis for management and the instrument of control of forest management results, and it is carried out by the Forest and Hunting Grounds Management Directorate of Montenegro and reports on it to the relevant Ministry and the public in accordance with Articles from 55 to 59 of the Law on Forests.

Forests of Orijen

The dominant forest community in the Orijen mountain range is represented by beech forests. According to the National Forest Inventory (2011), beech is the dominant species of forest trees in Montenegro in terms of area (27.8% of the total area under forest) and by volume (34%). The beech tree in Montenegro is located on the southern border of its natural range. Although the impact of climate change is most pronounced in the beech forests of the ecological region of the Montenegrin Littoral, it is recorded in all beech forests in Montenegro. The area of Orijen is characterised by a wealth of biodiversity, which is why the establishment of the Orijen Nature Park was proposed.

Beech forests on Orijen occur in the zone from 1000 to 1700 m above sea level, on about 6000-7000 ha. However, it has been found that beech forests in many positions of the Orijen massif are affected by the drying process, on all southern and western exposures, on ridges, slopes of high slopes, as well as on shallow and skeletal soils of flattened terrain. In addition, the health status of beech, which is weakened due to drought-induced stress, is aggravated by pathogenic fungi, primarily black scab of beech bark (*Biscohniauxia sp.*), which causes beech drying and large-scale degradation of beech forests. In addition to this pathogen, a large number of wood destroyer fungi and xylophagous insects have been recorded in beech forests, so it is necessary to continue and intensify the research on this problem.

In smaller areas, beech forests are affected by fire, and in privately owned forests, examples of clean logging have been recorded, which is prohibited by the Law on Forests and is especially harmful when carried out in forests that are under great pressure due to unfavourable environmental conditions.

In degraded beech forests that are in the process of drying, natural regeneration of maple, black ash, hornbeam and various types of shrubs, yews, and to some extent beech has been recorded.

Figure 76 Drying of beech, dry trees with a developed fruiting body of *Biscogniauxia*, fallen and hollowing trees, Orijen 2024, photo: Ž. Stračević

According to the data from the National Forest Inventory (2011), in Montenegro it occurs on 1.6% of the total area under forest, while in Orijen it is represented on about 300 ha of area. This is one of the few species of forest trees that can be said to be "gaining" under the pressure of climate change, as it has been recorded that they regenerate well naturally in their natural, primary and secondary, habitats.

On Orijen, the pine tree is characterised by good health and vitality. However, the presence of pathogenic fungi (some of which have the character of invasive pathogens) has been recorded on its conifers, and in poor habitat conditions and on more difficult terrains, cone diseases are of greater intensity and can occur in combination with harmful insects. That is why it is necessary to intensively monitor the health of the pine tree.

The greatest danger to the monica population is represented by forest fires, which have largely devastated monica forests in Montenegro in the last 20 years (over 25% of the monica forest disappeared in forest fires in this period).

Figure 77 Natural regeneration of the pine tree, Kosmaš, Orijen massif, photo by Ž. Stračević

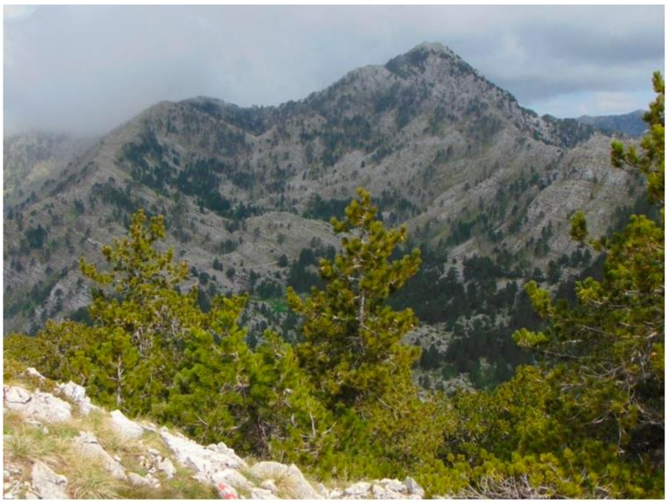


Figure 78 Pineapple tree damaged by fire, Orijen, photo by J. Lazarević

Forest management is an essential tool that can mitigate the negative impact of climate change on forests. Taking appropriate measures in forest management can to some extent reduce the environmental and socio-economic consequences of possible forest degradation under the influence of climate change. The fight against climate change requires action, responsible and knowledge-based management of forest resources. In order to implement adaptation measures, it is necessary to provide financial resources, train staff and work on strengthening social awareness and the overall level of knowledge about the problem.

The recommended adaptive measures in the beech forests on Oryen relate to the promotion of natural regeneration and direct conversion by substitution of tree species. It is necessary to preserve the genetic potential of beech from southern habitats (by *in situ* and *ex situ* conservation methods), which is in line with beech conservation efforts at the European level. Given the recorded level of drying, the encouragement of natural regeneration can be realised through the filling of degraded stands in which natural regeneration has not been recorded or burned stands and the care of young and young people in them. Direct conversion by substitution of woody species is carried out in forests with a high degree of degradation due to forest drying or after forest fire. In order to ensure the success of filling, it is necessary to analyse the afforestation techniques themselves (planting seedlings or sowing seeds, age of seedlings, different planting density, preparation of soil and planting pits before sowing or planting, etc.) depending on the purpose, habitat conditions, characteristics of the species, age and quality of planting material, planned level of maintenance of plantings and care measures after planting.

In pine forests, in locations with dense natural growth, the implementation of cleaning measures and thinning of young stands should be considered, in order to improve the young stand and direct the stand in early youth towards functional optimum. It is also very important in the prevention of wildfires. However it is also necessary to improve the system of meteorological observations and monitoring and alarming of the occurrence of a high risk of fire, as well as the system for early detection of fire, but also to improve the openness of the forest to forest roads.

The protection of the gene pool of forest species is the basis for their survival under the pressure of climate change, given that the natural adaptability of forest tree stands is based on a rich gene pool. In the area of Orijen, genetic conservation of pine trees, beeches, as well as other species of forest trees and shrubs is proposed. It is necessary to establish units of genetic conservation (*in situ* conservation of forest species of trees and shrubs), and to create conditions for *ex situ* conservation (collection of seeds according to the principle of targeted collection from selected adult trees). It is also necessary to develop a national program for the conservation and directed use of forest and genetic resources.

Given the scope of works on the remediation of degraded forest areas, special attention must be paid to the nursery production of planting material, so that it is purposeful and supports the planned adaptation measures.

8.3.4 Water resources

Hydrology

Climate change is clearly reflected in the hydrological system. On an annual basis, there may not be significant changes in the amount of precipitation, but changes in the precipitation regime affect the hydrological regime. Changes in seasonal cycles of precipitation, their duration, intensity, frequency, result in floods and droughts.

In Montenegro, there is no more precise and comprehensive overview of the impact of climate change on ***water resources***. It is very difficult to separate the consequences of human influence and the influence of natural factors in changing the water balance.

The data that are measured, and can be included in the analysis of the change in the water balance, are precipitation, temperatures and the amount of water in rivers or lakes. The importance of the hydrological and meteorological network and the data collected on them is noted here.

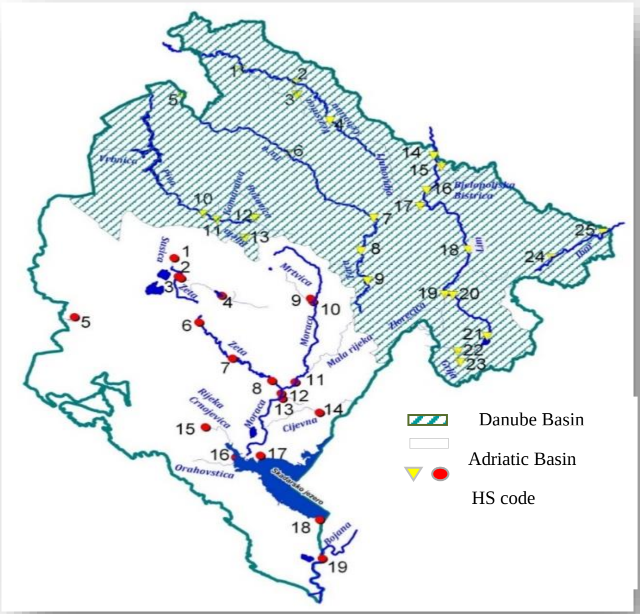
By monitoring the water regime of the main watercourses, i.e. lakes, by defining its change, it is possible to give an overview of the impact of climate change. This opens up space for defining adaptation measures, as well as for making plans with defined activities.

A major contribution to a better understanding of the impact of climate change on water resources is the development and maintenance of a hydrological and meteorological information system. These systems should serve not only as an archive, but also as a base from which events in nature can be perceived, i.e. indicators of change.

The Institute of Hydrometeorology and Seismology of Montenegro, in accordance with the Law on Hydrometeorological Affairs, is a centre for observation, measurement, collection, processing, analysis and issuance of hydrological data and information. The Institute provides hydrological information to all entities in charge of flood protection, sends data for international exchange, on the basis of international conventions and on the basis of signed cooperation, as well as to the media. On the WEB presentation of the Institute http://www.meteo.co.me, users have access to hydrological data from all stations from the observation network. Automatic stations record water levels every 15 minutes, and can be read on the website of the IHMS CG.

Figure 79 shows a map with a network of hydrological stations in the Adriatic and Danube basins. A significant reduction in hydrological stations occurred in the 1990s, but in the last decade the number of HS has increased again.

Figure 79 Network of hydrological stations (IHMS)



In the period from 2018 to 2020, through the IPA project "Capacity Building for the Implementation of the Water Framework Directive in Montenegro," a groundwater monitoring network was established in the IHMS. The total number of locations that make up this network is 47, of which 32 are with automatic data transmission. For the time being, there is no analysis of the data collected.

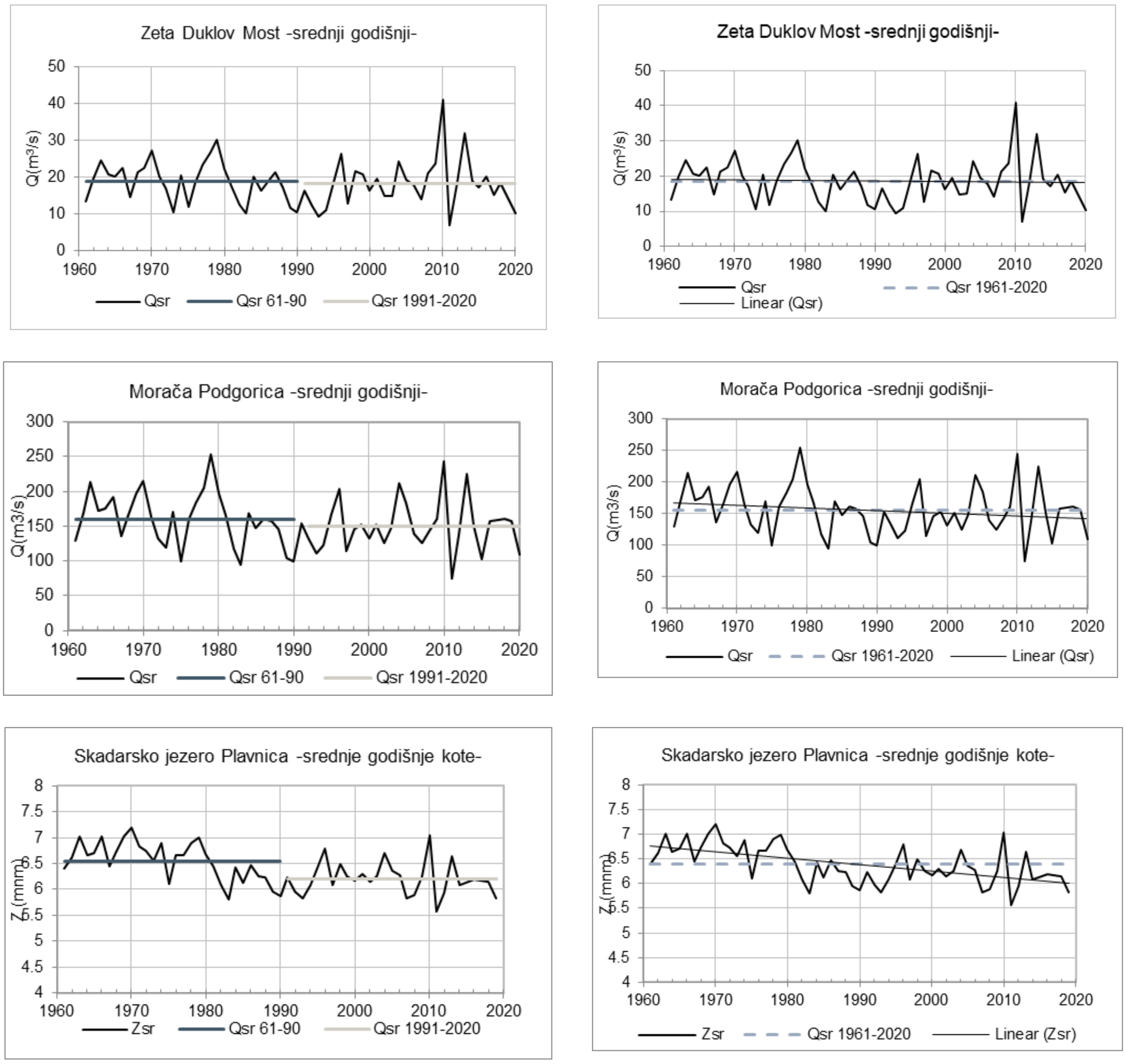
As far as groundwater is concerned, in the period 2018-2020, the IHMS network for groundwater monitoring was established through the IPA project **"Capacity Building for the Implementation of the Water Framework Directive in Montenegro".** The total number of locations that now make up the groundwater monitoring network under the jurisdiction of the Institute of Hydrometeorology and Seismology is 47, of which 32 are with automatic data transmission. For the time being, data has been collected, but not analysed.

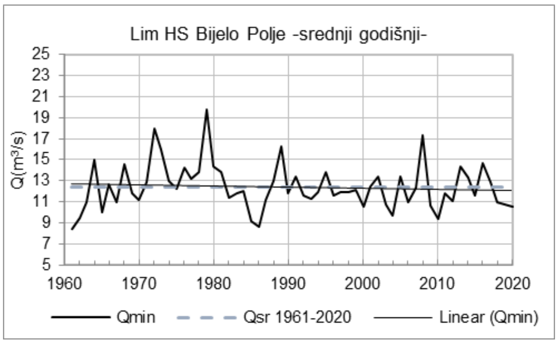
In order to present the water balance and its changes in the past period, an analysis of flows will be carried out on the main watercourses of the Adriatic (Zeta watercourse at the Duklov Most Mountain Forest, Morača watercourse at the Podgorica Mountain Forest, as well as at the Skadar Lake at the

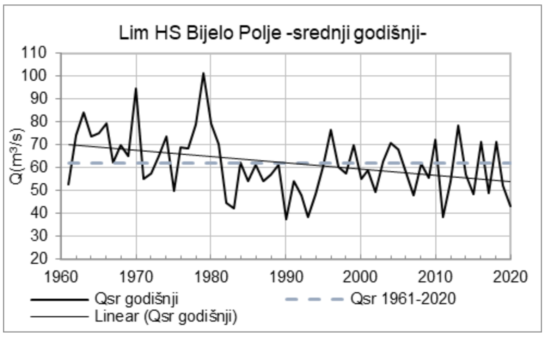
Plavnica Mountain Forest) and the Danube River Basin (Lim watercourse at the Bijelo Polje Mountain Forest, Tara River at the Trebaljevo Mountain Forest).

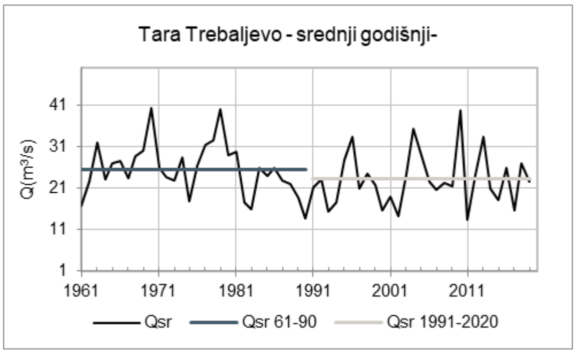
The following graphs give the time variation of flow (level) for small, medium and large waters using mean annual values. For the time periods of climatic normals, the mean values of the analysed flows (levels) were determined. By analysing the change in trends of characteristic flows (water levels) on the observed profiles, an assessment of the impact of climate change on water resources was carried out.

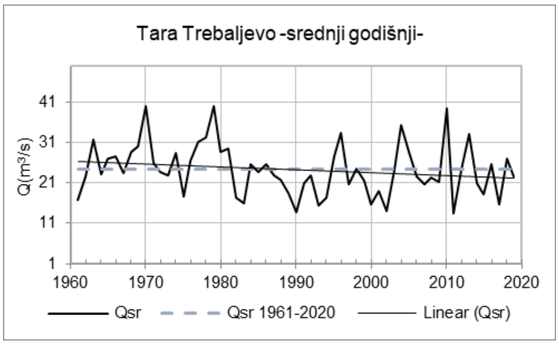
Figure 80 Variation of flow for water bodies in Montenegro (mean annual values)











By analysing the results shown in the graphs above, it can be seen:

1. At all hydrological stations, which were included in the analysis, a trend of decreasing small waters in the period 1991–2020 was observed, compared to the period 1961–1990, and this ranges from about 5% to about 27%.

2. At all analysed hydrological stations, a trend of decreasing middle waters in the period 1991–2020 is observed, compared to the period 1961–1990, and this ranges from about 2% to about 12%.

3. On all analysed watercourses (except for the HS Bijelo Polje on the Lim watercourse), a trend of increasing high waters in the period 1991-2020 is observed, compared to the period 1961-1990, and in the range of about 9% to about 15%. A decrease in medium high waters by 3.93% was observed in the period 1991-2020, compared to the period 1961-1990, which can also speak of the influence of the topography of the terrain, the presence or absence of groundwater, the length of significant precipitation and the state of the basin, human activities in the basin and much more. The reliability of the measured and observed data that goes into the analysis should not be neglected either.

For Skadar Lake (HS Plavnica), a decrease in medium high levels was also observed in the second analysed period by 1.3%.

The unevenness of changes from basin to basin is visible, and for some HS the disconnect between the change in precipitation in the basins and the change in water flow. All this points to the complexity of the conclusion about the impact of climate change on hydrology and the need for more extensive research activities for this purpose.

Water quality

The impact of climate change on water quality is primarily reflected in rising water temperatures and the frequent occurrence of floods and droughts.

An increase in water temperature leads to a decrease in the concentration of dissolved oxygen and a decrease in the capacity of water purification only. Furthermore, the increase in temperature reduces the amount of water in water bodies (due to more intense evaporation), which increases the content of pollutants in the water. This is especially true during periods of prolonged drought, which are becoming more frequent and intense. Water losses increase significantly during the summer (through evapotranspiration), and the increase in temperatures in winter adversely affects the formation of snow cover, and thus the distribution of flow in rivers during the year.

On the other hand, floods increase the amount of water and reduce the concentration of pollutants in the water, at the same time washing away the surrounding soil, introducing harmful substances (nutrients, nitrogen, phosphorus, pesticides) into the waters of rivers and lakes. The turbidity of water also increases, which has a negative impact on the living world of aquatic ecosystems.

Another consequence of climate change is that seawater enters deeper into the riverbeds and salinises them, especially in the summer months when the amount of water in the rivers is reduced. This is especially pronounced in the watercourse of the Bojana River and the groundwater of the Risan Bay.

In the conditions caused by climate change, aquatic ecosystems are very endangered, which are increasingly difficult to tolerate pollution and invasive human activities, which is visible through the degradation or loss of biodiversity. The increase in temperature affects the increased growth of phytoplankton, the time of emergence and abundance of insect populations, as well as the migration of fish.

All of the above may make it more difficult to meet the requirements of the Water Framework Directive and maintain the good status of water bodies in the future. According to the reporting of SDG indicator 6.3.2 (percentage of water bodies with good status), the percentage of water bodies with good quality in Montenegro was 94.1% in 2017 and 88.1% in 2020.

In order to monitor the impact of climate change on water quality, it is necessary to have a continuous set of data parameters such as water quality, water quantity, and water and air temperature. In this way, it is possible to determine the dependence of water quality parameters in relation to the increase in air temperature. IHMS performs systematic testing of surface water quality (rivers, lakes - natural and artificial, coastal sea and mixed water) and groundwater through monitoring that includes basic physical, chemical and biological parameters of water quality. However, the available set of data on surface water quality is not extensive enough to draw conclusions on the extent to which and how climate change affects water quality in Montenegro. Therefore, it is of the utmost importance to ensure continuous and high-quality observations and measurements in accordance with the Water Framework Directive and the Nitrates Directive.

In addition to monitoring, important measures are the improvement of the protection of water sources and the preservation of the quality of water resources, within which the following activities can be recommended: construction of urban wastewater treatment plants, cleaning and protection of river banks from illegal landfills, prohibition of uncontrolled exploitation of sand and gravel, protection of waters from eutrophication processes, reduction of the possibility of washing agricultural land with appropriate protective embankments and application of the principles good agricultural practices.

8.3.5 Energy

Montenegro's energy sector already faces significant risks from climate change. Rising temperatures and increases in the variability and distribution of precipitation predicted over the coming decades areonly going to extenuate the climate risks that the country's energy sector faces. This chapter looks at how the different component parts of Montenegro's energy sector are exposed to climate-related hazards and where the key vulnerabilities might be.

The energy sector is a wideand complex system that provides critical support to other key sectors including processing, manufacturing, tourism, hospitality and transport. For the purposes of this assessment, the energy sector has been categorised into five subsectors. Vulnerability and exposure to various climate and climate change related hazards are evaluated on each of the five subsectors.

1. Electricity Generation and Storage: Encompasses all processes and technologies used to convert energy into electrical power as well as those used to store electricity. This includes fossil fuels including coal and oil and renewable sources including hydropower, wind, solar and biomass. The storage technologies include batteries.

2. Grid Networks: Refers to the interconnected system of infrastructure which transports electricity from the sites of generation through to the end-users. This includes the high-voltage lines which carry electricity over distances to from the powerplants to substations (transmission), the lower voltage networks delivering electricity from substations to the end user (distribution) and the infrastructure connecting electrical grids to transfer electricity between regions and countries (interconnectors).

3. Natural Resource Availability: Refers to the availability of the resources required for electricity generation, including water for hydroelectric generation and for use in thermal cooling plants, and wind and sunlight for wind and solar power generation.

4. Fuel Supply Chains: Encompasses the processes of acquiring and delivering fuel resources for energy production. This includes the processing (refining and processing of raw fuels) and the transportation (moving fuels from production sites to processing facilities via shipping, pipelines and roads).

5. Demand and Staff: The amount of electricity or energy required by consumers at any given time, which may be influenced by population size, weather conditions and economic activity. Staff refers to all employees within the sector including engineers, technicians and operators

Montenegro's energy sector is small but diverse, serving 396,000 customers with an annual demand of 3,000 GWh. The country's main sources of electricity veneration are the coal-fired Pljevlja Thermal Power Plant (TPP) and two hydropower plants (HPPs), Perućica and Piva.

HPP Perućica, HPP Piva, and TPP Pljevlja are critical for the energy system in Montenegro, with a total generating capacity of 874 MW. The two hydropower plants generate the majority of this and the TPP Pljevlja contributing a significant amount of this capacity. Electricity generation is also supported by wind farms at Kronvo and Možura, a solar power plant at Čevo, and a selection of micro- and small-scale hydropower plants. As Montenegro aligns its energy policies with EU standards and expands its renewable energy share, the sector presents strong development and investment opportunities.

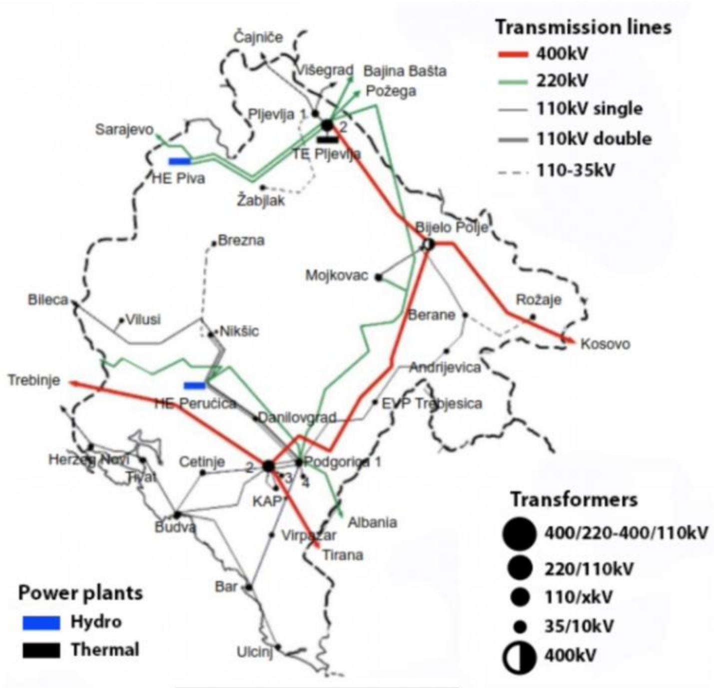
Montenegro can build its energy security and independence while developing increased resilience in the sector by safeguarding its hydroelectric assets and accelerating the integration of additional renewable energy sources such as solar and wind. Expanding on solar and wind energy, and exploring other viable renewable sources, such as geothermal, would diversify the energy mix, build resilience and reduce coal dependency, while significantly lowering emissions.

