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FIRST BIENNIAL UPDATE REPORT ON CLIMATE CHANGE

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MONTENEGRO

Podgorica, December 2015

Ministry of Sustainable Development and Tourism
Cente for Sustainable Development, Programme implemented jointly by the Govrenment of Montenegro and UNDP

List of Experts

National Circumstances:
- Borko Vulikic

National GHG Inventory:
- Irena Tadic

Climate Change Mitigation and Action Plan
- Nebojsa Jablan
- Vladislav Bizek

Constraints and Gaps: Technology, Financial and Capacity-Building Needs and Support Received
- Nebojsa Jablan

Monitoring, Reporting and Verification
- Eva Krtkova
- Ana Pejovic

Conclusions:
- Vladislav Bizek

Editor
- Vladislav Bizek

Project coordinators
- Snežana Dragojević, UNDP
- Olivera Kujundžić, Ministry of Sustainable Development and Tourism

Translators:
- Uroš Zeković

Proofreaders:
- Sanja Marjanović, Charlotte Rimmer

Design and Printing:
- APprint

Photographs:
- UNDP Montenegro

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LIST OF ABBREVIATIONS

BAT	Best Available Techniques
BUR	Biennial Update Report
BWDP	Biodegradable Waste Disposal Programme
CDM	Clean Development Mechanism
CLRTAP	UNECE Convention on Long-range Trans-boundary Air Pollution
CNG	Compressed Natural Gas
COP	Conference of Parties
CRF	Common Reporting Format
DEMM	Deterministic Equivalent Modelling Method
DRR	Disaster Risk Reduction
EAP	Environmental Action Programme
ECRAN	Environment and Climate Regional Accession Network
EDS	Energy Development Strategy
EDS 2030	Energy Development Strategy by 2030
EE	Energy Efficiency
EEA	European Environment Agency
EEPPB	Energy Efficiency Program in Public Buildings
EMAS	Eco Management and Audit Scheme
EMEP	European Monitoring and Evaluation Programme
EPA	Environment Protection Agency
EPCG	Electric Power Utility of Montenegro
ERA	Energy Regulatory Agency
ESCO	Energy Service Company
EU	European Union
EU ETS	EU Emissions Trading System
EUR	Euro
Eurostat	Statistical Office of the European Union
FBUR	First Biennial Update Report
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GWP	Global Warming Potential
HFCs	Hydro fluorocarbons
IBA	Important Bird Area
IBRD	International Bank for Reconstruction and Development
ICT	Information and Communication Technologies
IED	Industrial Emissions Directive
IFI	International Finance Institutes
INDC	Intended Nationally Determined Contribution
IPA	Important Plant Area
IPARD	Instrument for Pre-Accession Assistance in Rural Development.
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
KAP	Aluminium Plant Podgorica

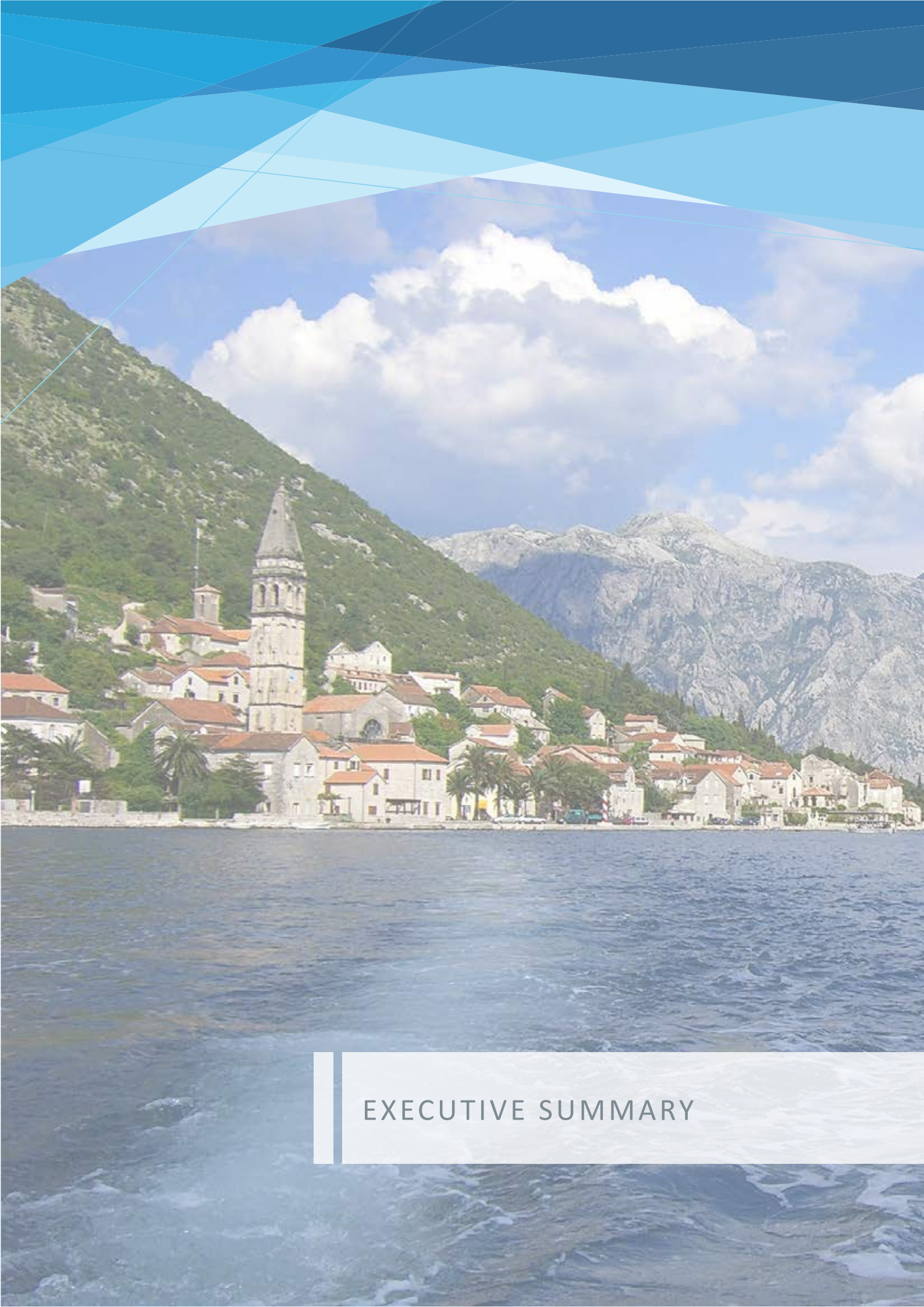
LCP	Large Combustion Plant
LPG	Liquefied Petrol Gas
LULUCF	Land Use, Land Use Change and Forestry
MEEP	Energy Efficiency Project in Montenegro
MONTESOL	Solar Water Heating Project for Montenegro's Domestic Sector
MONSTAT	Statistical Office of Montenegro
MRV	Monitoring, reporting and verification
MSDT	Ministry of Sustainable Development and Tourism
NAMA	Nationally Appropriate Mitigation Actions
NBSAP	National Biodiversity Strategy and Action Plan
NC	National Communications
NEC	National Emissions Ceiling
NFS	National Forest Strategy
NMVOC	Non Methane Volatile Organic Compounds
NP	National Park
NSAQM	National Strategy on Air Quality Management
NSSD	National Strategy of Sustainable Development
ODA	Official Development Assistance
ODS	Ozone Depleting Substance
OECD	Organisation for Economic Cooperation and Development
PA	Protected Area
PAM	Policies and Measures
PFCs	Perfluorocarbons
PPP	Parity of purchasing power
QA/QC	Quality Assurance / Quality Control
RES	Renewable Energy Sources
SARAD RPRP	Strategy for Agriculture and Rural areas Development
SEA	Strategic Environmental Assessment
SMART	Specific Measurable Achievable Realistic And Timely
SNC	Second National Communication
SRES	Special Report on Emissions Scenarios
TNA	Technology Needs Assessment
TPP	Thermal Power Plant
UN	United Nations
UNDP	United Nations Development Program
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WaM	With Additional Measures Scenario
WHO	World Health Organisation
WM	With Measures Scenario
WMS	Waste Management Strategy

List of Symbols

CF_4	Carbon Hexafluoride
C_2F_6	Hexafluoroethane
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2 eq.	Carbon Dioxide Equivalent
NO_X	Nitrogen Oxides
N_2O	Nitrous Oxide
SF_6	Sulphur Hexafluoride
SO_2	Sulphur Dioxide

List of Units

Gg	Gigagram
GWh	Gigawatthour
kg	Kilogram
ktoe	Kiloton of oil equivalent
kWh	Kilowatthour
m^2	Square metre
m^3	Cubic metre
MW	Megawatt
PJ	Potajoule
s	Second
t	Ton
TJ	Terrajoule
TWh	Terrawatthour



EXECUTIVE SUMMARY

INTRODUCTION

The First Biennial Update Report (FBUR) represents a significant national contribution towards fulfilling the country's commitments to the United Nations Framework Convention on Climate Change (UNFCCC).

The FBUR consolidates sectoral analyses on Greenhouse Gas (GHG) emissions and provides transparency regarding Montenegro's progress in relation to mitigation action and its effectiveness. The FBUR represents the next logical step which is built on the findings and recommendations of the following recent documents:

- The Second National Communication to the UNFCCC (submitted in 2015)
- The National Climate Change Strategy of Montenegro until 2030 (adopted 2015)
- Intended Nationally Determined Contribution of Montenegro (submitted 2015)

Thus, it captures information from the outcomes of on-going complementary projects within the country.

Montenegro's contribution to the international effort (INDC) to avoid dangerous climate change is expressed as a 30 % reduction in emissions by 2030 compared with the base year, 1990.

NATIONAL CIRCUMSTANCES

Montenegro can be characterised by the following parameters:

General Characteristics

- The area of the country is 13,812 km2
- It is a mountainous country
- Its climate characteristics range from Mediterranean to sub-Alpine
- It is a water rich country (average annual runoff 624 m3/s)
- It has high quality ground water
- Its territorial sea water totals approximately 2,540 km2
- Its coastal zone represents 11 % of the total territory
- Agricultural land represents 22.4 % of the total territory
- Forests cover more than 60 % of the total territory
- It is a biodiversity 'hot-spot' in the Mediterranean area
- Protected areas represent 11% of the territory
- Environmental problems are present (air and water pollution, waste management)

Basic Economic and Social Characteristics

- It has a population of 620,029 (2011)
- Its GDP is 41 % of the EU-28 average (in PPP)
- Its trade balance is €683 million (2013)
- It has experienced an increasing trend in GDP from 2000
- It has an unemployment rate of 19.7 % (2012)
- The share of solid fuels in the total energy mix represents around 70 %
- 21 – 37 % of its energy comes from renewable sources (mainly hydro power)
- The per capita consumption of primary energy is 1800 ktoe/year
- The share of industry in the GDP is 7 – 10 %
- The share of mining industry (bauxite, lead-zinc ore, lignite) in the GDP is 2 %
- The share of transport in the GDP is 11 – 12 %
- The role of tourism is increasing

Country Specific Issues

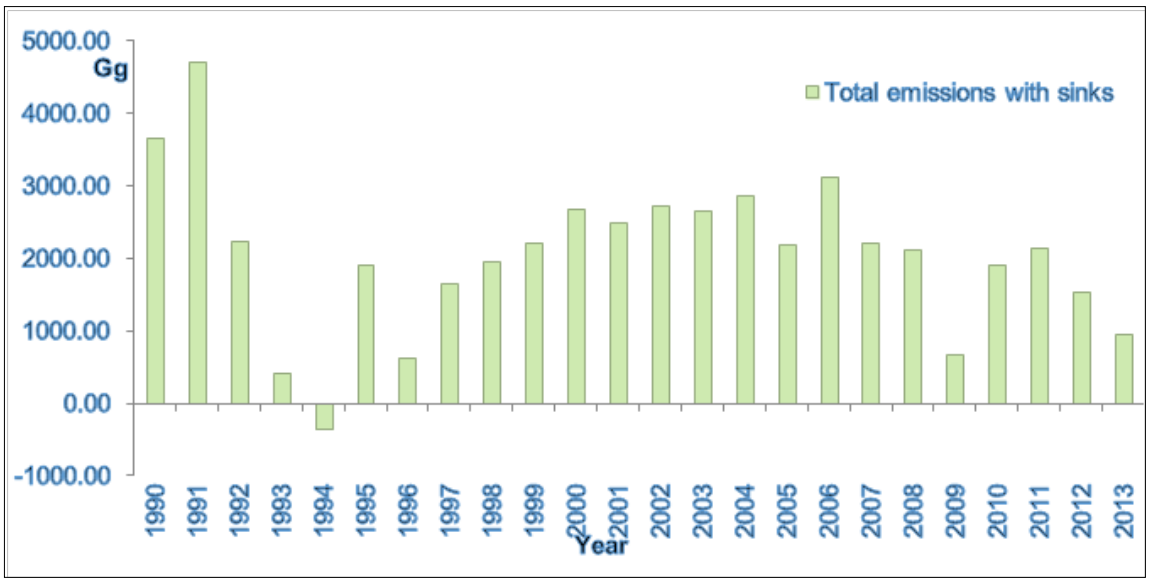
- **The majority of all of the national GHG emissions are produced by a very small number of stationary installations** (only one coal fired LCP[1] is in operation – TPP Pljevlja which has CO_2 emissions of up to 1,800 Gg, and there is one industrial installation – KAP – which has $CO_{2\ eq.}$ emissions varying from 216 Gg to 1,762 Gg). As the total annual national emissions of GHG (without removals) are at a level of 4,000 Gg of CO_2 eq., it can be seen that emissions from TPP Pljevlja and KAP could each individually represent up to 45 % of the national total and that both together could represent up to 90 %.
- **Montenegro's total national emission balance contains a very high share of synthetic gases (F-gases)** (depending of production levels at KAP Aluminium Works, Podgorica).
- **There are very high levels of CO_2 sinks in comparison with CO_2 emissions** (2,222 Gg compared with 2,440 Gg in 2013); **this is caused by high levels of forest coverage in the country** (69.8 % in 2013).

NATIONAL GHG INVENTORY

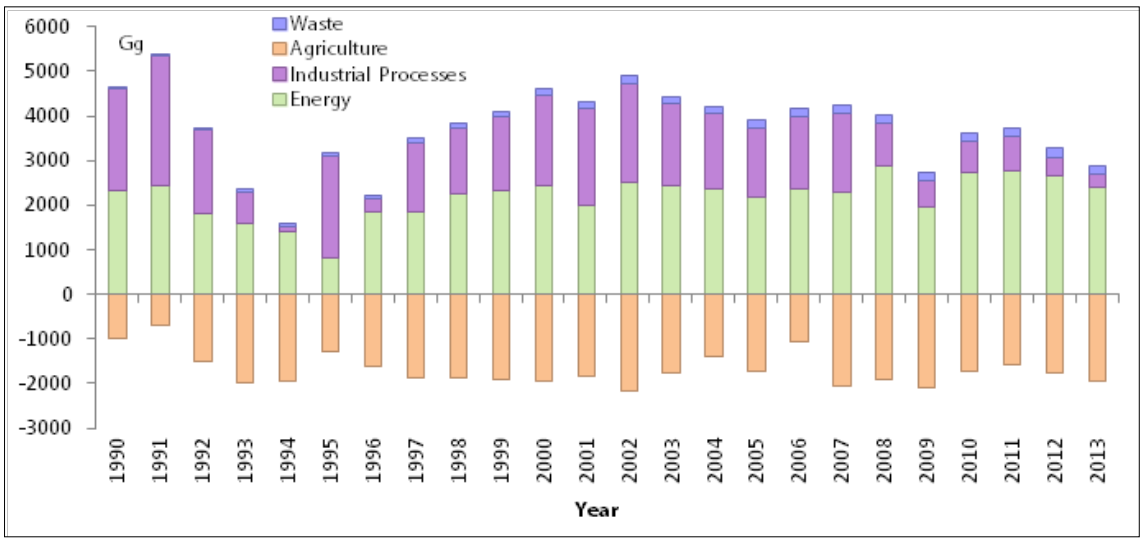
- **Total emissions including sinks ranged from -364.57 Gg CO_2 eq. in 1994 to 4703.27 Gg in 1991**
- **High levels of CO_2 sinks** are due to large forest areas in Montenegro; low emission levels, however, have been estimated in agriculture mainly due to incomplete estimates resulting from a lack of statistical data. This, as well as negative economic trends and a continuous decline in industrial production, has resulted in relatively low levels of emissions being recorded in some years during the observed period.
- **Total greenhouse gas emissions (without sinks) presented as CO2 eq range from 2,121.89 Gg in 1994 to 5,985.49 Gg in 1991**

Year	Energy	Industrial Processes	Agriculture and Land Use	Waste	Total Emissions With Sinks	Total Emissions Without Sinks
			(Gg CO_2 eq)			
1990	2,352.61	2,272.87	-987.83	19.618	3,657.27	5,238.52
1991	2,450.28	2,909.18	-691.16	34.97	4,703.27	5,985.49
1992	1,809.33	1,891.39	-1,504.53	45.41	2,235.27	4,293.39
1993	1,602.90	709.60	-1,974.81	57.43	418.00	2,923.52
1994	1,428.09	94.12	-1,946.76	68.97	-364.57	2,121.89
1995	825.24	2,272.87	-1,263.66	80.39	1,914.84	3,742.74
1996	1,842.40	294.48	-1,592.61	91.69	635.96	2,788.23
1997	1,850.80	1,547.59	-1,855.69	105.17	1,647.87	4,043.37
1998	2,259.86	1,471.88	-1,882.02	116.04	1,965.76	4,380.87
1999	2,332.16	1,648.27	-1,895.22	126.57	2,211.78	4,640.09
2000	2,427.50	2,046.92	-1,921.70	136.79	2,689.51	5,156.55
2001	2,013.42	2,173.09	-1,831.38	146.02	2,501.15	4,847.49
2002	2,517.68	2,223.86	-2,171.93	154.39	2,724.00	5,415.80
2003	2,427.77	1,846.00	-1,771.35	161.92	2,664.34	4,962.67
2004	2,388.09	1,665.62	-1,367.44	168.61	2,854.88	4,726.41
2005	2,200.89	1,544.11	-1,730.85	174.48	2,188.63	4,278.82
2006	2,356.22	1,635.67	-1,044.51	179.63	3,127.01	4,519.17
2007	2,293.34	1,769.81	-2,042.20	184.25	2,205.20	4,628.58
2008	2,904.72	930.08	-1,907.74	188.21	2,115.27	4,355.32
2009	1,979.14	572.38	-2,080.66	190.26	661.12	3,009.31
2010	2,725.54	722.66	-1,725.92	193.65	1,915.93	3,904.95
2011	2,768.15	765.59	-1,583.79	197.41	2,147.36	4,017.89
2012	2,684.24	398.94	-1,754.26	200.49	1,529.41	3,571.94
2013	2,415.87	282.93	-1,941.39	199.26	956.67	3,178.28

1 LCP = Large combustion plant with a rated thermal input of 50 MW or more.



- The share of emissions produced by the energy sector ranged from 22.12% in 1995 to 76.10% in 2013
- The share of emissions produced through industrial processes ranged from 4.43% in 1994 to 60.91% in 1995; CO_2 eq emissions produced by the agriculture sector ranged from 6.54% in 2010 to 20.16% in 1994
- The waste sector produced the least emissions with levels which ranged from 0.38% in 1990 to 6.33% in 2009



- CO_2 represented the highest share of all total GHG emissions (24.6-74.5%), followed by PFC (CF_4 and C_2F_6) which ranged from 3% to 40.9%
- The share of CH_4 ranged from 10% to 27.5%
- The share of N_2O ranged from 2.3% to 5.8 %.
- SF_6 represented the lowest share in all total emissions and ranged from 0.01% to 0.07%
- In line with data that was available when recalculating the inventory, HFC emissions (2012 and 2013) were only estimated for one subsector, 2.F., Product Uses as Substitutes for Ozone Depleting Substances (2.F.1 – Refrigeration and Air Conditioning).

CLIMATE CHANGE MITIGATION AND ACTION PLAN

Strategic Approach

- To move towards a 'low carbon economy'
- To focus on the coordination of measures regarding EU pre-accession activities
- To focus on 'one measure – more effects' measures (mainly in terms of the co-benefits resulting from an integrated approach regarding GHG mitigation and the emission of air pollutants; to reduce both whilst simultaneously minimising mutual trade-offs)
- To implement a top-down approach (two stationary sources represent the majority of all national GHG emissions)
- To have a strong focus on prioritisation (scenarios do not, however, include all possible GHG mitigation measures)

Scenarios

Due to the EU pre-accession process, scenario without measures has not been developed, as such scenarios would not be applicable to EU candidate countries; the following scenarios have therefore been proposed:

- **Scenario with measures** (WM scenario) which includes the measures that are laid down in national and/or EU legislation and strategies.
- **Scenario with additional measures** (WaM scenario) which includes the original WM scenario extended by additional measures that are not required by EU legislation and/or measures for which EU legislation allows flexibility regarding certain quantified requirements.

The scenario with measures (WM) includes 14 measures:

- Introduction of BAT[2] in energy and industry installations (2 measures – TPP Pljevlje, KAP)
- Energy sector (4 measures)
- Transport (2 measures)
- Forestry (1 measure)
- Agriculture (1 measure)
- Waste management (1 measure)
- Tourism and services (1 measure)
- Horizontal (cross-cutting) issues (3 measures)

The full implementation of the WM scenario could lead to a gross reduction in GHG emissions of more than 375 Gg CO_2 eq / year starting from 2024 (i.e. after the decommissioning of TPP Pljevlja I and its replacement by TPP Pljevlja II) in comparison with 2013. This reduction would, however, be cancelled out by an expected increase of emissions from the transport sector (an expected increase of 186 Gg CO_2 eq / year by 2020, when compared with 2013, and of 309 Gg CO_2 eq / year by 2025 plus an estimated increase in emissions from KAP (expected increase of 259 – 873 Gg CO_2 eq / year when compared to 2013). A reduction in the level of GHG emissions in the waste sector is estimated at a level of 80 Gg CO_2 eq. /year in 2020 in comparison to 2013. However, the overall level of GHG emissions could be reduced by more than 200 Gg of CO_2 eq / year in comparison to 2013.

As a result, the reconstruction of TPP Pljevlja, and also very importantly the implementation of BAT in KAP, is crucial regarding the overall level of national GHG emissions in Montenegro. Provided that all possible measures at KAP are implemented, the implementation of any additional WM scenario measures could also contribute to the partial 'neutralisation' of expected increases in GHG emissions in certain sectors (mainly transport).

The implementation of the WM scenario, in which all measures are based on EU legislation and policy,

2 BAT = Best Available Technique

would also help to reduce other negative impacts on the environment, especially air pollution.
Scenario WaM = Scenario WM + 6 additional measures (2 in the energy sector, 2 in the transport sector, one in waste management and one in the tourism sector).

Priorities

The WM and WaM scenarios do not include all of the possible measures that could lead to a reduction in the level of GHG emissions. Only the priority measures have been included, those for which a substantial reduction potential in GHG emissions can be expected (in many cases, also along with positive side-effects). The 20 priority measures have been divided into three categories:

Top Priorities

- Measure 1: The introduction of BAT into existing and newly built energy/industrial installations (especially TPP Pljevlja and KAP) (WM scenario)
- Measure 5: The improvement of energy performance in buildings (WM scenario)
- Measure 6: Support for alternative fuels in transport (WM scenario)
- Measure 8: Improvement regarding the status of forests and additional afforestation (WM scenario)
- Measure 14: Green procurement/green purchasing in the public sector (WM scenario)
- Measure 16: Support (subsidies) for households regarding the replacement of coal/wood fired boilers for new more efficient ones and/or regarding the improvement of the energy performance of buildings (WaM scenario)

High Priorities

- Measure 2: The construction of new hydro power plants (WM scenario)
- Measure 4: The construction of wind power plants (WM scenario)
- Measure 7: The redirection of 50 % of cargo transport to railways using electricity (WM scenario)
- Measure 10: The reduction of biodegradable waste in landfills (WM scenario)
- Measure 11: Support for 'low-carbon' tourism (WM scenario)
- Measure 15: Support (subsidies) for the use of solar thermal and photovoltaic energy (WaM scenario)
- Measure 17: The development of a transport infrastructure (highways, motorways, city by-passes (WaM scenario)

Medium Priorities

- Measure 3: The construction of biomass fired power plants (WM scenario)
- Measure 9: Support for organic farming (scenario WM scenario)
- Measure 12: The raising of public awareness regarding the reduction of GHG emissions (WM scenario)
- Measure 13: Emphasis on GHG mitigation measures in EIA and SEA processes (WM scenario)
- Measure 18: The improvement of road transport organisation in cities and the introduction of integrated concepts (SMART cities) (WaM scenario)
- Measure 19: Energy recovery from waste (WaM scenario)
- Measure 20: Support for sustainable tourism (eco-tourism) (WaM scenario)

The great majority of proposed measures represents general categories which will be implemented through specific projects. **In order to be able to prioritise particular projects, detailed criteria and methodology for project priority setting have been developed (see Annex 4).**

CONSTRAINTS AND GAPS: TECHNOLOGY, FINANCIAL AND CAPACITY-BUILDING NEEDS AND SUPPORT RECEIVED

- The institutional set-up and the capacity of the state have shown evident progress over recent years. However, there are still needs, gaps and obstacles that impede the further development of climate-related activities

- Currently available financial, technical and capacity-building support still cannot meet the growing requirements related to the challenges of climate change
- Montenegro must continue to draw support from a large number of international donors, including national governments, non-profit organisations and international organisations
- Bilateral technical cooperation across all sectors needs to be enhanced and expanded
- The exchange of expertise and technology needs to be promoted in order to achieve greater efficiency in mitigation activities

Technology Required for the Purpose of Climate Change Mitigation

- Energy-efficient technology in all sectors of the economy and in the housing and commercial sectors,
- Technology that uses renewable energy sources (hydro, wind, solar and biomass)
- Technology designed to efficiently use water, land, forests, coastal area and other natural resources.
- The introduction of low-carbon modern technology; this will require continuous cooperation with international organisations and institutions, along with a review of best international practices and the implementation of various projects supported by international donors.

Financial Needs Concerning Climate Change Mitigation

- A number of mitigation activities have already taken place in the country.
- The Government is still working on securing additional financial resources – thus, under IPA II Montenegro has been allocated €37.5 million for environment and climate change (not including the funds allocated for cross-border cooperation) and €32.1 million for transport for the period 2014-2020.
- Attracting investment is of major importance in ensuring the long-term, sustainable and balanced development of the country.

Capacity Building Needed for Mitigation Purposes

- Further support is needed to continue developing and consolidating existing technical and institutional capacities along with efforts to integrate climate change into national policies, programmes and plans.