Work to strengthen grid flexibility, leverage international projects such as their underwater energy cable to Italy, and deepen regional energy cooperation will further ensure stable power supply. Additionally, investments in energy storage solutions and infrastructure upgrades are important to build resilience to climatic impacts while supporting long-term sustainability. In the transmission system, a critical one-way underwater energy cable was constructed in 2017 to export power to Italy. The cable runs for 433km, at a depth of 1,200m, and will export energy from Montenegro to Western Europe from 2019.

The energy system is part of a regionally coordinated system which has proven effective during critical weeks for power operation. Analysed at an hourly level across the year, 74% of the total power which Montenegro imports is re-exported instantaneously.

In the emissions reduction strategy for the energy sector, the focus is on combined heat and power generation, industrial efficiency, and replacing coal with liquefied petroleum gas. Transport plans involve shifting to alternative fuels and creating a more efficient system. Agriculture strategies target better manure management and promoting organic farming, while in forestry, Montenegro aims to restore forests, improve habitats, and expand productive forests.

Figure 81 Transmission Lines and Transformers



Source: EPCG. No date.

Electricity Generation and Storage

Montenegro has a well-developed energy sector, characterised by a diversity of energy sources. Considering all imported and domestic sources of energy, coal (31%) and oil (37%) (2021) make up the largest shares. Domestically, the largest energy sources are coal, which constitutes 50% of the total produced, 24% from biofuels and waste and increasingly hydro power makes up a large share of 23%. Between 2005 and 2021, Montenegro's volume of imported energy grew by 93%, with annual fluctuations depending on the availability and success of domestic hydropower. Bankwatch noted that the ability of the Montenegrin energy sector to meet electricity demand has varied with the hydrometeorological conditions. In 2010, 2013, and 2018 – rainy years, the country was able to meet demand domestically, while in dry years – 2011, 2012 and 2017 – it still had to import relatively large amounts of electricity.

For coal production, the north and northeastern areas of Monenetgro, Pljevlja and Berane, are critical. While Pljevlja has a high degree of exploration, Berane is relatively underexplored. While future energy development is likely to involve expansion of hydro and thermal powerplants to utilise the abundance of rivers and streams across Montenegro, this should only be considered if the significant environmental impacts of hydropower plants can be mitigated, otherwise the subsequent environmental degradation may lead to increased vulnerabilities and exposure to climate risks.

Significant energy generation infrastructure in Montenegro is located in the Northern Region, including the Pljevlja TPP and supporting mines, the Piva HPP, and numerous small scale HPPs. Perućica HPP, the Kronovo and Možura wind farms, the Čevo solar power plant, and numerous other micro-scale HPPs are located in the central and coastal regions. Each of these energy generation assets face increasing risk of climate-related hazards such as fluvial and pluvial flooding, landslides, wildfires, and increasing temperatures.

Extreme precipitation can pose serious risks to the structural integrity of dams, and the major impacts of fluvial flood risk will arise for any energy infrastructure located near rivers or on river floodplains. Prolonged heavy rainfall and flooding may increase the pressure on dam infrastructure, raising the risk of a dam burst or uncontrolled release of water. This risk is especially pronounced for any infrastructure which lack spillways and gates and other adaptations. These impacts can potentially result in a loss of electricity generation and can leave regions without power for extended periods. This could not only lead to catastrophic flooding downstream but also the complete loss of hydropower generation from the affected facility and damage to critical equipment. In the event of such an incident, storage reservoirs might be drained or severely reduced, limiting Montenegro's capacity to store water for future power generation and increasing the country's dependence on other energy sources.

Wildfires pose a significant threat to electricity generation and storage infrastructure in Montenegro, particularly affecting coal production facilities. The intense heat and flames from wildfires can directly damage power plants, coal storage sites, and associated infrastructure, leading to operational disruptions or complete shutdowns. In regions where coal production is a primary energy source, wildfires can hinder mining operations, compromise coal supply chains, and result in significant economic losses.

As temperatures rise, TPP Pljevlja, which is a key component of Montenegro's energy mix, will likely experience reduced efficiency. At higher temperatures, thermal power plants struggle to cool, which lowers their overall output and requires an increase in their use of freshwater. Extreme heat also reduces the operational and output efficiency of solar energy panels. Additionally, extreme heat over a wide area would strain the grid's backup capacity, as demand for cooling increases and multiple regions simultaneously require more energy. This would leave Montenegro vulnerable to power shortages. Simultaneously, elevated temperatures are likely to accelerate the evaporation of surface water from reservoirs and rivers, reducing water availability for hydroelectric power generation. Since hydroelectricity is a critical source of renewable energy in Montenegro, this would limit the country's ability to rely on sustainable power, exacerbating the strain on the energy grid and increasing reliance on electricity imports.

An increase in storms and high winds especially in mountainous and coastal regions can limit the ability of repair teams to safely access fault sites, such as power plants, substations, or transmission lines. These types of events can also pose risks to wind farms. Delayedaccess can result in prolonged outages, leaving customers without power for extended periods of time, particularly in remote or hard-to-reach areas in the northern region of Montenegro. An increased frequency and intensity of extreme events are likely to cause more faults in the system, such as damage to power lines, transformers, and storage facilities. This rise in the number of faults will strain maintenance and repair resources, as energy providers struggle to keep up with the growing number of incidents.

While hydropower is generally located in areas less exposed to drought, there is still potential for Montenegro's energy supply to be affected by the projected increase in drought conditions, which would lead to low river flows and significant reductions in the overall electricity output from hydroelectric plants, which are a crucial part of Montenegro's energy mix. If the drought conditions affect other sectors (i.e., agriculture), it is likely that effects on the energy sector could be exacerbated by an increase demand for water in other sectors. Thermoelectric powerplants also require on water for cooling, will also have reduced water availability under drought conditions, straining the production of electricity and could cause overheating. Additional maintenance requirements are another possibility, potentially increasing expenses. There could be a requirement for alternative water sources to be identified, increasing the environmental impact and affecting the health of freshwater ecosystems in Montenegro to support cooling at powerplants.

Grid Network

Rising temperatures and heatwaves, which will be especially prominent in the coastal and central regions, will likely affect overhead line conductors, reducing their rating and ground clearance, leading to operational challenges and safety concerns. Maintenance programs may be disrupted, as increased temperatures are likely to increase the load, reducing opportunities for planned outages and network reinforcements, and limiting opportunities for essential upkeep. This will reduce the flexibility of the grid, as changing load patterns throughout the year will complicate the scheduling of maintenance. Switchgear and transformers, vital components of the grid, will be affected by extreme heat, leading to a reduction in their ratings and increasing the likelihood of overloading during peak summer months, particularly in urban heat islands (such as Podgorica) where air conditioning demand spikes. These heat-induced stresses on transformers could increase the risk of failures and outages, increasing potential vulnerabilities during high-demand periods. The overall efficiency of power plants and transmission lines will decrease as extreme heat strains equipment, leading to overheating and reduced reliability, especially during peak hours when the grid faces its highest loads. This combination of factors could severely challenge the resilience of Montenegro's electricity grid in the face of future climate extremes.

Substations located in flood risk zones in the Northern Region, are at increased risk of inundation during heavy rainfall or river overflow events. When substations flood, power outages can occur, and resources must be redirected from routine business activities to address these urgent issues. This diversion of resources can slow down regular operations, delay planned maintenance, and strain the network's capacity to handle other emerging faults. Flooding also undermines tree root stability, increasing the likelihood of trees falling onto power lines, causing additional faults and outages. Montenegro's mountainous regions are at risk of landslides, which are set to increase with high precipitation events, these can severely damage high-voltage grids, power lines, substations, and access roads, leading to widespread outages.

Substations located in coastal areas could be affected by seal level rise, requiring additional resources for flood and storm surge protection and repairs. Floodwaters will also extend fault restoration times, as engineers may face delays in accessing flooded areas. For more severe floods, substations may be permanently damaged or rendered non-functional. This would reduce the security of Montenegro's power supply in the coastal region, limiting the grid's redundancy and ability to reroute power, especially during peak demand periods or emergencies. Coastal transmission and distribution infrastructure could be severely damaged by salt water, causing corrosion and physical damage, resulting in short- and long-term outages as well as high repair costs.

Wildfires pose direct threats to trees and vegetation near electrical infrastructure, increasing the risk of falling branches or entire trees onto power lines and critical access routes. Such incidents can cause power outages, damage to transmission and distribution equipment, and potentially create safety hazards for both utility workers and the public. Smoke, heat, and debris from wildfires can disrupt the operation of substations and other critical components of the grid, leading to increased operational risks and equipment failures. The need for rapid response and maintenance becomes crucial during wildfire events, but the challenging conditions may hinder access for repair crews, prolonging outages and straining resources.

High winds and storms which will become more prevalent in the Coastal and Northern Regions are increasingly likely to impact the energy sector in Montenegro. High winds during storms, not accounted for in the original design of some overhead line structures, can cause physical damage to power lines, poles, and towers, leading to outages and costly repairs. Increased lightning activity occurring during more frequent storms poses significant risks to both overhead lines and transformers. In addition to igniting wildfires, lightning strikes can damage critical equipment, leading to additional faults, disruptions in power supply, and a need for expensive protective measures like surge protection systems. Snow and ice accumulation on trees during extreme winter events could cause branches to break and fall onto power lines, resulting in outages. Over time, repeated exposure to extreme weather can weaken trees, increasing the likelihood of debris-related faults. The combined effect of falling debris and frequent storms can overwhelm the grid, resulting in an increased number of major incidents and reduced reliability. More frequent storms and lightning strikes causing structural damage will contribute to the rising number of faults across the network. The result could be a prioritisation of immediate repairs over routine maintenance and upgrades

Natural Resource Availability

Extreme heat, prolonged drought, and general annual air temperature rises are likely to significantly reduce water availability, through lack of precipitation and higher evaporation rates, which is critical in Montenegro for hydroelectric power generation. Reduced power generation from hydroelectric sources will increase reliance on carbon intensive sources such as coal and imports. Reduced water availability will limit the capacity of thermal power plants that rely on water for cooling. Without sufficient water for cooling, these plants will experience reduced efficiency and output, putting further strain on the energy grid.

Drought will also limit water availability for coal production. Water is essential for cooling the cutting surfaces of mining equipment and minimising the risk of fires and explosions caused by coal dust. A lack of adequate water supply can compromise the safety and efficiency of mining operations, leading to reduced coal output and potentially increasing production costs. It could also result in temporary closures to mining operations.

Fuel Supply Chains

High temperatures could damage transportation infrastructure, such as roads, railways, and pipelines, making it more difficult to transport fuel supplies efficiently. In Montenegro, fuels are mostly transported by road. Extreme temperatures can affect roads through increased levels of rutting (where roads are not designed to expand and contract with temperature changes). This would slow down the delivery of critical fuel resources but also increase costs and create vulnerabilities in the energy system. The impact of these delays may impact vulnerable communities more severely. Imported fuel supplies could be affected by higher temperatures.

Extreme weather events in Montenegro will also disrupt fuel supply chains, primarily through damage to transport infrastructure such as roads, railways, and ports. Flooding, landslides, or storm damage can render key transport routes impassable, leading to delays in the delivery of essential fuels like oil, gas, and coal to power plants and other energy facilities. Ports, which are crucial for importing fuel supplies, may be temporarily shut down due to high winds, storm surges, or safety concerns, further hindering the flow of critical energy resources. There are likely to be delays in transporting fuel from storage facilities to power plants, industrial sites, and retail fuelling stations, causing bottlenecks in the supply chain.

Damage to coastal transport infrastructure, such as roads, and ports, can lead to delays in fuel deliveries, making it difficult for energy providers to maintain a steady supply of necessary resources. Safety concerns during extreme weather events may also hinder transportation routes, further exacerbating the risk of supply interruptions. If floodwaters inundate or damage key transport links, there will be difficulties moving fuel from storage facilities to power plants and distribution centres, potentially leading to shortages.

Demand and Staff

During extreme heat events energy demand is likely to increase to provide cooling, particularly in urban areas and sites of urban heat islands. This increase in demand will increase the strain on the electricity network resulting in higher loadings, potentially resulting in a higher number of faults and outages across the network. There may be a surge during peak hours which could push beyond the grid capacity, creating additional strain on generation and distribution systems. Vulnerable customers, such as the elderly or those with health conditions, will require additional prioritisation, placing further strain on energy providers to ensure a reliable service.

High temperatures will likely lead to increased staff absence due to heat-related illnesses, including heat stress, reducing the available internal workforce and impacting the sector's ability to respond to maintenance needs or emergencies. Other impacts on staff availability and capacity may arise from delays or disruption to transportation and health risks from travelling in high temperatures. The use of personal protective equipment (PPE) in high-heat conditions may become untenable, forcing the postponement of certain maintenance and operational activities, which could delay critical repairs and upgrades.

Safety concerns during storms, floods, or extreme winds may force the postponement of critical activities such as infrastructure maintenance, inspections, and planned upgrades. These delays can prolong the recovery and restoration process following outages and may also increase the vulnerability of the grid if essential maintenance is deferred. Increased demand for electricity during extreme weather, particularly for heating or cooling during harsh conditions, further strains the energy system.

Drought hazard, which is set to be high in coastal and central regions in Montenegro will have a big impact in the energy sector. As water availability decreases, there may be an increased reliance on alternative energy sources, such as thermal power plants, to compensate for the reduced output from hydropower. This shift can result in higher electricity consumption for cooling and other energy needs, especially during hot and dry periods when households and businesses rely more on air conditioning and refrigeration. Workers in the energy sector may face challenges as they adapt to these shifting demands. Increased workloads during drought conditions may lead to longer hours or the need for additional staffing, impacting employee wellbeing and morale.

8.3.6 Proposal of proposed adaptation measures by sector

Table 60 Adaptation measures by sector

Agriculture

Area	Measure	Description of the measure
Improving the policies and capacities of institutions	Development and improvement of the advisory system	Establishing a system for providing expert advice and recommendations to agricultural producers, including information on best practices and techniques for adapting to climate change.
	Improving cooperation between the scientific community, agricultural producers and decision-makers	Strengthening the links between these actors will ensure knowledge transfer and a process of informed decision-making and strategic planning in response to climate change.
Technical and technological measures	Improving the use of water and irrigation systems	The implementation of more efficient irrigation systems, such as local squeezing techniques, optimises water consumption. The use of micro tanks allows water to be supplied during dry periods, and at the same time it can be used to suppress fires.
	Construction of irrigation and drainage infrastructure	The modernisation and expansion of irrigation and drainage infrastructure enables the availability of water in dry periods and protection in the event of floods.
	Using the Precision Agriculture Approach	The use of advanced technologies to optimise the use of resources, such as water and soil, thereby increasing the efficiency of agricultural production.
	Integrated Plant Protection	Management of plant pests and diseases through the integration of different control methods that reduce the risk of yield loss.

	Adaptation of the area of cultivation of agricultural crops	Identification and development of new areas that become suitable for the cultivation of certain crops, due to changes in temperature and rainfall patterns.
Research, information and capacity building	Improvement of the phenological database	Increasing the volume and quality of phenological data collected, as well as their analysis to better understand and predict the impacts of climate change on plants, in order to improve the planning and adaptation of agricultural activities.
	Expansion of the Agricultural Data Monitoring and Collection Network	Increasing the volume and quality of data related to agricultural production, in order to enable the monitoring of the impacts of climate change.

Forestry

Area	Measure	Description of the measure
Improving the policies and capacities of institutions	Development of a National Program for the Conservation and Use of Genetic Resources	The development of this program should enable and facilitate *in situ* and *ex situ* conservation of forest species of trees and shrubs
Technical and technological measures	Improvement of forest management	Forest management should be improved to include a range of adaptation measures, such as
Research, information and capacity building	Improvement of the network of meteorological stations in mountain and forest areas	Increasing the number of meteorological data in forests, with the aim of monitoring and assessing the impact of climate change
	Improvement of the system for early warning and warning of the risk of forest fires	
	Improving capacity for the care of vital forests and remediation of degraded forests	Conducting training on climate hazards and adaptation measures

Waters

Area	Measure	Description of the measure
Technical and technological measures	Improving water quality and protecting aquatic ecosystems	Construction of urban wastewater treatment plants; cleaning and protection of river banks from illegal landfills; prohibition of uncontrolled exploitation of

		sand and gravel; protection of waters from the process of eutrophication; construction of protective embankments and application of the principles of good agricultural practice.
Research, information and capacity building	Improvement of the hydrological and meteorological observation network	Increasing the number of measuring stations, improving the database for storing data and analysing the collected data.
	Improving the Impact of Climate Change on Water Resources	Preparation of a study of the impact of climate change on Montenegro's water resources, in order to improve knowledge and enable the process of informed decision-making and strategic planning in the sector.
	Improving the Impact of Climate Change on Water Quality	Developing models that would contribute to a better understanding of potential changes in water quality due to climate change.

Energy

Area	Measure	Description of the measure
Improvement of policies and capacities of institutions	Incentivize solar and wind power within public and private sector	Developing fiscal mechanisms and tools to support the diversification of energy sources. Moving away from high emitting sources (gas/coal) and supporting vulnerable sources (hydro) of energy is critical to ensure energy generation is protected against climate change. Supporting the implementation of Public Private Partnerships and promoting climate finance in Montenegro's energy sector.
	Better monitor for early warning and emergency response	Developing methods to improve monitoring for both early warning and disaster response systems will improve the capacity for the energy sector to cope with extreme events and improve reliability.
	Develop climate data and resilience capacity for energy sector professionals	Develop training programs and courses designed to equip energy sector professionals with the knowledge and tools necessary to incorporate climate resilience and climate modelling and data into their operations.
	Develop adaptation policy frameworks in building, infrastructure and energy sectors	Strengthen policy frameworks to support adaptation measures, such as revising building codes for infrastructure resilience and incentivising the adoption of renewable energy.
Technical and technological measures	Upgrade transmission and distribution network	An improved transmission and distribution network can reduce the amount of energy lost to waste between production and use. Increasing energy efficiency. Upgrades can also improve resilience of

		network to breakages and failures caused by climate hazards, which disrupt networks and can increase costs and lead to increased energy waste.
	Promote and deploy battery storage systems	Develop and deploy battery storage systems to ensure a stable energy supply from renewable sources. Decentralized battery storage systems can increase the energy sector's resilience to extreme events and variations in production capacity.
	Implement Smart Grid Technologies	Use advanced technologies like smart grid technologies to optimise energy distribution and reduce losses.
	Maintenance and upgrade of infrastructure in urban areas	Transformers affected by urban heat islands and coincident air conditioning demand leading to overloading in summer months. Maintenance programme may be impacted as increased temperatures may increase loads during summer reducing opportunity for planned outages and network reinforcement to enable maintenance. Temperature increases could thus lead to a possible reduction in the flexibility of the network.
	Switch to water-efficient and heat-resilient production process	Increasing the efficiency of water and heat in energy production can make large scale improvements to energy generation capacity. Improved production processes will have more capacity to continue to operate efficiently during extreme events such as prolonged drought or heatwaves, periods where energy use is particularly vital, and when production methods are more likely to fail.
Research, information and capacity building	Conduct asset level CCRVAs, with a focus on Energy Generation and Production and Grid Network Assets	Producing Climate Change Risk and Vulnerability Assessments for assets in the energy industry. These assessments help to keep inventory of assets and allow more informed and effective decisions when responding to factors such as demand spikes, extreme events or production failures.
	Develop and legislate climate proofing in design and performance guidelines	Introducing climate proofing in the design and performance guidelines for assets in the energy sector is essential to ensuring that the next generation of assets will be less vulnerable to the effects of climate change.
	Build wider availability of climate-relevant data	Enhance access to reliable, locally relevant climate data for the energy sector by investing in data collection, sharing, and analysis to understand energy infrastructure vulnerabilities. Develop partnerships with climate research and academic institutions to refine models predicting long-term climate impacts on

		energy systems and promote resilient energy production.

9.

CONSTRAINTS AND GAPS: TECHNOLOGY, FINANCIAL AND CAPACITY BUILDING NEEDS AND SUPPORT RECEIVED

9.1 Climate finance

Montenegro is actively working to enhance its capacity to establish a comprehensive system for monitoring and evaluating the impacts of climate finance in the field of climate change. In parallel, efforts are underway to strengthen the assessment of financial resources necessary for effective climate action. Currently, these assessments are often conducted on a project-specific or sectoral basis, typically during the implementation of project activities or the development of strategic documents. As a result, the information gathered varies in structure, content, and quality, which can limit its broader applicability and usefulness. In the recent period, progress has been observed in this area, primarily in the normative regulation through the integration of the obligation to report on financing in the field of climate change within the Law on Protection against the Negative Impacts of Climate Change. A significant contribution in this direction was made through the project CBIT. Within this project, an analysis was carried out[101] with a focus on, among other things, the initial assessment of the capacity of institutions and the assessment of climate-relevant expenditures, the results of which will serve as guidelines and a plan for the implementation of the model for monitoring climate-relevant expenditures in Montenegro. The analysis also aims to provide an analytical basis for reform in the field of capacity building, as well as a more effective allocation of human and financial resources to achieve better performance in the field of climate change. In accordance with the fact that at the moment there is no comprehensive overview of the necessary financial support for the achievement of climate policy in the field of mitigation and adaptation to climate change, the table below will present information from relevant national strategic documents, primarily the NDC, as well as the draft NAP. The information from these documents has been adjusted in accordance with the current knowledge of the level of implementation of activities, as well as the success in obtaining the necessary donor and other funds for the implementation of individual projects or programs, so that only those projects for which there is still a need to find a source of financing are shown in Table 82 **(Annex A2)**. The reporting period to which the analysis of information on financial support received in accordance with Article 9 of the Paris Agreement refers is the period after the submission of the last Biennial Update Report, i.e. the period after 2021, and includes only new and additional funds compared to what is presented in the Third Biennial Update to the UNFCCC. Table 83 **(Annex A2)** provides an overview of the projects funded by donors.

9.2 Technology transfer and needs

In the last reporting period, Montenegro has not taken steps towards a comprehensive analysis of the needs for technology transfer, technology development and research. This area is still in the early stages of development. However, some progress has been noticeable, especially in terms of institutional arrangement in this area. Namely, the Ministry of Education, Science and Innovation has clear competencies regarding, among other things, the implementation of incentive measures for the development of research and innovation in cooperation with other competent institutions, including technologies and research in the field of climate change. Also, the recently established Innovation Fund plays a very important role in

[101] Capacity Assessment to Strengthen Institutional Transparency Mechanisms in the Field of Climate Change In the Black Hills

promoting and supporting innovative technologies and research activities, including those that contribute to climate change mitigation and adaptation. Another example of the institutional arrangement of this area is the recent announcement of the establishment of the Office for Technology Transfer as a joint initiative of the Ministry of Education, Science and Innovation, the University of Montenegro and the Science Technology Park of Montenegro. These institutions and initiatives will certainly contribute to progress in this area in the period to come. In the absence of a comprehensive overview of the needs in the field of technology transfer, development and research in the field of climate change, Table 61 provides an overview of projects in the NDC to GHG Emission Reductions that implicitly imply the need for technology transfer.

Table 61 Information on necessary technology transfer, technology development and research in accordance with Article 10 of the Paris Agreement

Sector	Subsector	Name of the activity, project or program	Description	Area	Type of technology	Timeline
Energy	Electricity generation	New renewable power plants	Construction of solar and wind power plants	Mitigation of CP	Technology for the production of electricity from the sun, wind, geothermal potentials, production of hydrogen, etc. Electricity storage technology	2025-2030
Energy	Central heating	Heating of Pljevlja	Development of District Heating System in Pljevlja	Mitigation of CP	Modern and efficient central heating technology	2025-2030

Similarly to the needs assessment, information on technology transfer, technology development and research received in accordance with Article 10 of the Convention of the Paris Agreement is not available in Montenegro and therefore cannot be tabulated at this time.

9.3 Capacity building needs

CBIT project conducted a comprehensive analysis of the capacities and needs of competent institutions at the national and local level, involved in the creation and implementation of climate policies in key areas (capacities and needs within the institutional arrangement, strategic and regulatory framework; administrative capacities and needs; capacities for financing in the field of climate change, knowledge management, and gender) and recommended measures to further strengthen them, in order to enable decision-makers to more effectively implement climate change mitigation and adaptation measures on a sustainable basis, in line with international commitments, primarily under the ratified Paris Climate Agreement. The conclusions of this analysis are fully reproduced.

1. In the domain of assessing capacities and needs within **the institutional arrangement, strategic and regulatory framework,** and in accordance with the adopted methodology, the capacity of institutions is characterised as **basic**. The basics of the strategic and regulatory framework are in place, but it is recommended to complete them further as follows:

    a. Finalisation of the NAP;

b. Finalising amendments to the Law on Protection from the Adverse Effects of Climate Change and Protection of the Ozone Layer, including bylaws;

c. Revision of the Nationally Determined Contribution to the Reduction of Greenhouse Gas Emissions (NDC) and its alignment with the decarbonisation objectives adopted within the framework of the Energy Community (EnC);

d. Finalising the development of the NECP in accordance with the guidelines and objectives adopted within the framework of the Energy Community;

e. Preparation of the LCDS by considering the possibility of integrating this document with the NECP;

f. In addition, it is necessary to establish a clear mandate and competencies for mitigating and/or adapting to climate change for all state administration institutions through the amendment of the Regulation on the Organisation and Operation of Public Administration and their internal acts,

g. To strengthen the capacities of local self-governments based on the definition of priorities, the development of strategic documents and the system of communication and reporting at the national level

h. Promote the consolidation of strategic documents, at the local level, in order to avoid overlapping objectives and facilitate their implementation;

i. The general recommendations also go in the direction of strengthening the regulatory framework and its consistent application;

2. In the domain **of administrative capacities and needs**, the current situation is assessed as **basic** capacity. The Rulebook on Internal Organisation and Systematisation of Jobs establishes that only some of the institutions have systematised jobs with job descriptions and tasks in the domain of mitigation and adaptation to climate change. Practice shows that tasks and responsibilities within organisational structures that are supposed to deal with climate change issues are performed on the basis of ad hoc decisions of the management structure, based on current needs or project activities. By analysing the current situation in relation to the target state, i.e. in a situation that allows the conditions of transparency in the field of climate change to be met, it can be concluded that it is necessary to further improve administrative capacities in such a way as to ensure:

a. An adequate level of expertise that would enable the consistent implementation of Montenegro's obligations on the basis of climate change. Although there is an undercapacity of the public administration on the issue of climate change, a detailed analysis is proposed to define the missing expertise and strike a balance between hiring new staff and strengthening the existing human capital through a training system. One of the ways to solve this issue would be to change the Rulebook on Organisation and Systematisation of Jobs, which will provide for an additional number of executors with a precise description of jobs and tasks within the functional responsibility in the field of climate change, whereby the personnel policy must ensure sustainability in the number of persons with appropriate knowledge and responsibilities so that the system does not depend on individuals;

b. In the case of entities that do not have clearly defined climate change within their mandates, human capital can be built on the basis of existing resources that will be built through adequate training;

c. Training programs for employees to cover all relevant components of climate change mitigation and adaptation. Programs need to be designed in individual modules that would address the issues of mitigation and adaptation to climate change from the basic level to more advanced technical and professional levels, aligned with the job description of the officers and their needs;

d. Financial support to training programs can be based on domestic expertise in higher education, through lifelong learning, or through project support for capacity building with the assistance of the Department for Program Implementation of the EU and other funds;

e. At the local level, build capacity by training existing staff and attracting people with appropriate expertise;

f. Use available mechanisms for staff training at the local level, using those resulting from the competences of the Community of Municipalities or project financing.

3. **Climate change financing capacities and needs** are assessed as **low**, as current financial resources are **insufficient** to achieve the objectives and priorities in the field of climate change mitigation (MCP) and/or climate change adaptation (ACP). Sources of financing in the field of climate change and/or ACP have not recorded a stable, sustainable and growing trend in recent years; there are no initiatives for sustainable finance; most institutions do not deal with ESG (environmental, social and governance) criteria in their activities in a systematic way. The budget classification in Montenegro, both economic and functional, does not recognise climate-relevant expenditures. This initially assessed low capacity in the field of climate finance is compatible with the capacity assessments in most other aspects of this analysis. In connection with the above, the recommendations are as follows:

a. Given the characteristics of the existing budget classification, policies, activities and projects in the field of climate policies (climate-relevant expenditures of the current budget and recognised capital budget projects), should be found and further monitored through programs and sub-programs, i.e. **program and project classification**, in order to come up with possible solutions for improving the information system for public finance management and recognising these expenditures in the next year period, using the resources of the CBIT project;

b. A number of important strategic documents are being drafted, which will provide an updated overview of measures and planned projects in the field of mitigation and adaptation, with which **financial indicators for climate-relevant expenditures should be aligned**, in the next phase of the CBIT project implementation, in order to create synergy and validate all financial data and estimates. In this sense, better horizontal coordination, analysis of methodologies, comparison of financial indicators and overall synergy with the following projects is necessary, i.e. the development of the following strategic documents:

- Draft National Adaptation[102] Plan, and
- Draft National Energy and Climate Plan,
- as well as the final document Risk Management Capability Assessment of Montenegro;

c. It is necessary to increase the number and value of climate-relevant projects in **the capital budget** at the national level, but also at the level of local self-governments, in order to increase the initial assessment of financial capacity in the medium term to **level 2** – basic capacity. Growth of investments is necessary in medium term budget planning, but also in the preparation of project proposals that would be supported from other sources;

d. Achieving a higher level of capacity of climate finance institutions is not possible without **additional mobilisation of funds**, as well as the preparation **of potential projects** for financing mitigation and adaptation measures, which should be found on the future **MRV-E portal;**

e. Consider drafting amendments to the "Decision on the Preparation of the Capital Budget and the Establishment and Evaluation of Criteria for the Selection of Capital Projects" in order to **include additional criteria for the evaluation of proposed projects**, which would also include the negative effects of climate change;

f. Prepare a specific **study on the analysis and capacity of climate finance in Montenegro** (using data for the period 2020-2023), which would include a separate section on the analysis of loss and damage according to the methodology developed by the UNFCC;

g. Given the increasingly pronounced negative effects of climate change, the periodic revision of the NDC to Emission Reduction, as well as raising awareness of the necessity of increasing investments in these policies and measures, it is necessary **to prepare several thematic workshops** dedicated to the financing of climate policies and their position in the development of the MRV-E system in Montenegro;

4. In the domain **<u>of capacity for monitoring and reporting, verification and evaluation</u>**, the assessment is that there is **a basic** capacity. The Law on Protection against the Negative Impacts of Climate Change prescribes the obligation to establish a national MRV-E system as a mechanism for support and exchange of information in the field of climate change mitigation, adaptation to climate change, climate-relevant finance and support. The analysis of the current situation has established that the strategic and regulatory framework has been further strengthened compared to the previous

[102] The public hearing of the Draft National Plan of Montenegro on Climate Change was organized in the period 4.6 – 3.7.2024.

period and that there is a clear legal and normative basis for the establishment of a national MRV-E system. Additional requirements for the establishment of the MRV-E system arise from Montenegro's obligation to implement the decision of the Council of Ministers of the Energy Community of 15 December 2022, regarding harmonisation with the set of EU regulations in the field of climate change and energy, including the establishment of the MRV-E system. The Ministry of Ecology, Sustainable Development and Northern Development has key competencies and tasks in functional units in the existing proposal of the national MRV-E system. However, the full functionality of the MRV-E system has not yet been established, as a result of frequent changes in the organisational structure, lack of qualified staff, poor intersectoral communication, etc. Therefore, in order to improve capacity and achieve the targets, it is proposed to:

a. Finalising amendments to the Law on Protection from the Negative Effects of Climate Change and Protection of the Ozone Layer, and, through the drafting of appropriate bylaws, providing the necessary preconditions for its functioning. This is primarily about cross-sectoral cooperation;

b. In addition, it is necessary to establish a stable and frequent training system for employees in all relevant institutions whose job description includes the collection, entry, processing, analysis and monitoring of data and information, as well as the management of the MRV-E system;

c. Define competencies in the system of data collection and processing at the national level, and above all, the mechanisms of data submission and reporting as well as, if any, intermediary entities in this (community of municipalities).

5. **Capacities and needs <u>for knowledge management</u>** were assessed as **low**. A more detailed analysis of the situation of the relevant institutions reveals a number of essential shortcomings that need to be addressed when building transparency capacity. Institutions have an insufficient number of employees in specific jobs; professional and communication connections with relevant partners at the national level are weak or negligible; there is almost no mechanism for capacity building through continuous education, especially for the implementation of regulations; the system of downloading, processing and analysing data is poorly developed; the latest data from relevant international factors are poorly used; strategic and planning documents are not updated efficiently enough. In order to improve capacity and achieve the transparency targets, it is proposed to:

a. Establishing an internal system for generating knowledge in the field of climate change and ensuring the availability of knowledge exchange within the institution;

b. Establishing a proactive internal and external communication system, vertically at the level of the institution as well as with relevant partners and the interested public, using and, so far, not using dissemination mechanisms such as parliamentary mechanisms;

c. Within the framework of the internal communication mechanism, use the possibility of establishing an intersectoral network of contact persons with the aim of timely and adequate collection and distribution of data;

d. At the local level, promote mechanisms to strengthen the capacity to define priorities. For the purpose of using the available mechanisms of the Community of Municipalities or project financing;

e. Strategic planning of public, dissemination of data relevant to people's health or wellbeing, which will include various models of public dissemination such as promotional campaigns, widely participatory forums;

f. Ensuring the preservation of institutional memory acquired through project activities through inter-project networking;

g. Establishing programs and activities to raise public awareness of the impacts of climate change;

h. To strengthen communication at the local level-national level, and in particular, the communication of local self-governments with the public;

i. Work on the diversification of the national educational offer at the level of higher education in order to merge knowledge and research with the regulatory framework in the field of climate change and the long-term creation of broad national expertise.

6. **The gender-sensitive assessment of capacities and needs** in the areas of climate change in Montenegro was assessed as **basic**. Women's leadership and awareness of the need to include the gender aspect in the planning and implementation of climate policies is sporadic and underdeveloped. A gender-equal budget is gradually being introduced, trainings are being conducted, but the results are yet to be expected. At the strategic level, only a few institutions (the Ministry of Agriculture and the Institute of Public Health) include the gender aspect in the planning of some of their policies, but in general, there is no systemic approach in this area, although the obligation to implement all policies is prescribed by the Law on Gender Equality. Most national institutions have gender equality contact persons and their advantage is that they have been cooperating as a group for years (through coordination by the Ministry of Human and Minority Rights), which is a good basis for further building their capacities for the MCP and ACP. Municipalities also have contact persons and it is necessary to create a network at both levels and strengthen it, especially with regards to the involvement of local people from different social groups in the creation and implementation of the MKP and ACP. The Ministry of Ecology, Spatial Planning and Urban Planning has a contact person for gender equality at the UNFCCC, which is a good basis for cooperation and exchange of experiences with other countries. Some of the gender-disaggregated data collected and processed by the Statistical Office are used in a small number of institutions, but they are insufficient to be systematically monitored**.** Within the Human Resources Directorate, there is no specialised education on the topic of the gender aspect of climate change. In order to increase the capacity of institutions in this area, it is proposed to:

   a. Promote women's leadership in decision-making positions and in the management of institutions in charge of the MKP and ACP.

   b. Make it mandatory for 50% of women to participate in climate delegations and monitor statistics on it.

c. Establish and strengthen a network of contact persons for gender equality at the national and local level.

d. Organise workshops for contact persons on the topic of gender mainstreaming and inclusion of vulnerable categories of the population in individual sectoral strategies, as well as in local action plans.

e. Conduct field research on cultural and gender patterns in Montenegro that may affect the formulation and implementation of the FEM and ACP. The results and recommendations of the research are used to develop communication strategies for climate policies.

f. Organise two regional workshops for UNFCCC Gender Equality Contact Persons, UNFCCC Secretariat representatives and contact persons from Montenegrin national and local institutions.

g. Within the Human Resources Directorate, design a one-day training on the topic: "Gender Aspects of Climate Change".

h. For persons who have completed training on gender budgeting, organise additional trainings on the gender aspects of FEM and ACP.

i. Design frameworks for gender-responsive monitoring, using good practices of other CBIT programs.

j. Each of the above topics in which the institutions have expressed interest should also include a gender aspect, so that the institutions better understand the importance of integrating gender equality in the MCP and ACP.

k. Create different training modules for MKP and ACP (with a built-in gender aspect) for different hierarchical levels within the institution.

l. Organise trainings for data analysis, policy planning and communication on issues and challenges related to the ICP and ACP, which will include a gender aspect. Representatives of national institutions and local self-governments should participate in these trainings.

m. Develop guidelines for gender-sensitive analysis of the impact of climate change on agriculture.

n. To make an analysis of the needs of the institutions participating in the ICC and ACP for the development of an internal platform for the exchange of knowledge and information and to propose software solutions for the platform.

In addition, **Table 83** and **Table 84** (**Annex A2**) presents activities and projects that have capacity building components, whether it is necessary or obtained capacity building in the field of climate change.

9.4 Transparency

Table 62 and Table 63 present the identified information on the needs and support received for the implementation of the obligations under Article 13 of the Paris Agreement and the Transparency Commitment.

Table 62 Information on the support required for the implementation of the obligations under Article 13. of the Paris Agreement and commitments to improve transparency, including capacity building for transparency

Name of the activity, project or program	Objectives and description	Timeline	User	Donor	Value (USD)	Status (planned, active, completed)
Support to the preparation of the Second and Third Biennial Transparency Reports and the preparation of the Fifth National Climate Change Report to the UNFCCC	Supporting reporting to the UNFCCC and enhancing transparency in accordance with Article 13 of the Paris Agreement	2025-2028	Ministry of Ecology, Sustainable Development and Northern Development	The GEF	1,233,000.00	In the plan
Support to the establishment of transparency mechanisms and capacity building in the field of climate change in line with Article 13 of the Paris Agreement – CBIT 2	Support to capacity building for transparency in line with Article 13 of the Paris Agreement	2026-2030	Ministry of Ecology, Sustainable Development and Northern Development	The GEF	2,000,000.00	In the plan

Table 63 Information on the support received for the implementation of the obligations under Article 13. of the Paris Agreement and commitments to improve transparency, including capacity building for transparency

Name of the activity, project or program	Objectives and description	Timeline	User	Donor	Value (USD)	Status (planned, active, completed)
Fourth National Communication and First Biennial Report on Montenegro's transparency towards the UNFCCC;	Support in the preparation of the Fourth Climate Change Report and the First Transparency Report to the UNFCCC	2022-2025	Ministry of Ecology, Sustainable Development and Northern Development	The GEF	517,000.00	Active

9.5 Public awareness

The project CBIT conducted a comprehensive analysis of knowledge management capacities and needs, including public awareness raising and education. Capacity at the national and local levels is rated as low. In order to improve capacity and achieve the transparency targets, it is proposed to:

- Establishing an internal system for generating knowledge in the field of climate change and ensuring the availability of knowledge exchange within the institution;
- Establishing a proactive internal and external communication system, vertically at the level of the institution as well as with relevant partners and the interested public, using and, so far, not using dissemination mechanisms such as parliamentary mechanisms;
- Within the framework of the internal communication mechanism, use the possibility of establishing an intersectoral network of contact persons with the aim of timely and adequate collection and distribution of data;
- At the local level, promote mechanisms to strengthen the capacity to define priorities. For the purpose of using the available mechanisms of the Community of Municipalities or project financing;
- Strategic planning of public, dissemination of data relevant to people's health or wellbeing, which will include various models of public dissemination such as promotional campaigns, widely participatory forums;
- Ensuring the preservation of institutional memory acquired through project activities through inter-project networking;
- Establishing programs and activities to raise public awareness of the impacts of climate change;
- To strengthen communication at the local level-national level, and in particular, the communication of local self-governments with the public;
- Work on the diversification of the national educational offer at the level of higher education in order to merge knowledge and research with the regulatory framework in the field of climate change and the long-term creation of broad national expertise.

ANNEXES

AI Montenegro's REDD+ possibilities

A1.1 Introduction

Recognising the potential role of forests in contributing to climate change mitigation, REDD+ is a mechanism under the UNFCCC for reducing emissions from deforestation and/or forest degradation, while supporting the conservation of forest carbon stocks, sustainable management of forests, and enhancement of forest carbon stocks. Under the UNFCCC, non-Annex-I countries would benefit from results-based payments. However, in the context of Montenegro, currently a non-Annex-I party but in the process of joining the European Union, it is fundamental to understand the rules where the reduction of emissions and enhancement of absorption of GHG in forests will stand in the short and medium term.

A note on terminology, the approach detailed under the UNFCCC is commonly referred to as 'reducing emissions from deforestation and forest degradation', often abbreviated as REDD+. Formally, the mechanism was originally dubbed 'reducing emissions from deforestation in developing countries' or REDD. However, this was extended to 'reducing emissions from deforestation and forest degradation in developing countries, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries' or REDD+. Throughout this section, the mechanism will be referred to as REDD+ for simplicity.

In its simplest form, REDD+ is a vehicle to provide technical and financial support for the reduction of emissions and enhancement of GHG removal at the national level through a host of forest management options. Since its inception in 2005 at the 11th session of the Conference of the Parties to the Convention (COP), the concepts behind REDD+ have been developed through decisions at successive COPs, ultimately leading to the formulation of the Warsaw Framework for REDD-plus, developed at COP 19.

A1.2 Montenegro's REDD+ eligibility

Montenegro's eligibility for funding via results-based payments under the REDD+ mechanism is not altogether clear according to the verbiage of the legal framework outlined in the relevant decisions. The text on REDD+ mechanisms consistently refers to 'developing countries'. However, according to the UN report on the 'World Economic Situation and Prospects 2019', Montenegro is defined as a country with an 'economy in transition'. This suggests that Montenegro is not the intended recipient of such a mechanism. There is also a lack of precedent for engaging with REDD+ programmes through multilateral channels in countries outside of Africa, Asia-Pacific, Latin America, and the Caribbean. For example, the UN-REDD Programme Collaborative.

However, there is some evidence of bilateral support for REDD+ activities in countries outside of Africa, Latin America, and Asia-Pacific, including for countries with 'economies in transition'. Up to 2010, Germany allocated US$261 million through bilateral projects Workspace lists 65 partner countries, exclusively from these regions Forest Carbon Partnership Agreement (FCPA), a World Bank-led initiative, lists support for 47 developing countries located in subtropical or tropical regions across Africa, Latin America, and Asia-Pacific – with over 20 developing countries including Armenia, Azerbaijan, and Russia.

Montenegro has begun to prepare a national forest monitoring system, though it has not started to develop any of the other elements required for engagement with the REDD+ mechanism. This may also be a reason for the lack of engagement with multilateral funding channels for REDD+ activities such as the UN-REDD Programme and FCPA to date.

This suggests that while the remit of many multilateral channels supporting REDD+ activities focuses on tropical or subtropical countries in Asia-Pacific, Africa, Latin America, and the Caribbean, there may be opportunities for Montenegro to secure funding through other channels. Securing REDD+ funding through established multilateral channels may also hinge on the development of the elements supporting national engagement with REDD+ such as the national strategy, FRL, NFMS, and safeguarding information.

Another key factor that may play a large role in Montenegro's access to funding under REDD+ is EU accession. Given the EU's involvement in funding REDD+ opportunities, it would seem contradictory that a party could be part of the EU and receive funding under REDD+. However, no clear guidance on this matter has been found. This aspect should be further discussed as part of the EU accession negotiations should Montenegro engage with the REDD+ mechanism.

A2 Key institutions involved in Montenegro's MRV system

Table 64 Key institutions involved in Montenegro's MRV system

Institution name	Responsibilities
National Council for Sustainable Development	The National Council should play a central role in engaging ministries in the Climate Change Action MRV system on adaptation and mitigation. The National Council can support MSDT DCC by establishing strong institutional arrangements for data gathering. It should also provide a forum for MESDNRD DCC to present the main findings and outputs from the MRV systems on progress with climate change action, key vulnerabilities, and risks to ministries and decision makers. This engagement can then be used for Montenegro to take on board key messages for sector-level decision making and strategies.
Directorate for climate change and sustainable development, Ministry of Ecology, Sustainable Development and North Region Development	The Directorate for climate change and sustainable development will take the leading role in engaging wider stakeholders including the Council. The DCC will be involved in all training activities, overseeing the quality of the MRV system's data, using the MRV system's data and tools to build climate awareness and play a key role in the collection and integration of data. This includes enabling the flow of data, assumptions, and perspectives on mitigation and adaptation from sector leads. As the key managers and coordinators of the MRV system, the DCC's technical experts will be key to making the system and platform user-friendly and keeping it up to date.

EPA	The EPA oversees the GHG inventory development and will take the lead for the compilation of projections with data supplied by DCC. The EPA's expertise, systems, and tools will be an important part of the overall MRV system. The EPA will be responsible for designing its data collection, analysis, and QA/QC systems and for recruiting and training its own (and potentially other institutions') experts. The EPA will also contribute to the building of awareness of the National Council and other bodies on GHG trends, indicators, and reports.
Statistical Office of Montenegro (MONSTAT)	MONSTAT is the institution in charge of producing Montenegro's official state statistics. MONSTAT collects, processes, and disseminates high-quality, transparent statistics in accordance with contemporary European standards[103]. A wide range of data and statistics is produced by MONSTAT (including GDP, the annual energy balance, and environmental surveys) which can be used by the Government, scientific research institutions, citizens, and the media. Due to its significant reach to generate data on a national level, it will be the main partner to process and supply data for GHG inventory calculations.
Institute for Hydrometeorology and Seismology (IHMS)	The IHMS has a network of observation stations which measure meteorological, hydrological, ecological, and agrometeorological parameters. Weather stations, for example, constantly measure parameters such as air temperature, pressure, humidity, precipitation quantity, wind speed and direction, and insolation. The institute is responsible for maintaining and enhancing this network of stations and for archiving their measurements. Their research activities include analysis of the data, utilising numerical models over short time ranges (up to 5 days) to produce weather forecasts, and the production of relevant studies (e.g. evaluation of soil, water, and air quality on the territory of Montenegro)[104].
Institute for Marine Biology, University of Montenegro	The Institute for Marine Biology is one of three scientific research institutes at the University of Montenegro. The research conducted at this institute spans a range of sectors, including fishery biology, aquaculture, environmental protection, and sustainable development[105]. The researchers also have an active role in coastal adaptation projects.
Directorate for Energy Efficiency, Ministry of the Energy	The Directorate should be the main source of official strategic assumptions on energy production and consumption in the future, as well as historical data on energy production and consumption. The Directorate will also be responsible for implementing the EU's Energy and Climate Union. This is a new regulation that will cover the five pillars of: Energy Security; Decarbonisation; Energy Efficiency; Energy Markets and Electricity Connectivity; and Energy Research and Development. Strategies for this implementation will require investment in energy modelling which will need to include input material for GHG projections. The Department for Energy Efficiency should collect detailed information on energy efficiency projects in Montenegro. This information is reported

103 http://www.monstat.org/eng/page.php?id=2.
104 http://www.meteo.co.me/.
105 http://www.ciesm.org/online/institutes/inst/Inst160.htm.

	via their quarterly Implementation Plan, sent to the EU. This system collects information on energy efficiency actions including carbon savings and financial data (though not where investments are coming from). This information should be made available to the DCC and summarised (e.g. grouping projects such as individual hydroelectric plants under one action) in order to allow DCC to present it in the Climate Change Action MRV system and its reports. The Ministry of the Energy should share (where possible) reports and data related to the progress of their projects and to engage the DCC in the design and use of the data collection systems it will be using.
Directorate for Industry and Entrepreneurship, Ministry of the Economic Development	The Directorate for Industry and Entrepreneurship oversees the country's industrial policy and will be important in designing industrial policy and innovative responses to GHG mitigation and adaptation challenges. This Directorate will need to contribute to and review assumptions on future industrial consumption, production, and economic trends and projections. It may also provide information on the performance of industry to date and statistics on industrial production and consumption. It will also oversee industry's response to the GHG mitigation needs of the NDC and other national GHG mitigation targets. This Directorate is also likely to oversee the expected emissions from facilities under the EU's Industrial Emissions Directive and be able to provide information on industry's expected response to this directive.
Directorate for Agriculture, Ministry of Agriculture, Forestry and Water Management	The Directorate for Agriculture oversees the country's agricultural policy and will be important in designing agricultural policy and responses to GHG mitigation and adaptation challenges. This Directorate will need to contribute to and review assumptions on future agricultural production and economic trends and projections. It may also provide information on the performance of agriculture to date and statistics on agricultural production and consumption. It will also oversee agriculture's response to the GHG mitigation needs of the NDC and other national GHG mitigation targets. The Ministry of Agriculture, Forestry and Water Management is responsible for sector-level agriculture policies that are the subject of the Effort Sharing Decision.
Directorate for Forestry, Ministry of Agriculture, Forestry and Water Management	The Directorate for Forestry oversees the country's forestry policy and will be important in designing forestry policy and responses to GHG mitigation and adaptation challenges. This Directorate will need to contribute to and review assumptions on future forestry production and economic trends and projections. It may also provide information on the performance of forestry to date and statistics on forestry production and consumption. It will also oversee forestry's response to the GHG mitigation needs of the NDC and other national GHG mitigation targets. The Directorate for Forestry and the Ministry of Agriculture, Forestry and Water Management are responsible for the sector-level agriculture policies that are the subject of the EU's upcoming LULUCF Regulation.