MONITORING, REPORTING AND VERIFICATION (MRV)

The MRV system is an important tool that is required to achieve national mitigation targets. The proposed concrete steps for the establishment of the MRV system in Montenegro include the following:

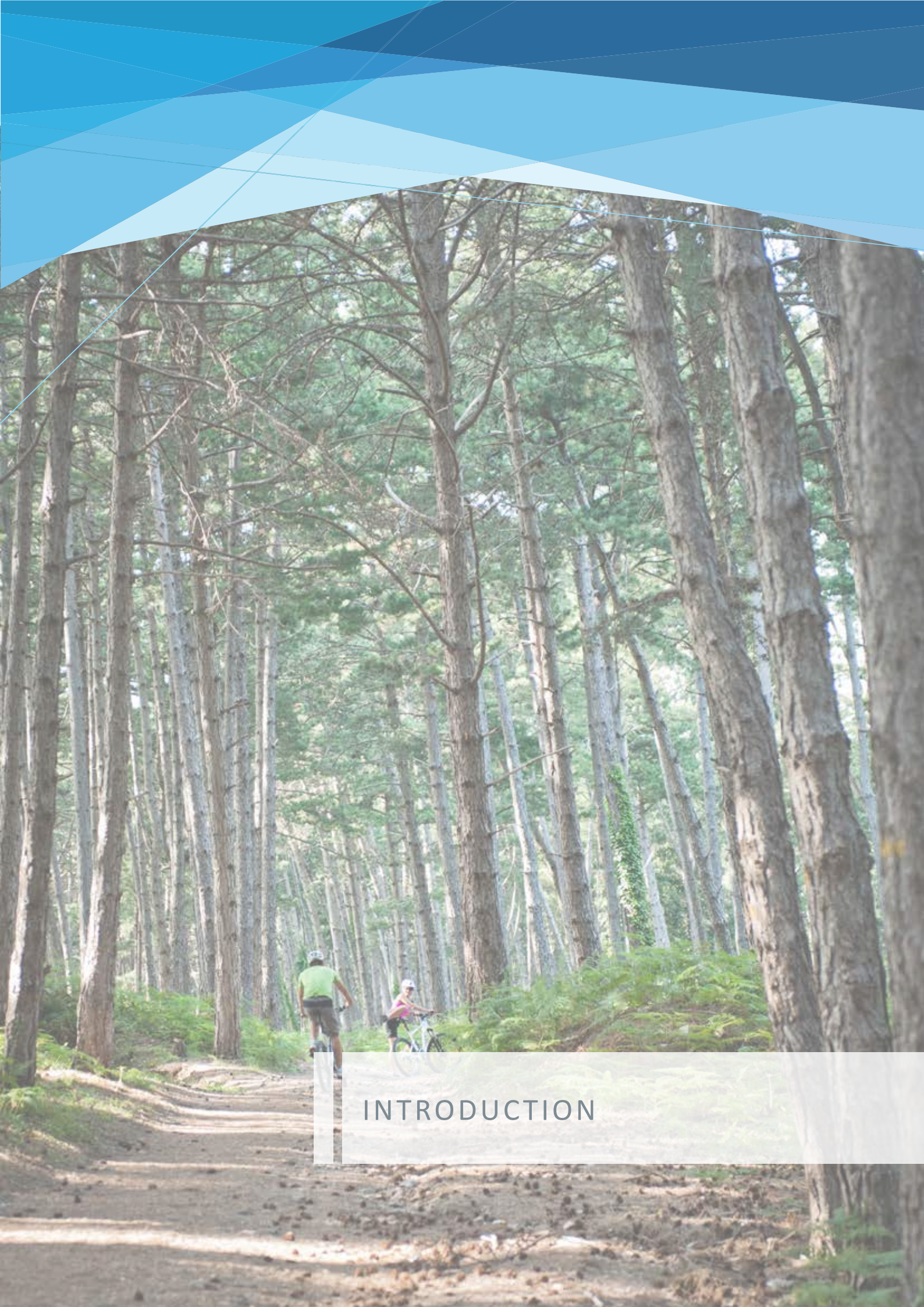
1. Precisely defined institutional arrangements and processes
2. Clearly defined GHG mitigation actions and accounting procedures
3. The establishment of data collection and reporting responsibilities
4. The establishment of clear and transparent reporting obligations
5. Verification and quality assurance.

CONCLUSIONS

Based on the information included in this First Biennial Update Report, it can be concluded that:

- Montenegro has speeded up its activities relating to climate change issues in 2015 (the preparation of the 2nd National Communication, the adoption of the National Climate Change Strategy till 2030 and the adoption of the Intended Nationally Determined Contribution)
- Montenegro has developed two realistic mitigation scenarios focused on a limited number of efficient measures as well as the Mitigation Action Plan till 2020
- Montenegro has substantial GHG emission reduction potential and, due to its specific conditions (high levels of afforestation, two easily defined stationary sources of GHG emissions), it can move towards a 'low carbon future'
- Montenegro has a detailed national emission inventory (till 2013); however, the methodology of the inventory should be improved to increase its accuracy and to cover source categories that are missing

- Montenegro has identified its technology needs, especially in the energy and industry sectors, where there is considerable scope for the reduction of GHG emissions. It is necessary for Montenegro to attract foreign investment in this area.
- Montenegro has developed basic administrative structures to deal with climate change issues, however additional capacity building is still needed.



INTRODUCTION

This First Biennial Update Report on Climate Change (FBUR) consolidates sectoral analyses on Greenhouse Gas (GHG) emissions and provides transparency for Montenegro's progress with mitigation actions and their effects. The FBUR represents the next logical step and is built on the findings and recommendations of the following documents:

- Second National Communication to the UNFCCC (submitted 2015)
- National Climate Change Strategy of Montenegro until 2030 (adopted 2015)
- Intended Nationally Determined Contribution of Montenegro (submitted 2015)

Thus, it captures information from the outcomes of on-going complementary projects within the country.

Montenegro's contribution to the international effort to avoid dangerous climate change is expressed as a 30 % reduction in emissions by 2030, when compared to the base year, 1990.

The ultimate goal of the FBUR is to analyse available information in order to assist Montenegro to mainstream and integrate climate change considerations into national and sectorial policies, whilst also continuing to strengthen institutional and technical capacities regarding climate change mitigation and sustainable development.

The level of detail and analysis of this report reflects Montenegro's status as an EU candidate country and as a Contracting Party to the Energy Community; this shows that the country has made significant efforts in improving its reporting systems as well as in implementing mitigation actions.

The First Biennial Update Report of Montenegro covers the following issues:

- An actual description of national circumstances
- National GHG inventory (till 2013)
- Mitigation scenarios 'with measures' and 'with additional measures', along with an Action Plan
- Description of gaps and constraints and of needs in the areas of technology, finance and capacity building
- Recommendations relating to the development of the Monitoring, Reporting and Verification system

NATIONAL CIRCUMSTANCES

CHAPTER 1

General Information (Geography, Geomorphology, Climate, Land Use, Water Resources, Forests, Coastal Areas, Environment)

Montenegro is a mountainous country in Southeast Europe; the length of its land borders total 614 km. Southwest Montenegro borders with the Adriatic Sea, as the crow flies the total distance is 200 km; the coastline, however totals 316 km. The total area of the territory is 13,812 km^2; the territorial sea area is approximately 2,540 km^2.

The Administrative Organisation of the Country

Montenegro has been a sovereign state from 2006 and has a parliamentary political system. It is divided administratively into 23 political-territorial units, into municipalities that provide local governance. Golubovci and Tuzi are categorised as urban municipalities, as administrative areas of the capital city, Podgorica.

Figure 1 *Administrative Organisation of Montenegro*

Geomorphology

Montenegro is situated in Southeastern Europe and in the Western Balkans. It belongs to a group of Mediterranean and Dinaric arc states. Montenegro covers an area that is close to both the Adriatic and Black Sea basins. The countries that share borders with Montenegro are: Albania, Kosovo, Serbia, Bosnia and Herzegovina and Croatia. Montenegro is a mostly mountainous country with very small lowland areas close to the coast including the Skadar Lake basin, the valleys of some of its major rivers (Lim, Tara, Ćehotina and Ibra) and karst fields; thus it is an extremely mountainous country that has been cut through by rivers and streams whose valleys have created carst valleys and canyons. Moving from the sea towards the interior of Montenegro, large flat plains are present in some coastal areas and in the Skadar Lake basin. Up to 500m above sea level, a Mediterranean climate predominates and this enables the cultivation of citrus fruit, winter vegetables, along with ornamental plants and flowers. Areas with an altitude of between 500-1,000m, where areas of flat land are present (with a gradient of up to 5°) and where there are gentle slopes (with a gradient of up to 7°), such as karst fields and river valleys, the climatic conditions are ideal for growing continental fruits and a variety of agricultural crops. In the mountainous zone that is situated at an altitude of between 1,000-1,500m, forests and pastures prevailing; arable land does exist in the highlands but is generally meadowland where only certain specific arable crops that have adapted to the climatic conditions can be grown. Above 1,500 meters, there is a mixture of forestland and mountain type pastures.

Climate

Montenegro's geographic position makes it subject to the climate characteristics of a Mediterranean to Sub-Alpine climate. These differences are caused by mountains, river valleys, valleys and plateaus. As a result several climatic zones prevail. The Montenegrin coastal area has a Mediterranean climate, which changes slightly in the Bojana valley, around Lake Skadar and in the Zeta, Moraca, Cijevna and Crnojevica river valleys. The average January temperature on the coast is quite high (6.8°C – 8.0°C) and rarely ever drops below 0 °C. In the Lake Skadar basin, temperatures are somewhat lower (4.2 – 5.1°C), and there is more snow and frost; on the coast this melts easily. Average temperatures on the coast range from 15.5°C -15.8 °C and in the Skadar Lake basin the average ranges from 14.2°C – 15.3° C. The maximum temperature ever recorded was 41°C. Average annual precipitation ranges from 1,400-1,940 mm in on the coast and in Zeta- Bjelopavliće the average ranges from 1,650 to 2,560 mm.

The second climatic zone encompasses the coastal mountain area (Rumija, Lovcen and Orijen) and from the karst area of Bileca Lake as far as the Albanian border. This zone benefits from a Mediterranean climate in terms of temperature and especially in terms of rainfall. Its main features are hot dry summers, a humid autumn and moderately severe winters. The average annual temperature in the karst areas is around 9.5°C – 10.7°C and rainfall is extremely high rainfall with an annual average of 3,140 - 4,740 mm. Snow is more common in this zone although, except for in the mountains, it quickly melts or is dissolved by rain.

The central mountain area of Montenegro has a combination of Continental and Sub-Alpine climates. The relevant data for Kolašin indicates that the average temperature for January is -1.9°C and for February is -0.7°C; the average temperature in the summer ranges from 13.9°C - 15.8°C. The average annual temperature in Zabljak is 4.7°C; the coldest months are January (-4.7°C) and February (-3.7°C). Temperatures remain below zero here from December through to March. Zabljak and the plateau surrounding Durmitor, Sinjajevina, Piva Mountain, Ljubisnja and the other high mountains, all have similar temperatures to April Littoral and the Zeta- Bjelopavlicka Plain; in summer the average monthly temperature is between 12.0°C – 13.9°C.

The highest temperature recorded in Kolasin was 32.8°C and the lowest was -29.8°C; this represents a difference of 62.6°C. In the highlands, the number of 'tropical' days is significantly lower; this affects fluctuations in temperature, making them less apparent than in the river valleys and ravines. The higher regions, however, experience low temperatures due to the penetration effect of the cold north wind and consequently the snow cover lasts longer. The average annual rainfall in the mountain areas of Montenegro is quite high and ranges from 1,500 - 2,500 mm.

A moderate Continental climate prevails in the northern areas of Montenegro; winters are fairly cold and summers are warm. The average annual temperature in Pljevlja is 8.2°C, in Plav 8.5°C, and in Berane and Bijelo Polje 8.8°C. The highest average temperatures are between 35°C and 37°C, and the lowest average temperatures are from -25 °C to -29 °C. January temperatures here are below zero and Pljevlja and Plav also experience temperatures below zero from December through to February. Although Pljevlja isat a lower altitude (784 m) than Plav (909 m), both have a Continental climate with low temperatures below zero due to the north wind.

The summer months are the warmest with average monthly temperatures ranging between 14.5°C and 18.4°C. September is warmer than May due to snow remaining on the surrounding mountains in the spring.

The average annual precipitation ranges from 796 mm in Pljevlja to 780 mm in Savino Polje. In Bijelo Polje, Bistrica, and Berane the average rises to 950 mm, and to 1,200 mm in Plav, to 1,345 mm in Mojkovac and to 1,467 mm in Gusinje.

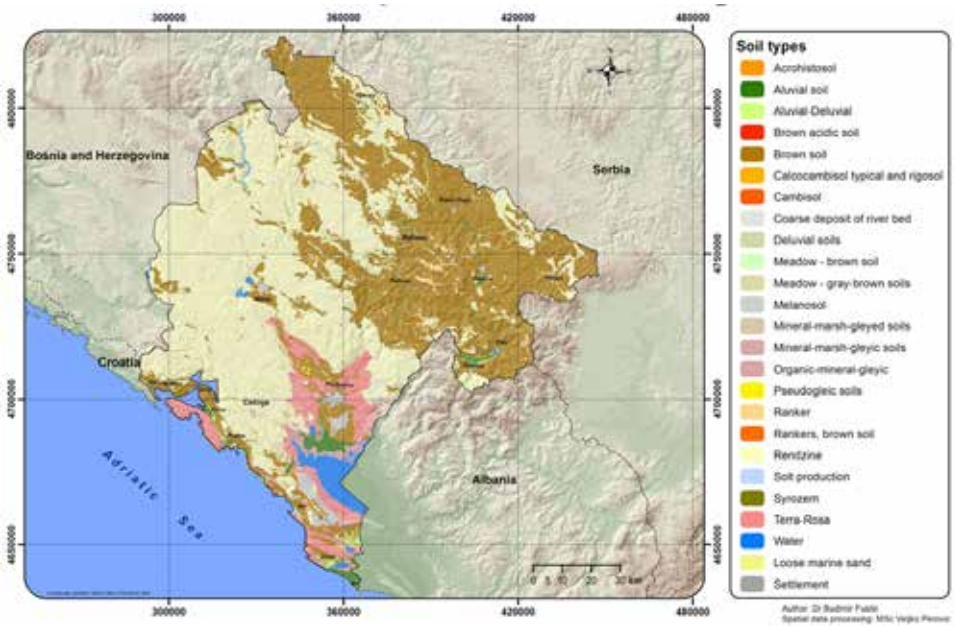
Land Use

Agricultural land in Montenegro covers an area of 309,241 hectares and represents 22.4 % of the territory (95.2 % family farms and 4.8% registered agricultural businesses). Agricultural land is very fragmented: 31.6 % plots cover up to 0.50 ha and 54.1 % cover between 0.10 ha to 1.0 ha; 0.9 % of family households have more than 100 hectares of land which represents 38 % of the total of all agricultural land. The de-population of rural areas in Montenegro has had a negative impact on agricultural land; this prevents a more complete evaluation of pastures and meadows and the way that forests are encroaching on them and reverting them to forest land.

The variety of soil in Montenegro is the result of interaction between natural soil factors, relief, parent sup-stranta, climate, vegetation and living organisms, including man, as well as sail-forming processes. Their conjunction has formed mainly autogenous, and to a much lesser extent, hydrogenous land.

Atlas soil maps 1: 50,000 and monographs Land Montenegro (Fuštić and Đuretić, 2000) provide relevant information about the presence of individual soil types and lower systematic units and about their distri-bution.

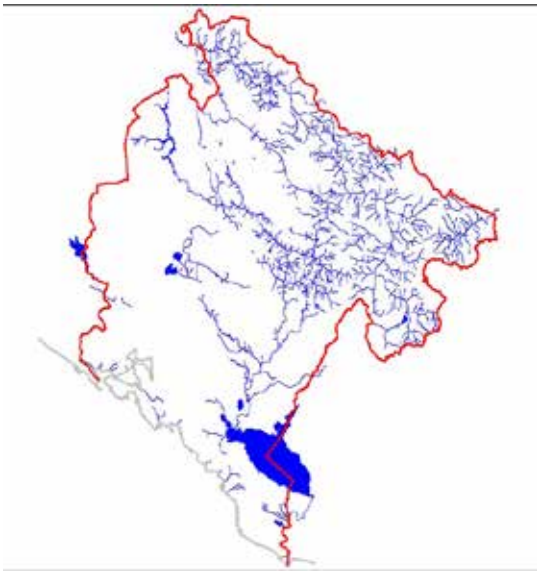
Figure 2 *Soil Types in Montenegro*



Water Resources

The distribution and abundance of water resources vary significantly in Montenegro. Generally speaking, with an average annual runoff of 624 m^3/s (i.e. the volume of 19.67 billion m^3), the territory of Montene-gro falls among those categorised as water rich areas. Montenegrin waters hydrologically belong to two watersheds - Black and Adriatic Sea. Water is returned to the Black Sea by large and small rivers including the Ibar, Lim, Tara, Piva and Ćehotina rivers.

Figure 3 *Hydrology Map of Montenegro*



The southern part of Montenegro consists of the Lake Skadar basin and its immediate catchment sea. The water in Skadar Lake comes from the Moraca, Zeta, Cijevna, Crnojevica and Crmnica rivers. The Bojana River flows out of Skadar Lake and partly forms a border waterway with Albania.

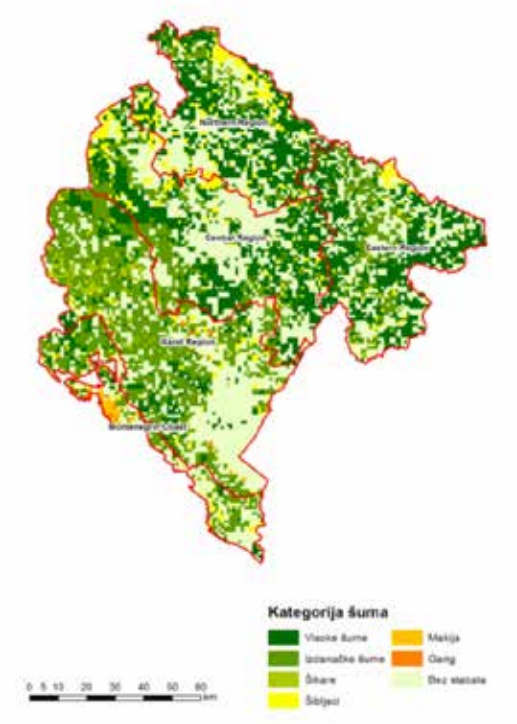
In Montenegro there are 30 natural lakes, the largest of which are Skadar Lake, Plav Lake, the Black Lake and Sasko Lake etc. Montenegro's groundwater (with which the country is rich as a result of it large karst land area) is of a very high quality.

Forests

Data from the National Forest Inventory, prepared in 2010, shows that forests cover 60% of the territory of Montenegro, and that forest soil covers an additional 9.7%. It can be concluded that forests and forest land covers significant part of the land area of Montenegro. Regarding the structure of forests, high forests cover 51.1% and represent 48.9% of the total forest area. Most of the high forest areas are in the northern part of Montenegro. Coppice forests are characteristic of the central and coastal part of the country, while on the coast there are substantial areas of forest underbrush and small areas occupied by wild scrubland and degraded forest formations.

According to the National Forest Inventory, Montenegro is characterised by a dominance of hardwood trees whose forests cover 76.2% of the area covered with forests; 23.8% of forest areas are covered by coniferous forest. Dominant species are beech, oak, spruce, fir and pine; the proportion of species present on the surface in relation to their proportion by volume is significantly different. The total number recoreded in the inventory include: 59 registered and 12 deciduous coniferous tree species. Within the context of degradation of forest land, fires have caused a great deal of damage in addition to the loss of wood; this is reflected in the degradation of the environment, in a reduction of resistance in forests and in their biodiversity, and in the destruction of authentic landscapes and soil structures, all of which have contributed to erosion and a serious degradation of the land.

Figure 4 *Categories of Forests in Montenegro*



Coastal Area

The coastal zone (six coastal municipalities) encompasses approximately 11% of the national territory. This region includes a zone designated as a special purpose coastal area (public maritime domain – 'M*orsko dobro');* this is a narrow coastal belt which includes inland water and territorial sea and covers a total area of approximately 2,540 km^2.

Environment

On a global level, Montenegro is one of the biodiversity 'hot spots' in the Mediterranean. Together with the mountain region in Bulgaria, the Montenegrin territory is one of the top 153 globally selected significant floristic biodiversity centres. The mountain areas of Lovćen and Prokletije stand out as being herpetofauna 'hot spots'.

The territory of Montenegro falls into two basic bio-geographical regions (Mediterranean and Alpine). In relation to its small surface of 13,812 km^2, it encompasses a wide range of ecosystems and habitats. According to the National Biodiversity Strategy and Action Plan (NBSAP, 2015), alpine, forest, dry grassland, freshwater and marine ecosystems are all found in the country. Due to their specific nature, habitat types and geological structures such as coastal habitats, karst, caves and canyons are also considered important for the protection of biodiversity in addition to the main ecosystems. With approximately 3,250 plant species, the floristic diversity of Montenegro is one of the richest in the region. The country's S/A index for vascular plants is 0.837 – the highest recorded value in any European country. A total of 223 endemic plant species and subspecies have been registered. The density index for birds nesting in Montenegro is 0.557; this is well above the Balkan average of 0.435. The specific agro-biodiversity of the country also represents an important quality. Numerous areas of international importance with rare, endemic and endangered species have been identified in the country as Important Bird Areas (IBA). The basic list of areas identified as IBA areas or as having potential (marked *) as IBA areas include: Bojana River Delta, Rumija Mountain, Buljarica Bay, Skadar Lake, Plav Lake and surrounding flood plain, Tivat Slatpans, Ćemovsko Field, Prokletije Mountain Range, Nikšić Lakes, Hajla Mountain, Biogradska Gora, Durmitor, Cijevna Canyon, Zeta River Valley*, Kučke Mountains*, Visitor Mountains*, Komovi*, Golija*, Pivska Highland* and Ljubišnja Mountain*.

22 locations have been identified as important plant areas (IPA) including many mountains and mountainous areas: Jerinja Glava, Lukavica, Trebjesa, Starac, Bogićevica, Visitor, Hajla, Orjen, Lovćen, Rumija, Babji Zub (Sinjajevina Mountain), Komovi, Durmitor and Biogradska Gora, Skadar Lake, Long Beach in Ulcinj, Piva Canyon, and the Tara, Komarnica, Mrtvica, Cijevna and Lim rivers.

Nationally protected areas (PAs) cover close to 180,000 ha which represents more than 11.00% of the entire territory. According to the Indicator Based Report (Environmental Protection Agency, 2013), five national parks (NP) account for majority of the total PA system; the remainder refer to more than 45 sites designated as natural monuments, areas of special natural interest and nature reserves. Moreover, several sites have received significant international recognition. NP Durmitor is on UNESCO's World Natural Heritage List together with the Tara River Canyon which is a part of UNESCO's network of Man & Biosphere reserves (together, the total surface area of the NP and the canyon area is close to 183,000 ha). Kotorsko-Risanski Bay (15,000 ha) is also listed as a World Natural and Cultural Heritage Site. National Parks Skadar Lake (20,000 ha) and Tivat Saltpans (150 ha) are Ramsar Sites. A total of 410 plant and 428 animal species are protected under national legislation.

The most significant sources of air pollution are the main industrial and energy plants that use old technology and, which as a rule, apply little or no adequate mitigation measures. Transport-related air pollution is increasing, especially in city centres. The air quality, calculated in terms of global indicators, is satisfactory. Regarding particular pollutants and particular locations, it is, however, necessary to take certain preventative measures against pollution.

In addition to municipal wastewater (which is mostly discharged into nature without prior treatment), untreated industrial wastewater and waste that is inadequately disposed of also contribute significantly to the pollution of water bodies. The quality of surface water is generally deemed to be good, with only occasional non-compliance with prescribed standards. Data on the generated, collected, treated and disposed volumes of waste, as well as on specific waste streams, are either incomplete or are entirely missing; thus, the planning of waste management is still largely based on estimates. Municipal waste recycling is poor and there are two sanitary landfill sites in operation at present (one for the Municipalities of Podgorica, Cetinje and Danilovgrad, and one for Bar).

Economic and Social Parameters (General Information, Energy, Industry and Mining, Transport, Tourism, Agriculture, Demographic and Population Trends, Economic Trends)

General Information

Montenegro, when compared in terms of its level of development, achieves 41% of the EU-28 average, as measured by GDP at purchasing power parity (PPP); this means that it is below the average level of development in the EU. One of the key reasons for a lower level of development in Montenegro, when compared to the EU, is uneven regional development, or more specifically, the uneven development of its three geographic regions: North, Central and Costal. This is primarily due to the fact that regions have not used available development resources appropriately during the past few decades which has led to a population drain and a growth in unemployment. The Northern Region, which represents 52.8% of the territory of Montenegro, is inhabited by only 28% of its population and is the least developed region in the country; it represents 50.1% of development in Montenegro.

During the period after the restoration of independence, Montenegro experienced a period of economic growth; this is, however, relatively limited now due to the negative impact of the global economic and financial crisis. The economic and financial crisis revealed a multitude of structural vulnerabilities within the Montenegrin economy, which is now a shadow of itself during the strong economic growth period experienced from 2006 to 2008. The following period, between 2009 and 2011, was characterised by a decline in foreign direct investment, negative balances in public finances and steadily rising unemployment. The

following table provides an overview of some macroeconomic indicators in Montenegro.

Table 1 *Montenegro's Basic Macroeconomic Indicators*

Macroeconomic indicators	2007.	2008.	2009.	2010.	2011.	2012.	2013.
GDP in current prices (mil. EUR)	2,680.0	3,085.6	2,981.0	3,104.0	3,234.0	3,148.9	3,350.11
GDP real growth rate - %	10.7	6.9	-5.7	2.5	3.2	-2.5	3.512
GDP per capita EUR	4,280	4,908	4,720	5,006	5,211	5,063	5,402
GDP PPS per capita	10,000	10,700	9,700	10,200	10,600	10,300	-
Industrial production growth -maternal %	0.1	-2	-32.2	17.5	-10.3	-7.1	10.6
Manufacturing - growth rate %	9.3	-11.3	-38.6	-0.3	6.8	-10.1	-5.0
Inflation , a method of consumer prices (%) – December	4.2	8.5	3.6	0.7	2.8	5.1	0.3
Number of tourists' arrivals	1,133, 432	1,188,116	1,207,694	1,262,985	1,373,454	1,439,500	1,492,006
Number of employees	216,902	166,221	174,152	161,742	163,082	166,531	171,474
Unemployment rate (%)	11.9	16.8	19.1	19.7	19.7	19.7	
Exports of goods and services (mil. EUR)	1,156.4	1,226.4	1,027.8	1,157.7	1,382.6	1,389.4	1,460.513
Imports of goods and services (mil. EUR)	2,305.7	2,880.5	1,948.8	1,960.5	2,099.6	2,166.4	2,143.7
Trade balance (million)	-1,149.3	-1,654.1	-921.0	-802.9	-717.0	-776.9	-683.2
Foreign direct investments - net (mil. EUR)	524.9	567.6	1,066.5	552.0	389.1	461.1	323.9
Poverty rate (%)	8.0	4.9	6.8	6.6	9.3	11.3	8,6

Source: MONSTAT

Energy

In 2008, total primary energy consumption amounted to 47.26 PJ, i.e. approximately equivalent to 1,800 kg of oil per capita. During the period 1997 – 2008, then average annual growth rate of primary energy consumption was 3.1%. Over the last ten years, the degree of energy self-sufficiency varied between 44% and 58%.

Fossil fuels play a dominant role in the consumption of energy and account for as much as 70% of the total. Solid and liquid fuels are almost exclusively used. The amount of solid fossil fuels (mostly lignite) consumed is provided entirely from the country's own resources. The consumption of liquid fossil fuels, dominated by motor petrol, diesel and oil fuel, are all imported.

The generation of electricity takes place locally at the hydro power plants of Piva and Perućica (which have a total installed capacity of 649 MW), and at the thermal power plant of Pljevlja (210 MW).