Directorate for Waste Management and Communal Development, Ministry of Ecology, Sustainable Development and North Region Development	The Directorate for Waste Management and Communal Development, which oversees the country's waste policy, will be important in designing waste policy and responses to GHG mitigation and adaptation challenges. This Directorate will need to contribute to and review assumptions on future waste disposal strategies, including the regulation of solid and liquid waste facilities under the EU's Industrial Emissions Directive. It will also oversee waste response to the GHG mitigation needs of the NDC and other national GHG mitigation targets. The Directorate for Waste Management and Communal Development also provides the Ministry of Finance with all financial information for its waste projects.
Directorate for EU Integration and International Cooperation, Ministry of Ecology, Sustainable Development and North Region Development	The Directorate for EU Integration and International Cooperation oversees the country's climate change finances, including GEF and GCF, and acts as the focal point of the Adaptation Fund. It will be important in understanding the financial flows necessary to implement GHG mitigation and adaptation options. This Directorate will help to indicate if certain GHG mitigation actions will receive funding and their implementation status for consideration in the projections.
Ministry of Finance	The Ministry of Finance also has relevant data on budget spending from the national budget. This Ministry has information on the amount of funding available for climate change projects and can open dedicated accounts for individual projects.
Ministry of Transport and and Ministry of Internal Affairs	Ministry of Transport and the Ministry of Internal Affairs are responsible for sector-level transport policies that are the subject of the Effort Sharing Decision and policymaking and legislation, regulating terms and conditions for the placement and use of cars and vans. These will be important inputs for the GHG inventory and projections, and need to be considered in combination with the projected energy demand balances for transport which will be the responsibility of Directorate for Energy, of the Ministry of the Economic Development.
The Accreditation Body of Montenegro	The Accreditation Body of Montenegro is Montenegro's competent body for accreditation and for bilateral and multilateral agreements on mutual recognition and the recognition of foreign licences. The Accreditation Body of Montenegro is responsible for the accreditation of laboratories to measure fuel quality and measurement related to ozone layer protection and fluorinated gases. This body will be important for defining and supporting Montenegro's measurement activities and the generation of country-specific emission factors for its GHG inventory.
Institute for Public Health (IPH)	The institution in charge of public health will be important in gathering, managing, and sharing information on the health-related impacts of climate change and the positive and potentially negative impacts of climate change actions. The IPH's experts will need to be trained in data quality improvement, evaluation, monitoring, and reporting of adaptation actions relating to public health. This includes working with the IHMS on early warning systems and strengthening links between climate change action and air quality. The institute sees a need to educate the media to communicate climate change and, broadly, environmental issues. The Institute would like

	to use materials such as leaflets that have already been produced and used as an example in the UK. The Institute of Public Health will start to share data on health-related impacts and actions with the DCC and IHMS.
Directorate for Emergency Situations, Ministry of Internal Affairs	The Directorate has reporting obligations related to the SDGs and the Sendai Framework. It is working to classify climate-related hazards and related data that can be useful for tracking action. The Disaster Risk Reduction Strategy Action Plan was approved in March and will provide some material relevant to climate adaptation actions.

A3 Methodologies and assumptions used to estimate the GHG emission reductions or removals due to each action, policy and measure

In CTF 5, Montenegro provides information on actions, policies and measures that support the implementation and achievement of its NDC under Article 4 of the Paris Agreement, focusing on those that have the most significant impact on GHG emissions or removals and those impacting key categories in the national GHG inventory. All these actions, policies and measures have been included in the WM projection scenario.

This annex complements the information presented in narrative format in the BTR and in tabular format in the CTF 5 with the details of the methodologies and assumptions used to estimate the GHG emission reductions or removals due to each action, policy and measure.

Overall rationale to avoid double counting and consider interaction of PAMs

The methodologies used for estimating the GHG emission reductions of all PAMs are based on the rationale followed by the MITICA framework[106], where GHG emission reduction of PAMs is attributed to a magnitude or the emission factor.

$$ME_{t_i-t_f} = R \cdot M_{t_i-t_f} \cdot [REF_t - MEF_t] \qquad \{1\}$$

Where:

- $ME_{t_i-t_f}$ represents the mitigation effect of the PAM for the entire projected period,
- $M_{t_i-t_f}$ is the magnitude of the measure representing the affected activity levels,
- R represents the reduction factor in magnitude from measure implementation,
- REF_t stands for the reference emission factor in the absence of the measure at time t, and

106 https://www.mdpi.com/2071-1050/16/10/4219
https://unfccc.int/documents/637527

- MEF_t is the mitigation emission factor, post implementation of the measure at time t.

From this general rationale, PAMs are adapted to national circumstances and specific methodologies are defined.

It has to be noted that the GHG emission reductions are expressed in GHG emission reductions against the WOM projections scenario, not against the latest GHG emission inventory. The reference year for the WOM is 2020, and therefore the WM for years 2021-2022 is equal to the national GHG inventory.

The impact of the PAMs is thus estimated against the WOM scenario, which uses 2020 as a reference year.

The PAMs are integrated into the WM calculation in an integrated manner, considering the annual implementation of all PAMs.

Double counting is avoided estimating the impact of certain PAMs in sequence (for instance, the impact of new RES capacity installed each year is estimated on annual basis after the estimation of energy efficiency PAMs) and considering all PAMs affecting each CRT category.

The following sections provide further details on the assumptions and estimation approach for each PAMs by sector.

Energy PAMs

Table 1. Summary of PAMs in the energy sector.

<table>
<tr><td colspan="2">Number of mitigation actions</td><td colspan="3">12</td></tr>
<tr><td colspan="2">Total estimated GHG emission reductions in 2022</td><td colspan="3">812.17 $ktCO_2e/yr$</td></tr>
<tr><td colspan="2">Name and NDC code of mitigation action</td><td>Status (planned, adopted, implemented)</td><td>Estimated GHG emission reductions achieved in 2022</td><td>Estimated GHG emission reductions expected in 2030</td></tr>
<tr><td colspan="4">Energy industry and residential/commercial sector</td><td></td></tr>
<tr><td>2E</td><td>Carbon pricing for TPP</td><td>Adopted</td><td>556.88</td><td>876.53</td></tr>
<tr><td>3E</td><td>NDC renewable power plants</td><td>Adopted</td><td>99.74</td><td>214.40</td></tr>
<tr><td>NA*</td><td>New renewable capacity</td><td>Adopted</td><td>0.00</td><td>313.48</td></tr>
<tr><td>4E</td><td>District Heating in Pljevlja</td><td>Adopted</td><td>0.00</td><td>5.47</td></tr>
<tr><td>5E</td><td>Development and Implementation of Energy Efficiency Regulatory Framework in Buildings</td><td>Adopted</td><td rowspan="5">151.13</td><td rowspan="5">245.43</td></tr>
<tr><td>6E</td><td>Increased Energy Efficiency in Public Buildings</td><td>Adopted</td></tr>
<tr><td>7E</td><td>Financial Incentives for Citizens/Private Households (for Energy Efficiency Investments)</td><td>Adopted</td></tr>
<tr><td>8E</td><td>Energy Labelling and Eco-Design Requirements for Energy-Related Products</td><td>Adopted</td></tr>
<tr><td>9E</td><td>Establishment and Implementation of Energy Efficiency Criteria in Public Tendering</td><td>Adopted</td></tr>
</table>

10E	Implementation of Energy Efficiency Measures in Public Municipal Companies, Utilities and Services	Adopted		
11E	Development of Transmission and Distribution Power Network (decrease in losses)	Adopted	0.00	22.86
12E	Refurbishment of Small Hydroelectric Power Plants (increased Energy Efficiency)	Adopted	4.42	3.75

**This PAM was not included in the NDC submission*

Common framework

All PAMs affecting the CRT category 1A1 (Fuel combustion in Energy Industries) were estimated in an integrated manner considering the relationship between PAMs. The estimation was made against the WOM estimated for category 1A1 in a sequential manner, avoiding overlaps between PAMs.

The WOM emissions for year 2020 were estimated using electricity production from Thermal Power Plants (TPP), reproducing the GHG emissions of the national GHG inventory for that year. The following provides further details on the WOM estimated, as the estimation of PAMs is derived from the WOM, adjusting the parameters and coefficients as PAMs get implemented.

The WOM scenario does not account for factors such as technological advancements, shifts in the energy mix, or improvements in energy efficiency, as these changes are assumed to occur only as a result of implementing PAMs and are therefore reflected exclusively in the mitigation scenarios.

In the WOM, which has 2020 as the reference year, an emission factor for thermal plants was calculated as the total emissions of category 1A1 divided by total electricity produced by thermal power plants (main producers). The resulting emission factor, considering the own use of thermal plants, and the transmission and distribution losses, allowed to calculate the emissions of 2020, reproducing the same GHG emissions calculated by the national GHG inventory.

From this reference point, WOM emissions are calculated for years 2021-2040 considering that the energy mix is constant (the same of 2020), and that all production needed to meet the demand would be made possible by the commissioning of new power plants, maintaining the same energy mix (renewable vs thermal).

The electricity production is driven by electricity demand, keeping the elasticity between electricity production and electricity demand of years 2015-2020 (weighted average)[107]. At the same time, the electricity demand[108] for years 2021-2040 is estimated assuming the evolution elasticity between GDP and electricity demand is constant at the 2015-2020 levels (weighted average). Therefore, the evolution of electricity demand, electricity production and

[107] To avoid potential impact on elasticity related to the COVID pandemic of years 2019-2020.
[108] The electricity demand is available from Monstat for years 2020-2023, however, the reference year for the WOM is 2020. The electricity demand from Monstat is considered the electricity demand of the WEM for these years.

GDP is considered to evolve together, maintaining the same characteristics and the same elasticity between variables for the WOM projected period.

Calculation:

Emission factor calculation for 2020:

$$EF_{2020} = \frac{E_{1A1,2020}}{P_{Thermal,2020}} \qquad \{2\}$$

Where

EF_{2020}= Emission factor for thermal power plants in 2020 (tCO2-eq/MWh)

$E_{1A1,2020}$= Total GHG emissions from category 1A1 in 2020 (tCO2-eq)

$P_{Thermal,2020}$ = Total electricity produced by thermal power plants in 2020 (MWh)

This emission factor is maintained constant in all the projected period, in line with the overall assumptions of the WOM.

GHG Emissions for WoM (2021-2040):

$E_{thermal,t} = P_{thermal,t} \cdot EF_{2020} \cdot A_{2020}$ {3}

Where

$E_{thermal,t} = Projected\ emissions\ from\ thermal\ power\ plants\ in\ year\ t\ (tCO2\_22)$
$P_{thermal,t} = Projected\ electricity\ production\ by\ thermal\ power\ plants\ in\ year\ t\ (MWh)$
$EF_{2020} = Emission\ factor\ for\ 2020\ (tCO2 - eq/MWh)$
$A_{2020} = Adjustment\ to\ account\ for\ own\ consumption\ and\ T\&D\ losses$

The consideration of own consumption and Transmission and Distribution losses is that this emission factor is maintained constant in all the projected period, in line with the overall assumptions of the WOM.

Electricity Production Driven by Demand:

$P_{thermal,t} = D_t \cdot (1 - \alpha_{2020})$ {4}

Where

$D_t = Projected\ electricity\ demand\ in\ year\ t\ (MWh)$
$\alpha_{2020} = Elasticity\ of\ electricity\ production\ to\ demand\ (weighted\ average\ 2015 - 2020)$

Electricity Demand Driven by GDP Growth:

$$D_t = D_{t-1} \cdot \left(\frac{GDP_t}{GDP_{t-1}}\right)^{\beta_{2015-2020}} \qquad \{5\}$$

Where:

$D_t = \textit{Projected electricity demand in year } t \ (MWh)$
$D_{t-1} = \textit{Electricity demand in year } t-1 \ (MWh)$
$GDP_t = \textit{Projected GDP in year } t (\textit{constant prices})$
$GDP_{t-1} = \textit{GDP in the previous year}$
$\beta_{2020} = \textit{Elasticity of electricity demand to GDP } (\textit{weighted average } 2015-2020)$

Summary of assumptions:

Constant energy mix, static elasticities, and demand-driven production growth.

Carbon pricing for TPP

The WOM for CRT category 1A1 (Fuel Combustion in Energy Industries) is calculated from 2020, estimating the electricity production that would have occurred in absence of any PAM. However, the efforts to implement an Emission Trading scheme have produced an increase in prices of electricity and a system of allowances that have led to the production of electricity to be reduced. These reductions are observed in the electricity production for year 2021-2023, as well as in the GHG emissions observed in the national GHG emission inventory.

The increase in prices and the indirect effect produced in other emitting activities are estimated in this PAM, reflected in GHG emission reductions in categories 1A1, but also indirectly in 2C1 (Industrial Processes emissions from iron and steel production) and 2C3 (Industrial Processes emissions from primary aluminium production).

The methodologies and assumptions used to estimate the impact of this PAM in both energy emissions and Industrial Processes emissions is presented in the following paragraphs.

Impact in category 1A1

For the years 2021–2023, GHG emissions in category 1A1 are calculated using Equation {3} above, now using electricity production data for 2021–2023 obtained from Monstat.

For the period 2024–2040, GHG emissions are calculated using exactly the same methodology of the WOM scenario, but now using 2023 as the reference year. This approach ensures that the observed impacts from 2021–2023 are reflected across the entire time series by recalculating electricity production projections for subsequent years based on the updated 2023 baseline.

As allowances beyond 2024 were set at levels higher than actual emissions, no additional impact is estimated in category 1A1 from the implementation of this PAM.

Table 2. Electricity produced by the TPP

Variable	2020	2021	2022	2023	2030	2040
Electricity production WOM (GWh)	1615	1824	1934	1927	1987	2093
Electricity production after implementation of this PAM (GWh)	1615	1444*	1551	1637	1687	1777

**The decline in electricity production in 2021 is not attributable to the COVID-19 pandemic, as Montenegro's GDP experienced significant growth during 2021. This suggests that other factors, unrelated to the pandemic, influenced the decrease in TPP electricity production.*

The impact of the PAM for category 1A1 is then estimated by subtracting the emissions calculated for 1A1 after the implementation of the PAM from the emissions of the WOM.

$$GHG\ emission\ reduction_{1A1,t} = WOM_{1A1,t} - Emissions\ after\ PAM_{1A1,t} \qquad \{6\}$$

Impact in categories 2C1 and 2C3

The indirect impact of the PAM in these two categories is estimated assuming that, in the absence of this PAM, the activity levels would have reached its peak production and associated emissions, as observed in the historical trend.

The GHG emission reduction is then estimated as in equation 6 above, but only for categories 2C1 and 2C3.

It is stressed again that the magnitude of the estimated impact would be significantly different if considered against year 2022. Indeed, the impact of PAMs is estimated against the WOM scenario and shall only be understood as an impact measured against the WOM.

NDC renewable power plants and Refurbishment of Small Hydroelectric Power Plants

This description covers PAMs "NDC renewable power plants" and "Refurbishment of small HPP"

The methodology to estimate the GHG emission reductions from renewable power plants is based on the assumption that the new installed capacity reduces or avoids emissions that are occurring with the electricity mix prior to its implementation, thus impacting the GHG emissions of category 1A1. As the implementation of the previous PAMs (Carbon pricing for TTP and Energy efficiency PAMs) is carried out before, the estimation of this PAM already considers the impact of previous PAMs, in particular to what relates to the electricity production and the grid emission factor.

The impact is calculated using the following expression:

$$GHG\ impact_{\ t,tech} = Cres_{t,tech} \cdot CF_{tech} \cdot 8760 \cdot (1 - Othermal) \cdot (1 - Tloss) \cdot EFgrid_t \cdot 10^{-3} \qquad \{7\}$$

Where:

$Cres_{t,tech} = installed\ renewable\ energy\ capacity\ in\ year\ t(GW)\ for\ a\ given\ technology$

$CF_{tech} = \ Capacity\ factor\ of\ the\ renewable\ energy\ system\ (dimensionless, e.g., 0.35\ for\ 35\%).$

$Othermal$
$= \ Fraction\ of\ energy\ consumed\ for\ own\ use\ by\ thermal\ plants\ (dimensionless, e.g., 0.05\ for\ 5\%).$

$Tloss = \ Transmission\ and\ distribution\ (T\&D)\ losses\ as\ a\ fraction\ (dimensionless, e.g., 0.08\ for\ 8\%).$

$EFgrid_t = grid\ emission\ factor\ for\ a\ given\ year$

Table 3. Parameters used to estimate the impact of the PAM by plant.

PAM Impact Estimation by Plant	2022	2025	2030	2035
Hydropower component				
RES installed capacity in year t (GW)	0.0585	0.0585	0.0585	0.0585
Capacity factor	40%	40%	40%	40%
Grid EF (tCO2/GWh)	401.135	343.516	335.511	341.181
Own use of thermal pants	0.032	0.032	0.032	0.032
Transmission and distribution losses	0.144	0.144	0.144	0.144
GHG emission impact (kt CO2-eq)	99.738	85.411	83.421	84.831
Refurbishment of Small HPP				
RES installed capacity in year t (GW)	0.0028	0.0028	0.0028	0.0028
Capacity factor	40%	40%	40%	40%
Grid EF (tCO2/GWh)	371.114	321.604	315.071	320.585
Own use of thermal pants	0.032	0.032	0.032	0.032
Transmission and distribution losses	0.144	0.144	0.144	0.144
GHG emission impact (kt CO2-eq)	4.417	3.827	3.750	3.815
Solar Power component				
RES installed capacity in year t (GW)		0.04	0.1	0.1
Capacity factor		20%	20%	20%
Grid EF (tCO2/GWh)		320.622	314.152	319.659
Own use of thermal pants		0.032	0.032	0.032
Transmission and distribution losses		0.144	0.144	0.144
GHG emission impact (kt CO2-eq)		27.254	66.761	67.931
Wind Power component				
RES installed capacity in year t (GW)		0.0546	0.0546	0.0546
Capacity factor		35%	35%	35%
Grid EF (tCO2/GWh)		313.630	297.794	303.166
Own use of thermal pants		0.032	0.032	0.032
Transmission and distribution losses		0.144	0.144	0.144

PAM Impact Estimation by Plant	2022	2025	2030	2035
GHG emission impact (kt CO2-eq)		63.684	60.469	61.559
Total GHG impact kt CO2-eq (3E_Renewable Energy)	**100**	**180**	**214**	**218**
Total GHG impact kt CO2-eq (12E_Refurb. Small HPP)	**4**	**4**	**4**	**4**

New renewable capacity

In this PAM, additional electricity capacity is added to the grid. Following the same approach followed in the previous PAM, the following electricity generation is added to the grid:

Table 4. Capacity assumptions for new renewable energy sources.

Plant	Capacity (GW)	Technology
SPP Velje Brdo	0.15	Solar
SPP Zeljezara (Steel mill)	0.06	Solar
WPP Gvozd	0.054	Wind
WPP Bijela	0.094	Wind
HPP Perucica - Aggregate A8	0.0585	Hidro

District Heating in Pljevlja

The estimation has been made assuming that the district heating will cover the population of the municipality of Pljevlja, which has a population of 24542 inhabitants.

Solid fuel consumption in the residential sector is as follows (CRT category 1A4b). As the PAM will eliminate the coal consumption for heating, the estimate is made by estimating coal consumption and the associated GHG emissions for the population of the municipality of Pljevlja.

Table 5. Summary of parameters and results of the impact of the PAM.

Variable		Unit	2022	2025	2030	2035
Fuel consumption CRT category 1A4b	Solid fuels	TJ	75.76	90.67	107.7	123.5
Fuel consumption in households in Pljevlja	Solid fuels	TJ	37.88	45.33	53.84	61.74
Population	Total	Inhabitants	6E+05	6E+05	6E+05	6E+05
	Pljevlja	Inhabitants	24542	24599	24693	24787
Emission Factor	CO_2	kg/TJ	1E+05	1E+05	1E+05	1E+05
	CH_4	kg/TJ	10	10	10	10
	N_2O	kg/TJ	1.5	1.5	1.5	1.5
GHG Emissions by gas	CO_2	kt	3.826	4.579	5.438	6.235
	CH_4	kt	4E-04	5E-04	5E-04	6E-04
	N_2O	kt	6E-05	7E-05	8E-05	9E-05
	CO_2	kt CO_2-eq	3.826	4.579	5.438	6.235
	CH_4	kt CO_2-eq	0.011	0.013	0.015	0.017
	N_2O	kt CO_2-eq	0.015	0.018	0.021	0.025

Total GHG emissions	**Total GHG**	**kt CO_2-eq**	**0**	**0**	**5.474**	**6.277**

Energy efficiency PAMs

The estimation of impact of the following PAMs is estimated in an aggregated manner for the following PAMs:

- Development and Implementation of Energy Efficiency Regulatory Framework in Buildings
- Increased Energy Efficiency in Public Buildings
- Financial Incentives for Citizens/Private Households (for Energy Efficiency Investments)
- Energy Labelling and Eco-Design Requirements for Energy-Related Products
- Establishment and Implementation of Energy Efficiency Criteria in Public Tendering
- Implementation of Energy Efficiency Measures in Public Municipal Companies, Utilities and Services

As all these PAMs derive in a reduced consumption of electricity, the GHG reduction impact is based on the estimation of how much electricity is consumed at national level after the implementation of these PAMs. Hence, the consumption of electricity (electricity demand) after the implementation of these PAM for years 2021-2040 was estimated by the Ministry of Energy using the software LEAP, considering a set of behavioural and technological changes in line with the specifications of each of the PAMs. The resulting energy demand is provided in the following table, together the energy demand of the WOM for comparative purposes.

Table 6. Electricity demand WOM vs electricity demand after implementation of energy efficiency PAMs.

Variable	2020	2021	2022	2025	2030	2035	2040
Electricity demand WOM (GWh)	3037	3428	3636	3653	3736	3834	3935
Electricity demand after implementation of the PAM (GWh)	3037	3067	2618	2631	2690	2761	2833

For the calculation of GHG emission reductions, it is assumed that a reduction in energy consumption leads to a proportional reduction in electricity production, thereby impacting the GHG emissions of category 1A1. GHG emissions are calculated again using Equation {3}, with two key adjustments:

i) The electricity demand series used corresponds to the values provided in the previous table.

ii) Electricity production is recalculated based on the assumption that reduced energy consumption directly results in a proportional reduction in electricity production.

Once the GHG emissions for category 1A1 are recalculated using the updated electricity demand series, the final GHG emission impact of the group of PAMs on category 1A1 is determined by subtracting the emissions calculated for 1A1 after the implementation of the PAMs from the emissions calculated for 1A1 after the implementation of the carbon pricing PAM. This subtraction is performed using an approach similar to Equation {6}, but applied to the emissions recalculated after the previous PAM's implementation. This method ensures that overlaps between PAMs are avoided, as the same calculation approach is consistently applied to 1A1, using the adjusted metrics following the prior PAM's implementation.

For the year 2022, the estimated GHG emission reductions for category 1A1 exceed the inventory-reported emissions by 151 kt. This discrepancy arises from the calculation methodology for this specific PAM. Considering that additional emission reductions are likely to be reflected in other inventory categories, particularly category 1A4, it is concluded that the 151 kt reduction can be attributed to those other categories.

Reduction of transmission and distribution Losses

This PAM estimates a reduction in transmission and distribution (T&D) losses.

The impact of this PAM is estimated after the implementation of all the previous measures.

The target is to reduce loses below 10%. The estimation of the impact is based on the assumption that a 9% level is achieved by 2030, and maintained thereafter.

The methodology from MITICA is applied directly to estimate the GHG emission impacts.