Between 27 and 46% of the country's primary energy production originates from renewable sources, whereas 21% to 37% comes from hydro power (almost exclusively generated by large hydro power plants), and 6 % to 10% comes from firewood.
The industry sector is responsible for the greatest energy consumption; general consumption and transport are responsible for the next highest levels of consumption. In 2004, losses in energy conversion processes amounted to 24.5% of the total consumed.

Energy consumption went up from 29.33 PJ in 1990 to 30.58 PJ in 2004. Electricity represented the largest share (ranging from 41% to 47%) in the total consumed and recorded an annual growth of 2.9% during the observed period.

In comparison with the EU, the consumption of primary energy per capita in Montenegro is considerably lower than in the twenty seven EU countries; electricity consumption per capita in Montenegro is, however, above the EU average. Existing energy intensity and energy efficiency data (although not calculated systemically and on a continuous basis) indicate that there is considerable scope for the introduction of energy saving measures and energy efficiency.

Industry and Mining

The processing industry represented between approximately 10% (2005) and 7% (2008) in the GDP. The contribution from the mining sector during the same period was less than 2%. Industrial plants predominantly use obsolete technology characterised by high levels of emissions. The largest industrial facilities operate in extractive metallurgy and metal processing. Recently, the structure of industrial production has changed somewhat due to an increase in the area of food and beverages and the introduction of chemical production.

Mining and mineral zones in Montenegro are numerous and are spread over large areas. Research in Montenegro terrains has identified 28 kinds of mineral resources, of which 15 have been exploited. It is estimated that 23 mineral types are raw materials that are of economic importance. In the previous spatial plans, areas that should be preserved for exploitation have not been precisely indicated. Data on the occurrence and deposit levels of white and red bauxite show that almost 1/3 of the territory of Montenegro could be registered. Coal mines are present near Berane and Pljevlja; at the Pljevlja power plant there are plans for the construction of another block.

The most important ore minerals are red and white bauxite, followed by lead - zinc ore, lignite, brown coal, copper, mercury, mineral resources for architectural and building purposes including building stone and decorative stone, tufa, gravel, sand, brick clay, cement marl, dolomite, barytes, bentonite, quartz sand, etc. Bauxite mines exist in the high karst areas (the most important of which are located in the Municipality of Niksic - Zupa Niksic), and lead and zinc mines which are located in Mojkovac and Pljevlja. Copper ore, which has not yet been exploited, is present in Varina near Pljevlja. Architectural - construction stone is present in several locations and in all parts of Montenegro. The total geological reserves of red bauxite amount to 96.244 million tons, white bauxite amounts to about 1.65 million tons with further potential reserves estimated at the level of around 2.9 million tons and total reserves of lead and zinc amount to 46,830,000 tons. Geological reserves of copper in Pljevlja are estimated at 5,297,000 tons with further potential reserves estimated at around 2,041,000 tons. The total reserves of architectural - building stone is estimated at around 95 million tons.

Transport

During the period 2005–2008, the amount represented by transport (including storage and communication) in GDP was between approximately 11–12%. Road transport is the dominant form of transport, and in 2008 represented approximately 5.5 million passengers and 2.5 million tons of transported freight. The density of main roads is equal to 13 km per 100 km^2, while the number of registered passenger cars is less than 190,000. The total length of railways in Montenegro is 250 km.

Tourism

Tourism is a significant branch of the economy which is regarded as one of the key development priorities. The number of tourists almost doubled during the period 2003 – 2007 (from approximately 0.6 to 1.1 million), while the number of overnight stays, during the same period, increased by more than 80%. In 2008, the country was visited by approximately 1.2 million tourists, with a total of 7.8 million overnight stays. The visits/overnight stays realised in the coastal region represent the most significant part of the total tourism turnover.

Agriculture

Agricultural land in Montenegro amounts to 309,241 hectares or 22.4 % of the total territory (95.2 % family farms and 4.8% registered agriculture businesses). Agricultural land is very fragmented: 31.6 % plots have an area of up to 0.50 ha and 54.1 % are between 0.10 ha and 1.0 ha in area; 0.9 % of family households have more than 100 hectares and account for 38 % of the total agricultural land. In 2013 agriculture created 2,771 registered jobs (1.6% of the total number of employees in Montenegro). However, this calculation did not take into account jobs created by family farms (according to the census of 2010, 48,824 family farms engaged a total of 98,341 people; calculated as annual work units this represents almost 30% of the total employment in Montenegro). In 2013, GDP was €3.327 billion, of which agriculture represented €436.8million (an increase of €42.4 million). Imports in 2013 amounted to €470.6million (26.4% of all imports). Primary agriculture represented the greatest share of GDP. Poor product finalisation in rural areas is due to a focus on self-subsistence, the sale and marketing of products through unregistered channels, a lack of cooperation between producers, poor market information and the infrequent use of new technology. Project work can improve the quality of production by improving the coordination and exchange of information, by improving cooperation at a local level and by localising or contextualising national processes and initiatives.

Demographic and Population Trends

According to census data from 2011, Montenegro has 620,029 inhabitants, 194,795 households and 247,000 apartments. Of a total number of 620,029 inhabitants, 306,236 are male and 313,793 are female. According to the census in 2011, 26.3% of the population was younger then 19 years old, 60.9% was between 19-65 years old and 12.8% was over 65 years old. Of the younger generation, 51.9% are male and 48.1% are female, in the group between 19 and 65 years the ratio was 49.5%: 50.5% and in the older group there was a higher percentage of women, 57.1%: 42.6%.

Table 2 *Population, Households and Apartments in Montenegro 1971 - 2011*

Years	Population			Number of Households	Dwellings for permanent residence	
	Total	Men	Women		Total	Urban Settlements
1971.	529.604	259.209	270.395	121.911	112.000	42.000
1981.	584.310	289.739	294.571	142.692	131.000	70.000
1991.	615.035	305.931	309.104	163.274	170.000	99.000
2003.	620.145	305.225	314.920	180.517	206.000	125.000
2011.	620.029	306.236	313.793	192.242	247.000	155.000

Source: MONSTAT - Statistical Yearbook 2013

During recent years, the migration of the population has increased from less developed areas of the northern region to the central and coastal regions, where living conditions are more favorable.

Table 3 *Natural Changes in the Population of Montenegro 1991 - 2012*

Years	Population Mid-Year	Newborns	Deceased		Natural Growth
			Total	Infants	
1971.	525.002	10.866	3.278	378	7.588
1981.	585.671	10.441	3.556	227	6.885
1991.	591.843	9.606	3.970	107	5.636
2001.	614.791	8.839	5.431	129	3.408
2008.	616.969	8.258	5.708	62	2.550
2009.	618.294	8.642	5.862	49	2.780
2010.	619.428	7.418	5.633	50	1.785
2011.	620.556	7.215	5.847	32	1.368
2012.	620.008	7.459	5.922	33	1.537

Source: MONSTAT - Statistical Yearbook 2013

The aforementioned migration has increased pressure on resources in the area of urban settlements which have developed for industrial and residential use. This negative impact has been reflected in rural areas, especially in mountainous areas, since many areas are now uncultivated and have reverted to weeds, bushes and trees.

Review of Economic Status and Trends

Since 1990, the economy of Montenegro can be categorised by two periods: stagnation and negative trends in the development of certain economic sectors, even when compared to 1989 after the war and breakup of Yugoslavia. This was followed by a recovery period which is still ongoing. The events that occurred along with the political situation are directly mirrored in the economic trends. The period after 2000 is marked by gradual economic recovery. Economic growth is becoming somewhat more stable and more dynamic, as indicated by the data regarding the GDP.

Table 4 *Gross Domestic Product in Montenegro 2000 - 2012*

Macroeconomic Indicators	2007.	2008.	2009.	2010.	2011.	2012.	2013.
GDP in current prices (mil. EUR)	2,680.0	3,085.6	2,981.0	3,104.0	3,234.0	3,148.9	3,350.1

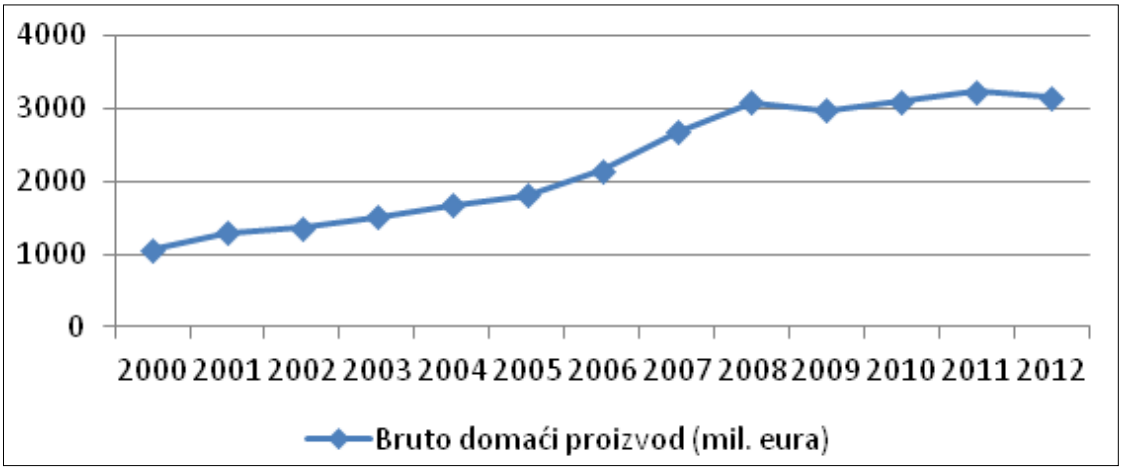
Source: Central Bank of Montenegro - Annual Report 2012

In the last decade of the 20th century, the economy largely relied on the use of local economic resources in which Montenegro is relatively rich. The result of this development, among other things, had consequences on land degradation, air pollution, water and the environment in general.

At the beginning of the 21st century certain results were achieved in area of restructuring and privatisation which, according to many estimates were not always successful. Positive trends were achieved in the banking sector including increased lending activity, deposits and savings. Visible progress was also made in combatting the informal nature of the economy; however, trade did not increase with foreign countries.

In 1989 Montenegro recorded a surplus in the exchange of goods, but afterwards recorded a deficit. In 2010 Montenegro exported goods and services worth €330 million and imported goods worth €1,657 million. In 2011 the ratio was €454: €1,823 and in 2012 it was €367: €1,821 million.

Figure 5 *Gross Domestic Product (2000-2012)*



Source: Central Bank of Montenegro - Annual Report 2012

Institutional and Legal Framework Relevant to Climate Change

Montenegro became a party to the United Nations Framework Convention on Climate Change (UNFCCC) as a non-Annex 1 Party on 27 January 2007. The Kyoto Protocol was ratified in 2007. Considering that EU accession is a national priority, the approximation of national legislation to parts of the *acquis communautaire,* regarding the environment and climate change, represents a process during which the national legal framework should be strongly and increasingly shaped.

The Ministry of Sustainable Development and Tourism (MSDT) has key responsibilities in the area of climate change. The Ministry is responsible for policy making and for adopting relevant regulations, while the **Environmental Protection Agency**, as an executive administration body, plays a significant role in the implementation of climate change policies. The Designated National Authority for the approval of CDM projects was established in 2008 within the Ministry of Spatial Planning and the Environment.

The **Ministry of Economy** also plays an important role in the area of climate change, by creating energy policies and by establishing objectives and measures to increase energy efficiency. Within this ministry there is also a department responsible for energy efficiency and renewable energy sources.

In addition:

<u>General requirements for creating a coordination in the field of climate change</u>
Status: The National Council for Sustainable Development and Climate Change is in the final stage of producing this.

<u>Green House Gas Monitoring and Reporting</u>
Existing competent institutions:

- Ministry of Sustainable Development and Tourism: general competence in policy and legislation in the field of climate change
- The Environmental Protection Agency: responsibilities for monitoring and reporting

<u>The EU Emissions Trading System</u>

- Existing competent institutions: Ministry of Sustainable Development and Tourism: general competence in policy and legislation on climate change
- The Environmental Protection Agency: responsibility for monitoring and reporting and licensing

- Acreditation Body of Montenegro: competence for accreditation and for bilateral and multilateral agreements on mutual recognition and the recognition of foreign licences

Effort Sharing Decision

- Existing competent institutions: Ministry of Sustainable Development and Tourism: general competence in policy and legislation on climate change
- Ministry of Economy, Ministry of Transport and Maritime Affairs, Ministry of Agriculture and Rural development: competence for sectoral policies that are the subject of this decision.

Carbon Capture and Storage:

- Existing competent institutions: Ministry of Sustainable Development and Tourism: general competence in policy and legislation on climate change

Fuel Quality

- Existing competent institutions: Ministry of Sustainable Development and Tourism: general competence in policy and legislation in the field of climate change and protection of the environment (air quality)
- Ministry of Economy: competence in the field of fuel and biofuel markets
- The Environmental Protection Agency: responsibility for monitoring and reporting in terms of fuel quality
- Acreditation Body of Montenegro: competence for the accreditation of laboratories

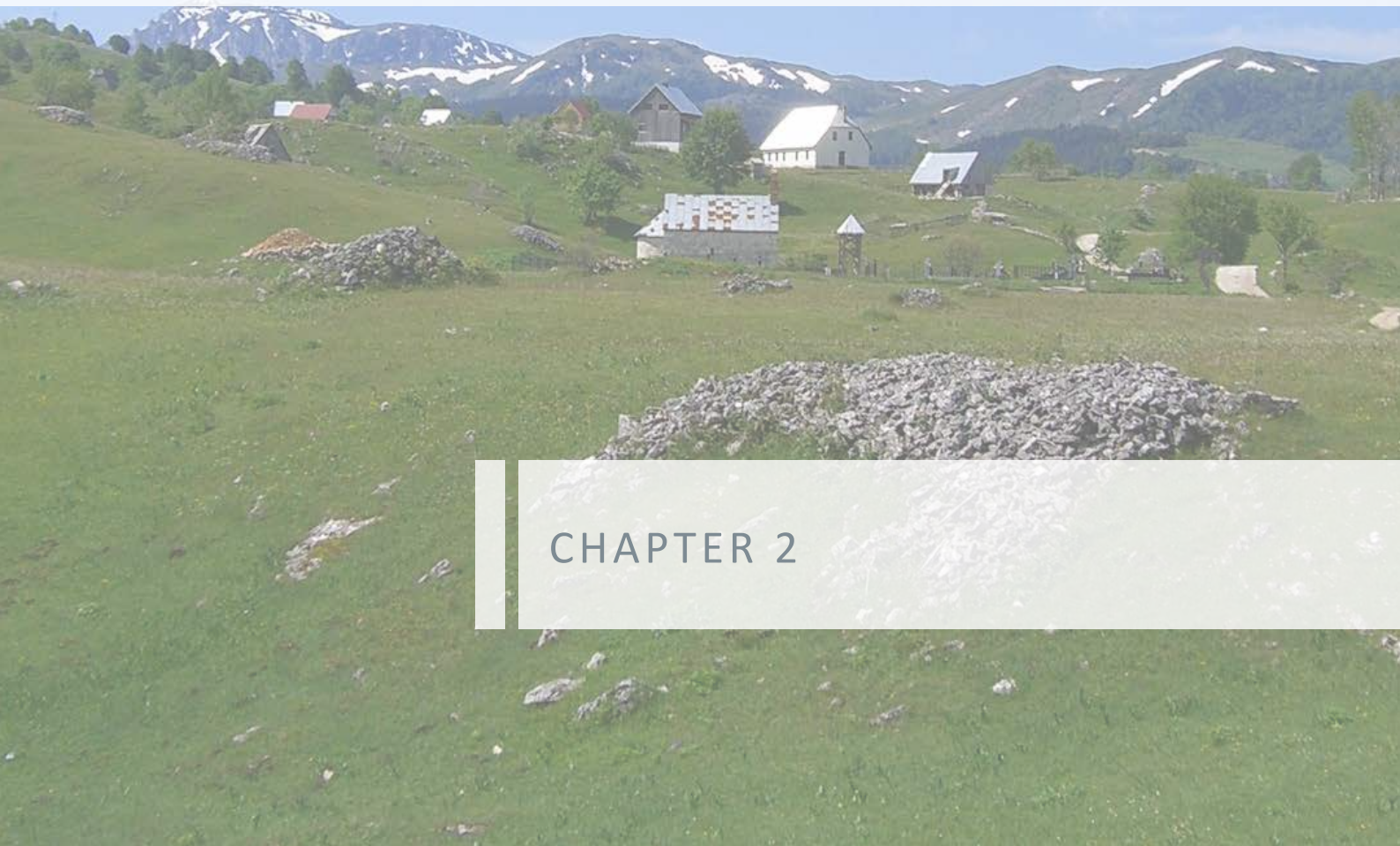
Cars / Vans

- Existing competent institutions: The Ministry of Transport and Maritime Affairs and the Ministry of Interior Affairs: general competence with regard to policy-making and legislation, regulating terms and conditions for the placement and use of cars and vans

Ozone Layer Protection and Fluorinated Gases

- Existing competent institutions: Ministry of Sustainable Development and Tourism: general competence in policy and legislation in the field of climate change and protection of the environment (air quality)
- The Environmental Protection Agency: responsibility for monitoring and reporting with respect to substances that deplete the ozone layer and F gases
- Accreditation Body of Montenegro: competence for the certification of accreditation bodies, for ozone layer protection and fluorinated gases

National GHG Inventory



CHAPTER 2

Introduction

The Montenegro Greenhouse Gas Inventory Report for the period 1990-2013, as well as the emission inventories for the same period were produced whilst preparing the First Biannual Update Report to the United Nations Framework Convention on Climate Change (FBUR). The report provides data on the preparation of the greenhouse gas (GHG) inventories for 2012 and 2013 and on the update of the inventories for the period 1990-2011. For the first time, the 2006 methodology of the Intergovernmental Panel on Climate Change (IPCC)[3] was applied; it required the recalculation of the entire time series (1990-2011) of the inventory produced based on the 1996 methodology for the purposes of the Second National Communication on Climate Change. The software tool of the Intergovernmental Panel on Climate Change was used to prepare the inventory.

The report offers information on the data sources used to calculate emissions, on the methodology for calculating emissions, on emission factors, and on GHG emission trends, as well as on quality control procedures.

Basic Information on Greenhouse Gas Inventories and Climate Change

Montenegro ratified the United Nations Framework Convention on Climate Change (UNFCCC) through succession in 2006 and thus, on 27 January 2007, became a party to the Convention as a non-Annex 1 country.

The Kyoto Protocol was ratified on 27 March 2007; Montenegro became a party of this with the status of a non-Annex B country on 2 September 2007. By ratifying UNFCCC and the Kyoto Protocol, Montenegro joined other countries that share their concerns and play an active role in international efforts aimed at addressing climate change issues.

This report was prepared in accordance with UNFCCC guidelines for reporting on annual inventories, approved by the COP (Conference of Parties) Decision 18/CP.8. In line with IPCC guidelines, national emission factors were used wherever possible (for activities in the sectors of energy, industry, agriculture and forestry), which enhanced the accuracy of the emissions calculated. Default values for emission factors were used in other activities that were sources of GHG emissions.

Calculations included emissions resulting from human activities and also those involving the following direct greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), synthetic gases (HFCs and SF_6).

Estimates of indirect greenhouse gases: carbon monoxide (CO), nitrogen oxide (NO_x), non-methane volatile organic compounds (NMVOC) and sulphur dioxide (SO_2) were not carried out for either 2012 or 2013 due to technical problems encountered when using E^2Gov software application. This software tool was applied to produce emission inventories (as requested by the Convention on Long-Range Transboundary Air Pollution – CLRTAP), in line with the EMEP/EEA methodology for the period 1990-2011. The data and emissions of indirect GHG from these inventories were presented in the Second National Communication of Montenegro on Climate Change.

Emission sources and sinks of greenhouse gases are divided into six main sectors: Energy, Industrial Processes, Solvents and Other Product Use, Agriculture, Forestry and Land Use and Waste Management.

3 *2006 IPCC Guidelines for National Greenhouse Gas Inventories and Good Practice Guidance and Uncertainty Management in National GHG inventories.*

Institutional and Organisational Structure for the Preparation of a Greenhouse Gas Emission Inventory

In Montenegro the Environment Law and the Air Protection Law together provide a legal framework with which to monitor status and to report on climate change in Montenegro. In Article 54, the Environment Law prescribes that the protection of the environment from the negative impact of climate change should be accomplished in conformity with the National Climate Change Mitigation Plan. According to the law, the National Climate Change Mitigation Plan includes the following:

- National inventory of greenhouse gas emissions;
- Analyses and projections of greenhouse gas emissions and reductions in emissions;
- Information and cartographic presentation regarding the monitoring, research and systemic observation of climate change;
- Action plan and climate change mitigation measures;
- Clean development mechanism;
- Economic analysis of measures proposed for the prevention and mitigation of climate change;
- Bodies, institutions and other legal entities responsible for the implementation of the national plan, action plan and other measures relating to the prevention and mitigation of climate change;
- Description of activities to raise public awareness, to educate and professionally train scientific, technical and managerial personnel along with details of the results achieved;
- Information on the fulfilment of commitments arising from international climate change treaties ratified by the state, etc.

The Environment Law also lays down the details for the preparation of a National Plan for a period of six years. The plan is to be prepared by the Ministry of Sustainable Development and Tourism in cooperation with state administration, local government bodies and other scientific and professional institutions.

The Air Protection Law states that the prevention and reduction of air pollution impacting on climate change should be carried out by monitoring greenhouse gas emissions, by applying flexible mechanisms and by adhering to other binding measures set out in relevant international treaties. This law along with secondary legislation aligned with it also provides: a list of greenhouse gases, methods for monitoring gas emissions, deadlines for the completion of reports and methods for developing greenhouse gas inventories.

This law delegates the commitments related to the development of greenhouse gas inventories, their update, data management and storage to the Environmental Protection Agency. An inventory of greenhouse gas emissions is an integral part of any environment related information system.

In line with the Air Protection Law, Montenegro adopted the Rulebook on the List of Gases and Method of Developing Greenhouse Gas Inventories and Exchange of Information. The rulebook states that greenhouse gas inventories should be produced in accordance with guidelines for reporting to the United Nations Convention on Climate Change and according to the guidance of the Intergovernmental Panel on Climate Change (IPCC).

QA/QC Plan and Verification

QA/QC Plan

The Plan for Quality Assurance and Control when developing greenhouse gas inventories is prescribed by the Rulebook on the List of Gases and Method of Developing Greenhouse Gas Inventories and Exchange of Information (Official Gazette of Montenegro 25/10). This rulebook sets out the way that procedures should be followed to ensure data quality control, as well as providing methods for archiving inventories, complementary materials and documentation.

In accordance with the Regulation on mechanisms for monitoring and reporting greenhouse gas emissions no. 525/2013 of the European Union, which is currently being transposed into the national legislation, completion of the quality control procedures is planned by 2017.

Data Verification

In line with the recommendations from the IPCC Guidelines[4], the inventory was verified through a series of simple checks to ensure the completeness and accuracy of data; this included checking arithmetic mistakes, comparing national statistics with international statistics and checking estimated carbon dioxide emissions from the energy sector by comparing the results obtained through the Sectoral and Reference approach.

Overview of Trends in Greenhouse Gas Emissions

Total $CO_{2\,eq.}$ Emissions

This section of the document describes total greenhouse gas emissions expressed in carbon dioxide emission equivalents (CO_2 eq).

GHG emissions were recalculated into $CO_{2eg.}$ in line with the Second Assessment Report of IPCC (SAR IPCC) where the global warming potential (GWP) is: CO_2 -1, CH_4 – 21, N_2O- 310, CF_4- 6500, C_2F_6- 9200 and SF_6- 23900.

Table 5 *Total GHG Emissions Expressed as CO_2 eq, by Sector, for the Period 1990-2013 (Gg)*

Year	Energy (Gg CO2 eq)	Industrial Processes (Gg CO2 eq)	Agriculture and Land Use (Gg CO2 eq)	Waste (Gg CO2 eq)	Total Emissions With Sinks (Gg CO2 eq)	Total Emissions Without Sinks (Gg CO2 eq)
1990.	2352.61	2272.87	-987.83	19.618	3657.27	5238.52
1991.	2450.28	2909.18	-691.16	34.97	4703.27	5985.49
1992.	1809.33	1891.39	-1504.53	45.41	2235.27	4293.39
1993.	1602.90	709.60	-1974.81	57.43	418.00	2923.52
1994.	1428.09	94.12	-1946.76	68.97	-364.57	2121.89
1995.	825.24	2272.87	-1263.66	80.39	1914.84	3742.74
1996.	1842.40	294.48	-1592.61	91.69	635.96	2788.23
1997.	1850.80	1547.59	-1855.69	105.17	1647.87	4043.37
1998.	2259.86	1471.88	-1882.02	116.04	1965.76	4380.87
1999.	2332.16	1648.27	-1895.22	126.57	2211.78	4640.09
2000.	2427.50	2046.92	-1921.70	136.79	2689.51	5156.55
2001.	2013.42	2173.09	-1831.38	146.02	2501.15	4847.49
2002.	2517.68	2223.86	-2171.93	154.39	2724.00	5415.80
2003.	2427.77	1846.00	-1771.35	161.92	2664.34	4962.67
2004.	2388.09	1665.62	-1367.44	168.61	2854.88	4726.41
2005.	2200.89	1544.11	-1730.85	174.48	2188.63	4278.82
2006.	2356.22	1635.67	-1044.51	179.63	3127.01	4519.17
2007.	2293.34	1769.81	-2042.20	184.25	2205.20	4628.58
2008.	2904.72	930.08	-1907.74	188.21	2115.27	4355.32
2009.	1979.14	572.38	-2080.66	190.26	661.12	3009.31
2010.	2725.54	722.66	-1725.92	193.65	1915.93	3904.95
2011.	2768.15	765.59	-1583.79	197.41	2147.36	4017.89
2012.	2684.24	398.94	-1754.26	200.49	1529.41	3571.94
2013.	2415.87	282.93	-1941.39	199.26	956.67	3178.28

4 *Good Practice Guidelines and Uncertainty Management in National GHG inventories.*

Figures 6 and 7 show the total GHG emissions expressed as CO_2 eq for the period 1990 - 2013. Figure 6 is an overview of the total emissions which also takes into account their sinks, while Figure 7 shows emissions without sinks.

Total emissions with sinks range from -364.57 Gg CO_2 eq. in 1994 to 4,703.27 Gg in 1991. High levels of CO_2 sinks are the consequence of large forest areas in Montenegro, while low levels of estimated emissions from agriculture are partly due to the incomplete estimation of emissions due to a lack of statistical data. This fact, as well as negative economic trends and the continuous decline of industrial production, has resulted in relatively low levels of emissions being recorded in some of the years during the observed period.

Total greenhouse gas emissions (without sinks) presented as CO_2 eq range from 2,121.89 Gg in 1994 to 5,985.49 Gg in 1991. Figure 8 shows CO_2 eq emissions, by sector, for the period 1990 - 2013.

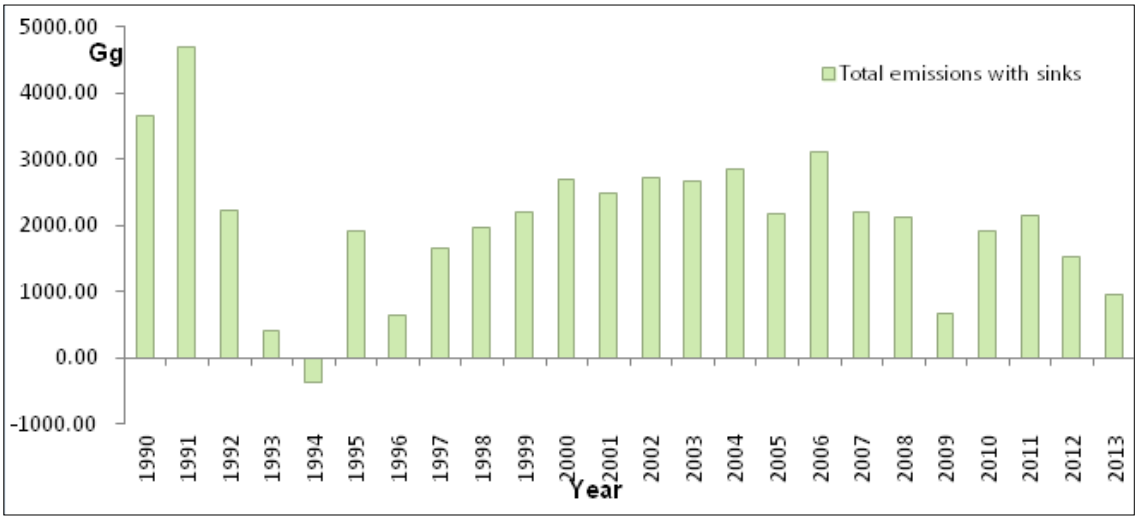


Figure 6 *Total GHG Emissions Expressed as CO_2 eq With Sinks, 1990-2013 (Gg)*

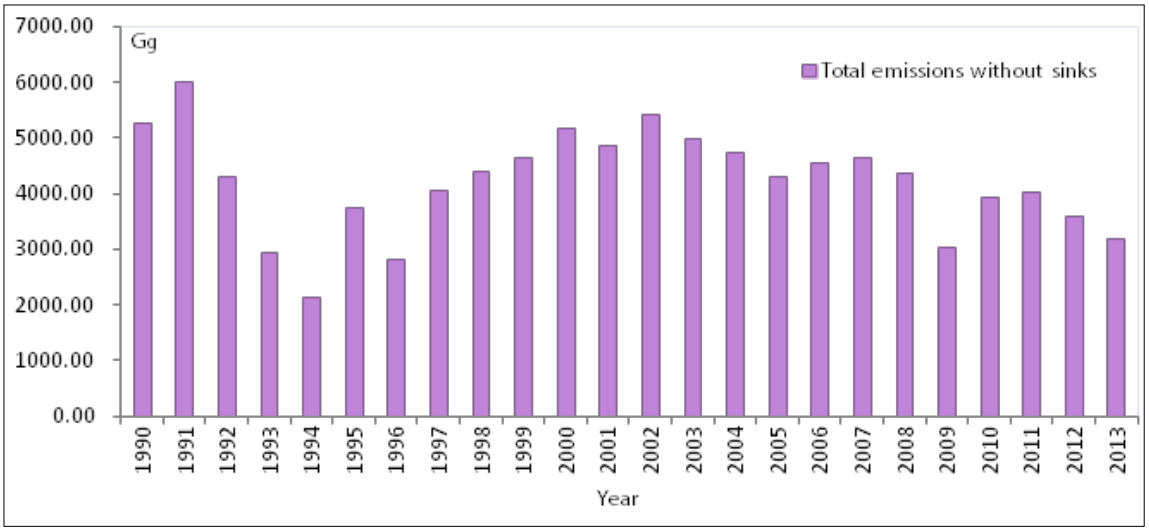


Figure 7 *Total GHG emissions expressed as CO_2 eq without sinks, 1990-2013 (Gg)*

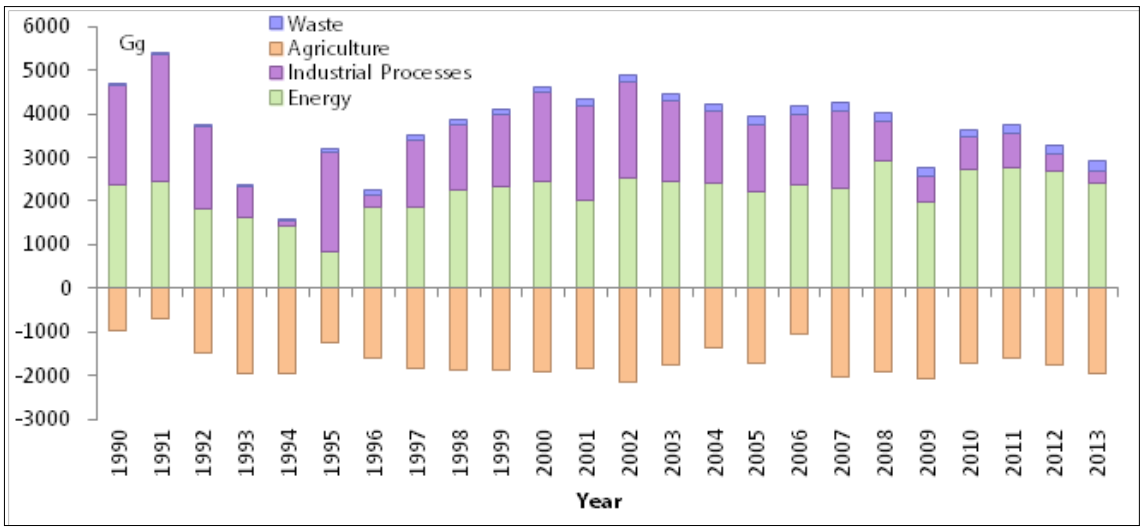


Figure 8 *GHG Emissions Presented as CO_2 eq, by Sector, 1990-2013 (Gg)*

As shown in Figure 9, the energy and industrial process sectors represented the greatest share of total CO_2eq emissions during the observed period. Accordingly, depending on the consumption of energy-generating products and depending on the level of industrial production, both the decline and the increase of estimated emissions were registered during the observed period.

In 2013 the share of emissions represented by the energy sector ranged from 22.12% in 1995 to 76.10%. The share of emissions represented by the industrial process sector ranged from 4.43% in 1994 to 60.91% in 1995. CO_2 eq emissions produced by the agriculture sector ranged from 6.54% in 2010 to 20.16% in 1994, while the waste sector produced the least emissions ranging from 0.38% in 1990 to 6.33% in 2009.

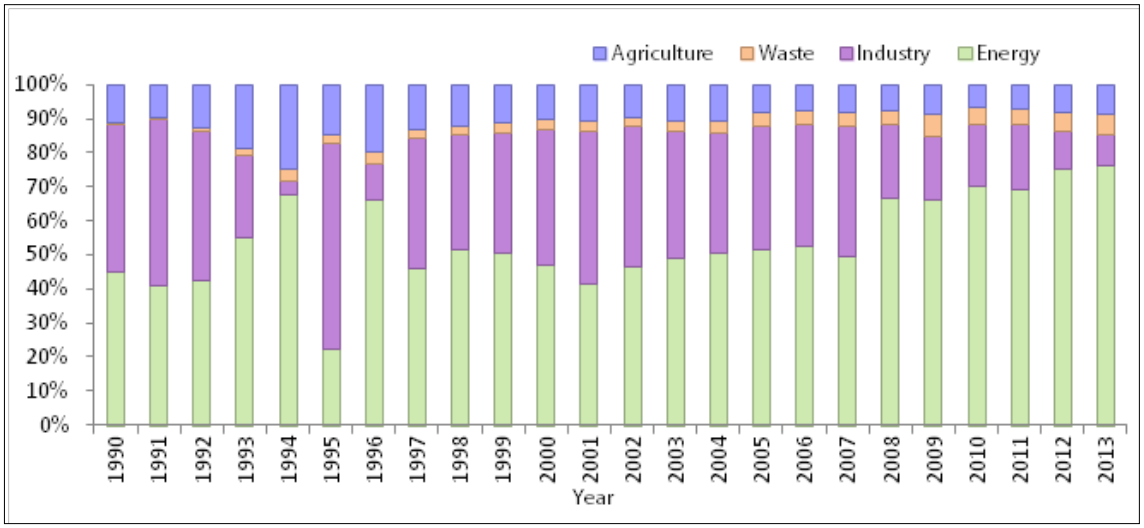


Figure 9 *Shares of GHG Emissions, on a Sector by Sector Basis, Within Total CO2eq Emissions, 1990-2013 (%)*

As shown in Table 6 and Figure 10, CO_2 represented the greatest share of total GHG emissions (24.6% - 74.5%), followed by PFC (CF_4 and C_2F_6) which represented between 3% and 40.9%. CH_4 represented between 10% and 27.5%, and the N_2O represented between 2.3% and 5.8 %. SF_6 represented the smallest share in the total emissions produced and ranged from 0.01% to 0.07%. In line with the data that was available at the time of recalculating the inventory, HFC emissions (in 2012 and 2013) were only estimated for subsector 2.F. Product Use as a Substitute for Ozone Depleting Substances (2.F.1 – Refrigeration and Air Conditioning).

Table 6 *Total GHG Emissions Expressed as CO_2 eq. Emissions, 1990-2013 (Gg CO_2 eq)*

Year	CO_2	CH_4-CO_2 eq	N_2O-CO_2 eq	PFC - CO_2 eq	SF_6 - CO_2 eq	HFC- CO_2 eq	Total
1990.	2417.29	608.14	153.06	2059.22	0.82		5238.52
1991.	2526.07	601.83	153.98	2702.78	0.82		5985.49
1992.	1852.03	591.99	137.63	1717.24	0.82		4293.39
1993.	1530.31	601.91	131.59	636.01	0.82		2923.52
1994.	1348.21	590.02	128.56	63.26	0.82		2121.89
1995.	916.25	629.37	137.10	2059.22	0.82		3742.74
1996.	1778.42	631.85	138.04	239.10	0.82		2788.23
1997.	1890.37	619.56	133.58	1399.05	0.82		4043.37
1998.	2296.04	625.37	129.72	1328.86	0.89		4380.87
1999.	2366.50	638.43	131.85	1502.44	0.89		4640.09
2000.	2483.43	656.26	137.47	1878.43	0.97		5156.55
2001.	2113.36	627.09	128.08	1977.98	0.97		4847.49
2002.	2578.41	688.07	129.14	2019.18	1.01		5415.80
2003.	2506.48	682.89	133.03	1639.07	1.21		4962.67
2004.	2474.08	671.48	131.07	1448.40	1.40		4726.41
2005.	2286.57	549.43	105.16	1336.17	1.50		4278.82
2006.	2441.41	552.41	105.28	1418.51	1.56		4519.17
2007.	2387.52	580.70	109.85	1548.96	1.56		4628.58
2008.	2967.87	550.24	110.06	725.54	1.60		4355.32
2009.	1969.06	484.19	97.79	456.65	1.61		3009.31
2010.	2717.47	502.49	99.86	583.48	1.63		3904.95
2011.	2775.21	532.26	102.28	567.43	1.67		4017.89
2012.	2659.09	533.64	102.33	222.78	2.10	52.00	3571.94
2013.	2358.01	522.35	96.63	139.31	2.29	59.68	3178.28

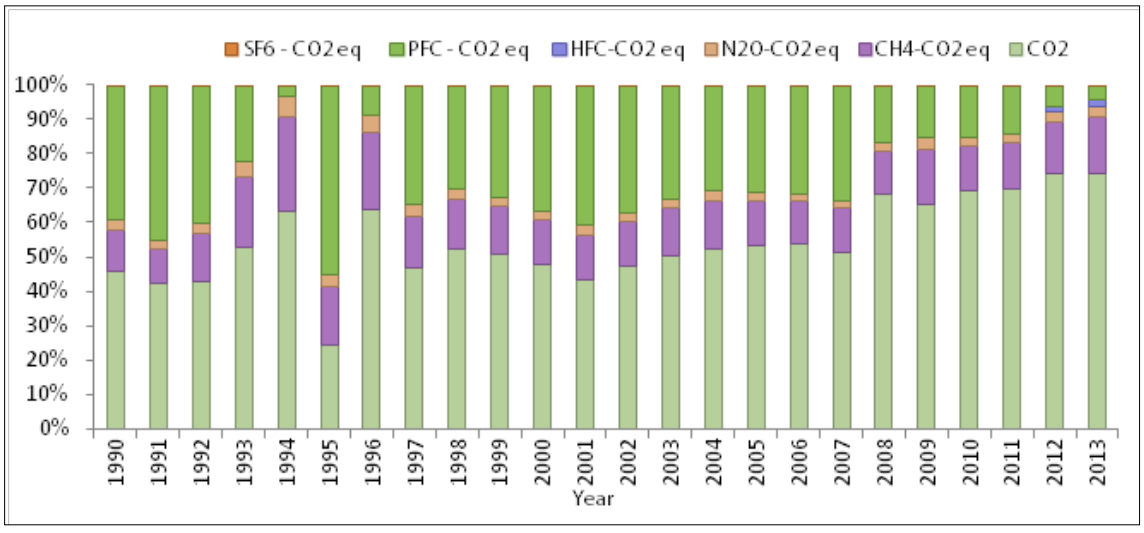


Figure 10 *Shares of GHG Emissions Within Total CO_2 eq. Emissions, 1990-2013*

Total CO_2 Emissions

Figure 11 shows the total CO_2 emissions. The energy sector represented the greatest share in the total CO_2 emissions during the observed period (76.8% - 97.8%), while the industry sector contributed 2.2% - 9.4%.

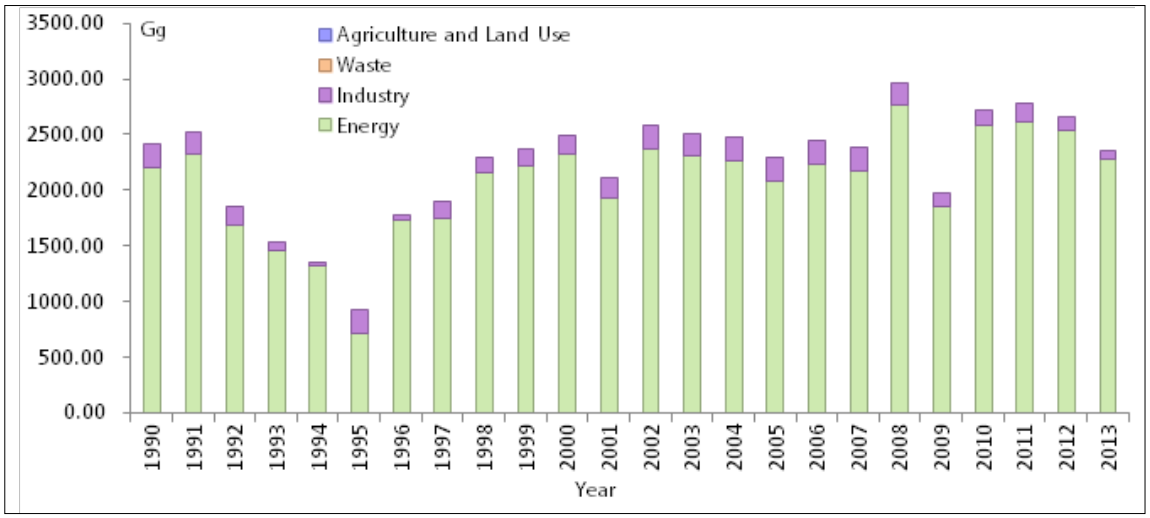


Figure 11 *Total CO_2 Emissions, by Sector, 1990-2013 (Gg)*

Total CH_4 Emissions

Figure 12 shows the total CH_4 emissions. The agriculture sector represented the greatest amount of CH_4 emissions during the observed period (40.7 - 78.3%), while the energy sector contributed 11.6% -22.4%; the waste sector contributed 2.3% - 37.6% of the total CH_4 emissions.

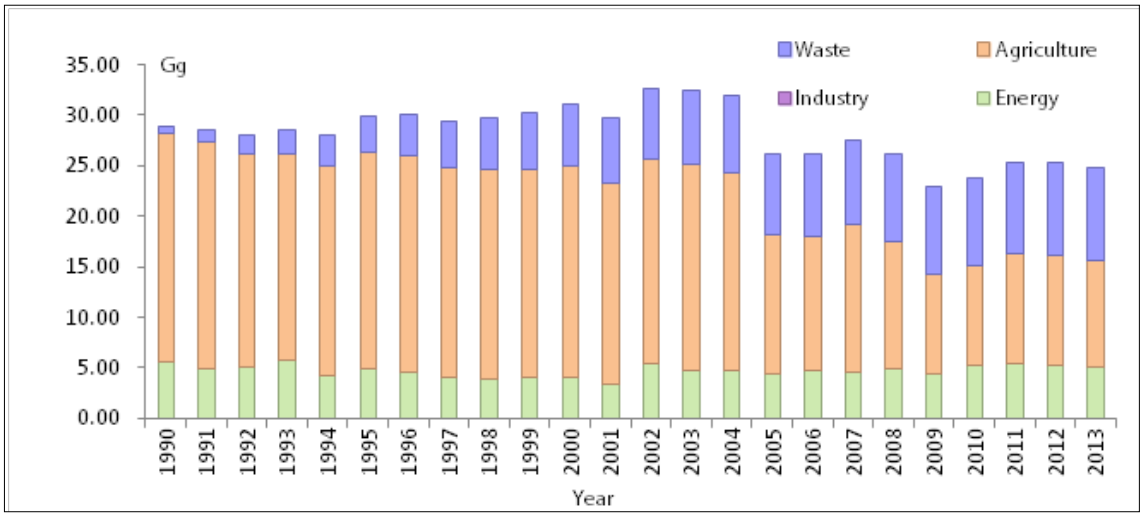


Figure 12 *Total CH_4 Emissions, by Sector, 1990-2013 (Gg)*

Total N_2O Emissions

Figure 13 shows the total N_2O emissions. The agriculture sector represented the greatest share of the total N_2O emissions during the observed period (54.9% - 81.7%), while the energy sector contributed 13.8% - 36% and the waste sector contributed 4% - 9.1% of the total N_2O emissions.

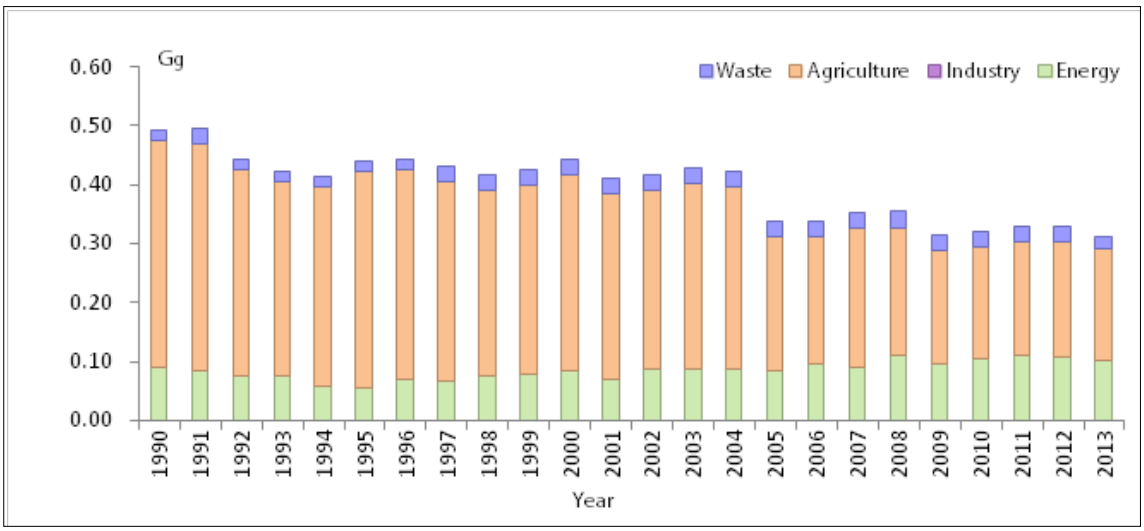


Figure 13 *Total N_2O Emissions, by Sector, 1990-2013 (Gg)*

Total PFC Emissions

PFC (CF_4, C_2F_6) emissions from the industry sector, i.e. aluminium production - the electrolysis plant, were estimated based on data available for the observed period (Figure14).

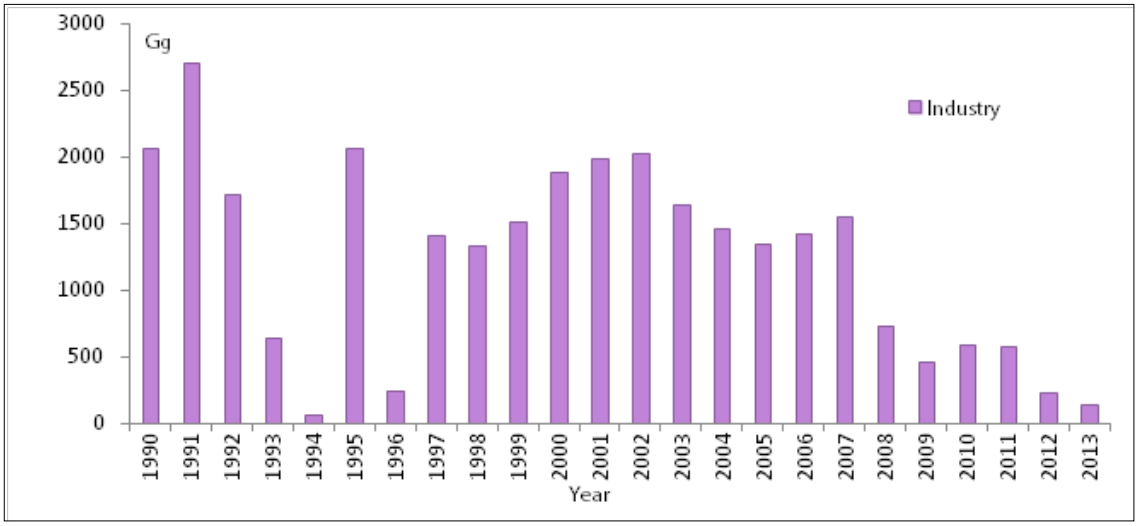


Figure 14 *Total PFC Emissions From the Industry Sector, 1990-2013 (Gg)*

Total SF_6 Emissions

SF_6 emissions from the subsector 2.G-Other Product Manufacture and Use, i.e. from the activity 2.G.1-Electrical Equipment, were estimated based on data available for the observed period (Figure 15).

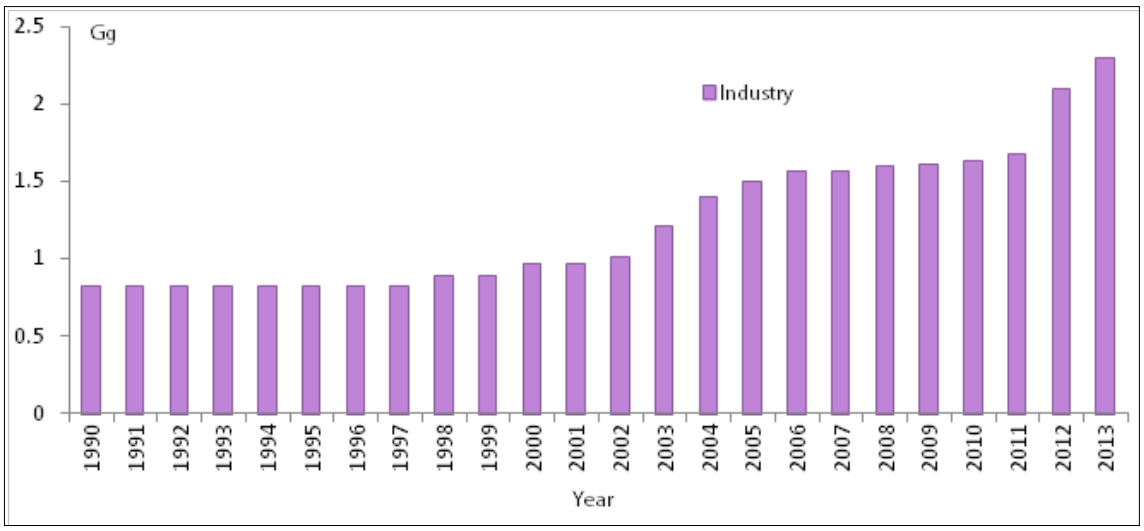


Figure 15 *Total SF_6 Emissions From the Industry Sector, 1990-2013 (Gg)*

Total HFC Emissions

2011-2013 data was available to estimate the total amount of HFC emissions. Emissions from the subsector 2.F-Product Uses as Substitutes for Ozone Depleting Substances, from activity 2.F.1-Refrigeration and Air Conditioning (Figure 16) were therefore estimated.

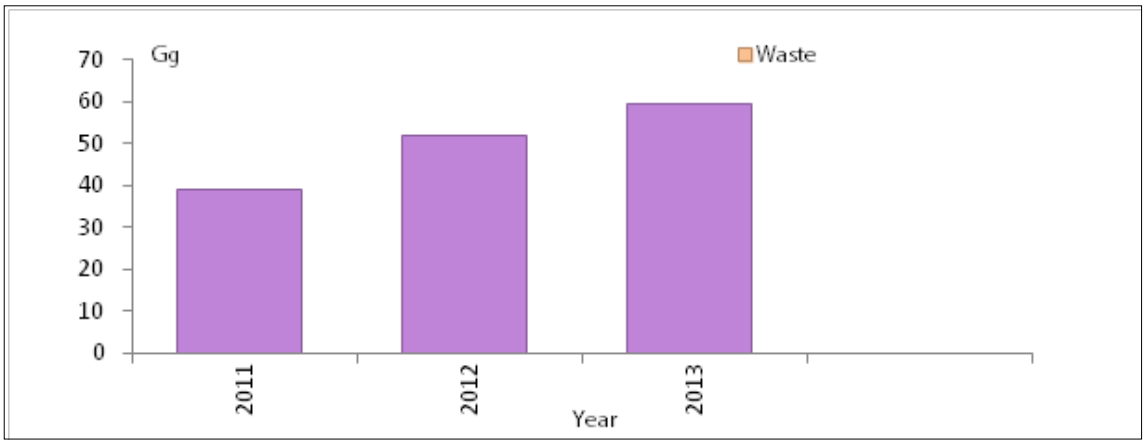


Figure 16 *Total HFC Emissions From the Industry Sector, 2011-2013 (Gg)*

Analysis of Key Emission Sources and Inventory Completeness

The Analysis of Key Sources and Inventory Completeness was produced based on the methodology provided by the Intergovernmental Panel on Climate Change[5], using a Tier 1 approach. Table 7 gives a trend assessment of key emission sources for 1990 and 2013, and Table 8 provides categories of sources and sinks for which emissions were not estimated in 2013. IPCC notation was used to show categories that were not estimated (Not occurring - NO, Not estimated - NE).