Transport PAMs

Table 7. Summary of PAMs in the transport sector.

<table>
<tr><td colspan="2">Number of mitigation actions</td><td colspan="3">2</td></tr>
<tr><td colspan="2">Total estimated GHG emission reductions in 2022</td><td colspan="3">7.37 ktCO$_2$e/yr</td></tr>
<tr><td colspan="2">Name and NDC code of mitigation action</td><td>Status (planned, adopted, implemented)</td><td>Estimated GHG emission reductions achieved in 2022</td><td>Estimated GHG emission reductions expected in 2030</td></tr>
<tr><td colspan="4">Transport sector</td><td></td></tr>
<tr><td>1T</td><td>Electric Cars</td><td>No longer in place</td><td rowspan="2">7.37</td><td rowspan="2">36.88</td></tr>
<tr><td>2T</td><td>Financial Incentives for Electric, Plug-In Hybrid and Full Hybrid Vehicles, for Both Citizens and Companies/Entrepreneurs</td><td>Adopted</td></tr>
</table>

Electric cars and Financial Incentives for Electric, Plug-In Hybrid and Full Hybrid Vehicles, for Both Citizens and Companies/Entrepreneurs

Both PAMs are estimated together on the assumption that the number of electric vehicles from the direct application of this PAM plus its indirect effect leads to the introduction of 12674 electric vehicles by 2030.

The methodology also comes from MITICA:
https://unfccc.int/sites/default/files/resource/Manual_draft_Mitigation_toolrev_v6.pdf

Table 8. Assumptions and parameters used to estimate the impact of transport PAMs.

Variable	2020	2022	2025	2030	2035
Number of cars	0	2535	6337	12,674	12674
Annual distance	12000	12000	12000	12000	12000
Gasoline consumption of cars	79	79	79	79	79
Electric consumption of new cars	0.202	0.202	0.202	0.202	0.202
NCV of gasoline	44.3	44.3	44.3	44.3	44.3
CO_2 EF of gasoline	69300	69300	69300	69300	69300
Specific CO_2 EF of the grid	0.449	0.371	0.314	0.298	0.303
Mitigation effect	0	7.375	18.44	36.88	36.88

IPPU PAMs

Table 9. Summary of PAMs in the IPPU sector.

<table>
<tr><th colspan="2">Number of mitigation actions</th><td colspan="3">1</td></tr>
<tr><th colspan="2">Total estimated GHG emission reductions in 2022</th><td colspan="3">0 ktCO₂e/yr</td></tr>
<tr><th colspan="2">Name and NDC code of mitigation action</th><th>Status (planned, adopted, implemented)</th><th>Estimated GHG emission reductions achieved in 2022</th><th>Estimated GHG emission reductions expected in 2030</th></tr>
<tr><td colspan="4">Refrigeration and Air-conditioning</td><td></td></tr>
<tr><td>2I</td><td>Reduction of HFCs in line with the Law Acknowledging Amendments to the Montreal Protocol on Substances that Deplete the Ozone Layer</td><td>Adopted</td><td>0</td><td>12.48</td></tr>
</table>

Reduction of HFCs in line with the Law Acknowledging Amendments to the Montreal Protocol on Substances that Deplete the Ozone Layer

To estimate the GHG emission reduction of this PAM the assumptions used are as follows:

- the reduction targets of HFC consumption and deadlines set for the countries of Article 5 (Group I) of the Montreal Protocol, to which Montenegro belongs, and which have been included in the Law Acknowledging Amendments to the Montreal Protocol on Substances that Deplete the Ozone Layer are met as follows: A freeze of HFCs consumption levels in 2024 keeping it as the baseline (average HFC consumption levels for 2020-2022 + 65% of HCFC baseline) and a 10% reduction by 2029; 30% reduction by 2035; 50% reduction by 2040 and 80% reduction by 2045.

- The 10% reduction in HFC consumption by 2029 will result in an associated 10% reduction in HFC emissions ten (10) years later (that is, in 2040, since the stock of HFCs will continue to operate).
- A linear reduction takes place in the period 2030-2040 (the 10% of emissions that are reduced in 2040 are reduced linearly in the projected period).

Waste PAMs

Table 10. Summary of PAMs in the waste sector.

Number of mitigation actions		2		
Total estimated GHG emission reductions in 2022		0 $ktCO_2e/yr$		
Name and NDC code of mitigation action		Status (planned, adopted, implemented)	Estimated GHG emission reductions achieved in 2022	Estimated GHG emission reductions expected in 2030
Waste				
W1	Reduction of Bio-Waste in Municipal Waste	Adopted	0	19.44
W2	Increase in Connection Rate to Sewerage System (target 93% by 2035)	Adopted	0	36.41

Reduction of Bio-Waste in Municipal Waste

This PAM consists of the implementation of the Landfill Directive (1999/31/EC), requiring a reduction of the share of biodegradable waste being sent to solid waste disposal sites (SWDS) to 75% of the 2010 level by 2025, 50% by 2029, and 35% by 2033.

The mitigation potential was calculated by projecting the First Order Deay (FOD) model from the latest GHG inventory from 2022 until 2030 under two scenarios – the baseline and the mitigation scenarios.

Both scenarios utilise the projected population and per capita waste generation rates under the Landfill Directive. The following 2022 parameters from the GHG inventory were kept constant through to 2030:

Table 11. Parameters used to estimate the impact of the reduction of biowaste in municipal waste.

Type of SWDS	Percent Distribution	MCF
Unmanaged shallow	2%	0.4
Unmanaged deep	37%	0.8
Managed anaerobic	56%	1.0
Uncategorised	5%	0.6

The per capita waste generation rate, percentage sent to SWDS, and methane recovery rates were extrapolated linearly from 2022 based on the GHG inventory historical rates as follows:

Table 12. Per capita waste generation rate, percentage sent to SWDS, and methane recovery rates during he projected period.

Year	Per capita generation rate	Percent sent to SWDS	Methane recovery (Gg/y)
2022	520.30	87.38%	1.2285
2023	509.72	87.34%	1.2509
2024	499.15	87.31%	1.2733
2025	488.59	87.28%	1.2957
2026	477.33	87.25%	1.3181
2027	466.08	87.22%	1.3405
2028	454.84	87.19%	1.3629
2029	443.62	87.15%	1.3853
2030	436.43	87.12%	1.4078

All other default parameters from the IPCC Guidelines as used in the GHG inventory were kept constant.

Under the baseline scenario, the 2022 waste composition from the GHG inventory was kept constant through 2030 as follows:

Table 13. Waste composition used.

Food	Garden	Paper	Wood	Textile	Nappies	Inerts
13.00%	15.70%	20.10%	0.00%	1.70%	0.00%	49.50%

Under the mitigation scenario, the total quantity of food and garden waste sent to SWDS from 2010 was used to calculate the targeted 25%, 50%, and 65% reduction by 2025, 2029, and 2033, respectively, then linearly extrapolated between 2022 and 2030.

The proportion of the other waste fractions were maintained constant as follows:

Table 14. Waste fractions used during the projected period.

Targets - Annual Quantity of Waste Sent to SWDS (Gg/y)								
Year	Food	Garden	Paper	Wood	Textile	Nappies	Inerts	TOTAL
2010	48.15	38.91	62.70	-	14.00	-	116.17	279.93
2025	36.11	29.18	55.90	-	4.73	-	137.67	263.59
2029	24.07	19.45	55.30	-	4.68	-	136.20	239.70
2033	16.85	13.62	54.71	-	4.63	-	134.74	224.55

Increase in Connection Rate to Sewerage System (target 95% by 2035)

This PAM consists of increasing the share of aerobic wastewater treatment plants (WWTP) to 95% by 2035.

Two scenarios were developed: a mitigation scenario and a baseline scenario considering the four types of wastewater treatments in Montenegro: latrines, septic tanks, collected but untreated, and aerobic WWTP. The GHG emissions of each scenario were compared to assess the GHG mitigation potential of the PAM.

For the baseline scenario, the GHG inventory until 2022 was projected until 2030 by utilising the projected total population growth until 2030 and maintaining the 2022 degree of utilisation of the various wastewater treatment methods constant as reported in the GHG inventory, namely: latrines (0.1%), sceptic tanks (52.0%), collected but untreated (23.7%) and aerobic WWTP (24.0%).

The following parameters were also kept constant for both the baseline and mitigation scenarios, as reported in the latest GHG inventory, consistent with the IPCC Guidelines:

Table 15. Parameters used by type of treatment.

Type of treatment	Latrines	Septic tanks	Collected but untreated	Aerobic WWTP
BOD (kg/person/yr)	21.9	21.9	21.9	21.9
I (unitless)	1	1	1	1.25
Bo (kg CH4/kg BOD)	0.6	0.6	0.6	0.6
MCF (fraction)	0.1	0.5	0.1	0

The mitigation scenario utilised the same parameters as above but changed the degree of utilisation of the various types of wastewater treatment. A target value was set for 95% aerobic WWTP by 2035. It was therefore assumed that latrine utilisation by 2035 would remain at 0.1%, while the collected but untreated method would reduce to 0%, thus meaning the use of septic tanks would reduce to 4.9% by 2035. To complete the time series between 2022 and 2030, linear interpolation was used between the known 2022 degrees of utilisation and the target 2035 degrees of utilisation as follows:

Table 16. Degree of utilisation of the various types of wastewater treatment used during the projected period.

Type of treatment	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Latrines	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Septic tanks	52.0%	48.4%	44.8%	41.1%	37.5%	33.9%	30.3%	26.6%	23.0%	19.4%	15.8%	12.1%	8.5%	4.9%
Collected but untreated	23.7%	21.9%	20.1%	18.2%	16.4%	14.6%	12.8%	10.9%	9.1%	7.3%	5.5%	3.6%	1.8%	0.0%

Aerobic WWTP	24.0%	29.5%	34.9%	40.4%	45.8%	51.3%	56.8%	62.2%	67.7%	73.2%	78.6%	84.1%	89.5%	95%

A4 Additional information from the GHG inventory

Emissions from the energy sector

GHG emissions from energy sector by gas

Table 65 CO_2 emissions from energy sector and subsectors for 1990–2022 (kt)

CO_2 emissions	1	1.A	1.A.1	1.A.2	1.A.3	1.A.4	1.A.5	1.B
	Energy	Fuel Combustion Activities	Energy Industries	Manufacturing Industries and Construction	Transport	Other Sectors	Non-Specified	Fugitive emissions from fuels
	kt							
1990	**2,358.42**	2,357.90	1,525.49	293.69	344.21	194.51	NE	0.52
1991	**2,393.60**	2,393.08	1,435.30	393.19	395.43	169.16	NE	0.51
1992	**1,735.58**	1,735.08	1,114.77	257.09	248.64	114.58	NE	0.50
1993	**1,441.09**	1,440.67	958.76	190.59	192.40	98.93	NE	0.42
1994	**1,313.14**	1,312.77	798.25	202.13	214.51	97.88	NE	0.37
1995	**698.77**	698.53	159.04	197.68	230.56	111.26	NE	0.25
1996	**1,749.71**	1,749.29	1,122.72	230.63	284.48	111.46	NE	0.41
1997	**1,699.53**	1,699.15	1,070.62	181.30	300.37	146.87	NE	0.38
1998	**2,103.63**	2,103.16	1,352.93	173.68	420.70	155.86	NE	0.47
1999	**2,273.23**	2,272.78	1,419.24	174.36	515.85	163.34	NE	0.44
2000	**2,207.74**	2,207.28	1,392.70	171.26	512.59	130.74	NE	0.46
2001	**1,841.72**	1,841.37	1,094.56	179.59	441.68	125.53	NE	0.35
2002	**2,319.77**	2,319.24	1,636.00	177.12	353.32	152.80	NE	0.53
2003	**2,237.87**	2,237.39	1,554.59	158.88	368.46	155.46	NE	0.48
2004	**2,266.80**	2,266.35	1,523.50	167.13	433.67	142.05	NE	0.45
2005	**2,004.22**	2,003.84	1,119.97	370.40	478.62	34.85	NE	0.38
2006	**2,182.58**	2,182.13	1,271.60	372.99	472.27	65.28	NE	0.45
2007	**2,122.05**	2,121.69	994.39	472.87	615.22	39.20	NE	0.35
2008	**2,697.87**	2,697.36	1,525.54	523.35	615.37	33.09	NE	0.51
2009	**1,781.55**	1,781.26	815.79	286.72	637.63	41.12	NE	0.28
2010	**2,608.79**	2,608.22	1,728.33	138.43	701.27	40.20	NE	0.57
2011	**2,540.75**	2,540.16	1,767.40	105.35	647.21	20.20	NE	0.58
2012	**2,348.18**	2,347.65	1,576.71	129.21	615.19	26.54	NE	0.53

2013	**2,299.25**	2,298.75	1,532.99	219.07	504.11	42.59	NE	0.50
2014	**2,264.83**	2,264.34	1,485.55	213.90	493.86	71.03	NE	0.49
2015	**2,396.37**	2,395.84	1,551.59	194.36	566.75	83.15	NE	0.52
2016	**2,186.56**	2,186.15	1,251.00	188.07	668.40	78.68	NE	0.41
2017	**2,298.56**	2,298.13	1,287.37	223.06	718.70	69.00	NE	0.43
2018	**2,526.69**	2,526.22	1,479.31	200.97	772.73	73.21	NE	0.47
2019	**2,620.94**	2,620.47	1,525.97	207.91	812.44	74.16	NE	0.47
2020	**2,549.62**	2,549.13	1,592.32	200.69	692.97	63.15	NE	0.49
2021	**2,587.49**	2,587.04	1,384.06	225.29	903.28	74.41	NE	0.46
2022	**2,682.34**	2,681.83	1,486.02	204.70	919.13	71.97	NE	0.51
Trend								
1990 - 2022	*13.7%*	*13.7%*	*-2.6%*	*-30.3%*	*167.0%*	*-63.0%*	*NA*	*-1.9%*
2005 - 2022	*33.8%*	*33.8%*	*32.7%*	*-44.7%*	*92.0%*	*106.5%*	*NA*	*32.8%*
2021 - 2022	*3.7%*	*3.7%*	*7.4%*	*-9.1%*	*1.8%*	*-3.3%*	*NA*	*11.2%*

Table 66 CH_4 emissions from energy sector and subsectors for 1990–2022 (kt CO_2eq)

CH_4 emissions	1	1.A	1.A.1	1.A.2	1.A.3	1.A.4	1.A.5	1.B
	Energy	Fuel Combustion Activities	Energy Industries	Manufacturing Industries and Construction	Transport	Other Sectors	Non-Specified	Fugitive emissions from fuels
	kt CO_2eq							
1990	**17.25**	4.89	0.49	0.44	3.27	0.68	NE	12.36
1991	**17.70**	5.40	0.59	0.52	3.71	0.59	NE	12.30
1992	**15.28**	3.64	0.42	0.36	2.43	0.43	NE	11.64
1993	**12.87**	2.80	0.35	0.27	1.79	0.39	NE	10.06
1994	**11.58**	2.95	0.32	0.28	1.98	0.37	NE	8.63
1995	**7.90**	2.93	0.14	0.28	2.09	0.42	NE	4.97
1996	**13.79**	3.65	0.40	0.36	2.49	0.40	NE	10.14
1997	**13.40**	3.98	0.45	0.32	2.70	0.52	NE	9.42
1998	**16.74**	5.03	0.52	0.31	3.66	0.54	NE	11.71
1999	**16.90**	5.72	0.55	0.32	4.28	0.56	NE	11.18
2000	**16.61**	4.99	0.55	0.28	3.68	0.49	NE	11.62
2001	**13.16**	4.25	0.48	0.28	3.04	0.46	NE	8.90
2002	**17.20**	3.78	0.62	0.28	2.32	0.56	NE	13.41
2003	**16.08**	3.98	0.60	0.24	2.57	0.57	NE	12.10

2004	**15.40**	4.02	0.60	0.24	2.65	0.52	NE	11.38
2005	**13.04**	3.33	0.31	0.49	2.38	0.15	NE	9.71
2006	**14.55**	3.30	0.35	0.45	2.25	0.24	NE	11.25
2007	**12.29**	3.40	0.28	0.54	2.41	0.17	NE	8.89
2008	**16.34**	3.35	0.42	0.60	2.18	0.15	NE	12.98
2009	**10.26**	3.12	0.23	0.32	2.40	0.17	NE	7.14
2010	**17.55**	3.06	0.48	0.14	2.27	0.17	NE	14.49
2011	**17.35**	2.63	0.49	0.11	1.76	0.27	NE	14.72
2012	**15.73**	2.43	0.44	0.15	1.54	0.30	NE	13.30
2013	**14.96**	2.30	0.42	0.24	1.28	0.36	NE	12.66
2014	**14.83**	2.45	0.41	0.25	1.34	0.45	NE	12.37
2015	**15.76**	2.56	0.43	0.25	1.38	0.50	NE	13.21
2016	**12.88**	2.46	0.35	0.25	1.39	0.47	NE	10.42
2017	**13.28**	2.38	0.36	0.28	1.30	0.45	NE	10.89
2018	**14.29**	2.36	0.41	0.24	1.26	0.46	NE	11.93
2019	**14.18**	2.34	0.42	0.25	1.21	0.46	NE	11.84
2020	**14.35**	1.99	0.44	0.24	0.89	0.42	NE	12.36
2021	**13.74**	2.39	0.38	0.28	1.21	0.51	NE	11.35
2022	**14.88**	2.41	0.41	0.24	1.25	0.51	NE	12.47
Trend								
1990 - 2022	*-13.7%*	*-50.7%*	*-16.5%*	*-47.0%*	*-61.8%*	*-24.5%*	*NA*	*0.9%*
2005 - 2022	*14.1%*	*-27.7%*	*32.7%*	*-51.9%*	*-47.4%*	*238.5%*	*NA*	*28.4%*
2021 - 2022	*8.3%*	*0.8%*	*7.4%*	*-16.2%*	*2.9%*	*0.1%*	*NA*	*9.9%*

Table 67 N_2O emissions from energy sector and subsectors for 1990–2022 (kt CO_2eq)

N_2O emissions	1	1.A	1.A.1	1.A.2	1.A.3	1.A.4	1.A.5	1.B
	Energy	Fuel Combustion Activities	Energy Industries	Manufacturing Industries and Construction	Transport	Other Sectors	Non-Specified	Fugitive emissions from fuels
	kt CO_2eq							
1990	**11.24**	11.24	5.84	0.74	4.14	0.52	NE	NE
1991	**11.17**	11.17	5.21	0.91	4.63	0.42	NE	NE
1992	**8.38**	8.38	4.12	0.62	3.29	0.34	NE	NE
1993	**6.95**	6.95	3.57	0.46	2.63	0.28	NE	NE
1994	**6.71**	6.71	2.92	0.49	3.03	0.28	NE	NE

1995	**4.50**	4.50	0.40	0.48	3.30	0.31	NE	NE
1996	**9.28**	9.28	4.20	0.59	4.15	0.33	NE	NE
1997	**9.57**	9.57	3.85	0.50	4.77	0.44	NE	NE
1998	**12.66**	12.66	4.99	0.49	6.71	0.47	NE	NE
1999	**14.42**	14.42	5.21	0.50	8.19	0.52	NE	NE
2000	**13.32**	13.32	5.10	0.45	7.40	0.37	NE	NE
2001	**11.22**	11.22	3.90	0.46	6.50	0.36	NE	NE
2002	**12.18**	12.18	6.05	0.46	5.23	0.44	NE	NE
2003	**12.84**	12.84	5.72	0.40	6.28	0.43	NE	NE
2004	**12.79**	12.79	5.57	0.41	6.42	0.39	NE	NE
2005	**11.52**	11.52	4.41	0.84	6.15	0.13	NE	NE
2006	**12.22**	12.22	5.00	0.79	6.20	0.23	NE	NE
2007	**10.38**	10.38	3.91	0.96	5.36	0.13	NE	NE
2008	**13.32**	13.32	6.00	1.06	6.13	0.12	NE	NE
2009	**10.06**	10.06	3.21	0.56	6.13	0.16	NE	NE
2010	**13.37**	13.37	6.80	0.23	6.18	0.16	NE	NE
2011	**12.07**	12.07	6.96	0.17	4.88	0.07	NE	NE
2012	**11.30**	11.30	6.21	0.24	4.77	0.09	NE	NE
2013	**11.08**	11.08	6.03	0.43	4.50	0.12	NE	NE
2014	**10.64**	10.64	5.85	0.45	4.16	0.18	NE	NE
2015	**11.36**	11.36	6.11	0.44	4.60	0.21	NE	NE
2016	**10.85**	10.85	4.92	0.43	5.29	0.21	NE	NE
2017	**11.44**	11.44	5.07	0.50	5.71	0.17	NE	NE
2018	**12.75**	12.75	5.82	0.43	6.33	0.18	NE	NE
2019	**13.43**	13.43	6.01	0.45	6.79	0.18	NE	NE
2020	**12.25**	12.25	6.27	0.42	5.40	0.15	NE	NE
2021	**13.29**	13.29	5.45	0.50	7.17	0.18	NE	NE
2022	**13.73**	13.73	5.85	0.43	7.29	0.17	NE	NE
Trend								
1990 - 2022	*22.2%*	*22.2%*	*0.2%*	*-42.3%*	*76.1%*	*-67.3%*	*NA*	*NA*
2005 - 2022	*19.2%*	*19.2%*	*32.7%*	*-48.9%*	*18.5%*	*31.6%*	*NA*	*NA*
2021 - 2022	*3.3%*	*3.3%*	*7.4%*	*-14.0%*	*1.7%*	*-4.0%*	*NA*	*NA*

Table 68 Activity data and Emissions from International Bunkers - International aviation

International aviation	Emission				Activity data		
	GHG	CO_2	N_2O	CH_4	Jet Kerosene	Aviation fuel	Biomass
	kt CO_2 equivalent	kt	kt	kt	[TJ]	[TJ]	
1990	10.54	10.42	0.0004	0.0004	145.33	NO	NO
1991	11.61	11.48	0.0004	0.0004	160.14	NO	NO
1992	1.62	1.60	0.0001	0.0001	22.36	NO	NO
1993	0.81	0.80	0.0000	0.0000	11.18	NO	NO
1994	0.81	0.80	0.0000	0.0000	11.18	NO	NO
1995	0.81	0.80	0.0000	0.0000	11.18	NO	NO
1996	0.81	0.80	0.0000	0.0000	11.18	NO	NO
1997	0.81	0.80	0.0000	0.0000	11.18	NO	NO
1998	4.05	4.01	0.0002	0.0002	55.90	NO	NO
1999	10.54	10.42	0.0004	0.0004	145.33	NO	NO
2000	10.54	10.42	0.0004	0.0004	145.33	NO	NO
2001	12.97	12.82	0.0005	0.0005	178.87	NO	NO
2002	7.13	7.05	0.0003	0.0003	98.39	NO	NO
2003	8.56	8.47	0.0003	0.0003	118.09	NO	NO
2004	15.44	15.26	0.0006	0.0006	212.92	NO	NO
2005	15.11	14.94	0.0006	0.0006	208.39	NO	NO
2006	18.79	18.58	0.0007	0.0007	259.24	NO	NO
2007	23.53	23.27	0.0009	0.0009	324.55	NO	NO
2008	27.02	26.72	0.0010	0.0010	372.75	NO	NO
2009	25.42	25.14	0.0010	0.0010	350.67	NO	NO
2010	28.77	28.45	0.0011	0.0011	396.80	NO	NO
2011	28.05	27.73	0.0011	0.0011	386.86	NO	NO
2012	35.81	35.41	0.0014	0.0014	493.88	NO	NO
2013	36.07	35.67	0.0014	0.0014	497.51	NO	NO
2014	27.74	27.43	0.0011	0.0011	382.65	NO	NO
2015	28.86	28.54	0.0011	0.0011	398.14	NO	NO
2016	31.27	30.92	0.0012	0.0012	431.25	NO	NO
2017	37.73	37.31	0.0014	0.0014	520.40	NO	NO
2018	59.73	59.06	0.0023	0.0023	823.88	NO	NO
2019	64.35	63.64	0.0024	0.0024	887.67	NO	NO
2020	14.71	14.55	0.0006	0.0006	202.95	NO	NO
2021	32.92	32.55	0.0013	0.0013	454.03	NO	NO
2022	48.00	47.47	0.0018	0.0018	662.00	NO	NO

Trend							
1990 - 2022	*356%*	*356%*	*356%*	*356%*	*NA*	*NA*	*NA*
2005 - 2022	*218%*	*218%*	*218%*	*218%*	*NA*	*NA*	*NA*
2021 - 2022	*46%*	*46%*	*46%*	*46%*	*NA*	*NA*	*NA*