5 *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*

Table 7 *Key Source Analysis – Trend Assessment for 1990 and 2013*

Category	CO_2eq Emission Estimate for 1990 (Gg)	CO_2eq Emission Estimate for 2013 (Gg)	Trend Assessment	Cumulative Share of Total Emissions (%)
2C3 – Metal Industry –Aluminium production – PFCs	2,059	139	0.2118309	37.2%
1A1 – Fuel Combustion Activities - Energy Industries (solid fuels) - CO2	1,089	1,505	0.1624299	65.7%
1A3b – Fuel Combustion Activities - Transport – Road Transportation - CO_2	327	585	0.0742573	78.7%
4A – Solid Waste Disposal - CH_4	12	178	0.0327847	84.5%
1A2 – Fuel Combustion Activities - Manufacturing Industries and Construction - CO_2	273	74	0.0174763	87.6%
1A4 Fuel Combustion Activities – Other Sectors - CO_2	175	29	0.0147449	90.2%
1A5 - Fuel Combustion Activities - Non-Specified - CO_2	19	71	0.0114626	92.2%
2F1 – Product Uses as Substitutes for Ozone Depleting Substances - Refrigeration and Air Conditioning - HFCs, PFCs	NA	60	0.0114379	94.2%
3A1 – Enteric Fermentation - CH_4	401	189	0.0102265	96.0%

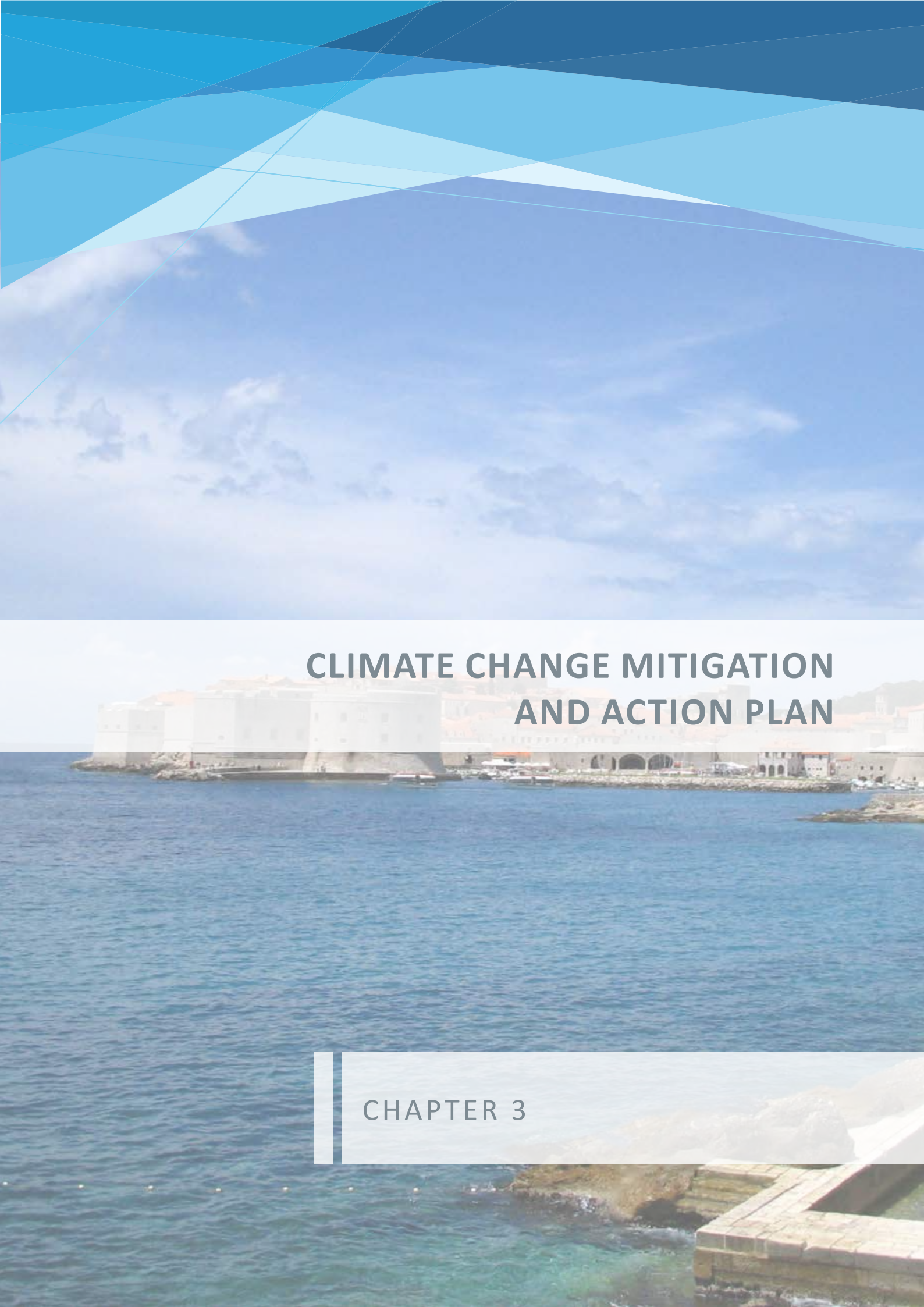
Table 8 *Categories of GHG Sources and Sinks not Estimated for 2013*

Sector/Source Category by IPCC	IPCC Notation
1 Energy	
1A2 Manufacturing Industries and Construction	
1A2b Non-Ferrous Metals	NO
1A2c Chemicals	NO
1A2d Pulp, Paper and Print	NO
1A2g Transport Equipment	NO
1A2h Machinery	NO
1A2i Mining and Quarrying	NE
1A2k Construction	NE
1A2l Textile and Leather	NO
1A3 Transport	
1A3c Railway Transport	NE
1A3di International bunkers (water-borne)	NE
1A3e Other Transportation	NE
1A4 Other Sectors	
1A4ci Stationary	NE
1A4ciii Fishing (mobile combustion)	NE
1A5 Non-Specified	
1A5b Mobile	
1A5bi Mobile (aviation component)	NE
1A5bii Mobile (water-borne component)	NE

1A5c Multilateral Operations	NE
1B Fugitive Emissions	
1B1ai Underground Mines	NO
1B1b Uncontrolled combustion and burning coal dumps	NE
1B1c Solid Fuel Transformation	NE
1B2 Oil and Natural Gas	NO
1B3 Other Emissions from Energy Production	NE
1C Carbon dioxide Transport and Storage	NO
2 Industrial Processes and Product Use	
2A Mineral Industry	NO
2B Chemical Industry	NO
2C Metal Industry	
2C2 Ferroalloys Production	NO
2C4 Magnesium Production	NO
2C5 Lead Production	NO
2C6 Zink Production	NO
2C7 Other	NO
2E Electronics Industry	NO
2F Product Use as a Substitute for Ozone Depleting Substances	
2F1b Mobile Air Conditioning	NE
2F2 Foam Blowing Agents	NE
2F3 Fire Protection	NE
2F4 Aerosols	NE
2F5 Solvents	NE
2F6 Other Applications	NE
2G Other Product Manufacture and Use	
2G1a Manufacture of Electrical Equipment	NO
2G1c Disposal of Electrical Equipment	NE
2G2 SF_6 and PFC from Other Product Use	NE
2G3 N_2O from Product Uses	NE
2H Other	
2H1 Pulp and Paper Industry	NO
2H3 Other	NO
3 Agriculture, Forestry and Other Land Use	
3A Livestock	
3A1b Enteric Fermentation – Buffalo	NO
3A1e Enteric Fermentation – Camels	NO
3A1g Enteric Fermentation - Mules and Asses	NE
3A1j Enteric Fermentation Other	NE
3A2b Manure Management – Buffalos	NO
3A2e Manure Management – Camels	NO
3A2g Manure Management - Mules and Asses	NE
3A2g Manure Management – Other	NE
3B Land	
3B1b Land Converted to Forest Land	NE
3B3b Land Converted to Grassland	NE
3B4 Wetlands	NE

3B5 Settlements	NE
3B6 Other Land	NE
3C Aggregate Sources and Non-CO2 Emissions Sources on Land	
3C1c Biomass Burning in Grasslands	NE
3C1d Biomass Burning in all Other Land	NE
3C2 Liming	NE
3C3 Urea Application	NE
3C7 Rice Cultivations	NE
3C8 Other	NE
3D Other	NE
4 Waste	
4B Biological Treatment of Solid Waste	NO
4C1 Waste Incineration	NO
4C2 Open Burning of Waste	NE
4D2 Industrial Wastewater Treatment and Discharge	NE
4E Other	NE
5 Other	NE

GHG inventory of Montenegro by sectors (Energy, Industry, Agriculture and Land Use and Waste) is presented in Annex 5.



CLIMATE CHANGE MITIGATION AND ACTION PLAN

CHAPTER 3

Country specific issues

Present situation in Montenegro in relation to GHG mitigation can be characterized by the following **country specific issues**:

- **Very low number of stationary installations represent the majority of national GHG emissions** (only one coal fired LCP operated – TPP Pljevlja with CO_2 emissions up to 1 800 Gg, one industrial installation – KAP - with $CO_{2\,eq.}$ emissions varying from 216 Gg to 1762 Gg)
  As total annual national emissions of GHG (without removals) are at the level of 4000 Gg of CO_2 eq., it can be seen that emissions from TPP Pljevlja and KAP could reach up to 45 % of national total each and both together up to 90 %.
- **Very high share of synthetic gases (F-gases) in total national emission balance of Montenegro** (depending of the level of production of KAP Aluminium Works Podgorica)
- **Very high amount of CO_2 sinks in comparison with CO_2 eq. emissions** (2222 Gg against 2440 Gg in 2013) which is caused by the **high share of forests and forest areas in the total national area** (69.8 % in 2013)

Outstanding issues

- **Power station Pljevlja**

Energy transformation and electricity generation at TPP Pljevlja is the most important subsector within the energy sector. TPP Pljevlja (block I) is a condensation thermal power plant with an installed capacity of 218.5 MW el. In 2013, TPP Pljevlja used 1.648 Mt of lignite with a calorific value of 9,190 kJ/kg, sulphur content of (0.8–1)% and ash content 25% to generate 1.5 TWh. Efficiency of conversion is estimated at the level of 29 – 32 %. Emissions of CO_2 in 2013 were estimated at the level of 1360 Gg which represents almost 58 % of total national emissions of CO_2 without removals (counted for 2358 Gg in 2013).

Under the Decision of the Ministerial Council of the Energy Community[6], block I of TPP Pljevlja is expected to be allowed for the limited operational time of 20,000 hours between 2018 and 2023. After 2023 (at the latest), existing block I will be decommissioned and a new block of roughly the same installed capacity[7] will be built in the meantime.

Operator of TPP Pljevlja still has not received integrated permit[8].

- **Aluminium Plant Podgorica** (KAP)

About 99 per cent of emissions from the sector of industrial processes and products use (IPPU) sector originate from the Aluminium Plant Podgorica (KAP). Most of the emissions arise during electrolysis as synthetic gases[9] tetrafluoromethane (CF_4) and hexafluoroethane (C_2F_6), which both have a very high global warming potential. In 2007, emissions of synthetic gases counted for 1549 Gg of $CO_{2\,eq.}$ (while total national emissions of GHGs without removals represented 3965 $CO_{2\,eq.}$). Moreover, KAP has emitted 213 Gg of CO_2 in 2007. After 2007 KAP has reduced its production and introduced some technological improvements (automatic control of anode effects), so emissions of synthetic gases from KAP dropped drastically in 2008 and have been at a lower level since now (decrease from 725 Gg of $CO_{2\,eq.}$ in 2008 to 139 Gg $CO_{2\,eq.}$ in 2013). The same development can be seen in the case of emissions of CO_2 (decrease from 178 Gg in 2008 to 77 Gg in 2013).

6 Decision of the Ministerial Council of The Energy Community on the implementation of Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants.

7 According to Skoda Prague, it will have a power rated input of 254 MW.

8 According to the 2005 Law on Integrated Prevention and Control of Environmental Pollution

9 perfluorocarbons or PFCs

The future development of KAP is uncertain due to both external (aluminium market) and internal reasons (ownership of company). However, decommissioning of KAP is not acceptable for the Government of Montenegro.
Operator of KAP still has not received integrated permit.

National GHG balance

It can be concluded that CO_2 emissions are more or less in balance with CO_2 removals in the years when the TPP Pljevlja was working at reduced capacity (since 1990, removals exceeded emissions in 1992-1999, 2001, 2002, 2007 and 2009) and the total balance is governed by the emissions of synthetic gases (F-gases) from KAP.

Strategic approach

- **Low carbon economic development which takes into account recently developed concepts of "green economy" (UNEP[10]) and "green growth" (OECD[11])**
- **Focus on coordination of measures with the EU pre-accession activities**
- **Focus on "one measure – more effects" measures** (mainly co-benefits of integrated approach to GHG mitigation and air pollution reduction together with minimization of mutual trade-offs)
- **Top-down approach** (two stationary sources represent majority of national GHG emissions)
- **Strong focus on prioritization**

Financial assessment

For the purposes of financial assessment, measures are divided among 4 categories

- **Fully quantified measures** (total costs available)
- **Semi-quantified measures** (unit costs available)
- **Non-quantified measures** (quantification not possible)
- **Low-cost measures**

Scenarios

Taking into account that the future membership in the EU is the top priority for Montenegro and the pre-accession process is in progress, it has been decided that the scenario without measures does not have any real meaning (is only theoretical and cannot happen) and is not further developed[12], as measures required by the EU legislation and national strategies/policies are already in place or have to be implemented in any case. Therefore, Montenegro has developed two realistic scenarios:

- **Scenario with measures** (WM scenario[13])
  WM scenario includes those measures which are laid down by national and/or EU legislation and strategies.
- **Scenario with additional measures** (WaM scenario) **which includes the original WM scenario extended by additional measures that are not required by EU legislation and/or measures for which EU legislation allows flexibility regarding certain quantified requirements** [14].

10 *See http://www.unep.org/greeneconomy/Portals/88/documents/ger/ger_final_dec_2011/Green%20EconomyReport_Final_Dec2011.pdf*
11 *See http://www.oecd.org/greengrowth/towards-green-growth-9789264111318-en.htm*
12 *Measures related to the implementation of EU legislation will have to be implemented in any case.*
13 *Which is in fact identical to the business as usual scenario.*
14 *Certain parameters of BAT (Best Available Technique) are defined by the interval of values.*

SCENARIO WITH MEASURES (WM SCENARIO)

The EU pre-accession process is based on the National Programme for Integration for the period 2008 – 2012 followed by the Programme of Montenegro´s Accession to the EU 2015 – 2018 (PPCG). During this process, several pieces of new legislation in the energy sector, that are relevant for GHG mitigation, have been adopted (2010 Law on Energy, 2014 Law on Efficient Use of Energy, compliant with main EU directives in the field of energy efficiency: Directive 2012/27/EC on energy efficiency; Directive 2010/31/EC on the energy performance of buildings; Directive 2010/30/EU on energy labelling of energy related products; Directive 2009/125/EC establishing a framework for the setting of eco-design requirements for energy-related products), 2011 Energy Policy of Montenegro until 2030 (EDS 2030), as well as important strategic documents (2014 Energy Development Strategy till 2030, 2014 National Renewable Energy Action Plan till 2020, the second National Action Plan for Energy Efficiency (2013 – 2015). The National Climate Change Strategy till 2030 has been adopted in September 2015.

The above mentioned legislation and strategic documents, as well as international obligations (Energy Community) set the following quantified targets:

- 9 % savings in the country's average final consumption by 2018 compared with the average level of consumption during the period 2002-2006 (excluding KAP),
- 33 % of renewable energy within the total gross amount of energy consumed by 2020[15] (26.3 % in 2009).

Measures

Outstanding Issues[16]

Measure 1: ***Introduction of BAT into existing and newly built energy/industrial installations***

Sub-Measure 1: Construction of a new thermal power plant (TPP Pljevlja, Block II)

With a view to utilising available coal reserves in Pljevlja, EDS 2030 envisages the implementation of a construction project to develop a second block at the thermal power plant at Pljevlja (TPP Pljevlja II). A consortium of Slovenian companies, hired by EPCG[17], prepared a conceptual design, a feasibility study and an environmental impact assessment study (EIA) for the project regarding TPP Pljevlja II and for the construction of the thermal power plant Pljevlja II (2012). Both the detailed spatial plan and the strategic environmental impact assessment for this facility are in their final stage. On the basis of the conceptual design and according to the results of the feasibility study, the key technical parameters for the future Block II have been identified as follows:

- The level of power should be the same as for Block 1 (220 MW);
- The level of efficiency would be about 40%;
- The calorific value of coal should be calculated at a level of 9,560 kJ/kg (the current value is 9,211 kJ/kg);
- It has been confirmed that there is sufficient coal around the existing coal mine pits in Pljevlja. The newest pit that is some distance away is Maoče;
- The second block of the thermal power plant is expected to solve heating and air pollution issues at Pljevlja.

After the full replacement of Block 1 with Block 2 (by the end of 2023 at the latest), CO_2 emissions should have decreased by more than 375 Gg/year (at the same level of power generation).

15 *According to the 2012 Decision of the Ministerial Council of the Energy Community on the implementation of EU Directive 2009/28/EU on the promotion of renewable energy.*

16 *Both KAP and TPP Pljevlja fall within the scope of Directive 2010/75/EU on industrial emissions and respective measures are therefore included in the WM scenario.*

17 *EPCG – Electric Power Utility of Montenegro*

The investment cost of Block 2 is estimated at a level of €370 million.[18]

Sub-Measure 2: Modernisation of technological processes at KAP

Because of the uncertain future of KAP (which went bankrupt in 2013) and its high volume of emissions within the national total, two projections have been developed. They are dependent on time-scales with KAP working at:

- reduced capacity (till 2020)
- full capacity (after 2020)

Both mitigation projections assume that KAP will undergo renovation and that BAT will be used regarding energy efficiency and the reduction of emissions[19]. These measures include an increase in efficiency and better process control, as well as the application of point dosage of alumina and aluminium fluoride. Measures leading to a substantial reduction in emissions have been introduced on a gradual basis in the mitigation projections. According to business-as-usual practice, industrial process emissions will reach 1,649 Gg in 2020 which is still lower than in 1990. Regarding mitigation measures for KAP, emissions from the industrial sector can be reduced to 1,012 Gg $CO_{2\ eq.}$ or, in the case of KAP having a reduced capacity of KAP, they could even be as low as 392 Gg $CO_{2\ eq.}$ in 2020.

In August, KAP shut down its series 'A' Electrolysis in which there was no automatic process. The number of anode effects in series 'A' amounted to 24.1 anode effects / cell / day. The anode effect on electrolytic cells in series 'A' lasted 4.95 min.

In the 'B' Electrolysis series, the number of anode effects was 0.82 anode effects / cell / day. The duration of anode effects on electrolytic cells in series 'B' was 0.60 min.

KAP is obliged to submit an application for an integrated permit to the Agency for Environmental Protection by January 2017. As an existing installation KAP must, together with the application, submit a program of measures for the adjustment of existing facilities or activities in compliance with the requirements of best available techniques (BAT) as well as adhering to implementation deadlines.

KAP plans to build a new electrolysis operation line which will be designed and built in accordance with BAT. The investment for the implementation of BAT at KAP is estimated at a level of €48 million without taking into consideration the building of a new electrolysis operation line; the building of a new electrolysis operation line would cost around €350 million.

Sub-Measure 3: Other installations

Apart from KAP, the industrial installation that currently emits the most GHG is the Nikšič Iron Works (whose operator has not received an integrated permit). Regardless of this, its GHG emissions are quite low; however, it also emits a certain amount of indirect GHGs along with other air pollutants (dust). The requirements of BAT[20] should be applied both in the case of existing installations[21] as well as in the case of newly built installations within the scope of Directive 2010/75/EU on industrial emissions.

18 *Study on the Need for Modernisation of Large Combustion Plants in the Energy Community, South East European Consultants, Ltd., November 2013*

19 *See Best Available Techniques (BAT) Reference Document for the Non-Ferrous Metals Industries – Chapter 4, Final draft (October 2014), see http://eippcb.jrc.ec.europa.eu/reference/BREF/NFM_Final_Draft_10_2014.pdf*

20 *See http://eippcb.jrc.ec.europa.eu/reference/*

21 *Either in the case of the first (still missing) permit or in the case of updated permit after the substantial change.*

Energy Sector

The analysis of the reduction of GHG emissions in the energy sector was based on the Energy Development Strategy 2030 (EDS 2030) and takes into account all of the forecasts and calculations in the strategy and sets them against the adopted baseline year, i.e. plans to develop the electricity generation sector, development scenarios regarding consumption in all energy sub-sectors, energy efficiency measures and savings, demographic data and the assessment of increases in GDP per capita. For the purposes of drafting the EDS, three basic scenarios regarding the development of key factors in energy consumption in Montenegro were analysed[22].

Energy - Renewables[23]

Measure 2: *Construction of new hydropower stations*

There are plans for two existing large hydro power stations (HEs) to be reconstructed by 2020:

- HPP Perućica: Increase in capacity from 307 MW to 372 MW (2017); investment cost €44 million
- HPP Piva: Increase in capacity from 342 MW to 363 MW (2018); investment cost €70 million

There are plans for two new large hydro power stations (HEs) to be built by 2020:

- HPPs on Morača - 238 MW (2019); investment cost €543 million
- HPP Komarnica - 168 MW (2020); investment cost €183 million

In relation to small hydro-power plants, construction of 44 small HPPs has been approved up to now, with total installed capacity of 80.61 MW and planned annual production of 257.5 GWh.

Total investment in the hydro power sector is estimated to be around €1.05 billion by 2020.

Measure 3: *Construction of biomass fired power plants*

The construction of a biomass fired plant is planned by 2020; it is expected to have a total installed power/planned generation level of 29.3 MW/101 GWh. The investment cost is estimated at around €67 million by 2020.

Measure 4: *Construction of wind power stations*

Construction of the following new wind power stations (WE) is anticipated by 2020:

- WPP Možura with an installed capacity of 46 MW
- WPP Krnovo with an installed capacity of 72 MW
- WPP (without site specification) with an installed capacity of 33.2 MW (2016 – 2020)

The total investment in the wind power sector is estimated at around €195 million by 2020.

Energy Efficiency and Savings[24]

Measure 5: *Improvement of energy performance of buildings*[25]

Households:

- The implementation of legislation on thermal protection in newly constructed buildings which will reduce the consumption of useful thermal energy for heating to a level of 80 kWh/m^2 of heated surfaces from 2014 onwards;

22 see The Second National Communication on Climate Change, sub-chapter 5.2.1.

23 All measures in the field of renewables are related to the commitment of 33 % set by existing strategies and are therefore included in the WM scenario.

24 All measures in the field of energy efficiency and energy savings are related to the commitment of 9 % savings set by existing strategies and are therefore included in the WM scenario.

25 See Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings

- The refurbishment of 28,000 housing units by 2020 i.e. 4,000 housing units a year starting from 2015 with a 60% reduction in heat loss in refurbished housing units;
- A reduction in the non-thermal consumption of energy per household by 150 kWh a year by 2020, as a result of the classification of household appliances and various other measures.

Services:

- As for the services sector, the implementation of legislation regarding thermal protection in newly constructed buildings will reduce the consumption of thermal energy for heating to a level of 80 kWh /m^2 of heated surfaces from 2014 onwards;
- The refurbishment of one third of all surfaces in buildings in the service sector, based on information from 2010, to achieve a consumption level of 80 kWh/m^2 by 2020;
- A reduction in the consumption of electricity for non-heating needs of up to 10% through the activities of energy agencies and ESCO[26] companies.

The cost of insulation measures (insulation of roof, walls and ground floor) can be estimated as being between €20 and €50 EUR per m^2.

This measure has already been carried out for a long time in the public building sector (educational and health institutions), through the following projects[27]: Energy Efficiency Project in Montenegro (MEEP), funded by the International Bank for Reconstruction and Development (IBRD) and the Energy Efficiency Program in Public Buildings (EEPPB) in cooperation with the German Development Bank (KfW). It is recommended that the implementation of these measures should focus on the residential and commercial sectors.

Transport

Transport is the only sector where available projections predict substantial increases in GHG emissions (mainly due to a combination of an increasing number of vehicles and also due to an increase in mileage of both cars and lorries. As a result, GHG emissions in the transport sector are expected to increase from 609 Gg of CO_2 eq in 2013 to 795 Gg of CO_2 eq in 2020, to 918 Gg of CO_2 eq in 2025 and to 993 Gg of CO_2 eq in 2030. In order to (at least partially) mitigate this increase, the following measures have been proposed:

Measure 6: ***Introduction of alternative fuels in transport***

In addition to the extended use of biofuels[28], this scenario assumes an improved usage level of alternative energy sources (liquefied petroleum gas - LPG and compressed natural gas - CNG) and electricity in transport, including the development of the infrastructure[29]. It should be noted that biodiesel represents about 7%, of the total consumption of liquid fossil fuels; this is very important in terms of GHG reduction because the consumption of diesel is significantly larger than is the consumption of other liquid fossil fuels. It is recommended that this scenario should be supported by the implementation of measure 14 (green procurement/green purchasing in public sector).

26 ESCO = Energy Service Company

27 See http://www.energetska-efikasnost.me/

28 A number of EU directives cover the use of biofuels including the Renewable Energy Directive 2009/28/EC, the Fuel Quality Directive and the Biofuels Directive.

29 Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure

Measure 7: *Redirection of 50% of cargo transport to railways using electricity*[30]

The greatest change to fuel consumption in transport could be achieved by the introduction of a transport policy directed a large part of transit cargo to the railway system. However, the current condition of the railway infrastructure is such that it hinders normal transport and its existing volume is inadequate to generate sufficient revenue to cover its costs.

Forestry

Forestry represents considerable potential for the reduction of GHG; this could be further increased by both improving the status of existing forests and by enlarging forests and forest areas.

Measure 8: *Improving the status of forests and generating additional afforestation*[31]

The National Forest Strategy, along with the Forest and Forestry Development Plan up to 2023, defines two broad objectives which relate to forests as ecosystems, to natural resources and to the economic sector in terms of forestry and the wood-processing industry:

1. To improve the sustainability of forest management and increase the growing stock in commercial forests from 104 to 115 million m^3 of gross wood mass.

Montenegro has enough natural and healthy forests, but many of them, particularly privately owned coppice forests, do not achieve their full productivity. Management, planning, care and planting should increase the quality, stability, resilience and productivity of forests, thus providing a basis for long-term sustainable use. The introduction of technology for the use of poor quality wood would contribute to the greater use of silvicultural measures and would bring about the revitalisation of low-yield forests in Montenegro. This applies most specifically to the production of pellets and to the subsequent production of electricity based on biomass.

This measure could lead to an increase in the reduction of GHG emissions by more than 10 % (i.e. 200 Gg/year).

2. To increase GDP in the forestry sector, in the timber industry and in other industries that depend on forests from 2% to 4% of GDP

The forestry and wood industry sectors do not achieve economic effectiveness in accordance with their potential. Investments in forests and in rural infrastructures, in development activities associated with forestry and timber industries, in the diversification of the timber market and in developing cooperation within the forestry sector, would increase the number of jobs, the socio-economic status of the rural population and the volume of company businesses, including government revenue from forestry and wood industries.

Regardless of the high proportion of the country's territory covered by forests or forest land, there is still scope to further increase this; such action would also lead to more positive environmental, economic and social effects.

30 *Redirection of transport from road to rail was requested in the EU White paper 2011: Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system*

31 *A new EU Forest Strategy: for forests and forest-based sectors {SWD(2013) 342 final}*

Agriculture

Measure 9: *Support for organic farming*[32]

The agricultural sector is a source of methane (CH_4) and nitrous oxide (N_2O), which mainly originates from livestock and from the use of nitrogen fertilizers in crop production. As shown in the inventory of GHG emissions, these two gases are most present in agriculture, but agriculture contributes very little directly to CO_2 emissions.

Organic farming aims to establish a sustainable system of agriculture that respects natural systems and cycles as well as maintaining and improving soil and water quality, the health of plants and animals, levels of mutual balance that contribute to high levels of biodiversity, the rational use of energy and natural resources (water, soil, organic matter and air), respect for animal welfare and, in particular, meeting the specific needs of animals in relation to their species. Organic farming is essentially the production of agricultural products using methods that do not harm the environment, human health, or plant and animal health and welfare.

Support from the agro-budget is provided to producers and manufacturers of organic products to improve their levels of production. Support is provided for both plant and livestock production. Through IPARD measures, producers and manufacturers are able to improve the infrastructure at farms and at manufacturing plants. In this way, the seasonal character of production should be reduced as manufacturers should be able to produce their primary products more consistently and should thus be able to establish continuity both in production and in the market.

Waste Management

Measure 10: *Reduction of bio-degradable waste in landfills*[33]

The Biodegradable Waste Disposal Programme (BWDP) will specify measures to reduce the amount of biodegradable waste that can be disposed of; it will include measures for recycling and composting, for producing biogas and other materials and for energy processing, in order to ensure that the amount of biodegradable municipal waste sent to landfill sites reaches a target figure equivalent to 35% of the total mass of biodegradable waste produced in 2010. BWDP is an integral part of the Draft National Waste Management Plan for the period 2014-2020. To achieve the desired level of biologically degradable municipal waste going to landfill, the percentage shares of biodegradable waste produced were calculated as follows:

- 75% of the total mass of biodegradable waste produced in 2010 will be sent to landfill no later than 2017;
- 50% of the total mass of biodegradable waste produced in 2010 will be sent to landfill no later than 2020;
- 35% of the total mass of biodegradable waste produced in 2010 will be sent to landfill no later than 2025.

Provided that the majority of GHG emissions from the waste sector originate from the landfilling of biodegradable waste, a reduction in emissions, in relation to the above mentioned targets, could be 80 Gg $CO_{2\ eq.}$ in 2020.

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32 Action Plan for the Future of Organic Production in the European Union, COM(2014) 179 final

33 Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste*, Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste, Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)*

Tourism and Services

Measure 11: *Support for 'low-carbon tourism'*[34]

Tourism remains one of the main drivers of the national economy and its potential is expected to grow further (in 2012, 1.44 million tourists visited Montenegro with a total of 9.15 million of overnight stays). For example, the introduction of environmental management systems (EMAS[35]) in hotels and other accommodation facilities could have GHG mitigation potential[36]. GHG mitigation potential could also be realised by giving preference to 'eco-labelled' products and services[37].

Horizontal (cross-cutting) Measures

Measure 12: *The raising of public awareness*

As stated in the 7th Environment Action Programme[38] - Article 15, the public should play an active role in environmental policy and should be properly informed. Since the environment policy is a shared competence in the EU, one of the purposes of the 7th EAP is to create common ownership of shared goals and objectives and to ensure a level playing field for businesses and public authorities. Clear goals and objectives also provide policy makers and other stakeholders, including regions and cities, businesses, social partners and individual citizens with a sense of direction and with a predictable framework for action.

Measure 13: *Emphasis of GHG mitigation measures in EIA*[39] *and SEA*[40]

Maximum levels of GHG mitigation measures that are economically feasible should be required both in Environmental Impact Assessment and in Strategic Environmental Assessment procedures.

Measure 14: Green procurement/green purchasing in the public sector[41]

Public expenditure, which represents a considerable percentage of GDP, includes the construction and reconstruction of buildings, the purchasing of vehicles and appliances. The introduction of GHG emission reduction criteria could have a considerable impact in this area. Moreover, appliances complying with the requirements of the Eco-design Directive[42] and with related legal acts should be given priority.

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34 Influences on consumer behaviour Policy implications beyond nudging. Final Report, 8 April 2014 (see http://ec.europa.eu/environment/enveco/economics_policy/)

35 The EU Eco-Management and Audit Scheme (EMAS) is a management instrument developed by the European Commission for companies and other organisations to evaluate, report, and improve their environmental performance. EMAS is open to every type of organisation eager to improve its environmental performance. It spans all economic and service sectors and is applicable worldwide. See http://ec.europa.eu/environment/emas/index_en.htm

36 At present the UNDP project 'Towards Low-Carbon Tourism' is still in progress.

37 The EU Eco-label helps consumers to identify products and services that have a reduced environmental impact throughout their life cycle, from the extraction of raw materials through to their production, use and disposal. Recognised throughout Europe, the EU Eco-label is a voluntary label that promotes environmental excellence which can be trusted. See http://ec.europa.eu/environment/ecolabel/

38 General Union Environment Action Programme to 2020: Living well, within the limits of our planet

39 Directive 2014/52/EU of the European Parliament and of the Council amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment

40 Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment

41 Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts

42 Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of eco-design requirements for energy-related products

Conclusion

It is evident that the full implementation of the WM scenario could lead to a gross reduction in GHG emissions of more than 375 Gg CO_2 eq / year from 2024 (i.e. after the decommissioning of TPP Pljevlja I and its replacement by TPP Pljevlja II) in comparison with 2013.

This reduction would, however, be cancelled out by increases in emissions in the transport sector (an expected increase of 186 Gg CO_2 eq / year by 2020 and of 309 Gg CO_2 eq / year by 2025 in comparison with 2013) and emissions produced by KAP (an expected increase of 259[43] – 873[44] Gg CO_2 eq / year in comparison to 2013).

Reductions of GHG emissions in the waste management sector are estimated to be 80 Gg CO_2 eq. /year in 2020 in comparison with 2013.

Moreover, the reduction of GHG emissions could be further improved by more than 200 Gg of CO_2 eq in comparison with 2013 (measure 8: Improvement of the status of forests).

As a result, **the reconstruction of TPP Pljevlja and also the implementation of the best available techniques at KAP will be crucial in terms of the total national GHG emission levels achieved in Montenegro.** Provided that all possible measures at KAP are implemented, the implementation of additional WM scenario measures could contribute to the partial 'neutralisation' of increases in GHG emissions expected in certain sectors (mainly transport). The implementation of the WM scenario, in which all measures are based on EU legislation and policies, would also bring about the reduction of other negative environmental impacts, particularly air pollution (mainly measures 1, 4, 5, 7, 8 and 10).

SCENARIO WITH ADDITIONAL MEASURES (WAM SCENARIO)

It can be seen that the implementation of the WM scenario would not be sufficient to 'neutralize' an increase in GHG emissions from certain sectors (mainly transport) if KAP were to run at full capacity; thus additional measures are needed.

The WaM scenario includes the full WM scenario along with the application of additional measures in certain sectors where there is additional potential for the reduction of GHG emissions.

Measures

Energy

Measure 15: *Support (subsidies) for the use of solar thermal and photovoltaic energy*

In Montenegro there are, on average, 2,000 -2,500 sunny hours a year; the use of solar energy is presently limited to solar heating systems for water in the residential, public and service sectors. Support for the increasing use of solar heating is recommended (similar to the method that has been applied in the MONTESOL programme[45]) as well as support (subsidies) for photovoltaic plants and their operation.

The total investment costs in the photovoltaic power sector are estimated at €24 million by 2020.

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43 Reduced capacity

44 Full capacity

45 See http://www.solarthermalworld.org/content/montesol-solar-water-heating-project-montenegros-domestic-sector

Measure 16: ***Support (subsidies) for households for the replacement of coal/wood fired boilers for new more efficient ones and / or for the improvement of the energy performance of buildings***

In the households and services sectors, the percentage share of the total amount of solid fuels (coal, wood) used for heating is 55 %[46]. In addition to a significant level of GHG emissions, local heating based on coal has a significant negative impact on local air quality (particulate matter PM_{10} and $PM_{2.5}$, benzo(a) pyrene). Financial support given to households to replace obsolete low efficient coal-fired boilers with new more efficient ones (biomass, coal/biomass, coal, gas, heat pump, solar heating) or to improve the energy parameters of buildings (measure 5) would have strong synergistic effect on the emissions of both GHG and air pollutants. Both types of measures could be implemented in parallel. Coordination with the ENERGY WOOD programme[47] is recommended.

The average cost of a new boiler (coal, wood, pellets and gas) with the best emission and efficiency parameters (5th emission class) is around €4,000.

Transport

CO_2 and air pollutant emissions depend not only on engine and fuel quality but also on fuel consumption according to the fluency of vehicle motion. Measures to increase the fluency of motion include both the development of a suitable infrastructure and improvement in the organisation of transport.

Measure 17: ***Development of transport infrastructure*** *(highways, motorways, city by-passes)*

The implementation of such measures is limited by the geomorphology of Montenegro; however, the construction of the first motorway is in progress[48]. The total cost is estimated at €800 million.

Measure 18: ***Improvement of road transport organisation in cities and the introduction of integrated concepts (SMART cities[49])***

Concrete measures include integrated transport systems, telematics, parking policies, intelligent transport systems, support for public transport and support for cyclists.

The smart city concept goes beyond the use of ICT and aims to achieve a better use of resources and less emissions. It represents smarter urban transport networks, upgraded water supplies and waste disposal facilities, and more efficient ways of lighting and heating buildings. It also encompasses more interactive and responsive city administration, safer public spaces and aims to meet the needs of the population.

So far, the European Innovation Partnership (EIP) on Smart Cities and Communities has received around 370 commitments to fund and develop smart solutions in the areas of energy, ICT and transport. These commitments involve more than 3,000 partners from across Europe and provide Montenegro with great potential for making cities more attractive as well as creating business opportunities.

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46 Stanovi prema opremljenosti instalacijama. Popis stanovništva, domaćinstava i stanova u Crnoj Gori 2011. Godine, MONSTAT 2012, see http://www.MONSTAT.org/userfiles/file/popis2011/saopstenje/STANOVI%20Saopstenje%2023_10_2012.pdf

47 See http://www.energetska-efikasnost.me/ee.php?id=24&l=en

48 The motorway from Bar to Boljari is 169.2 kilometres long. Per km, this will be one of the most expensive motorways in Europe due to the tunnels, bridges and viaducts that will make up over 40% of its total length. The construction of this motorway is the greatest engineering construction project that has ever taken place in Montenegro and is one of the biggest projects to be implemented in Europe. The route will require the construction of 42 tunnels and 92 bridges and viaducts. The average daily traffic on the existing road from Bar to the border with Serbia, in certain sections, ranges from 5,100 to 8,300 vehicles with distinct seasonal annual intensity that reaches up to 20,000 vehicles.

49 See https://ec.europa.eu/digital-agenda/en/smart-cities

Waste Management

Measure 19: *Energy recovery from waste*

After the prevention of waste, maximum waste reduction recovery and the treatment of materials (taking into account only materials of high and medium calorific value), one very relevant issue should be considered; energy recovery from residual waste. In 2020, the potential for energy recovery from residual waste is expected to be in the range of 73,000 tons of high calorific waste and 12,000 tons of medium calorific waste (sludge) materials that could be used for energy generation The Draft National Waste Management Plan for the period 2014-2020 provides for the development of a feasibility study at a national level in order to review potential, viable technology and locations for the construction of a plant for the recovery of energy from waste.

The investment cost in case of forming one region for municipal waste management with building facility for using energy from waste amaunts to 134.690,000 EUR.

Tourism and Services

Measure 20: *Support to the sustainable tourism (eco-tourism)*[50]

Long term sustainability requires a balance between sustainability in economic, socio-cultural and environmental terms. The need to reconcile economic growth and sustainable development also introduces an ethical dimension. Major challenges for sustainable tourism include:

- Preserving natural and cultural resources
- Limiting negative impact at tourist destinations; including use of natural resources and waste production
- Promoting the wellbeing of the local community
- Reducing seasonal demand
- Limiting the environmental impact of tourism on related transport
- Making tourism accessible to all
- Improving the quality of tourism jobs.

The implementation of the WaM scenario could further contribute to the 'neutralisation' of the increase in GHG emissions expected from certain sectors (mainly transport) and to the achievement of a 'zero-carbon balance'.

Priorities

The WM and WaM scenarios do not include all of the possible measures that could lead to a reduction in GHG emissions. Only priority measures have been included, and are those for which a substantial reduction in GHG emissions could be expected (and in many cases positive side-effects). These 20 priority measures have been divided into three categories:

- Top priorities
- High priorities
- Medium priorities

Top Priorities

- Measure 1: The introduction of BAT into existing and newly built energy/industrial installations (especially TPP Pljevlja and KAP); WM scenario
- Measure 5: The improvement of energy performance in buildings (WM scenario)
- Measure 6: Support for alternative fuels in transport (WM scenario)
- Measure 8: The improvement of the status of forests and the development of additional afforestation (WM scenario)

50 See http://ec.europa.eu/enterprise/sectors/tourism/sustainable-tourism/index_en.htm

- Measure 14: Green procurement/green purchasing in the public sector (WM scenario)
- Measure 16: Support (subsidies) for households regarding the replacement of coal/wood fired boilers for new more efficient ones and / or the improvement of energy performance in buildings (WaM scenario)

High Priorities

- Measure 2: The construction of new hydro power plants (WM scenario)
- Measure 4: The construction of wind power plants (WM scenario)
- Measure 7: The redirection of 50 % of cargo transport to railways using electricity (WM scenario)
- Measure 10: The reduction of biodegradable waste in landfills (WM scenario)
- Measure 11: Support for 'low-carbon' tourism (WM scenario)
- Measure 15: Support (subsidies) for the use of solar thermal and photovoltaic energy (WaM scenario)
- Measure 17: The development of a transport infrastructure (highways, motorways, city by-passes (WaM scenario)

Medium Priorities

- Measure 3: The construction of biomass fired power plants (WM scenario)
- Measure 9: Support for organic farming (WM scenario)
- Measure 12: The raising of public awareness regarding reductions in GHG emissions (WM scenario)
- Measure 13: To place emphasis on GHG mitigation measures in EIA and SEA processes (WM scenario)
- Measure 18: The improvement of road transport organisation in cities and the introduction of integrated concepts (SMART cities) (WaM scenario)
- Measure 19: Energy recovery from waste (WaM scenario)
- Measure 20: Support for sustainable tourism (eco-tourism) (WaM scenario)

The huge majority of proposed measures represents general categories which will be implemented through particular projects. **In order to be able to prioritise particular projects, detailed criteria and methodology for project priority setting have been developed (see Annex 4).**

Conclusions

The GHG Mitigation Action Plan of Montenegro is presented in Annex 2.

Tables on GHG mitigation measures are presented in Annex 3.

The implementation of measures proposed in both the WM and WaM scenarios, regarding the priorities presented above together with prioritisation in concrete projects as outlined in the methodology in Annex 4, may move Montenegro towards a 'zero-carbon balance'.

CONSTRAINTS AND GAPS: TECHNOLOGY, FINANCIAL AND CAPACITY-BUILDING NEEDS AND SUPPORT RECEIVED

CHAPTER 4

As a developing country, Montenegro has often asked for international assistance in the form of financial assistance, capacity building, technical assistance and technology transfer; this has been to help the country to move towards meeting its obligations under the UN Framework Convention on Climate Change. The majority of the initiatives to date have addressed climate change mitigation i.e. a reduction in GHG emissions, and have primarily involved financial assistance, capacity building and technical assistance.

This year intensive work has been undertaken to design and implement activities to enable the country to respond to the challenge of climate change. Montenegro recently submitted its Second National Commmunication and adapted National Climate Change Strategy and a Technical Paper on the Intended Nationally Determined Contribution to the Reduction of GHG Emissions (INDC); thus Montenegro committed to reducing GHG emissions after 2020 in the context of a new global international agreement that has been adopted in Paris later this year.

The institutional set-up and the capacity of the state have made evident progress over recent years. However, it is still possible to identify needs, gaps and obstacles that impede further development in the area of climate-related activities. Besides the currently available financial, technical and capacity-building support, Montenegro still cannot meet the growing requirements related to the climate change challenge.

In order to overcome its identified shortcomings in the near future, Montenegro must continue to draw support from a large number of international donors, including national governments, non-profit organisations and international organisations. In addition, bilateral technical cooperation across all sectors needs to be enhanced and expanded, and the exchange of expertise and technology needs to be promoted in order to achieve greater efficiency in mitigation activities.

It is therefore very important to identify Montenegro's technological requirements within the current economic situation and to accurately assess its financial and capacity-building needs to prevent the harmful effects of global climate change.

The need to set up a permanent and binding system for drafting national reports, Biennial Updated Reports (BURs) and Intended Nationally Determined Contributions is also a challenge; this could be overcome by securing specific budgetary funding for the ongoing financing of reporting activities.

The UNFCCC Guidelines for the preparation of BURs for non-Annex I Parties to the Convention (Annex III, Decision 2/CP177) served as the methodological framework for the identification of needs and support received.

The information presented under this chapter should be seen as interim and incomplete, in need of constant updates; it was not possible, during the short time span available to review in detail all of the aspects relevant for the identification of constraints and gaps, along with all of the related financial, technical and capacity-building needs of Montenegro.

Technology Needs for the Purpose of Climate Change Mitigation

The introduction and application of new technology in the country should rely on the national economic, social and environmental development priorities; the same process should also be aligned with national interests and should render other benefits, in addition to climate change mitigation.

The identified technology needs in Montenegro address a wide range of issues. The main priorities are the introduction of technology to reduce GHG emissions and technology to facilitate adaptation to climate change. These include energy-efficient technology in all sectors of the economy and in the housing and commercial sectors, technology using renewable energy sources (hydro, wind, solar and biomass) and technology for the efficient use of water, land, forests, coastal areas and other natural resources.

Technology needs were assessed and the results identified that financial and capacity- building needs were an important factor for identifying mitigation measures; the assessment of financial and capacity-building needs should therefore be regarded as a prerequisite for the implementation of measures. Technology needs assessments are conducted regularly due to the progress of available technology, the need for additional technology, the amount of funds required, funding sources, expertise, sufficient capacity to implement measures, the need for new skills and abilities and the importance of international support required to implement mitigation measures across all sectors.

Mitigation measures call for the prior assessment of any technology required for their implementation as Montenegro is fully dependent on new technology being imported. The use of renewable energy sources in various sectors of the economy could prevent environmental pollution and contribute towards energy security. In Montenegro, renewable energy sources could be used in all sectors of the economy (energy, industry, transport, tourism and agriculture), as well as in the housing and commercial sectors.

According to estimates, the hydro-potential of rivers could potentially ensure energy security and mitigate the effects of climate change. During recent years, several small hydro-power plants have been built and commissioned, and there are ambitious plans for the further exploitation of small and large watercourses. There are also plans and initiatives to generate energy from wind, solar energy and biomass; this is coupled with a greater level of awareness and expertise among national experts concerning the use of new technology.

A number of activities have been launched in order to reduce energy consumption: energy audits, the application of rational standards concerning energy characteristics, and the certification of new and existing buildings. In addition, there are initiatives that promote energy efficiency in public buildings and in low-carbon tourism and there are subsidies available for solar water-heating and modern biomass-heating along with the installation of photovoltaic collectors in rural areas which have no electricity grid. In the area of energy efficiency technology, there is room for further reduction in energy consumption through the widespread use of 'smart' systems in consumption management and in network technology. To conclude, the application of low-carbon modern technology in the country requires continuous cooperation with international organisations and institutions, the review of best international practice and the implementation of various projects carried out with the support of international donors.

Financial Needs Concerning Climate Change Mitigation

Despite the fact that Montenegro, being a non-Annex I party to the Convention, has not committed to any targets concerning reductions in GHG emissions by 2020, a number of mitigation activities have already taken place in the country. The state is still working on securing additional financial resources; thus, under IPA II, Montenegro has been allocated €37.5 million for the environment and for climate (not including funds allocated for cross-border cooperation) as well as €32.1 million for transport for during the period 2014-2020.

Attracting investment is of major importance in ensuring the long-term, sustainable and balanced development of the country. Over recent years there has been an evident increase in the volume of investment in energy infrastructure development. Major investments have addressed the reconstruction of existing hydro-power plants, the construction of new wind-power plants and small hydro-power plants, the new capacity levels of electricity transmission systems, 'smart' electricity meters and various other activities. The development of renewable energy sources has been set as a priority for the forthcoming period in line with international obligations. Consequently, further major investment is planned for the purpose of developing this sector. The strategic framework envisages further investment in the continuous development of the energy infrastructure including: pipelines, new transmission system facilities, upgrades of the existing transmission and distribution systems, support for entrepreneurship in the energy sector, and reductions in technical and technological losses in electricity generation and transmission/distribution. Additionally, there are plans to build a new block at the existing thermo-power plant using lignite from

the surrounding area; this will support the existing inadequate block. In addition to in the energy sector, considerable investment has been made to develop the transport, tourism, agriculture and waste sectors. Over the past few years, significant steps have been taken to build the first motorway in the country and works on this started recently. In agriculture, national and international funds have been secured to invest primarily in organic farming, along with smaller-scale investment in forestry. In the waste sector, loans have been secured from international lenders to invest in infrastructure i.e. in solid waste, industrial waste and wastewater management facilities. No major steps forward have been achieved regarding the operation of industrial plants, except that metal-processing plants will, in the near future, be expected to shift towards using modern low-emission technology in line with the BAT guidelines.

The following conclusions can be drawn regarding this area:

- There is growing concern among institutions regarding threats due to climate change.
- The total number of implemented projects, directly or indirectly linked to fighting climate change, is still not sufficient; the same applies to the area of mitigation.
- More cross-border projects need to be implemented and regional cooperation and the exchange of experience need to be strengthened. Practice has shown that the best results can be achieved if all stakeholders are involved and work together.
- In addition to national budget funds, there are a whole range of funding sources that address climate change. These range from international funds and grants as well as loans that have relatively low interest rates (from international financial institutions and state-owned and private banks).
- A consolidated database needs to be set up and integrated into the IT system of the national Statistical Office. The database should include all of the data required for the development of a GHG inventory, for reporting and developing NAMA project proposals and initiatives, and for recording data on all projects and their results to ensure a better overview of their impact.
- Public institutions and organisations and local governments need to focus more on using funds to enhance energy efficiency, to use renewable energy sources, to introduce alternative modes of transport, to adapt to climate change by introducing activities in relevant facilities and in plants under their control.
- Research should be conducted and services developed concerning climate change, particularly in insurance services.
- Funding is required to enhance public awareness regarding climate change, to involve the private sector, local authorities and community; at the same time, the population needs to be further motivated to reduce GHG emissions through incentives, workshops and the dissemination of material.

Financial Support Received

Financial support from international organisations and the exchange of expertise with other countries has enabled Montenegro to implement or manage a series of projects concerning climate change. Between 2006 and 2014, the state received Official Development Assistance - ODA[51] of more than €490 million from a number of partners, to respond to climate change. The EU along with a variety of its programmes have been the principal source of donations; together they have contributed approximately 60% of all project funding. Together, the UN and GEF also contributed approximately 30% of the total funding through programmes and donations.

The review of climate change projects and investment to date shows that approximately €490 million has been spent on mitigation, adaptation and mixed projects: approximately €350 million in loan funds and €140 million in grant funds. The total number of projects relating to climate change is probably higher than the number put forward in this report.

51 http://www.oecd.org/dac/stats/officialdevelopmentassistancedefinitionandcoverage.htm

The majority of grants have been provided by a group of multilateral funds and organisations concerned with climate initiatives; other grants have been provided by bilateral donors and financial support has also been given by international financial institutions.

Since financial indicators point to a high level of public debt, at around 60% of GDP, additional borrowing would clearly have a negative effect on the sustainability of public debt which would, in time, pose a challenge to fiscal stability.

In this regard, it is necessary, in addition to allocations from the national budget, to step up the implementation of EU support programs in order to fund climate change activities. More efforts are also needed to secure donations for projects as this would diminish the need for loans.

The role of local governments in policy making and implementation should be reinforced and financial liability explicitly defined; this is important due to the long term effect of eliminating the negative effects of climate change.

Capacity Building Needed for Mitigation Purposes

In order to meet the obligations arising from the conferences of the parties held in Cancun and in Durban, and in line with decisions concerning reporting (national reports and BURs), further support is needed to continue developing and consolidating existing technical and institutional capacity along with efforts to integrate climate change into national policies, programmes and plans.

Following accession to the Convention, Montenegro implemented a number of activities in this area at a national level, in order to meet some of the requirements under the Convention which rendered good results. However, given changes in the Convention mechanisms and the identification of new, modern mechanisms, methods and approaches, all of which require new expertise, it is necessary to constantly develop capacity and upgrade expertise and skills to achieve a reduction in GHG emissions.

The expertise and skills required to implement mitigation measures have been identified as a very important factor in capacity building. For the sake of the efficient coordination of such activities, the staff of the Ministry of Sustainable Development and Tourism, Environmental Protection Agency and all those directly addressing climate change (Ministry of Economy, Ministry of Agriculture and Rural Development) need to possess and constantly develop expertise in this area.

Since any type of economic activity implies fuel consumption, it is particularly necessary to upgrade expertise concerning energy efficiency and renewable energy sources. In addition to training staff working in public institutions, it is necessary to work with individuals, with the private sector and with local governments; events such as round tables or seminars promoting various initiatives should be held nationwide. One such activity is the promotion and installation of solar PV systems for cattle breeders and farmers on their summer pastures (*katun*). Scientific institutions should also assume an important role and should take an active part in activities concerning capacity building and the assessment of technological capacity, information and notification. Their staff should enhance their level of expertise and skills in the area of climate change.

With regard to further capacity building, Montenegro requires the following:

- Continuous training in policy and legislation drafting in line with the EU legislation and policies on climate change and the requirements under the Convention to ensure efficient coordination between national and local authorities.
- The technical team for the development of a GHG Inventory needs constant assistance - both administrative and financial – to upgrade the inventory and to calculate country-specific emission factors, in order to guarantee integrity and to ensure full sustainability and quality control of future inventory development.

- Capacity strengthening for drafting a low-carbon development strategy, which should encompass all relevant sectors and should consider the development of a low-carbon economy at all levels, including in companies.
- Experts from relevant institutions who are responsible for the implementation of intended measures need to establish better cooperation and acquire the necessary expertise and skills to design NAMA policies, to set criteria for gathering information on mitigation projects, to measure and quantify GHG reduction measures, programs and projects, to develop sectoral and inter-sectoral NAMA projects, to apply new technology, to finance climate change through donor involvement, to use various financial mechanisms under the Convention and to access the growing pool of public and private funds supporting climate preservation projects.
- Capacity building for staff working in the relevant institutions to be involved in the setting up and operation of a national Monitoring, Reporting and Verification (MRV) system for NAMA projects.

Technical Assistance and Capacity Building Provided

Montenegro has been granted significant capacity-building and technical assistance for a number of programs, projects and partnerships by the following donors: European Commission, UN and the World Bank, EBRD, GiZ, EIB, KfW, LuxDev, ADA, the Governments of Italy, Germany, Luxemburg, Austria, Norway, the Netherlands, Greece etc. The greatest share has been provided by the European Commission and the UN, who have supported projects, workshops, studies, initiatives and specific programs of considerable impact regarding overall capacity strengthening and technical assistance.