A1.3 Emissions from the industry sector

GHG emissions from the industry sector by gas

Table 69 CO_2 Emissions from CRT subcategory 2 IPPU by subcategories for the period 1990-2022

CO_2 emissions	2	2.A	2.B	2.C	2.D	2.E	2.F	2.G	2.H
	IPPU	Mineral industry	Chemical industry	Metal industry	Non-energy products from fuels and solvent use	Electronic industry	Product uses as substitutes for ODS	Other product manufacture and use	Other
	kt								
1990	**210.13**	24.85	NO	185.28	0.00	NA	NA	NA	NO
1991	**202.78**	23.34	NO	179.43	0.00	NA	NA	NA	NO
1992	**170.65**	16.57	NO	154.08	0.00	NA	NA	NA	NO
1993	**79.98**	9.79	NO	70.19	0.00	NA	NA	NA	NO
1994	**30.35**	3.01	NO	27.34	0.00	NA	NA	NA	NO
1995	**54.07**	5.27	NO	48.80	0.00	NA	NA	NA	NO
1996	**95.95**	6.02	NO	89.92	0.00	NA	NA	NA	NO
1997	**145.58**	6.02	NO	139.55	0.00	NA	NA	NA	NO
1998	**139.83**	6.02	NO	133.81	0.00	NA	NA	NA	NO
1999	**142.53**	6.02	NO	136.51	0.00	NA	NA	NA	NO
2000	**164.98**	5.36	NO	159.62	0.00	NA	NA	NA	NO
2001	**191.56**	9.78	NO	181.78	0.00	NA	NA	NA	NO
2002	**201.38**	8.38	NO	193.00	0.00	NA	NA	NA	NO
2003	**203.19**	6.13	NO	197.06	0.00	NA	NA	NA	NO
2004	**213.26**	7.98	NO	205.29	0.00	NA	NA	NA	NO
2005	**206.49**	4.52	NO	200.79	1.18	NA	NA	NA	NO
2006	**215.08**	6.11	NO	207.78	1.18	NA	NA	NA	NO
2007	**219.20**	5.34	NO	212.68	1.18	NA	NA	NA	NO

2008	**202.88**	7.41	NO	194.29	1.18	NA	NA	NA	NO
2009	**114.25**	3.39	NO	109.68	1.18	NA	NA	NA	NO
2010	**137.77**	0.63	NO	135.96	1.18	NA	NA	NA	NO
2011	**158.45**	2.60	NO	154.08	1.77	NA	NA	NA	NO
2012	**121.70**	NO	NO	121.11	0.59	NA	NA	NA	NO
2013	**81.84**	NO	NO	78.90	2.95	NA	NA	NA	NO
2014	**74.88**	NO	NO	69.57	5.31	NA	NA	NA	NO
2015	**76.23**	NO	NO	70.93	5.31	NA	NA	NA	NO
2016	**67.39**	NO	NO	61.49	5.90	NA	NA	NA	NO
2017	**72.47**	NO	NO	66.57	5.90	NA	NA	NA	NO
2018	**73.82**	NO	NO	67.81	6.01	NA	NA	NA	NO
2019	**67.80**	NO	NO	61.25	6.54	NA	NA	NA	NO
2020	**68.20**	NO	NO	64.31	3.89	NA	NA	NA	NO
2021	**62.13**	NO	NO	59.18	2.95	NA	NA	NA	NO
2022	**7.44**	NO	NO	4.55	2.89	NA	NA	NA	NO
Trend									
1990 - 2022	*-96.5%*	*NA*	*NA*	*-97.5%*	*166851.2%*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*-96.4%*	*NA*	*NA*	*-97.7%*	*144.8%*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*-88.0%*	*NA*	*NA*	*-92.3%*	*-2.0%*	*NA*	*NA*	*NA*	*NA*

Table 70 CH_4 Emissions from CRT subcategory 2 IPPU by subcategories for the period 1990-2022

CH_4 emissions	2	2.A	2.B	2.C	2.D	2.E	2.F	2.G	2.H
	IPPU	Mineral industry	Chemical industry	Metal industry	Non-energy products from fuels and solvent use	Electronic industry	Product uses as substitutes for ODS	Other product manufacture and use	Other
	kt CO_2eq								
1990	**0.00208**	NO	NO	0.0021	NO	NO	NA	NO	NO
1991	**0.00196**	NO	NO	0.0020	NO	NO	NA	NO	NO
1992	**0.00143**	NO	NO	0.0014	NO	NO	NA	NO	NO
1993	**0.00115**	NO	NO	0.0012	NO	NO	NA	NO	NO
1994	**0.00112**	NO	NO	0.0011	NO	NO	NA	NO	NO
1995	**0.00089**	NO	NO	0.0009	NO	NO	NA	NO	NO
1996	**0.00102**	NO	NO	0.0010	NO	NO	NA	NO	NO
1997	**0.00132**	NO	NO	0.0013	NO	NO	NA	NO	NO
1998	**0.00141**	NO	NO	0.0014	NO	NO	NA	NO	NO

1999	**0.00088**	NO	NO	0.0009	NO	NO	NA	NO	NO
2000	**0.00085**	NO	NO	0.0008	NO	NO	NA	NO	NO
2001	**0.00110**	NO	NO	0.0011	NO	NO	NA	NO	NO
2002	**0.00083**	NO	NO	0.0008	NO	NO	NA	NO	NO
2003	**0.00059**	NO	NO	0.0006	NO	NO	NA	NO	NO
2004	**0.00150**	NO	NO	0.0015	NO	NO	NA	NO	NO
2005	**0.00102**	NO	NO	0.0010	NO	NO	NA	NO	NO
2006	**0.00161**	NO	NO	0.0016	NO	NO	NA	NO	NO
2007	**0.00174**	NO	NO	0.0017	NO	NO	NA	NO	NO
2008	**0.00202**	NO	NO	0.0020	NO	NO	NA	NO	NO
2009	**0.00103**	NO	NO	0.0010	NO	NO	NA	NO	NO
2010	**0.00048**	NO	NO	0.0005	NO	NO	NA	NO	NO
2011	**0.00061**	NO	NO	0.0006	NO	NO	NA	NO	NO
2012	**0.00026**	NO	NO	0.0003	NO	NO	NA	NO	NO
2013	**0.00020**	NO	NO	0.0002	NO	NO	NA	NO	NO
2014	**0.00014**	NO	NO	0.0001	NO	NO	NA	NO	NO
2015	**0.00037**	NO	NO	0.0004	NO	NO	NA	NO	NO
2016	**0.00045**	NO	NO	0.0005	NO	NO	NA	NO	NO
2017	**0.00045**	NO	NO	0.0005	NO	NO	NA	NO	NO
2018	**0.00045**	NO	NO	0.0005	NO	NO	NA	NO	NO
2019	**0.00024**	NO	NO	0.0002	NO	NO	NA	NO	NO
2020	**0.00034**	NO	NO	0.0003	NO	NO	NA	NO	NO
2021	**0.00003**	NO	NO	0.0000	NO	NO	NA	NO	NO
2022	**NO**	NO	NO	NO	NO	NO	NA	NO	NO
Trend									
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*

Table 71 Emissions of HFCs, PFCs and SF6 from CRT subcategory 2 IPPU by subcategories

GHG emissions (kt CO_2 eq)	2	2.A	2.B	2.C	2.D	2.E	2.F	2.G	2.H
	IPPU	Mineral industry	Chemical industry	Metal industry	Non-energy products from fuels and	Electronic industry	Product uses as substitutes for ODS	Other product manufactu re and use	Other

					solvent use				
	GHG			**PFCs**			**HFCs**	**SF6**	
1990	**1,345.67**	NA	NO	1,340.48	NA	NO	NA	5.19	NA
1991	**1,801.68**	NA	NO	1,796.49	NA	NO	0.01	5.19	NA
1992	**1,124.75**	NA	NO	1,119.45	NA	NO	0.11	5.19	NA
1993	**414.22**	NA	NO	408.72	NA	NO	0.31	5.19	NA
1994	**88.09**	NA	NO	82.10	NA	NO	0.81	5.19	NA
1995	**316.85**	NA	NO	310.30	NA	NO	1.37	5.19	NA
1996	**799.40**	NA	NO	792.14	NA	NO	2.07	5.19	NA
1997	**1,227.65**	NA	NO	1,219.58	NA	NO	2.88	5.19	NA
1998	**898.91**	NA	NO	889.92	NA	NO	3.80	5.19	NA
1999	**940.75**	NA	NO	930.78	NA	NO	4.78	5.19	NA
2000	**1,235.51**	NA	NO	1,224.54	NA	NO	5.77	5.19	NA
2001	**1,277.69**	NA	NO	1,265.73	NA	NO	6.76	5.19	NA
2002	**1,222.10**	NA	NO	1,207.48	NA	NO	9.43	5.19	NA
2003	**1,005.35**	NA	NO	989.78	NA	NO	10.38	5.19	NA
2004	**892.58**	NA	NO	876.05	NA	NO	11.33	5.19	NA
2005	**799.56**	NA	NO	781.75	NA	NO	12.62	5.19	NA
2006	**891.24**	NA	NO	870.87	NA	NO	15.18	5.19	NA
2007	**988.24**	NA	NO	964.30	NA	NO	18.76	5.19	NA
2008	**1,130.08**	NA	NO	1,101.74	NA	NO	23.15	5.19	NA
2009	**338.98**	NA	NO	305.63	NA	NO	28.16	5.19	NA
2010	**486.04**	NA	NO	447.09	NA	NO	33.76	5.19	NA
2011	**425.36**	NA	NO	380.44	NA	NO	39.73	5.19	NA
2012	**252.39**	NA	NO	200.72	NA	NO	46.48	5.19	NA
2013	**165.52**	NA	NO	103.76	NA	NO	56.57	5.19	NA
2014	**149.96**	NA	NO	77.88	NA	NO	66.89	5.19	NA
2015	**144.83**	NA	NO	64.69	NA	NO	74.95	5.19	NA
2016	**127.30**	NA	NO	40.99	NA	NO	81.12	5.19	NA
2017	**142.96**	NA	NO	40.59	NA	NO	97.18	5.19	NA
2018	**143.99**	NA	NO	33.56	NA	NO	105.24	5.19	NA
2019	**158.75**	NA	NO	30.60	NA	NO	122.96	5.19	NA
2020	**183.54**	NA	NO	31.92	NA	NO	146.44	5.19	NA
2021	**159.85**	NA	NO	17.89	NA	NO	136.77	5.19	NA
2022	**145.59**	NA	NO	1.66	NA	NO	138.74	5.19	NA
Trend									

1990 - 2022	*-89.2%*	*NA*	*NA*	*-99.9%*	*NA*	*NA*	*NA*	*0.0%*	*NA*
2005 - 2022	*-81.8%*	*NA*	*NA*	*-99.8%*	*NA*	*NA*	*999.2%*	*0.0%*	*NA*
2021 - 2022	*-8.9%*	*NA*	*NA*	*-90.7%*	*NA*	*NA*	*1.4%*	*0.0%*	*NA*

Emission factors

In accordance with the national data available, it was possible to use the Tier-2 approach to estimate the emissions from the aluminium industry. The assessment of other GHG emissions from industrial processes was done following the Tier-1 approach.

Table 72 Emission factors for IPPU, 1990–2022

Industry sector	CO_2 emission factor	Unit	CH_4 emission factor	Unit
2.A.2 – Production of lime	0.75	t/t	NA	
2.C.1 – Manufacture of iron and steel	0.08	t/t	0.01	kg/t
2.C.3 – Manufacture of aluminium	1.6	t/t	NA	
2.H.2 – Food and beverage industry – beer	20	t C/TJ	NA	
2.H.2 – Food and beverage industry – bread	8×10^{-9}	t/t	NA	
2.H.2 – Food and beverage industry – wine	6.15×10^{-6}	t/t	NA	
2.A.2 – Production of lime	8.3×10^{-9}	t/t	NA	

Table 73 PFC emission factor calculation (I)

Elektroliza A	Unit	2015	Remark
IPCC const		1.698	
P		0.08	
CE -Electicity ef.	CE	0.91	
slope coefficient for CF_4	kg $_{PFC}$/t$_{Al}$) / (AE-Mins/cell day	0.143	Calculated
Number of AE/Total number of anodes effects by year		C	PS
Pots per days (eleCRTolytic cells per day)		C	PS
AEF	num of AE / pot days	1.24	Calculated
AED -Estimation of anodes effects duration [min]		C	PS

Table 74 PFC emission factor calculation (II)

Elektroliza A	Unit	2015	Remark
EF		0.80	Calculated
AEM - anode effect minutes per cell-day	AE-Mins/cell-day	C	Calculated
IPCC range - up to 380%		99%	*2006 IPCC GL, Vol. 3, Chap. 4*; TABLE 4.15
Metal production EL A	t	5 123	PS
CF_4 emissions	t	4.1	Calculated
C_2F_6/CF_4 ratio		0.121	*2006 IPCC GL, Vol. 3, Chap. 4*; TABLE 4.16
C_2F_6 emissions	t	0.5	Calculated
GWP CF_4		7 390	
GWP C_2F_6		12 200	
CF_4	t CO_2eq	30 102	Calculated
C_2F_6	t CO_2eq	6 013	Calculated
TOTAL Elektroliza A	t CO_2eq	36 115	Calculated

A1.4 Emissions from the agriculture sector

GHG emissions from the agriculture sector

Table 75 CO_2 Emissions from CRT subcategory 3 Agriculture by subcategories for the period 1990-2022

CO_2 emissions	3	3.A	3.B	3.C	3.D	3.E	3.F	3.	3.H	3.I	3.J
	Agriculture	Enteric Fermentation	Manure Management	Rice Cultivation	Agricultural soils	Prescribed burning of savannas	Field burning of agricultural residues	Liming	Urea application	Other carbon-containing fertilisers	Other
	kt										
1990	0.490	NA	NA	NA	NA	NA	NA	0.065	0.425	NA	NA
1991	0.488	NA	NA	NA	NA	NA	NA	0.063	0.425	NA	NA

1992	0.485	NA	NA	NA	NA	NA	NA	0.061	0.424	NA	NA
1993	0.484	NA	NA	NA	NA	NA	NA	0.060	0.424	NA	NA
1994	0.485	NA	NA	NA	NA	NA	NA	0.062	0.424	NA	NA
1995	0.482	NA	NA	NA	NA	NA	NA	0.059	0.423	NA	NA
1996	0.481	NA	NA	NA	NA	NA	NA	0.058	0.423	NA	NA
1997	0.479	NA	NA	NA	NA	NA	NA	0.057	0.422	NA	NA
1998	0.473	NA	NA	NA	NA	NA	NA	0.055	0.418	NA	NA
1999	0.470	NA	NA	NA	NA	NA	NA	0.054	0.416	NA	NA
2000	0.469	NA	NA	NA	NA	NA	NA	0.054	0.415	NA	NA
2001	0.464	NA	NA	NA	NA	NA	NA	0.050	0.414	NA	NA
2002	0.461	NA	NA	NA	NA	NA	NA	0.048	0.413	NA	NA
2003	0.454	NA	NA	NA	NA	NA	NA	0.047	0.407	NA	NA
2004	0.440	NA	NA	NA	NA	NA	NA	0.048	0.392	NA	NA
2005	0.434	NA	NA	NA	NA	NA	NA	0.049	0.384	NA	NA
2006	0.420	NA	NA	NA	NA	NA	NA	0.049	0.370	NA	NA
2007	0.420	NA	NA	NA	NA	NA	NA	0.050	0.370	NA	NA
2008	0.417	NA	NA	NA	NA	NA	NA	0.050	0.367	NA	NA
2009	0.417	NA	NA	NA	NA	NA	NA	0.050	0.367	NA	NA
2010	0.409	NA	NA	NA	NA	NA	NA	0.050	0.359	NA	NA
2011	0.402	NA	NA	NA	NA	NA	NA	0.050	0.352	NA	NA
2012	0.322	NA	NA	NA	NA	NA	NA	0.039	0.282	NA	NA
2013	0.375	NA	NA	NA	NA	NA	NA	0.060	0.315	NA	NA
2014	0.375	NA	NA	NA	NA	NA	NA	0.060	0.315	NA	NA
2015	0.382	NA	NA	NA	NA	NA	NA	0.045	0.337	NA	NA
2016	0.375	NA	NA	NA	NA	NA	NA	0.034	0.341	NA	NA
2017	0.371	NA	NA	NA	NA	NA	NA	0.028	0.343	NA	NA
2018	0.371	NA	NA	NA	NA	NA	NA	0.028	0.343	NA	NA
2019	0.371	NA	NA	NA	NA	NA	NA	0.028	0.343	NA	NA
2020	0.371	NA	NA	NA	NA	NA	NA	0.028	0.343	NA	NA
2021	0.371	NA	NA	NA	NA	NA	NA	0.028	0.343	NA	NA
2022	0.414	NA	NA	NA	NA	NA	NA	0.042	0.372	NA	NA
Trend											
1990 - 2022	*-15.5%*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*-34.6%*	*-12.6%*	*NA*	*NA*
2005 - 2022	*-4.4%*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*-14.1%*	*-3.2%*	*NA*	*NA*
2021 - 2022	*11.7%*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*50.1%*	*8.5%*	*NA*	*NA*

Table 76 CH_4 Emissions from CRT subcategory 3 Agriculture by subcategories for the period 1990-2022

CH4 emissions	3	3.A	3.B	3.C	3.D	3.E	3.F	3.	3.H	3.I	3.J
	Agriculture	Enteric Fermentation	Manure Management	Rice Cultivation	Agricultural soils	Prescribed burning of	Field burning of agricultural residues	Liming	Urea application	Other carbon-	Other
	kt										
1990	18.79	14.80	3.99	NO	NA	NO	0.0015	NA	NA	NA	NO
1991	18.74	14.76	3.98	NO	NA	NO	0.0015	NA	NA	NA	NO
1992	17.58	13.84	3.74	NO	NA	NO	0.0015	NA	NA	NA	NO
1993	16.94	13.34	3.60	NO	NA	NO	0.0016	NA	NA	NA	NO
1994	17.23	13.56	3.67	NO	NA	NO	0.0017	NA	NA	NA	NO
1995	17.73	13.96	3.77	NO	NA	NO	0.0017	NA	NA	NA	NO
1996	17.65	13.89	3.76	NO	NA	NO	0.0016	NA	NA	NA	NO
1997	17.08	13.43	3.65	NO	NA	NO	0.0017	NA	NA	NA	NO
1998	16.72	13.14	3.58	NO	NA	NO	0.0017	NA	NA	NA	NO
1999	16.74	13.14	3.59	NO	NA	NO	0.0014	NA	NA	NA	NO
2000	16.22	12.74	3.48	NO	NA	NO	0.0014	NA	NA	NA	NO
2001	15.73	12.34	3.39	NO	NA	NO	0.0015	NA	NA	NA	NO
2002	16.06	12.59	3.47	NO	NA	NO	0.0015	NA	NA	NA	NO
2003	15.95	12.49	3.46	NO	NA	NO	0.0014	NA	NA	NA	NO
2004	15.67	12.26	3.41	NO	NA	NO	0.0013	NA	NA	NA	NO
2005	11.67	9.17	2.50	NO	NA	NO	0.0012	NA	NA	NA	NO
2006	10.88	8.55	2.33	NO	NA	NO	0.0011	NA	NA	NA	NO
2007	10.13	7.96	2.17	NO	NA	NO	0.0005	NA	NA	NA	NO
2008	9.98	7.83	2.15	NO	NA	NO	0.0005	NA	NA	NA	NO
2009	9.53	7.46	2.06	NO	NA	NO	0.0005	NA	NA	NA	NO
2010	9.11	7.13	1.98	NO	NA	NO	0.0004	NA	NA	NA	NO
2011	9.01	7.16	1.84	NO	NA	NO	0.0007	NA	NA	NA	NO
2012	8.53	6.71	1.82	NO	NA	NO	0.0007	NA	NA	NA	NO
2013	8.92	7.05	1.87	NO	NA	NO	0.0008	NA	NA	NA	NO
2014	9.35	7.39	1.96	NO	NA	NO	0.0009	NA	NA	NA	NO
2015	9.18	7.24	1.94	NO	NA	NO	0.0008	NA	NA	NA	NO
2016	8.83	6.94	1.90	NO	NA	NO	0.0008	NA	NA	NA	NO
2017	8.91	7.06	1.85	NO	NA	NO	0.0009	NA	NA	NA	NO
2018	8.63	6.82	1.80	NO	NA	NO	0.0009	NA	NA	NA	NO
2019	8.41	6.66	1.75	NO	NA	NO	0.0009	NA	NA	NA	NO

2020	8.14	6.45	1.69	NO	NA	NO	0.0008	NA	NA	NA	NO
2021	7.52	5.97	1.55	NO	NA	NO	0.0009	NA	NA	NA	NO
2022	7.48	5.95	1.53	NO	NA	NO	0.0008	NA	NA	NA	NO
Trend											
1990 - 2022	*-60.2%*	*-59.8%*	*-61.5%*	*NA*	*NA*	*NA*	*-44.6%*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*-35.9%*	*-35.1%*	*-38.7%*	*NA*	*NA*	*NA*	*-30.9%*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*-0.5%*	*-0.4%*	*-1.0%*	*NA*	*NA*	*NA*	*-2.0%*	*NA*	*NA*	*NA*	*NA*

Table 77 N_2O Emissions from CRT subcategory 3 Agriculture by subcategories for the period 1990-2022

N_2O emissions	3	3.A	3.B	3.C	3.D	3.E	3.F	3.	3.H	3.I	3.J
	Agriculture	Enteric Fermentation	Manure Management	Rice Cultivation	Agricultural soils	Prescribed burning of savannas	Field burning of agricultural residues	Liming	Urea application	Other carbon-containing	Other
	kt										
1990	0.315	NA	0.034	NA	0.281	NO	0.00004	NA	NA	NA	NO
1991	0.312	NA	0.034	NA	0.278	NO	0.00004	NA	NA	NA	NO
1992	0.293	NA	0.032	NA	0.261	NO	0.00004	NA	NA	NA	NO
1993	0.277	NA	0.030	NA	0.247	NO	0.00004	NA	NA	NA	NO
1994	0.283	NA	0.030	NA	0.253	NO	0.00004	NA	NA	NA	NO
1995	0.301	NA	0.032	NA	0.269	NO	0.00004	NA	NA	NA	NO
1996	0.304	NA	0.032	NA	0.272	NO	0.00004	NA	NA	NA	NO
1997	0.298	NA	0.031	NA	0.268	NO	0.00004	NA	NA	NA	NO
1998	0.296	NA	0.031	NA	0.265	NO	0.00004	NA	NA	NA	NO
1999	0.293	NA	0.030	NA	0.263	NO	0.00004	NA	NA	NA	NO
2000	0.296	NA	0.032	NA	0.264	NO	0.00004	NA	NA	NA	NO
2001	0.299	NA	0.032	NA	0.267	NO	0.00004	NA	NA	NA	NO
2002	0.305	NA	0.033	NA	0.272	NO	0.00004	NA	NA	NA	NO
2003	0.289	NA	0.030	NA	0.259	NO	0.00004	NA	NA	NA	NO
2004	0.306	NA	0.031	NA	0.276	NO	0.00003	NA	NA	NA	NO
2005	0.222	NA	0.023	NA	0.199	NO	0.00003	NA	NA	NA	NO
2006	0.210	NA	0.020	NA	0.190	NO	0.00003	NA	NA	NA	NO
2007	0.193	NA	0.020	NA	0.173	NO	0.00001	NA	NA	NA	NO
2008	0.185	NA	0.018	NA	0.167	NO	0.00001	NA	NA	NA	NO
2009	0.176	NA	0.017	NA	0.159	NO	0.00001	NA	NA	NA	NO

2010	0.176	NA	0.016	NA	0.159	NO	0.00001	NA	NA	NA	NO
2011	0.156	NA	0.016	NA	0.140	NO	0.00002	NA	NA	NA	NO
2012	0.161	NA	0.016	NA	0.145	NO	0.00002	NA	NA	NA	NO
2013	0.165	NA	0.016	NA	0.148	NO	0.00002	NA	NA	NA	NO
2014	0.174	NA	0.018	NA	0.156	NO	0.00002	NA	NA	NA	NO
2015	0.176	NA	0.018	NA	0.158	NO	0.00002	NA	NA	NA	NO
2016	0.176	NA	0.018	NA	0.158	NO	0.00002	NA	NA	NA	NO
2017	0.172	NA	0.017	NA	0.154	NO	0.00002	NA	NA	NA	NO
2018	0.165	NA	0.016	NA	0.149	NO	0.00002	NA	NA	NA	NO
2019	0.161	NA	0.016	NA	0.145	NO	0.00002	NA	NA	NA	NO
2020	0.153	NA	0.015	NA	0.139	NO	0.00002	NA	NA	NA	NO
2021	0.151	NA	0.014	NA	0.137	NO	0.00002	NA	NA	NA	NO
2022	0.154	NA	0.014	NA	0.140	NO	0.00002	NA	NA	NA	NO
Trend											
1990 - 2022	*-51.2%*	*NA*	*-58.4%*	*NA*	*-50.3%*	*NA*	*-44.6%*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*-30.6%*	*NA*	*-38.0%*	*NA*	*-29.8%*	*NA*	*-30.9%*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*2.2%*	*NA*	*5.3%*	*NA*	*1.9%*	*NA*	*-2.0%*	*NA*	*NA*	*NA*	*NA*