Montenegro takes part in the Environment and Climate Regional Accession Network – ECRAN which provides support in the form of training, and of the Union for Mediterranean Climate Change Expert Group-UfMCCEG. From September 2013 to September 2015, ECRAN has supported a large number of training events, and has increased the available capacity for the drafting of future national reports. The training events addressed the following topics:

1. ECRAN Climate–Working Group 1: 'Climate policy development and climate awareness' – regional capacity-building workshop for drafting low-emission strategies and modeling (kick-off workshop);
2. Kick-off workshop on MMR: regional training on the development of a GHG inventory, focusing on the energy sector;
3. Regional training on involving aviation in the EU emission trading system;
4. Initial forum on the environment and on climate;
5. Regional training on selected climate chapters – workshop on ODS and F gases;
6. High-level regional conference and seminar on adaptation to climate change;
7. Module 2: regional training on the assessment of reliability regarding GHG inventories;
8. EU ETS regional training on MR and A&V rulebooks;
9. EU ETS study visit to the Netherlands on the work of the competent national body for emission trading;
10. Contribution to the International Climate Agreement (2015) and de-carbonisation planning;
11. Kick-off workshop for national adaptation teams;
12. Modeling: training for Module 1 – practical training on quantitative models and scenario development to assess climate and energy policies and to set GHG reduction targets
13. The first forum on the environment and on climate;
14. Expert training on risk, vulnerability assessment and adaptation planning in the water management sector;
15. Expert training on risk, vulnerability assessment and adaptation planning in the urban planning sector;
16. Regional training seminar on the assessment of GHG inventories in the energy and industrial processes sectors;
17. Modeling: support mission for Module 1;
18. Regional training on Intended Nationally Determined Contributions to the Reduction of GHG Emissions (INDC)–contribution to the Global Climate Agreement;

19. Regional seminar on the implementation of ETS and a strategy for its development;
20. Support mission on modeling emission scenarios;
21. Expert training on risk, vulnerability assessment and adaptation planning in the energy sector;
22. Regional training seminar on the assessment of GHG inventories in the forestry sector and regarding other land use;
23. Forum on the environment and on climate: climate change policy;
24. Regional dialogue between the EU, candidate countries and potential candidate countries on the INDC as a contribution to the global climate agreement (2015);
25. Advanced technical training on the EU rulebook regarding monitoring and reporting;
26. Monitoring progress in transposing and implementing EU regulations on the environment and on climate;
27. Modeling: training for Module 2;
28. Forum on the environment and climate – regional planning and capacity building;
29. Workshop on national adaptation policies and regulations: the identification of adaptation options;
30. National mission: drafting an INDC Technical Paper for Montenegro;
31. Modeling: training for Module 3: practical training regarding quantitative models and the development of scenarios to asses climate and energy policies and to set GHG reduction targets;
32. Regional training seminar on the assessment of the results of GHG inventory (including projections).

These topics were selected with the aim of facilitating the drafting of reports (national communications and BURs), the modelling and defining of NAMA project ideas and the drafting of climate change policies. In addition to this, extensive technical assistance was provided by a number of international and regional organisations such as UNFCCC, UNEP, UNDP, GiZ, USAID and WHO.

Briefing on the National Resources Allocated to Climate Change Following UNFCCC Ratification

Due to a lack of budget information regarding some of the projects, it is not possible to give a precise overview of the considerable share of national co-financing (cash or in-kind). For the reviewed projects, where financial data was available, such national contributions amounted to some €15 million. The actual contribution is bound to have been larger; the exact amount needs to be determined.

Assessment of Gender-Disaggregated Data and Recommendations for Improvement

Montenegro's national statistics currently do not include gender-disaggregated data on climate change.

In order to provide a better overview of mitigation measures, it is necessary to collect gender-disaggregated data and thus to take into account gender differences; this is a modern approach to this issue. The different needs, attitudes and priorities of men and women need to be considered when designing gender-specific policies and measures. As a consequence, mitigation strategies cannot rely exclusively on technology and on markets, but should include a broad spectrum of structural and lifestyle changes.

Women tend to be more concerned with climate change and are more likely to accept ambitious efforts to cut GHG emissions; they have different needs from men concerning energy consumption and mobility. However, women contribute more to mitigation within their role of household management. Women are more prepared to change their habits in order to reduce energy consumption and to buy low-emission products. However, they are often less aware of their own energy consumption and resist measures that require additional work. Men and women have different preferences concerning technology associated with the reduction of GHG – most women reject risky methods such as nuclear energy, carbon capture and storage technologies.

Insight into the way the differences in the social roles and economic status of men and women impact on climate change and the way climate change impacts on them differently should be taken into account when determining adaptation and mitigation activities. Existing mechanisms for financing climate activities should include gender policies; women should be given equal representation in the decision-making process on climate change in order to contribute their professionalism, experience and vision to this process, in particular regarding the management of natural resources. In order to ensure that the measurement, reporting and verification (MRV) activities relating to mitigation are gender-sensitive, the people responsible for MRV should attend training on gender equality and gender issues related to climate change mitigation.
In order to improve women's participation, this aspect should be more thoroughly considered and included both in existing and future national policies and in action plans under measures concerning sustainable development and climate change; such improvement could be achieved through systematic gender analysis, the collection and use of gender-disaggregated data, by setting gender indicators and by developing practices that support greater focus on and commitment to gender equality. The gender-disaggregated data that should be collected for inclusion in the national statistics should, at least, include the following:

- Share (number) of women in administrative positions in charge of climate change decisions;
- Percentage shares of men and women in sectors concerned with climate change;
- Number of women working as farmers;
- Beneficiaries of fuel subsidies (disaggregated for men and women);
- Level of education (disaggregated for women and men);
- Number of women who own cars, who are drivers and users of public transport, disaggregated by age and gender, and by geographic location.

The use of such indicators and data monitoring would highlight shortcomings and gaps and could thus help to enhance the level of expertise regarding gender mainstreaming when dealing with climate issues.

MONITORING, REPORTING AND VERIFICATION (MRV) SYSTEM IN MONTENEGRO

CHAPTER 5

As an EU Candidate country, Montenegro is at the beginning of the process of developing its own MRV system under mitigation action. The establishment of a MRV system is important for achieving national mitigation targets. Montenegro is committed to the global concern of climate change mitigation. This system includes reporting on National Communications, on Biennial Update Reports, on GHG Inventories and on other relevant information on a regular basis. Montenegro has achieved a higher level than that which is expected from non-Annex I countries as it regularly prepares inventories, and has also prepared 1st and 2nd National Communications and a 1st Biennial Update Report.

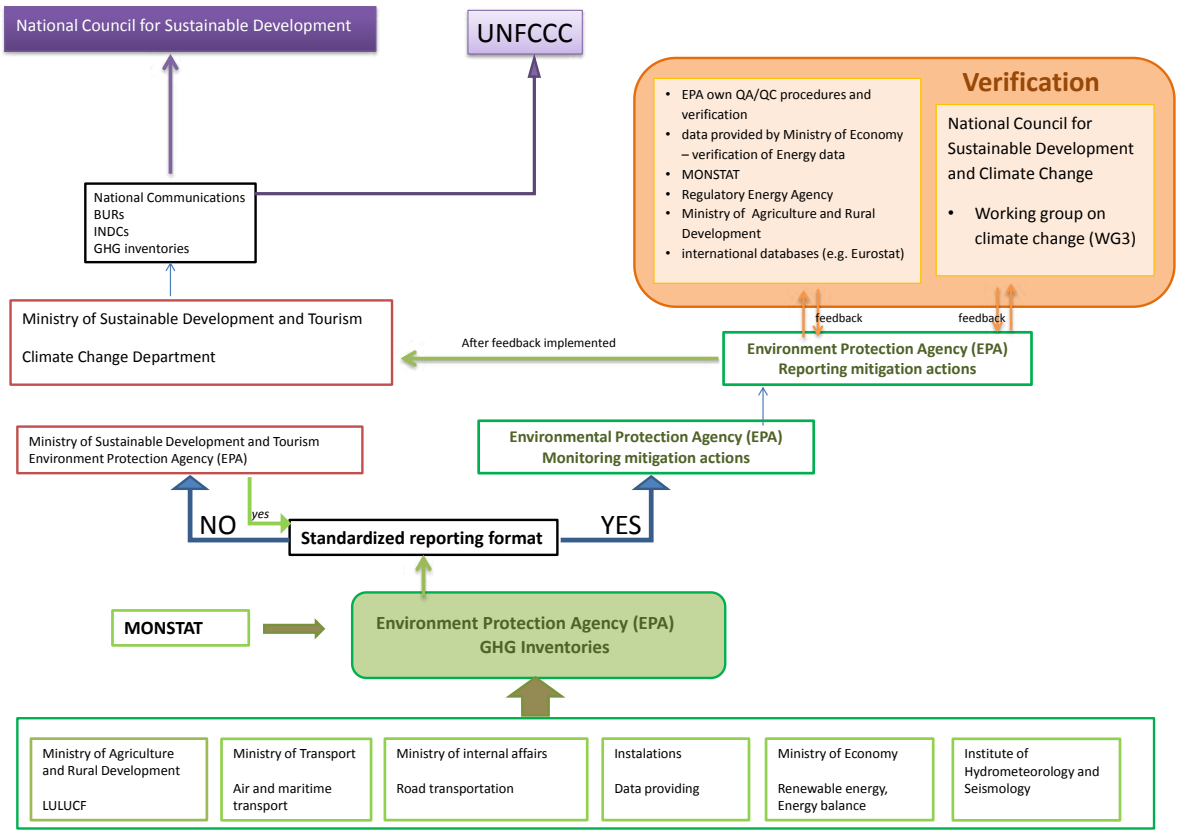
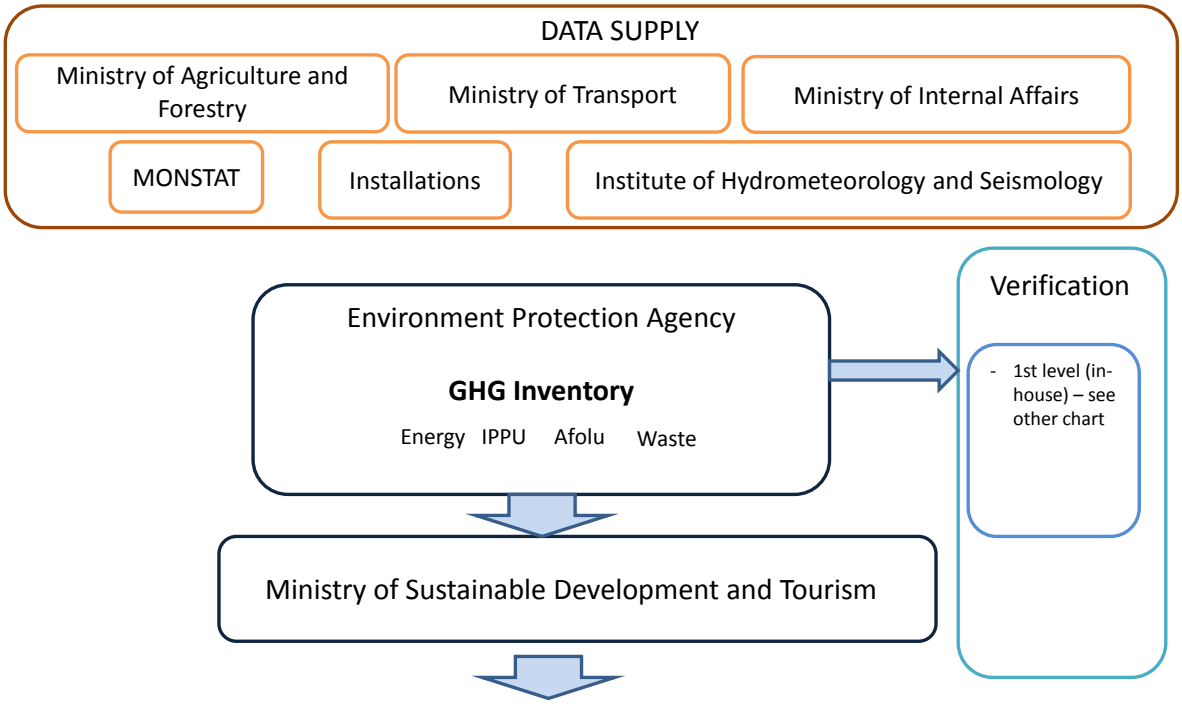


Figure 17 *Proposed Institutional Arrangements for a MRV System in Montenegro*

Data for a greenhouse gas inventory should be obtained from various sources, specifically from every sector. Data should be provided by the Ministry of Agriculture and Rural Development (LULUCF sector), the Ministry of Transport (air and maritime transport), the Ministry of Internal Affairs (road transportation) and also directly by specific industrial and energy installations. Within the data provided, energy balance plans should also be included; these are compiled every year by the Ministry of Economy[52]. The Montenegrin State Statistical Office (MONSTAT) has a special position in terms of providing data as it would also be expected to provide other official statistical data necessary for the greenhouse gas inventory. All of the data provided should then be collected by the Environmental Protection Agency (EPA) team, responsible for compiling the greenhouse gas inventory. A standardised reporting format is still currently being developed within the EC funded project that is responsible for developing an information system for the EPA. Once this has been developed (questionnaires for data providers etc.), a standardised reporting format will help the EPA to process data after its collection. According to recent amendments in the Law on Air Protection (June 2015), the Ministry of Sustainable Development and Tourism will publish an Annual Plan for data collection every year. Through its official standardised reporting format, the EPA would then be responsible for monitoring and reporting mitigation action. Reporting should be controlled and verified. The EPA regularly conducts its own quality control procedures which are carried out internally. Additionally, quality controls should be carried

52 Data on planned energy balances should be provided by the Ministry of Economy, while data on realised energy balances should be provided by the State Statistical Office (MONSTAT).

out, at the same level, regarding data provided by the Ministry of Economy and by the Ministry of Agriculture and Rural Development. MONSTAT has its own verification procedures which also include official controls by EUROSTAT; these procedures represent an important part of the verification of activity data. The Working Group on Climate Change under the National Council for Sustainable Development and Climate Change has been proposed as the third party for verification. The EPA would seek to obtain comments from all of the experts and institutions participating in the verification process along with comments which would, together, be reflected in the final report. Once the report had been completed, it would be forwarded to the Ministry of Sustainable Development and Tourism (Climate Change Department) which would be responsible for reporting officially to international bodies (EU, UNFCCC).



- UNFCCC
- EEA
- Strategic document – energy, IP, waste, agriculture, forestry, transport etc.
- CC mitigation and adaptation

Figure 18 *MRV Scheme for Montenegro´s GHG Inventory*

The arrangement of the GHG inventory preparation process is presented in the Figure 18. For the first time in Montenegro, a proposed MRV system has been developed, as represented in Figure 17; it represents part of the First Biennial Update Report.

The establishment of a MRV system in Montenegro can be compared to similar systems in other countries which are of a similar size or where a similar amount of emissions are produced. The Macedonian MRV system has been established on a similar basis to the one in Montenegro. Malta is already an EU member as well as being an Annex 1 country; despite the fact that no MRV scheme has been discussed in detail, Malta is obliged to operate this system. A similar situation is applicable in Cyprus; here, simple information regarding the compilation of a GHG inventory is in line with the main pillars shown in Figure 17. Generally, it can be stated that countries which are EU members, or which are considered to be Annex I Parties, have very specific obligations in terms of establishing a MRV scheme. The details of each MRV scheme can differ; however, the main pillars have to be the same. Comparisons between any of the countries mentioned shows that compatibility exists regarding the major part of each MRV scheme and regarding the conceptual framework that is proposed for Montenegro.

Potential further indicators which should be used for measuring the progress of NAMAs are listed in Table 9.

Table 9 *Potential Further Indicators and NAMAs Applicable to Montenegro*

Measure/Project	**Indicators for Specific Measures**
Introduction of BAT in existing and newly built energy/industry installations - Construction of new Block II at TPP Pljevlja	CO_2 emissions / year
Construction of new hydropower stations	Installed capacity in MW, real annual production of electricity in GWh
Construction of biomass fired power plants	Installed capacity in MW, real annual production of electricity in GWh
Construction of wind power stations	Installed capacity in MW, real annual production of electricity in GWh
Improvement of energy performance in buildings	Annual emissions of CO_2
Introduction of alternative fuels in transport	Annual emissions of CO_2
Redirection of 50 % of cargo transport to railways using electricity	Annual emissions of CO_2
Improvement of status of forests and the development of additional afforestation	Sinks of CO_2
Support for organic farming	Annual emissions of CH_4, N_2O
Reduction of bio-degradable waste in landfills	Annual emissions of CH_4
Support for 'low-carbon' tourism	Annual emissions of CO_2
Raising of public awareness regarding the reduction of GHG emissions	Annual emissions of CO_2 eq
Emphasis on GHG mitigation measures in EIA and SEA	Annual emissions of CO_2 eq
Green procurement/green purchasing in the public sector	Annual emissions of CO_2
Support (subsidies) for the use of solar thermal and photovoltaic energy	Installed capacity in MW (thermal or electric), real annual production of heat or electricity in GWh
Support (subsidies) for households regarding the replacement of coal/wood fired boilers for new more efficient ones and/or the improvement of energy performance in buildings	Annual emissions of CO_2
Development of a transport infrastructure (highways, motorways, city by-passes)	Annual emissions of CO_2
Improvement of road transport organisation in cities and the introduction of integrated concepts (SMART cities)	Annual emissions of CO_2
Energy recovery from waste	Annual emissions of CH_4
Support for sustainable tourism (eco-tourism)	Annual emissions of CO_2

The steps proposed for the establishment of a MRV system in Montenegro include the following:

1. Precise definition of institutional arrangements and processes
2. Definition of GHG mitigation actions and accounting
3. Establishment of data collection and reporting responsibilities
4. Establishment of clear and transparent reporting obligations
5. Verification and quality assurance.

Step 1: Precise definition of institutional arrangements and processes

Montenegro has identified institutional responsibilities for policymaking, data collection, data analysis and reporting. For the QA/QC Montenegro is in the process of identifying specific responsibilities. A proposed solution is given in Figure 17.

The Ministry of Sustainable Development and Tourism, through its Directorate on Climate Change, plays an advisory and political role as well as being responsible for coordination. This ministry has overall responsibility for climate change mitigation policy and thus plays a crucial role.

It was also suggested that the Ministry of Sustainable Development and Tourism should have overall responsibility in terms of coordinating projections through its advisory bodies and/or technical support.

The goal of establishing a proper domestic MRV system is to clearly indicate the rights of specific institutions and to report on and monitor specific policies and measures whilst also specifying the obligations of other institutions to provide necessary data. To date, Montenegro has been classed as a developing country; thus the establishment of a precise MRV scheme has not been necessary. However, this conceptual framework should help to develop better policies and measures.

Montenegro recently adopted its National Climate Change Strategy, including the INDCs as an Annex.

Step 2: Definition of GHG mitigation actions and accounting

Specific mitigation actions can be measured using the list of indicators listed in Table 1. Measuring and reporting GHG emissions in the sectors defined in the IPCC methodology (i.e. Energy, Industrial Processes and Product Use, Agriculture, LULUCF, Waste) is currently the optimal indicator for measuring mitigation action. The results of the GHG inventory in Montenegro clearly indicate Montenegro's specific contribution to global GHG levels, as well as its contribution in terms of a reduction in emissions.

Step 3: Establishment of clear and transparent data collection and reporting responsibilities

Figure 18 indicates specific responsibilities for data collection/provision (e.g. MONSTAT, installations etc) and reporting responsibilities (e.g. EPA, Ministry of Sustainable Development and Tourism). The projected MRV terms also include specific responsibilities for proposing and implementing policies and measures.
Through the project dealing with the development of the EPA Information System, Montenegro is currently developing standardised templates/questionnaires for the purposes of data collection. This information system will cover the data needed for the GHG inventory and CLRTAP (air pollution reporting and GHG reporting). This work is in progress at present.

Step 4: Establishment of reporting obligations

The MRV system involves quantifiable, reportable and verifiable nationally appropriate mitigation actions. Since Montenegro is a non-Annex I country of UNFCCC and a non-Annex B country for the purposes of Kyoto Protocol, it does not yet have to define specific emissions reduction targets. However, Montenegro defined its own INDCs (Intended Nationally Determined Contributions), and adopted them at the Government's session in September 2015, as an annex to the National Climate Change Strategy.
A properly established measuring and reporting system should provide necessary feedback regarding the effectiveness of mitigations measures, policies and projects.

Step 5: Verification and quality assurance

The last step in the establishment of MRV includes verification and control procedures. These actions should ensure quality and accuracy both in terms of measurements and of reporting. Regarding some specific elements (e.g. the reduction of emissions), established quality control and assurance systems will help to monitor mitigation actions and measures undertaken. Verification should enable feedback and allow users to improve their measurements and reports.

There are two types of quality control (QC) and verification procedures. The first type of QC is auto-control and is carried out by the institution responsible for reporting. It is expected that auto-control procedures will be carried out by the EPA. The second type of QC requires a third party to verify and approve the reliability and comparability of mitigation action, reporting and measures. In the proposed MRV scheme (Figure 17) the role of a third party will be played by the Working Group for Climate Change, established by the Government as a support group for the National Council for Sustainable Development and Climate Change. The Working Group for Climate Change should comprise 15 members from various ministries, local authorities, businesses, the media and NGOs. The group is a permanent body and should meet regularly.

CONCLUSIONS

CHAPTER 6

Based on the information included in this First Biennial Update Report, it can be concluded that:

- Montenegro has speeded up its activities relating to climate change issues in 2015 (preparation of the 2nd National Communication, adoption of the National Climate Change Strategy till 2030, adoption of the Intended Nationally Determined Contribution)
- Montenegro currently has available to it the Detailed National Emission Inventory (till 2013); however, the methodology used in this inventory should be further improved to increase its accuracy and to cover missing source categories.
- Montenegro has identified its technology needs, especially in the energy and industry sectors where considerable potential for the reduction of GHG emissions can be found. Thus, it is necessary for Montenegro to attract foreign investment.
- Montenegro has developed basic administrative structures to deal with climate change issues, however additional capacity building is needed.
- Montenegro has developed two realistic mitigation scenarios focused on limited number of efficient measures as well as the Mitigation Action Plan till 2020
- Montenegro has substantial potential for the reduction of GHG emissions and, due to specific conditions (high level of afforestation, two decisive stationary sources of GHG emissions), it can move towards a 'low carbon future'.

Detailed Conclusions

Country Specific Issues

Montenegro differs from the majority of European countries due to the following specific issues:

- **The majority of all of the national GHG emissions are produced by a very small number of stationary installations** (only one coal fired LCP[53] is in operation – TPP Pljevlja which has CO_2 emissions of up to 1,800 Gg, and there is one industrial installation – KAP – which has $CO_{2\,eq.}$ emissions varying from 216 Gg to 1,762 Gg). As the total annual national emissions of GHG (without removals) are at a level of 4,000 Gg of CO_2 ., it can be seen that emissions from TPP Pljevlja and KAP could each individually represent up to 45 % of the national total and that both together could represent up to 90 %.
- **Montenegro's total national emission balance contains a very high level of synthetic gases (F-gases)** (depending of production levels at KAP Aluminium Works, Podgorica).
- **There are very high levels of CO_2 sinks in comparison with CO_2 ~~eq.~~ emissions** (2,222 Gg compared with 2,440 Gg in 2013); this is caused by a **high levels of forest coverage in the country** (69.8 % in 2013).

National GHG Inventory

- Total emissions, with sinks, ranged from -364.57 Gg CO_2 eq. in 1994 to 4,703.27 Gg in 1991
- High levels of CO_2 sinks
- Total greenhouse gas emissions (without sinks) presented as CO_2 eq ranged from 2,121.89 Gg in 1994 to 5985.49 Gg in 1991
- The share of emissions from the energy sector ranged from 22.12% in 1995 to 76.10% in 2013
- The share of emissions from industrial processes ranged from 4.43% in 1994 to 60.91% in 1995 CO_2 eq and emissions from the agriculture sector ranged from 6.54% in 2010 to 20.16% in 1994
- The waste sector represented the smallest share in total emissions which ranged from 0.38% in 1990 to 6.33% in 2009
- CO_2 represented the highest share within total GHG emissions (24.6-74.5%), followed by PFC (CF_4 and C_2F_6) which ranged from 3% to 40.9%
- The share of CH_4 ranged from 10% to 27.5%
- The share of N_2O ranged from 2.3% to 5.8 %.

53 LCP = Large combustion plant with a rated thermal input of 50 MW or more.

- SF_6 represented the lowest share within total emissions and ranged from 0.01% to 0.07%
- In line with the data that was available during the recalculation of the inventory, HFC emissions (2012 and 2013) were only estimated for the subsector 2.F. Product Uses as Substitutes for Ozone Depleting Substances (2.F.1 – Refrigeration and Air Conditioning)

Climate Change Mitigation – Scenarios

Due to the EU pre-accession process, scenarios without measures have not be developed (as they are not applicable to EU candidate countries). Thus, the following scenarios are proposed:

- **Scenario with measures** (WM scenario) which includes the measures that are laid down in national and/or EU legislation and strategies.
- **Scenario with additional measures (WaM scenario) which includes the original WM scenario extended by additional measures that are not required by EU legislation and/or measures for which EU legislation allows flexibility regarding certain quantified requirements.**

Climate Change Mitigation – Priority Measures

The WM and WaM scenarios do not include all possible measures which could lead to a reduction in the level of GHG emissions. Only 20 priority measures have been included, for which substantial GHG emission reduction potential can be expected (and in many cases positive side-effects). These 20 priority measures are divided into three categories:

Top Priorities

- Measure 1: The introduction of BAT into existing and newly built energy/industrial installations (especially TPP Pljevlja and KAP) (WM scenario)
- Measure 5: The improvement of energy performance in buildings (WM scenario)
- Measure 6: Support for alternative fuels in transport (WM scenario)
- Measure 8: An improvement in the status of forests and the development of additional afforestation (WM scenario)
- Measure 14: Green procurement/green purchasing in the public sector (WM scenario)
- Measure 16: Support (subsidies) for households regarding the replacement of coal/wood fired boilers for new more efficient ones and / or in the improvement of energy performance in buildings (WaM scenario)

High Priorities

- Measure 2: Construction of new hydro power plants (WM scenario)
- Measure 4: Construction of wind power plants (WM scenario)
- Measure 7: Redirection of 50 % of cargo transport to railways using electricity (WM scenario)
- Measure 10: Reduction of biodegradable waste in landfills (WM scenario)
- Measure 11: Support for 'low-carbon' tourism (WM scenario)
- Measure 15: Support (subsidies) for the use of solar thermal and photovoltaic energy (WaM scenario)
- Measure 17: Development of a transport infrastructure (highways, motorways, city by-passes (WaM scenario)

Medium Priorities

- Measure 3: Construction of biomass fired power plants (WM scenario)
- Measure 9: Support for organic farming (WM scenario)
- Measure 12: The raising of public awareness regarding the reduction of GHG emissions (WM scenario)
- Measure 13: Emphasis on GHG mitigation measures in EIA and SEA processes (WM scenario)
- Measure 18: Improvement of road transport organisation in cities and the introduction of integrated concepts (SMART cities) (WaM scenario)
- Measure 19: Energy recovery from waste (WaM scenario)
- Measure 20: Support for sustainable tourism (eco-tourism) (WaM scenario)

The majority of the proposed measures represents general categories which will be implemented through particular projects. **In order to be able to prioritise particular projects, detailed criteria and methodology for project priority setting have been developed (see Annex 4).**

Climate Change Mitigation – Action Plan

The above-mentioned priority measures are included in the Action Plan, which is presented in Annex 2.

Constraints and Gaps: Technology, Financial and Capacity-Building Needs and Support Received

- The institutional set-up and capacities of the state have made evident progress over recent years. However, there are still needs, gaps and obstacles that impede further development regarding climate-related activities
- Currently, available financial, technical and capacity-building support still cannot meet the growing requirements related to the climate change challenge
- Montenegro must continue to draw support from a large number of international donors, including national governments, non-profit organisations and international organisations
- Bilateral technical cooperation across all sectors needs to be enhanced and expanded
- The exchange of expertise and technology needs to be promoted for the sake of greater efficiency of mitigation activities

Technology Needs for the Purpose of Climate Change Mitigation

- Energy-efficient technology to be introduced into all sectors of the economy and into the housing and commercial sectors,
- Technology using renewable energy sources (hydro, wind, solar and biomass)
- Technology for the efficient use of water, land, forests, coastal area and other natural resources.
- The introduction of low-carbon modern technology into the country requires continuous cooperation with international organisations and institutions, a review of best international practice and the implementation of various projects with the support of international donors.

Financial Needs Concerning Climate Change Mitigation

- A number of mitigation activities have already taken place in the country.
- The Government is still working to secure additional financial resources – thus, under IPA II Montenegro has been allocated €37.5 million for the environment and for climate (not including the funds allocated for cross-border cooperation) and €32.1 million for transport for the period 2014-2020.
- Attracting investment is of major importance in ensuring the long-term, sustainable and balanced development of the country.