A1.5 Emissions from the waste sector

Table 78 CH_4 Emissions from CRT sector 5 Waste for the period 1990 - 2022

CH_4 emissions	5 TOTAL Waste	5.A Solid Waste Disposal	5.B Biological Treatment of Solid Waste	5.C Incineration and Open Burning of Waste	5.D Wastewater Treatment and Discharge
	kt	kt	kt	kt	kt
1990	8.19	6.14	0.00	0.00	2.05
1991	8.38	6.31	0.00	0.00	2.07
1992	8.55	6.48	0.00	0.00	2.07
1993	8.73	6.65	0.00	0.00	2.08
1994	8.91	6.83	0.00	0.00	2.08
1995	9.13	7.04	0.00	0.00	2.09
1996	9.36	7.27	0.00	0.00	2.09
1997	9.62	7.53	0.00	0.00	2.09
1998	9.87	7.79	0.00	0.00	2.08

1999	10.12	8.05	0.00	0.00	2.07
2000	10.39	8.33	0.00	0.00	2.07
2001	10.63	8.56	0.00	0.00	2.07
2002	10.84	8.76	0.00	0.00	2.08
2003	11.03	8.93	0.00	0.00	2.10
2004	11.18	9.07	0.00	0.00	2.11
2005	11.29	9.18	0.00	0.00	2.12
2006	11.39	9.26	0.00	0.00	2.13
2007	11.55	9.41	0.00	0.00	2.14
2008	11.78	9.62	0.00	0.00	2.16
2009	11.93	9.76	0.00	0.00	2.17
2010	12.07	9.89	0.00	0.00	2.17
2011	12.21	10.03	0.00	0.00	2.18
2012	12.05	9.87	0.00	0.00	2.18
2013	12.05	9.87	0.00	0.00	2.19
2014	12.02	9.83	0.00	0.00	2.19
2015	11.93	9.74	0.00	0.00	2.19
2016	11.97	9.75	0.00	0.00	2.22
2017	11.92	9.67	0.00	0.00	2.24
2018	12.01	9.74	0.00	0.00	2.27
2019	12.07	9.78	0.00	0.00	2.29
2020	12.20	9.89	0.00	0.00	2.32
2021	12.19	9.88	0.00	0.00	2.31
2022	12.24	9.94	0.00	0.00	2.30
Trend					
1990 - 2022	49.4%	61.9%	NA	NA	12.2%
2005 - 2022	8.4%	8.4%	NA	NA	8.7%
2021 - 2022	0.5%	0.6%	NA	NA	-0.2%

Table 79 Total N_2O Emissions from CRT sector Waste for the period 1990 - 2022

N_2O emissions	5 TOTAL Waste	5.A Solid Waste Disposal	5.B Biological Treatment of Solid Waste	5.C Incineration and Open Burning of Waste	5.D Wastewater Treatment and Discharge
	kt	kt	kt	kt	kt

1990	0.040	NA	0.00	0.00	0.04
1991	0.040	NA	0.00	0.00	0.04
1992	0.043	NA	0.00	0.00	0.04
1993	0.042	NA	0.00	0.00	0.04
1994	0.040	NA	0.00	0.00	0.04
1995	0.043	NA	0.00	0.00	0.04
1996	0.044	NA	0.00	0.00	0.04
1997	0.043	NA	0.00	0.00	0.04
1998	0.042	NA	0.00	0.00	0.04
1999	0.040	NA	0.00	0.00	0.04
2000	0.037	NA	0.00	0.00	0.04
2001	0.036	NA	0.00	0.00	0.04
2002	0.038	NA	0.00	0.00	0.04
2003	0.037	NA	0.00	0.00	0.04
2004	0.038	NA	0.00	0.00	0.04
2005	0.037	NA	0.00	0.00	0.04
2006	0.039	NA	0.00	0.00	0.04
2007	0.041	NA	0.00	0.00	0.04
2008	0.043	NA	0.00	0.00	0.04
2009	0.043	NA	0.00	0.00	0.04
2010	0.044	NA	0.00	0.00	0.04
2011	0.046	NA	0.00	0.00	0.05
2012	0.045	NA	0.00	0.00	0.04
2013	0.046	NA	0.00	0.00	0.05
2014	0.045	NA	0.00	0.00	0.04
2015	0.046	NA	0.00	0.00	0.05
2016	0.047	NA	0.00	0.00	0.05
2017	0.048	NA	0.00	0.00	0.05
2018	0.048	NA	0.00	0.00	0.05
2019	0.048	NA	0.00	0.00	0.05
2020	0.049	NA	0.00	0.00	0.05
2021	0.050	NA	0.00	0.00	0.05
2022	0.05	NA	0.00	0.00	0.05
Trend					
1990 - 2022	*25.1%*	*NA*	*NA*	*NA*	*25.1%*
2005 - 2022	*35.2%*	*NA*	*NA*	*NA*	*35.2%*

2021 - 2022	0.0%	NA	NA	NA	0.0%

A1.6 National emissions and uncertainties

Table 80 Level Assessment - excluding LULUCF 2022

Level Assessment - 2022		GHG	Year 2022 Estimate Ex,t	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
CRT Code	CRT Category		Gg CO_2-equivalent		
1 A 1 a solid	Public electricity and heat production	CO_2	1,486	43.5%	43.5%
1 A 3 b Diesel oil	Road transportation	CO2	772	22.6%	66.1%
5 A	Solid waste disposal	CH_4	249	7.3%	73.4%
2 F	Product Uses as Substitutes	HFC	139	4.1%	77.4%
1 A 3 b Gasoline	Road transportation	CO2	122	3.6%	81.0%
3 A 1	Cattle	CH4	115	3.4%	84.3%
5 D	Wastewater treatment and	CH4	58	1.7%	86.0%
1 A 2 e liquid	Food processing, beverages and tobacco	CO2	56	1.6%	87.7%
1 A 2 g viii liquid	Other	CO2	47	1.4%	89.0%
1 A 2 g iv liquid	Wood and wood products	CO2	43	1.3%	90.3%
3 D 1	Direct N_2O emissions from	N2O	42	1.2%	91.5%
1 A 4 a liquid	Commercial/institutional	CO_2	37	1.1%	92.6%
3 B 1	Cattle	CH4	29	0.9%	93.4%
1 A 2 g iii liquid	Mining (excluding fuels) and quarrying	CO_2	29	0.9%	94.3%
3 A 2	Sheep	CH4	27	0.8%	95.1%

Table 81 Approach 1 uncertainty analysis for the period 1990 - 2022

CRT category code	CRT category name	Gas	Base year emissions or removals	Year t emissions or removals	Activity data uncertainty	Emission factor uncertainty [142]	Combined uncertainty	Contribution to variance by category in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend [143] in national emissions introduced by EF uncertainty	Uncertainty in trend [144] in national emissions introduced by AD uncertainty	Uncertainty introduced into the trend in total national emissions
			kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
1 A 1 a liquid	Public electricity and heat production	CO_2	87.41	0.00	2.0	3.0	3.6	0.000	0.013	0.000	0.0	0.0	0.0
1 A 1 a solid	Public electricity and heat production	CO_2	1,438.08	1,384.06	2.0	2.0	2.8	1.335	0.077	0.289	0.2	0.2	0.0
1 A 2 a liquid	Iron and steel	CO_2	83.99	1.32	5.0	3.0	5.8	0.000	0.012	0.000	0.0	0.1	0.0
1 A 2 a solid	Iron and steel	CO_2	30.16	13.67	2.0	2.0	2.8	0.000	0.002	0.003	0.0	0.0	0.0
1 A 2 b liquid	Non-ferrous metals	CO_2	112.88	0.01	5.0	3.0	5.8	0.000	0.017	0.000	0.0	0.1	0.0
1 A 2 c liquid	Chemicals	CO_2	0.00	3.75	5.0	3.0	5.8	0.000	0.001	0.001	0.0	0.0	0.0
1 A 2 c biomass	Chemicals	CO_2	0.00	0.01	0.0	0.0	0.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 d liquid	Pulp, paper and print	CO_2	0.00	2.49	5.0	3.0	5.8	0.000	0.001	0.001	0.0	0.0	0.0
1 A 2 e liquid	Food processing, beverages and tobacco	CO_2	2.63	46.75	5.0	3.0	5.8	0.006	0.009	0.010	0.0	0.0	0.0
1 A 2 e solid	Food processing, beverages and tobacco	CO_2	2.41	4.46	2.0	2.0	2.8	0.000	0.001	0.001	0.0	0.0	0.0
1 A 2 e biomass	Food processing, beverages and tobacco	CO_2	0.00	0.04	0.0	0.0	0.0	0.000	0.000	0.000	0.0	0.0	0.0

1 A 2 f liquid	Non-metallic minerals	CO_2	0.00	13.18	5.0	3.0	5.8	0.001	0.003	0.003	0.0	0.0	0.0
1 A 2 g i liquid	Manufacturing of machinery	CO_2	0.00	1.22	5.0	3.0	5.8	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 g i solid	Manufacturing of machinery	CO_2	0.00	1.01	2.0	2.0	2.8	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 g i biomass	Manufacturing of machinery	CO_2	0.00	0.00	0.0	0.0	0.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 g iii liquid	Mining (excluding fuels) and quarrying	CO_2	0.00	31.65	5.0	3.0	5.8	0.003	0.007	0.007	0.0	0.0	0.0
1 A 2 g iv liquid	Wood and wood products	CO_2	0.00	46.52	5.0	3.0	5.8	0.006	0.010	0.010	0.0	0.0	0.0
1 A 2 g iv solid	Wood and wood products	CO_2	0.00	1.52	2.0	2.0	2.8	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 g iv biomass	Wood and wood products	CO_2	0.00	0.00	0.0	0.0	0.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 g vi liquid	Textile and leather	CO_2	0.00	0.31	5.0	3.0	5.8	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 g vi solid	Textile and leather	CO_2	22.92	0.00	2.0	2.0	2.8	0.000	0.003	0.000	0.0	0.0	0.0
1 A 2 g viii liquid	Other	CO_2	18.18	56.54	5.0	3.0	5.8	0.009	0.009	0.012	0.0	0.0	0.0
1 A 2 g viii solid	Other	CO_2	20.51	0.91	2.0	2.0	2.8	0.000	0.003	0.000	0.0	0.0	0.0
1 A 2 g viii biomass	Other	CO_2	0.00	0.00	0.0	0.0	0.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 3 b Gasoline	Road transportation	CO_2	217.29	120.61	5.0	5.0	7.1	0.063	0.007	0.025	0.0	0.0	0.0
1 A 3 b Diesel oil	Road transportation	CO_2	120.59	756.60	5.0	5.0	7.1	2.494	0.140	0.158	0.7	0.7	1.0
1 A 3 b LPG	Road transportation	CO_2	0.00	26.07	2.0	2.0	2.8	0.000	0.005	0.005	0.0	0.0	0.0

1 A 3 c liquid	Railways	CO_2	3.16	0.00	5.0	5.0	7.1	0.000	0.000	0.000	0.0	0.0	0.0
1 A 3 d Gas/diesel oil	Domestic Navigation	CO_2	3.16	0.00	5.0	5.0	7.1	0.000	0.000	0.000	0.0	0.0	0.0
1 A 4 a liquid	Commercial/institutional	CO_2	28.43	40.73	5.0	5.0	7.1	0.007	0.004	0.008	0.0	0.0	0.0
1 A 4 a solid	Commercial/institutional	CO_2	49.46	7.19	2.0	2.0	2.8	0.000	0.006	0.001	0.0	0.0	0.0
1 A 4 a biomass	Commercial/institutional	CO_2	0.00	0.04	0.0	0.0	0.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 4 b liquid	Residential	CO_2	60.94	4.73	5.0	5.0	7.1	0.000	0.008	0.001	0.0	0.0	0.0
1 A 4 b solid	Residential	CO_2	30.16	8.10	2.0	2.0	2.8	0.000	0.003	0.002	0.0	0.0	0.0
1 A 4 b biomass	Residential	CO_2	0.80	5.08	30.0	30.0	42.4	0.004	0.001	0.001	0.0	0.0	0.0
1 A 4 c liquid	Agriculture/forestry/fishing	CO_2	24.71	8.53	5.0	5.0	7.1	0.000	0.002	0.002	0.0	0.0	0.0
1 A 4 c biomass	Agriculture/forestry/fishing	CO_2	0.00	0.00	0.0	0.0	0.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 1 a liquid	Public electricity and heat production	CH_4	0.09	0.00	2.0	100.0	100.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 1 a solid	Public electricity and heat production	CH4	0.40	0.38	2.0	100.0	100.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 a liquid	Iron and steel	CH4	0.09	0.00	5.0	100.0	100.1	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 a solid	Iron and steel	CH4	0.08	0.04	2.0	100.0	100.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 b liquid	Non-ferrous metals	CH4	0.12	0.00	5.0	100.0	100.1	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 e liquid	Food processing, beverages and tobacco	CH4	0.00	0.05	5.0	100.0	100.1	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 e solid	Food processing, beverages and tobacco	CH4	0.01	0.01	2.0	100.0	100.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 g vi solid	Textile and leather	CH4	0.06	0.00	2.0	100.0	100.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 g viii liquid	Other	CH4	0.02	0.06	5.0	100.0	100.1	0.000	0.000	0.000	0.0	0.0	0.0

1 A 2 g viii solid	Other	CH4	0.06	0.00	2.0	100.0	100.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 3 b Gasoline	Road transportation	CH4	2.90	0.53	5.0	100.0	100.1	0.000	0.000	0.000	0.0	0.0	0.0
1 A 3 b Diesel oil	Road transportation	CH4	0.35	0.51	5.0	100.0	100.1	0.000	0.000	0.000	0.0	0.0	0.0
1 A 3 c liquid	Railways	CH4	0.00	0.00	5.0	100.0	100.1	0.000	0.000	0.000	0.0	0.0	0.0
1 A 3 d Gas/diesel oil	Domestic Navigation	CH4	0.01	0.00	5.0	50.0	50.2	0.000	0.000	0.000	0.0	0.0	0.0
1 A 4 a liquid	Commercial/institutional	CH4	0.11	0.15	5.0	100.0	100.1	0.000	0.000	0.000	0.0	0.0	0.0
1 A 4 a solid	Commercial/institutional	CH4	0.14	0.02	2.0	100.0	100.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 4 a biomass	Commercial/institutional	CH4	0.00	0.00	0.0	0.0	0.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 4 b liquid	Residential	CH4	0.22	0.01	5.0	100.0	100.1	0.000	0.000	0.000	0.0	0.0	0.0
1 A 4 b solid	Residential	CH4	0.08	0.02	2.0	100.0	100.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 4 b biomass	Residential	CH4	0.06	0.27	30.0	200.0	202.2	0.000	0.000	0.000	0.0	0.0	0.0
1 A 4 c liquid	Agriculture/forestry/fishing	CH4	0.07	0.03	5.0	100.0	100.1	0.000	0.000	0.000	0.0	0.0	0.0
1 A 1 a liquid	Public electricity and heat production	N_2O	0.18	0.00	2.0	2.0	2.8	0.000	0.000	0.000	0.0	0.0	0.0
1 A 1 a solid	Public electricity and heat production	N2O	5.66	5.45	2.0	2.0	2.8	0.000	0.000	0.001	0.0	0.0	0.0
1 A 2 a liquid	Iron and steel	N2O	0.17	0.00	5.0	150.0	150.1	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 a solid	Iron and steel	N2O	0.12	0.05	2.0	150.0	150.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 b liquid	Non-ferrous metals	N2O	0.23	0.00	5.0	150.1	150.2	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 e liquid	Food processing, beverages and tobacco	N2O	0.00	0.09	5.0	5.0	7.1	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 e solid	Food processing, beverages and tobacco	N2O	0.01	0.02	2.0	2.0	2.8	0.000	0.000	0.000	0.0	0.0	0.0
1 A 2 g viii liquid	Other	N2O	0.03	0.11	5.0	0.0	5.0	0.000	0.000	0.000	0.0	0.0	0.0

1 A 2 g viii solid	Other	N2 O	0.08	0.00	2.0	0.0	2.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 3 b Gasoline	Road transportation	N2 O	1.85	0.65	5.0	0.0	5.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 3 b Diesel oil	Road transportation	N2 O	1.84	5.93	5.0	0.0	5.0	0.000	0.001	0.001	0.0	0.0	0.0
1 A 4 a liquid	Commercial/institutional	N2 O	0.06	0.08	5.0	150.0	150.1	0.000	0.000	0.000	0.0	0.0	0.0
1 A 4 a solid	Commercial/institutional	N2 O	0.19	0.03	2.0	150.0	150.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 4 a biomass	Commercial/institutional	N2 O	0.00	0.00	0.0	0.0	0.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 4 b liquid	Residential	N2 O	0.12	0.00	5.0	150.0	150.1	0.000	0.000	0.000	0.0	0.0	0.0
1 A 4 b solid	Residential	N2 O	0.12	0.03	2.0	150.0	150.0	0.000	0.000	0.000	0.0	0.0	0.0
1 A 4 b biomass	Residential	N2 O	0.01	0.02	30.0	300.0	301.5	0.000	0.000	0.000	0.0	0.0	0.0
1 A 4 c liquid	Agriculture/forestry/fishing	N2 O	0.02	0.02	5.0	150.0	150.1	0.000	0.000	0.000	0.0	0.0	0.0
1 B 1 a	Coal mining and handling	CO_2	0.52	0.46	3.0	200.0	200.0	0.001	0.000	0.000	0.0	0.0	0.0
1 B 1 a	Coal mining and handling	CH_4	11.04	10.13	3.0	100.0	100.0	0.090	0.000	0.002	0.0	0.0	0.0
2 A 2	Lime production	CO 2	24.85	0.00	10.0	3.0	10.4	0.000	0.004	0.000	0.0	0.0	0.0
2 C 1	Iron and steel production	CO 2	16.61	0.24	10.0	10.0	14.1	0.000	0.002	0.000	0.0	0.0	0.0
2 C 3	Aluminium production	CO 2	168.67	58.93	1.0	5.0	5.1	0.008	0.013	0.012	0.1	0.0	0.0
2 D 3	Other	CO 2	0.00	0.00	50.0	60.0	78.1	0.000	0.000	0.000	0.0	0.0	0.0
2 C 1	Iron and steel production	CH4	0.05	0.00	10.0	400.0	400.1	0.000	0.000	0.000	0.0	0.0	0.0

2 G 1	Electrical Equipment	SF6	5.19	5.19	100.0	20.0	102.0	0.024	0.000	0.001	0.0	0.0	0.0
2 F	Product Uses as Substitutes for ODS	HFC	73.51	136.77	30.0	50.0	58.3	5.541	0.018	0.029	0.9	0.5	1.1
2 C 3	Aluminium production	PFC	1,340.48	17.89	1.0	6.0	6.1	0.001	0.193	0.004	1.2	0.2	1.4
3 A 1	Cattle	CH4	280.14	116.52	5.0	20.0	20.6	0.503	0.017	0.024	0.3	0.1	0.1
3 A 2	Sheep	CH4	73.51	26.94	10.0	20.0	22.4	0.032	0.005	0.006	0.1	0.1	0.0
3 A 3	Swine	CH4	0.61	0.61	10.0	30.0	31.6	0.000	0.000	0.000	0.0	0.0	0.0
3 A 4 d	Goats	CH4	6.80	3.63	10.0	30.0	31.6	0.001	0.000	0.001	0.0	0.0	0.0
3 A 4 e	Horses	CH4	8.96	1.63	15.0	30.0	33.5	0.000	0.001	0.000	0.0	0.0	0.0
3 B 1	Cattle	CH4	77.62	29.53	5.0	30.0	30.4	0.070	0.005	0.006	0.2	0.0	0.0
3 B 2	Sheep	CH4	18.25	6.22	10.0	30.0	31.6	0.003	0.001	0.001	0.0	0.0	0.0
3 B 3	Swine	CH4	2.42	2.43	10.0	30.0	31.6	0.001	0.000	0.001	0.0	0.0	0.0
3 B 4 d	Goats	CH4	0.23	0.12	10.0	30.0	31.6	0.000	0.000	0.000	0.0	0.0	0.0
3 B 4 e	Horses	CH4	0.82	0.15	15.0	30.0	33.5	0.000	0.000	0.000	0.0	0.0	0.0
3 B 4 g	Poultry	CH4	0.46	0.30	20.0	30.0	36.1	0.000	0.000	0.000	0.0	0.0	0.0
3 B 1	Cattle	N_2O	8.98	3.28	5.0	100.0	100.1	0.009	0.001	0.001	0.1	0.0	0.0
3 B 2	Sheep	N2O	0.06	0.02	10.0	100.0	100.5	0.000	0.000	0.000	0.0	0.0	0.0
3 B 3	Swine	N2O	0.07	0.04	10.0	100.0	100.5	0.000	0.000	0.000	0.0	0.0	0.0
3 B 4 d	Goats	N2O	0.31	0.18	10.0	100.0	100.5	0.000	0.000	0.000	0.0	0.0	0.0
3 B 4 e	Horses	N2O	0.15	0.14	15.0	100.0	101.1	0.000	0.000	0.000	0.0	0.0	0.0
3 B 4 g	Poultry	N2O	0.71	0.41	20.0	150.0	151.3	0.000	0.000	0.000	0.0	0.0	0.0
3 D 1	Direct N2O emissions from managed soils	N2O	83.71	40.83	1.0	200.0	200.0	5.810	0.004	0.009	0.8	0.0	0.6
3 F 1	Cereals	CH4	0.04	0.02	50.0	100.0	111.8	0.000	0.000	0.000	0.0	0.0	0.0

3 F 1	Cereals	N2O	0.01	0.01	50.0	100.0	111.8	0.000	0.000	0.000	0.0	0.0	0.0
3 G	Liming	CO_2	0.06	0.03	20.0	50.0	53.9	0.000	0.000	0.000	0.0	0.0	0.0
3 H	Urea application	CO_2	0.43	0.34	20.0	50.0	53.9	0.000	0.000	0.000	0.0	0.0	0.0
5 A	Solid waste disposal	CH_4	153.58	247.03	30.0	50.0	58.3	18.076	0.029	0.052	1.4	0.9	2.8
5 B	Biological treatment of solid waste	CH4	0.00	0.00	0.0	0.0	0.0	0.000	0.000	0.000	0.0	0.0	0.0
5 D	Wastewater treatment and discharge	CH4	51.26	57.63	30.0	100.0	104.4	3.153	0.004	0.012	0.4	0.1	0.2
5 E	Other	CH4	0.00	0.00	2.0	5.0	5.4	0.000	0.000	0.000	0.0	0.0	0.0
5 B	Biological treatment of solid waste	N_2O	0.00	0.00	5.0	3.0	5.8	0.000	0.000	0.000	0.0	0.0	0.0
5 D	Wastewater treatment and discharge	N_2O	11.98	14.99	30.0	150.0	153.0	0.458	0.001	0.003	0.2	0.0	0.0
Total			**4,796.00**	**3,394.27**			**6598**	37.72					**7.37**
					Percentage uncertainty in total inventory			**6.1**				**Trend uncertainty**	**2.7**

A2 Additional information detailing climate finance and capacity building needs and aid provided

Table 82 Information on the financial support needed under Article 9 of the Paris Agreement

Sector	Subsector	Name of the activity, project or program	Description	Value (Euro)	Value[109] (USD)	Timeline	Financial Instrument	Sector	Contribution to the transfer and development of technology (yes/no)	Contribution to capacity building (yes/no)	It is based on the Strategic Strategy Document (NDC), Strategy (yes/no)
Energy	Electricity generation	New renewable power plants	Construction of solar and wind power plants	739,600,000	803,057,680	2025-2030	Grant Loan on favourable terms	Mitigation of CP	Yes I do	No	Yes
Energy	Central heating	Heating of Pljevlja	Development of District Heating System in Pljevlja	23,000,000	24,973,400	2025-2030	Grant Loan on favourable terms	Mitigation of CP	Yes I do	No	Yes
Energy	Energy Efficiency	Improving Energy Efficiency in Public Buildings	Improvement of energy efficiency and comfort conditions in selected public sector buildings	55,800,000	60,587,640	2025-2030	Grant Loan on favourable terms	Mitigation of CP	Not	Not	Yes
Energy	Energy Efficiency	Implementation of Energy Efficiency Measures in Public Municipal Enterprises	This measure envisages the improvement of conditions, supervision and maintenance, as well as investment in improving energy efficiency in relation to: • public lighting	5,120,000	5,559,296	2025-2030	Grant Loan on favourable terms	Mitigation of CP	No	No	Yes

[109] Exchange rate 1 EUR = 1.0858 USD (31/10/2024). Source: https://www.bloomberg.com/quote/EURUSD:CUR

Sector	Subsector	Name of the activity, project or program	Description	Value (Euro)	Value[109] (USD)	Timeline	Financial Instrument	Sector	Contribution to the transfer and development of technology (yes/no)	Contribution to capacity building (yes/no)	It is based on the Strategic Strategy Document (NDC), Strategy (yes/no)
			• Water supply and sewage • other utilities								
Energy	Ostali sector	Development of the energy transmission and distribution network (reduction of losses)	With this measure, energy transmission and distribution network operators will improve network capacities in order to ensure reliable electricity supply to all users on the network	640,000,000	694,912,000	2025-2030	Grant Loan on favourable terms	Mitigation of CP	No	No	Yes
Energy	Electricity generation	Overhaul of small hydro power plants (increased EE)	The renovation will carry out the reconstruction/replacement and modernisation of equipment and facilities of existing small hydropower plants	3,260,000	3,539,708	2025-2030	Grant Loan on favourable terms	Mitigation of CP	No	No	Yes
Waste management	Bio-waste management	Reducing bio-waste in municipal waste	Reducing emissions from biodissolution	33,800,000	36,700,040	2025-2035	Grant Loan on favourable terms	Mitigation of CP	Not	Not	Yes
Wastewater	Domestic wastewater management	Increasing the rate of connection to the sewage system (target value of 93% by 2035)	Reducing GHG emissions through better wastewater management	553,900,000	601,424,620	2025-2035	Grant Loan on favourable terms	Mitigation of CP	No	No	Yes
Agriculture	Agricultural production	To raise the capacity and	Combined production practices can refer to a	750,000	814,350	2025-2030	Grant	Customisation to KP	No	Also	Also

Sector	Subsector	Name of the activity, project or program	Description	Value (Euro)	Value[109] (USD)	Timeline	Financial Instrument	Sector	Contribution to the transfer and development of technology (yes/no)	Contribution to capacity building (yes/no)	It is based on the Strategic Strategy Document (NDC), Strategy (yes/no)
		awareness of combined production practices in agriculture	range of techniques/strategies that agricultural producers can employ to reduce vulnerability to climate hazards, thus providing an instrument to mitigate their impact/alternative source of income if the dominant crop/livestock production fails due to adverse weather events								
Agriculture	Agricultural production	Improving the implementation of climate-smart agrotechnical measures	Increase the resilience of agricultural practices and systems to climate hazards, both those that occur quickly (storms, floods) and those that develop more slowly (temperature increases, decrease in precipitation)	728,000	790,462.40	2025-2030	Loan on favourable terms	Customisation to KP	No	Yes	Yes
Agriculture	Squash	Identification and implementation of measures to reduce climate stress on livestock	Improvement of common livestock farming practices in order to increase resilience to climate stress	994,000	1,079,285.20	2025-2030	Grant	Customisation to KP	Not	Also	Also
Agriculture	Squash	Conservation of meadows and pastures and	Adaptation measures for pastures and meadows may include grazing	1,410,000	1,530,978	2025-2030	Grant	Customisation to KP	Not	Also	Also

Sector	Subsector	Name of the activity, project or program	Description	Value (Euro)	Value[109] (USD)	Timeline	Financial Instrument	Sector	Contribution to the transfer and development of technology (yes/no)	Contribution to capacity building (yes/no)	It is based on the Strategic Strategy Document (NDC), Strategy (yes/no)
		promotion of sustainable land use practices	management (livestock rotation, grazing regime, use of underused pastures), land restoration, regeneration and rehabilitation of degraded grasslands (through sowing, agroforestry, runoff and erosion control, improvement of water retention), as well as prevention of further degradation from fires and invasive species (through fire fencing, weeding)								
Water management	Water monitoring	Strengthening the network of measuring stations and improving the monitoring of water-related data	Through this measure, technical and human capacities for monitoring water-related data will be improved in the following ways: ● Procurement and installation of new meteorological and hydrological measuring stations (at least six of each type) ● Conducting geodetic surveys to obtain updated	1,575,000	1,710,135	2025-2030	Grant	Customisation to KP	Not	Also	Also

Sector	Subsector	Name of the activity, project or program	Description	Value (Euro)	Value[109] (USD)	Timeline	Financial Instrument	Sector	Contribution to the transfer and development of technology (yes/no)	Contribution to capacity building (yes/no)	It is based on the Strategic Strategy Document (NDC), Strategy (yes/no)
			information on river bed profiles for the purpose of flood monitoring ● Capacity building for relevant personnel in the field of warehousing, handling and data analysis ● Procurement of adequate field equipment to strengthen the technical capacities of relevant personnel								
Water management	Flood water management	Improving flood risk mapping and interventions that prioritise natural water retention measures	Natural Water Retention Measures (LCD) are measures that preserve and improve the water retention capacity of dispensed, land, and ecosystems. These can be achieved through the maintenance and rehabilitation of natural aquatic ecosystems (e.g. restoration of river banks and wetlands, reconnection of river beds and meanders), as well as through land use planning and interventions (such as	167,000	181,328.60	2025-2035	Grant	Customisation to KP	No	No	Yes

Sector	Subsector	Name of the activity, project or program	Description	Value (Euro)	Value[109] (USD)	Timeline	Financial Instrument	Sector	Contribution to the transfer and development of technology (yes/no)	Contribution to capacity building (yes/no)	It is based on the Strategic Strategy Document (NDC), Strategy (yes/no)
			forest protection and management, afforestation of upstream catchment areas, restoration and maintenance of pastures, buffer belts, land management practices, urban forests, etc.).								
Water management	Water management	Improving the capacity of policymakers and strengthening research and management capacities to assess the risks and occurrences of adverse impacts of climate change and adaptation of freshwater systems	This measure will consist of the following: - Develop and implement a targeted training program on climate change adaptation for policy makers in the water sector - Develop and implement a targeted training program for data collection, analysis and use (special focus on GIS) for use in the water sector and planning, as well as in various programs and projects - Procurement and installation of appropriate hardware and software in relevant institutions and	438,000	475,580.40	2025-2035	Grant	Customisation to KP	No	Yes	Yes

Sector	Subsector	Name of the activity, project or program	Description	Value (Euro)	Value[109] (USD)	Timeline	Financial Instrument	Sector	Contribution to the transfer and development of technology (yes/no)	Contribution to capacity building (yes/no)	It is based on the Strategic Strategy Document (NDC), Strategy (yes/no)
			training of employees in their use								
Water management	Water supply	Develop new methodologies and develop watershed protection zone projects on all water sources that integrate climate change aspects	Strengthening the legislative and policy framework through the inclusion and implementation of climate change adaptation measures, as well as raising the capacity of water utilities to address and implement these requirements	726,000	788,290.80	2025-2035	Credit on favourable terms.	Customisation to KP	No	Yes	Yes
Human health	Health system	Improve the preparedness of personnel, facilities and systems in the health sector for climate hazards, through training, climate risk assessment and specific interventions	Improving the health system in Montenegro in order to be able to cope with the growing challenges posed by climate change	504,000	547,243.20	2025-2030	Credit on favourable terms.	Customisation to KP	No	Yes	Yes
Human health	Health system	Include and define the role of the health sector in emergency preparedness and	Integrating aspects of health services into crisis preparedness plans, including those triggered by climate change	678,000	736,172.40	2025-2030	Credit on favourable terms.	Customisation to KP	No	Yes	Yes

Sector	Subsector	Name of the activity, project or program	Description	Value (Euro)	Value[109] (USD)	Timeline	Financial Instrument	Sector	Contribution to the transfer and development of technology (yes/no)	Contribution to capacity building (yes/no)	It is based on the Strategic Strategy Document (NDC), Strategy (yes/no)
		response in national and local preparedness plans									
Human health	Health system	Introduce an early warning system to prepare the health sector for an appropriate response during weather extremes, supported by training programs to improve the knowledge and skills of health care workers	Introduction of an Early Warning System (SRU) to prepare the health sector to respond to extreme weather events and reduce their impact	834,000	905,557.20	2025-2030	Grant	Customisation to KP	Yes I do	Yes	Yes
Human health	Health system	Development and promotion of education, awareness raising and general guidance and support to facilities for the population during heatwaves and extreme conditions	Improving the knowledge of the general population about the health risks associated with heatwaves and extreme weather events in order to reduce the vulnerability of the population, especially vulnerable marginalised and isolated groups, to climate change	552,000	599,361.60	2025-2030	Grant	Customisation to KP	No	Yes	Yes
Tourism	Tourist offer	Developing community-based	Assisting the community in building adequate	520,000	564,616	2025-2035	Grant	Customisation to KP	Not	Yes	Yes

Sector	Subsector	Name of the activity, project or program	Description	Value (Euro)	Value[109] (USD)	Timeline	Financial Instrument	Sector	Contribution to the transfer and development of technology (yes/no)	Contribution to capacity building (yes/no)	It is based on the Strategic Strategy Document (NDC), Strategy (yes/no)
		tourism programs as a strategy to build climate resilience, e.g. promoting rural, agro and eco-tourism and other high-value, low-impact tourism products	infrastructure and capacity to manage potential changed conditions due to changes in climate parameters and available resources								
Tourism	Tourist offer	Providing financial and non-financial support to tourism communities that are vulnerable to climate change to help diversify and adapt to climate change, with a sustainable tourism offer	Helping communities diversify their tourism offerings and adapt to climate change in a way that they are able to create a climate-resilient offering	556,000	603,704.80	2025-2035	Grant	Customisation to KP	No	Yes	Yes
Tourism	Tourist offer	Improving funding opportunities to facilitate research and innovation in sustainable tourism practices and so that they can be	Providing appropriate support to the scientific community, researchers, innovators, non-governmental organisations and entrepreneurs in the development of new	834,000	905,557.20	2025-2035	Grant	Customisation to KP	No	Yes	Yes

Sector	Subsector	Name of the activity, project or program	Description	Value (Euro)	Value[109] (USD)	Timeline	Financial Instrument	Sector	Contribution to the transfer and development of technology (yes/no)	Contribution to capacity building (yes/no)	It is based on the Strategic Strategy Document (NDC), Strategy (yes/no)
		implemented more widely	technologies and practices in the tourism sector in order to create a sustainable and resilient tourism sector								
Tourism	Tourist infrastructure	Upgrading the early warning system for tourism businesses and users and implementing awareness-raising programs	Establishment of an effective early warning system for tourists and tourist operettas in order to provide timely information about impending dangers and slowly developing events	376,000	408,260.80	2025-2035	Loan on favourable terms	Customisation to KP	Yes I do	Yes	Yes
Cross-sectoral activities	Monitoring and Evaluation	Creating detailed procedures for data collection, monitoring and reporting across all sectors, with a database for data management to ensure the availability of data for planning, policy and programming	Establishing transparent, detailed and comprehensive procedures for collecting, managing and monitoring data to enable successful adaptation to climate change	928,000	1,007,622.40	2025-2030	Loan on favourable terms	Customisation to KP	No	Yes	Yes
Cross-sectoral activities	Agriculture, tourism, health and	Cross-sectoral programming for the integration of	The aim of this action is to establish cross-sectoral programming that	1,016,000	1,103,172.80	2025-2030	Grant	Customisation to KP	No	Yes	Yes

Sector	Subsector	Name of the activity, project or program	Description	Value (Euro)	Value[109] (USD)	Timeline	Financial Instrument	Sector	Contribution to the transfer and development of technology (yes/no)	Contribution to capacity building (yes/no)	It is based on the Strategic Strategy Document (NDC), Strategy (yes/no)
	water sectors	planning in agricultural sectors, Tourism, Health and Water, with a joint programme addressing climate change. risks in these sectors	integrates planning and planning. in the agriculture, tourism, health and water sectors. The aim of the action is to develop a common A program that proactively addresses climate risks and enhances resilience in these areas. interconnected sectors								
Cross-sectoral activities	Awareness raising and education	Develop educational programs for schools, institutions of higher education (Universities/Lifelong Learning) and Programs for Competent Sectoral Institutions institutions that raise awareness, capacity and preparedness for climate change changes and their impact	Raising awareness education at all levels to deal with the consequences and preparedness for climate change in Montenegro	1,192,000	1,294,273.60	2025-2030	Grant	Customisation to KP	No	Yes	Yes

Table 83 Information on financial support received in accordance with Article 9 of the Paris Agreement

Name of the activity, project or program	Description	Donor	User	An entity that conducts	Value (Euro)	Value[110] (USD)	Timeline	Financial Instrument	Status (assigned/ contracted)	Area	Sector	Under-Sector	Contribution to the transfer and development of technology (yes/no)	Contribution to capacity building (yes/no)	Status (planned, active, completed)
Support in the preparation of projects for the environment and climate action sector	Support in compliance with the EU acquis and implementation of regulations	EU IPA	Ministry of Ecology, Sustainable Development and Northern Development	Capital Projects	3,234,000.00	3,511,477.20	2021-2024	Grant	Allocated funds	Mitigation of CP	Environment and climate change	Climate change	No	Yes I do	Active
Technical support for capacity building	Support in the preparation of technical documentation and capacity building	EU IPA	Ministry of Ecology, Sustainable Development and Northern Development	Capital Projects	2,024,999.00	2,198,743.91	2024-2027	Grant	Contracted funds	Mitigation of CP	Environment and climate change	Climate change	No	Yes I do	Active
Support for the preparation of an updated national Climate Promise 2 (NDC)	Support in updating the Nationally Determined Contribution to GHG Emission Reductions	UNDP	Ministry of Ecology, Sustainable Development and Northern Development	UNDP	257,874.38	280,000.00	2023-2024	Grant	Contracted funds	Mitigation of CP	Climate change	Decarbonisation	No	Yes I do	Active
Improving the capacity of	The project will focus on	GCF (ZKF)	National Contact	Environmental Protection	276,293.98	300,000.00	2023-2024	Grant	Contracted funds	Mitigation of CP	Climate change	Decarbonisation	No	Yes I do	Active

[110] Exchange rate 1 EUR = 1.0858 USD (31/10/2024). Source: https://www.bloomberg.com/quote/EURUSD:CUR

the National Contact Point for cooperation with the GCF and strengthening national activities for the implementation of the updated Nationally Determined Contribution to GHG Emission Reductions in line with the Paris Agreement (NDC)	achieving the following objectives: • Improving the capacity of the National Contact Person for cooperation with the Chamber of Commerce and Industry. Improving the capacity of the Eco Fund for planning and accessing climate finance and supporting the implementation of the Nationally Determined Contribution to the Reduction of Greenhouse Gas Emissions (NDC). Updating the National Programme		Person for Cooperation with ZKF and Environmental Protection Fund - Eco Fund	Fund - Eco Fund											

	of Priority Actions in the Field of Climate Change Mitigation and Adaptation within Montenegro's cooperation with the GCF and its harmonisation with the NDC. Support for the implementation of the NDC through the development of an investment plan for the financing of priority activities														
Adapting to Climate Change and Improving Resilience in the Mountainous Region of	Improving the resilience of the mountainous region of Montenegro to the negative	Adaptation Fund (AF)	Ministry of Agriculture, Forestry and Water Management	IFAD	9,209,799.23	10,000,000.00	2023-2029	Grant	Contracted funds	Customisation to KP	Climate change	Rural development	No	Yes I do	Active

Montenegro – GORA	impacts of climate change														

Table 84 Information on the necessary support for capacity building in accordance with Article 11 of the Paris Agreement

Sector	Subsector	Name of the activity, project or program	Description	Area	Timeline
Agriculture	Agricultural production	To raise the capacity and awareness of combined production practices in agriculture	Combined production practices can refer to a range of techniques/strategies that agricultural producers can employ to reduce vulnerability to climate hazards, thus providing an instrument to mitigate their impact/alternative source of income if the dominant crop/livestock production fails due to adverse weather events	Customisation to KP	2025-2030
Telugu	Agricultural production	Improving the implementation of climate-smart agrotechnical measures	Increase the resilience of agricultural practices and systems to climate hazards, both those that occur quickly (storms, floods) and those that develop more slowly (temperature increases, decrease in precipitation)	Customisation to KP	2025-2030
Agriculture	Squash	Identification and implementation of measures to reduce climate stress on livestock	Improvement of common livestock farming practices in order to increase resilience to climate stress	Customisation to KP	2025-2030
Agriculture	Squash	Conservation of meadows and pastures and promotion of sustainable land use practices	Adaptation measures for pastures and meadows may include grazing management (livestock rotation, grazing regime, use of underused pastures), land restoration, regeneration and rehabilitation of degraded grasslands (through sowing, agroforestry, runoff and erosion control, improvement of water retention), as well as prevention of further degradation from fires and invasive species (through fire fencing, weeding)	Customisation to KP	2025-2030
Water management	Water monitoring	Strengthening the network of measuring stations and improving the monitoring of water-related data	Through this measure, technical and human capacities for monitoring water-related data will be improved in the following ways: ● Procurement and installation of new meteorological and hydrological measuring stations (at least six of each type) ● Conducting geodetic surveys to obtain updated information on river bed profiles for the purpose of flood monitoring ● Capacity building for relevant personnel in the field of warehousing, handling and data analysis	Customisation to KP	2025-2030

			● Procurement of adequate field equipment to strengthen the technical capacities of relevant personnel		
Water management	Flood water management	Improving flood risk mapping and interventions that prioritise natural water retention measures	Natural Water Retention Measures (LCD) are measures that preserve and improve the water retention capacity of dispensed, land, and ecosystems. These can be achieved through the maintenance and rehabilitation of natural aquatic ecosystems (e.g. restoration of river banks and wetlands, reconnection of river beds and meanders), as well as through land use planning and interventions (such as forest protection and management, afforestation of upstream catchment areas, restoration and maintenance of pastures, buffer belts, land management practices, urban forests, etc.).	Customisation to KP	2025-2035
Water management	Water management	Improving the capacity of policymakers and strengthening research and management capacities to assess the risks and occurrences of adverse impacts of climate change and adaptation of freshwater systems	This measure will consist of the following: - Develop and implement a targeted training program on climate change adaptation for policy makers in the water sector - Develop and implement a targeted training program for data collection, analysis and use (special focus on GIS) for use in the water sector and planning, as well as in various programs and projects - Procurement and installation of appropriate hardware and software in relevant institutions and training of employees in their use	Customisation to KP	2025-2035
Water management	Water supply	Develop new methodologies and develop watershed protection zone projects on all water sources that integrate climate change aspects	Strengthening the legislative and policy framework through the inclusion and implementation of climate change adaptation measures, as well as raising the capacity of water utilities to address and implement these requirements	Customisation to KP	2025-2035
Human health	Health system	Improve the preparedness of personnel, facilities and systems in the health sector for climate hazards, through training, climate risk assessment and specific interventions	Improving the health system in Montenegro in order to be able to cope with the growing challenges posed by climate change	Customisation to KP	2025-2030
Human health	Health system	Include and define the role of the health sector in emergency preparedness and response in national and local preparedness plans	Integrating aspects of health services into crisis preparedness plans, including those triggered by climate change	Customisation to KP	2025-2030
Human health	Health system	Introduce an early warning system to prepare the health sector for an	Introduction of an Early Warning System (SRU) to prepare the health sector to respond to extreme weather events and reduce their impact	Customisation to KP	2025-2030

		appropriate response during weather extremes, supported by training programs to improve the knowledge and skills of health care workers			
Human health	Health system	Development and promotion of education, awareness raising and general guidance and support to facilities for the population during heatwaves and extreme conditions	Improving the knowledge of the general population about the health risks associated with heatwaves and extreme weather events in order to reduce the vulnerability of the population, especially vulnerable marginalised and isolated groups, to climate change	Customisation to KP	2025-2030
Tourism	Tourist offer	Developing community-based tourism programs as a strategy to build climate resilience, e.g. promoting rural, agro and eco-tourism and other high-value, low-impact tourism products	Assisting the community in building adequate infrastructure and capacity to manage potential changed conditions due to changes in climate parameters and available resources	Customisation to KP	2025-2035
Tourism	Tourist offer	Providing financial and non-financial support to tourism communities that are vulnerable to climate change to help diversify and adapt to climate change, with a sustainable tourism offer	Helping communities diversify their tourism offerings and adapt to climate change in a way that they are able to create a climate-resilient offering	Customisation to KP	2025-2035
Tourism	Tourist offer	Improving funding opportunities to facilitate research and innovation in sustainable tourism practices and so that they can be implemented more widely	Providing appropriate support to the scientific community, researchers, innovators, non-governmental organisations and entrepreneurs in the development of new technologies and practices in the tourism sector in order to create a sustainable and resilient tourism sector	Customisation to KP	2025-2035
Tourism	Tourist infrastructure	Upgrading the early warning system for tourism businesses and users and implementing awareness-raising programs	Establishment of an effective early warning system for tourists and tourist operettas in order to provide timely information about impending dangers and slowly developing events	Customisation to KP	2025-2035
Cross-sectoral activities	Monitoring and Evaluation	Creating detailed procedures for data collection, monitoring and reporting across all sectors, with a database for	Establishing transparent, detailed and comprehensive procedures for collecting, managing and monitoring data to enable successful adaptation to climate change	Customisation to KP	2025-2030

		data management to ensure the availability of data for planning, policy and programming			
Cross-sectoral activities	Agriculture, tourism, health and water sectors	Cross-sectoral programming for the integration of planning in agricultural sectors, Tourism, Health and Water, with a joint programme addressing climate change. risks in these sectors	The aim of this action is to establish cross-sectoral programming that integrates planning and planning. in the agriculture, tourism, health and water sectors. The aim of the action is to develop a common A program that proactively addresses climate risks and enhances resilience in these areas. interconnected sectors	Customisation to KP	2025-2030
Cross-sectoral activities	Awareness raising and education	Develop educational programs for schools, institutions of higher education (Universities/Lifelong Learning) and Programs for Competent Sectoral Institutions institutions that raise awareness, capacity and preparedness for climate change changes and their impact	Raising awareness education at all levels to deal with the consequences and preparedness for climate change in Montenegro	Customisation to KP	2025-2030

Table 85 Information on the support received for capacity building in accordance with Article 11 of the Paris Agreement

Name of the activity, project or program	Description	Timeline	User	An entity that conducts	Area	Sector	Subsector	Status (planned, active, completed)	Additional information
Support in the preparation of projects for the environment and	Support in compliance with the EU acquis and implementation of regulations	2021-2024	Ministry of Ecology, Sustainable Development	Capital Projects	Mitigation of CP	Environment and climate change	Climate change	Active	

climate action sector			and Northern Development						
Technical support for capacity building	Support in the preparation of technical documentation and capacity building	2024-2027	Ministry of Ecology, Sustainable Development and Northern Development	Capital Projects	Mitigation of CP	Climate change	Decarbonisation	Active	
Support for the preparation of an updated national Climate Promise 2 (NDC)	Support in updating the Nationally Determined Contribution to GHG Emission Reductions	2023-2024	Ministry of Ecology, Sustainable Development and Northern Development	UNDP	Mitigation of CP	Climate change	Decarbonisation	Active	
Improving the capacity of the National Contact Point for cooperation with the GCF and strengthening national activities for the implementation of the updated Nationally Determined Contribution to GHG Emission Reductions in line with the Paris Agreement (NDC)	The project will focus on achieving the following objectives: ● Improving the capacity of the National Contact Person for cooperation with the Chamber of Commerce and Industry.Improving the capacity of the Eco-Fund for planning and accessing climate finance and supporting the implementation of the Nationally Determined Contribution to the Reduction of Greenhouse Gas Emissions (NDC). Updating the National	2023-2024	National Contact Person for Cooperation with ZKF and Environmental Protection Fund - Eco Fund	Environmental Protection Fund - Eco Fund	Mitigation of CP	Climate change	Rural development	Active	

	Programme of Priority Actions in the Field of Climate Change Mitigation and Adaptation within Montenegro's cooperation with the GCF and its harmonisation with the NDC. Support for the implementation of the NDC through the development of an investment plan for the financing of priority activities								
Adapting to Climate Change and Improving Resilience in the Mountainous Region of Montenegro – GORA	Improving the resilience of the mountainous region of Montenegro to the negative impacts of climate change	2023-2029	Ministry of Agriculture, Forestry and Water Management	IFAD	Customisation to KP			Active	