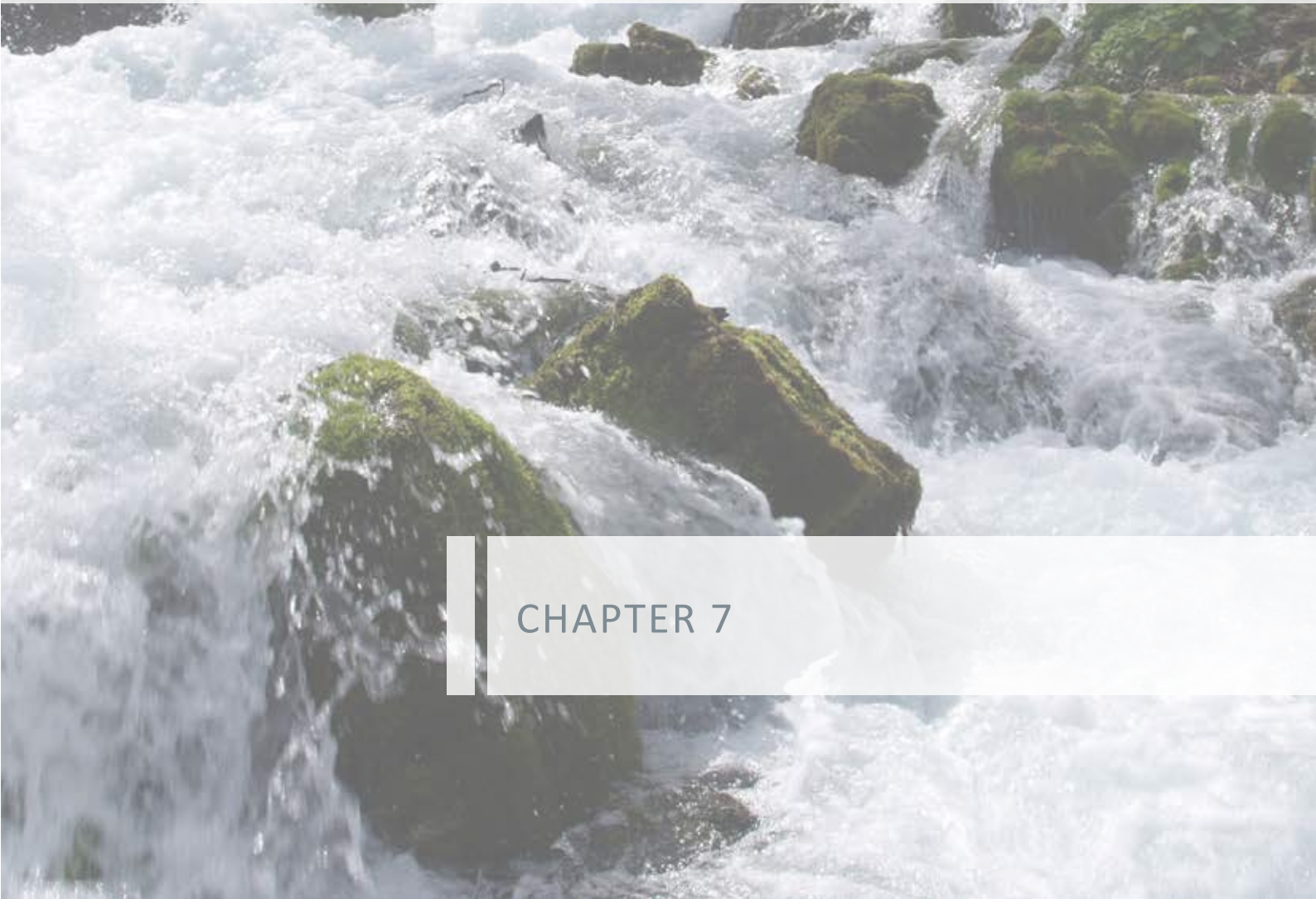
Capacity Building Needed for Mitigation Purposes

- Further support is needed to continue developing and consolidating existing technical and institutional capacity along with efforts to integrate climate change into national policies, programmes and plans.
- Since local authorities are considered as very important in relation to achieving climate policy objectives, from both mitigation and adaptation point of view, it is necessary to work further on strengthening administrative capacities on local level as well in the forthcoming period.

REFERENCE

- Ministry of Economy of Montenegro: http://www.mek.gov.me/en/ministry
- Ministry of Agriculture and Rural Development of Montenegro: http://www.minpolj.gov.me/en/ministry
- Ministry of Transport and Maritime Affairs of Montenegro: http://www.minsaob.gov.me/en/ministry
- Environmental Protection Agency of Montenegro: http://www.epa.org.me/
- MONSTAT: http://www.MONSTAT.org/cg/
- Accreditation Body of Montenegro: http://www.atcg.co.me/cg/
- 2nd National Communication of Montenegro: http://unfccc.int/essential_background/library/items/3599.php?rec=j&priref=7802#beg

ANNEXES



CHAPTER 7

ANNEX 1:

Intended Nationally Determined Contribution (INDC) of Montenegro

Government of Montenegro

Intended Nationally Determined Contribution (INDC) of Montenegro Following Decision 1/CP.19 and Decision 1/CP.20

Podgorica, September 2015

This document presents Montenegro's Intended Nationally Determined Contribution following Decision 1/CP.19 and Decision 1/CP.20 of the United Nations Framework Convention on Climate Change (UNFCCC), which invited Parties to communicate to the UNFCCC Secretariat their INDCs, with the aim of achieving the ultimate objective of the UNFCCC, as set out in Article 2 of the Convention.

The region of South East Europe, including Montenegro, is highly vulnerable to the impacts of climate change; thus, avoiding dangerous climate change is of paramount importance for the country.

Montenegro is a non-Annex I country with a population of 621,200. According to 2013 data, GDP per capita is €5,356. The size the of country causes reduced flexibility in the application of policies in some sectors where a single source of emissions is dominant; this distorts the emission profile of the country. It should also be noted that tourism is one of the main drivers of the economy; the number of tourists visiting the country annually is more than twice the number of the local population.

Montenegro's contribution to the international effort to avoid dangerous changes in climate is expressed by a **30 % reduction in emissions by 2030 compared with the base year, 1990**. The level of greenhouse gas emissions for Montenegro, from the sectors covered by INDC, was 5,239 kilotons in 1990; Montenegro has pledged to reduce this by at least by 1,572 kilotons to a level of 3,667 kilotons or less. This reduction is expected to be achieved by a general increase in energy efficiency, by the improvement of industrial technology, by increasing the share of renewables and by modernisation in the power sector.

The following Annex provides additional information regarding the INDC in order to ensure clarity, transparency and understanding.

ANNEX to the INDC of Montenegro

Intended Nationally Determined Contribution of Montenegro	
Type	Economy-wide emission reduction target, based on the base year
Gases covered	All greenhouse gases not controlled by the Montreal Protocol: Carbon Dioxide (CO_2), Methane (CH_4) Nitrous Oxide (N_2O) Hydrofluorocarbons (HFCs) Perfluorocarbons (PFCs) Solapur hexafluoride (SF_6) Nitrogen trifluoride (NF_3)
Base year	1990
Target year	2030
Reduction level	30% reduction in emissions by 2030 compared with 1990
Sectors covered	Sectors included: Energy Fuel combustion Fugitive emissions from fuels CO2 transport and storage Industrial processes Mineral industry Chemical industry Metal industry Non-energy products from fuels and solvent use Electronic industry Product use as a substitute for ODS Other product manufacture and use Other Agriculture Livestock Aggregate sources and non-CO_2 emissions sources on land Waste
Planning process	The planning process of the INDC included a review of available data and modelling work applicable to greenhouse gas reduction pathway as well as consultations with government stakeholders, operators of key installations and the general public. The scenarios for the INDC were developed in consultation with the authors of the National Climate Change Strategy of Montenegro. Within the preparation process of the INDC it became clear that significant data uncertainty exists regarding emissions and their removal in the land use, land use change and forestry sectors.

Participation in international market mechanism	Montenegro intends to sell carbon credits during the forthcoming period to contribute towards achieving its emission reduction objectives; this would be a cost-effective way of assisting the development of methods for and the implementation of low emissions. Montenegro foresees that the utilisation of international market mechanisms is dependent on having effective accounting rules, developed under the UNFCCC, to ensure the environmental integrity of mechanisms.
Fairness, Equity, Ambition and Means of Implementation	
Fairness, equity and ambition	Montenegro is a non-Annex I country and is highly vulnerable to the effects of climate change. National emissions of greenhouse gases represent only 0,009 % of global emissions; the net per capita GHG emissions in Montenegro was 7.25 tCO_2eq in 2010. Montenegro will take into account the ultimate objective of the UNFCCC during its future development and will be committed to decoupling greenhouse gas emissions from economic growth; it will embark on a low emission development pathway. The INDC submitted by Montenegro is both fair and ambitious because it aims to secure a significant reduction in the emission of greenhouse gases while satisfying the country's need for economic development; thus it is allowing a feasible pathway for long-term decarbonisation.
Means of implementation	The National Climate Change Strategy will be the main planning tool, along with various action plans, for the implementation of Montenegro's Intended Nationally Determined Contribution until 2030. The Energy Development Strategy of Montenegro by 2030 also takes into consideration climate change as one of its six objectives; the INDC has been developed in line with trends predicted for the development of the energy sector in Montenegro. Montenegro is in the process of accession to the European Union which involves the gradual transposition and implementation of the European Union's climate and energy legislation.
Key Assumptions	
Metric applied	The metric used for GHG emissions is Global Warming Potential on a 100 year timescale in accordance with the IPCC's 2nd Assessment Report
Inventory methodology	The IPCC 2006 Guidelines have been used for the preparation of the inventory. Improved inventory data was used for the INDC and also for the Biennial Update Report of Montenegro, compared with data used in the 2nd National Communication.
Approach to accounting for agriculture, forestry and other land uses	Greenhouse gas emissions and removals from agriculture, forestry and other land uses have currently not been included in the accounting. Emissions and removals from these sectors can be included in the INDC at a later stage when technical conditions allow for that.

Due to a relatively high level of uncertainty regarding emissions in the LULUCF sector, Montenegro reserves the right to review its INDC up until 2020, when more accurate data should be available and when there should be more improved technical conditions regarding land use, land use change and forestry; such data could then be included in the Nationally Determined Contribution.

If the agreement or related COP decisions are amended before they come into force, in such a way that they include rules or provisions that significantly affect the assumptions under which this INDC has been developed, Montenegro reserves the right to revisit the INDC.

Montenegro requests the UNFCCC Secretariat to publish this submission on the UNFCCC webpage and to include the INDC in the synthesis report prepared by the Secretariat.

ANNEX 2:

GHG Mitigation Action Plan (WM and WaM scenarios)

Measure		Type	Timeframe	Budget Required	GHG Emission Reduction
Number	Name				
WM scenario					
1	Introduction of BAT in existing and newly built energy/industrial installations - Construction of new Block II in TPP Pljevlja - Modernisation of KAP technology process	Investment Investment	2024 2020	€370 million €48 – 380 million	375 Gg CO_2 /year At least 500 Gg CO_2 eq /year
2	Construction of new hydro power station	Investment	2020	€1.05 billion	
3	Construction of biomass fired power plants	Investment	2020	€67 million	
4	Construction of wind power stations	Investment	2020	€195 million	
5	Improvement of energy performance in buildings	Investment	2020		
6	Introduction of alternative fuels in transport	Investment	2020		
7	Redirection of 50 % of cargo transport to railways using electricity	Investment	2020		
8	Improvement of the status of forests and the development of additional afforestation	Combined	2020		Increased sinks by 200 Gg CO_2 /year
9	Support for organic farming	Administrative /subsidy	2020		
10	Reduction of biodegradable waste in landfills	Combined	2025		80 Gg CO_2 /year
11	Support for 'low-carbon' tourism	Administrative /subsidy	2020		
12	Raising of public awareness	Administrative	Permanent	Low cost	
13	Emphasis on GHG mitigation measures in EIA and SEA	Administrative	Permanent	Low cost	
14	Green procurement/green purchasing in the public sector	Administrative	Permanent	Low cost	
WaM scenario					
15	Support for the use of solar thermal and photovoltaic energy	Combined	2020	€24 million	
16	Support (subsidies) for households regarding the replacement of boilers for new more efficient ones and/or for the improvement of energy performance in houses	Subsidy	2020	Up to €4000 per household	
17	Development of the transport infrastructure	Investment	2020	€800 million	
18	Improvement of road transport organisation in cities and Implementation of integrated concepts (SMART cities)	Administrative	2020		
19	Energy recovery from waste	Investment	2020	€77 million	
20	Support for sustainable tourism (eco-tourism)	Subsidy	Permanent		

ANNEX 3:

Tables of Mitigation Measures

Number	1
Title	Introduction of BAT into existing and newly built energy/industry installations - Construction of new Block II at TPP Pljevlja
Scenario	WM
Priority	Top
Time frame	By the end of 2023
Cost assessment	€370 million at the latest
Gas	CO_2
Indicators	CO_2 emissions / year
Projection	Decrease in annual emissions of CO_2 by 375 Gg
Additional impacts	Substantial reduction of dust, sulphur dioxide and nitrogen oxide emissions
Description	Reduction in operating time at the existing TPP Block I to 20,000 hours between 2018 and 2023 and following decommissioning. Construction of a new Block II with a capacity of up to 250 MW with an efficiency level of 40 % compliant with the requirements of Directive 2010/75/EU on industrial emissions (Annex 5, part 2) BAT[54] requirements must be applied to both existing[55] and new installations in accordance with Directive 2010/75 / EU on industrial emissions.
Assumptions	Financing available
Risks	Lack of financing, administrative problems.
Steps taken	Idea project completed, feasibility study completed, EIA report completed, drafting detailed spatial plan and SEA assessment.
Steps envisaged	Construction of Block II started.
Expected result	Reconstruction fully completed by the end of 2023.
Title	Introduction of BAT into existing and newly built energy/industry installations Modernisation of KAP technological process
Scenario	WM
Priority	Top
Time frame	2020
Cost assessment	€48 – 350 million
Gas	CF_4, C_2F_6, CO_2
Indicators	CO_2 eq. emissions/year
Projection	In the business-as-usual practice, industrial process emissions will reach 1,649 Gg in 2020 but still be lower than in 1990. With mitigation measures for KAP, the industrial sector's emissions can be reduced to 1,011.7 Gg $CO_{2\ eq.}$ (KAP's full production level is 120,000 t of cast aluminium) or, in the case of KAP having a reduced capacity level (70,000 t of cast aluminium), as low as 391.7 Gg $CO_{2\ eq.}$ in 2020.
Additional impacts	Reduction of emissions of indirect GHG (dust, VOCs and PAH), as well as the minimisation of waste generation
Description	Requirements of BAT[56] must be applied both to existing[57] and new installations in accordance with Directive 2010/75 / EU on industrial emissions. Regarding KAP, the following measures are expected • Increased efficiency, • Point dosage of alumina and aluminium fluoride, • Better process control, • Other measures related to BAT in accordance with the BREF document[58].
Assumptions	Unclear situation of KAP´s future will be solved. Directive 2010/75/EU on industrial emissions will be implemented.

54 See http://eippcb.jrc.ec.europa.eu/reference/

55 Either by obtaining the first (missing) integrated permit or by obtaining an updated permit after substantial changes at the plant.

56 See http://eippcb.jrc.ec.europa.eu/reference/

57 Either by obtaining the first (missing) integrated permit or by obtaining an updated permit after substantial changes at the plant.

58 See Best Available Techniques (BAT) Reference Document for the Non-Ferrous Metals Industries – Chapter 4, Final draft (October 2014), see http://eippcb.jrc.ec.europa.eu/reference/BREF/NFM_Final_Draft_10_2014.pdf See http://eippcb.jrc.ec.europa.eu/reference/

Risks	Unclear situation of KAP´s future will not be solved. The resistance of plant operators and the extension of deadlines by the competent authorities.
Steps taken	No information
Steps envisaged	Decision about the future of KAP. Integrated permit obtained by 2018.
Expected result	Reduction of annual CO_2 eq. emissions by 2020 by at least 500 Gg comparing to 2007. Reduction of emissions of indirect GHG, dust, VOCs and PAH, as well as the minimisation of waste generation

Number	2
Title	Construction of new hydropower stations
Scenario	WM
Priority	High
Time frame	2020
Cost assessment	€1.05 billion
Gas	CO_2
Indicators	Installed capacity in MW, real annual production of electricity in GWh
Projection	Not available yet
Additional impacts	Reduction of electricity imports
Description	Two existing large hydro power station (HEs) are planned to be reconstructed by 2020: • HPP Perućica: Increase in capacity from 307 MW to 372 MW (2017) • HPP Piva: Increase in capacity from 342 MW to 363 MW (2018) Two new large hydro power stations (HEs) are planned to be built by 2020: • HPPs on Morača - 238 MW (2019) • HPP Komarnica - 168 MW (2020) In relation to small hydro-power plants, construction of 44 small HPH has been approved up to now, with total installed power of 80.61 MW and planned annual production of 257.5 GWh.
Assumptions	Financing available
Risks	Lack of financing
Steps taken	
Steps envisaged	
Expected result	Additional zero-emission capacity of 587 MW.

Number	3
Title	Construction of biomass fired power plants
Scenario	WM
Priority	Medium
Time frame	2020
Cost assessment	€67 million
Gas	CO_2
Indicators	Installed capacity in MW, real annual production of electricity in GWh
Projection	Not available yet
Additional impacts	Reduction of electricity imports, increase of emissions of indirect GHG (nitrogen oxides), PM[59] and PAHs[60].
Description	Construction of a biomass fired plant is planned by 2020 with a total installed power/ planned generation of 29.3 MW/101 GWh.

59 PM = particulate matter (PM_{10}, $PM_{2.5}$)

60 PAH = polycyclic aromatic hydrocarbons

Assumptions	Financing available
Risks	Lack of financing
Steps taken	
Steps envisaged	
Expected result	Additional zero-carbon capacity of 29.3 MW/101 GWh

Number	4
Title	Construction of wind power stations
Scenario	WM
Priority	High
Time frame	2020
Cost assessment	€195 million
Gas	CO_2
Indicators	Installed capacity in MW, real annual production of electricity in GWh
Projection	Not available yet
Additional impacts	Reduction of electricity imported, negative impact on the local population (noise) and on fauna (birds)
Description	• WPP Možura with installed capacity of 46 MW • WPP Krnovo with installed capacity of 72 MW • WPP (without site specification) with installed capacity of 33,2 MW (2016 – 2020)
Assumptions	Acceptance by the local population, financing available.
Risks	Opposition by the local population, financing not available.
Steps taken	
Steps envisaged	
Expected result	Additional zero-emission capacity of 151.2 MW.

Number	5
Title	Improvement of energy performance in buildings
Scenario	WM
Priority	Top
Time frame	2020
Cost assessment	The cost of insulation measure (roof, envelope, ground floor) can be estimated at between €20 and €50 per m^2.
Gas	CO_2
Indicators	Annual emissions of CO_2
Projection	Not available yet.
Additional impacts	Reduction of emissions of indirect GHGs, PM, VOC[61] and PAH

61 VOC = volatile organic compounds

Description	Newly constructed buildings: • Reduction of consumption of thermal energy used for heating in newly constructed buildings to a level of 80 kWh/m^2 from 2014 onwards; Households: • Refurbishment of 28,000 housing units by 2020 starting from 2015 with a 60% reduction in heat loss in refurbished housing units; • Reduction of non-thermal consumption of energy per household by 150 kWh a year by 2020 (classification of household appliances and other measures Services: • Refurbishment of 1/3 of the surfaces in buildings in based on information from 2010 to achieve a level of consumption of 80 kWh/m^2 by 2020; • Reduction in the consumption of electricity for non-heating needs of up to 10% through the activities of energy agencies and ESCO[62] companies
Assumptions	Financing available
Risks	Lack of financing, administrative obstacles
Steps taken	
Steps envisaged	
Expected result	Reduction of emissions of CO_2, indirect GHGs, dust, VOC and PAH

Number	6
Title	Introduction of alternative fuels in transport
Scenario	WM
Priority	Top
Time frame	2020
Cost assessment	
Gas	CO_2
Indicators	Annual emissions of CO_2
Projection	Not available
Additional impacts	Reduction of dust emissions
Description	Improved level of use of alternative energy sources (liquefied petroleum gas - LPG and compressed natural gas - CNG), biofuel and electricity in transport including the development of infrastructure.
Assumptions	Financing available
Risks	Lack of financing
Steps taken	Biodiesel represents 7 % of total national consumption of liquid fuels
Steps envisaged	
Expected result	Reduction of emissions of CO_2, indirect GHGs, dust, VOC and PAH

Number	7
Title	Redirection of 50 % of cargo transport to railways using electricity
Scenario	WM
Priority	High
Time frame	2020
Cost assessment	Not available
Gas	CO_2

62 ESCO = Energy Service Company

Indicators	Annual emissions of CO_2
Projection	Not available
Additional impacts	Reduction of emissions of indirect GHGs, dust, VOC and PAH
Description	Direction a larger part of transit cargo transport to the railway system
Assumptions	Financing available
Risks	Lack of financing
Steps taken	
Steps envisaged	
Expected result	Reduction of CO_2 emissions, indirect GHGs, dust, VOC and PAH

Number	8
Title	Improvement of status of forests and additional afforestation
Scenario	WM
Priority	Top
Time frame	2023
Cost assessment	Not available
Gas	CO_2
Indicators	Sinks of CO_2
Projection	This measure could lead to an increase in the potential reduction of GHG emissions by more than 10 % (i.e. 200 Gg/year).
Additional impacts	Improvement of biodiversity, positive economic impact
Description	Improvement of the sustainability of forest management and an increase in the growing stock in commercial forests from 104 million m^3 to 115 million m^3 gross wood mass. Increase in the GDP of the forestry sector, timber industry and other industries that depend on forests from 2% to 4% of GDP
Assumptions	Financing available
Risks	Lack of financing
Steps taken	The National Forest Strategy along with the Forest and Forestry Development Plan up to 2023 has been adopted
Steps envisaged	
Expected result	Increased sinks of CO_2, improvement of biodiversity, positive economic impact.

Number	9
Title	Support for organic farming
Scenario	WM
Priority	Medium
Time frame	2020
Cost assessment	Not available
Gas	CH_4, N_2O
Indicators	Annual emissions of CH_4, N_2O
Projection	Not available.
Additional impacts	Reduction in the level of emissions of indirect GHG (nitrogen oxides from mineral fertilizers)
Description	Introduction of organic farming methods in husbandry and in crop production

Assumptions	Farmers interested, public financial support available
Risks	Farmers not interested, public financial support not available.
Steps taken	
Steps envisaged	
Expected result	Reduction of annual emissions of CH_4, N_2O, reduction of emissions of indirect GHG (nitrogen oxides)

Number	10
Title	Reduction of bio-degradable waste in landfills
Scenario	WM
Priority	High
Time frame	Steps 2017, 2020, 2025
Cost assessment	Not available
Gas	CH_4
Indicators	Annual emissions of CH_4
Projection	The reduction of emissions related to the targets mentioned below could be at a level of 80 Gg $CO_{2\ eq.}$ in 2020, compared to 2013.
Additional impacts	
Description	• More than 75% of the total mass of biodegradable waste produced in 2010 will go to landfill no later than 2017; • More than 50% of the total mass of biodegradable waste produced in 2010 will go to landfill no later than 2020; • More than 35% of the total mass of biodegradable waste produced in 2010 will go to landfill no later than 2025.
Assumptions	The Biodegradable Waste Disposal Programme (BWDP) will be adopted and fully implemented.
Risks	BWDP will not be fully implemented.
Steps taken	
Steps envisaged	
Expected result	The reduction of emissions at a level of 80 Gg $CO_{2\ eq.}$ in 2020, compared to 2013.

Number	11
Title	Support for 'low-carbon' tourism
Scenario	WM
Priority	High
Time frame	2020
Cost assessment	Not available
Gas	CO_2
Indicators	Annual emissions of CO_2
Projection	Not available
Additional impacts	Reduction of emissions of indirect GHGs, dust, VOC and PAH
Description	Introduction of 'green codex' in hotels and in other accommodation facilities[63]

63 *Influences on consumer behaviour Policy implications beyond nudging Final Report, 8 April 2014 (see http://ec.europa.eu/environment/enveco/economics_policy/)*

Assumptions	Interest of operators
Risks	Operators not interested
Steps taken	Special project in progress.
Steps envisaged	
Expected result	Reduction of emissions of CO_2 indirect GHGs, dust, VOC and PAH

Number	12
Title	Raising of public awareness regarding the reduction of GHG emissions
Scenario	WM
Priority	Medium
Time frame	Continuing activity
Cost assessment	Low cost measure
Gas	Mainly CO_2 but also other direct GHGs and indirect GHGs
Indicators	Annual emissions of CO_2 eq.
Projection	Not available
Additional impacts	Increase in general environmental awareness
Description	Provision of understandable information to the general public
Assumptions	Active approach of central government and other authorities.
Risks	
Steps taken	
Steps envisaged	
Expected result	Higher motivation of stakeholders for GHG mitigation measures

Number	13
Title	Emphasis on GHG mitigation measures in EIA and SEA
Scenario	WM
Priority	Medium
Time frame	Continuing activity
Cost assessment	Low cost measure
Gas	All direct and indirect GHGs
Indicators	Annual emissions of CO_2 eq.
Projection	Not available
Additional impacts	
Description	Maximum economically feasible level of GHG mitigation measures should be required throughout assessment procedures.
Assumptions	Active approach of competent authorities
Risks	Preference of economic factors in assessment procedures
Steps taken	
Steps envisaged	
Expected result	A reduction in the level of direct and indirect GHG emissions

Number	14
Title	Green procurement/green purchasing in the public sector
Scenario	WM
Priority	Top
Time frame	Continuing activity
Cost assessment	Low cost measure (incremental costs)
Gas	Mainly CO_2 but also indirect GHGs
Indicators	Annual emissions of CO_2
Projection	Not available.
Additional impacts	Reduction of air pollution
Description	Introduction of GHG emission reduction criteria into the construction and reconstruction of buildings, into procurement and into the purchasing of vehicles and appliances. Appliances complying with the requirements of the Eco-Design Directive and of related legal acts should be given priority.
Assumptions	Interest of public sector
Risks	Lack of interest of public sector
Steps taken	
Steps envisaged	
Expected result	Reduction of emissions of CO_2, indirect GHG and dust

Number	15
Title	Support (subsidies) for the use of solar thermal and photovoltaic energy
Scenario	WaM
Priority	High
Time frame	2020
Cost assessment	€24 million
Gas	CO_2
Indicators	Installed capacity in MW (thermal or electric), real annual production of heat or electricity in GWh
Projection	Not available yet
Additional impacts	Reduction of electricity imports
Description	Support for an increase in the use of solar heating and rational support for photovoltaic plants (similar to the way that has been applied in the MONTESOL programme) related to SWH (solar water heating).
Assumptions	Financing available
Risks	Lack of financing
Steps taken	Implementation of the MONTESOL programme.
Steps envisaged	
Expected result	Reduction of electricity imports

Number	16
Title	Support (subsidies) for households regarding the replacement of coal/wood fired boilers for new more efficient ones and/or in the improvement of energy performance in buildings
Scenario	WaM
Priority	Top
Time frame	2020 and beyond
Cost assessment	Average cost of a new boiler (coal, wood, pellets and gas) with the best emission and efficiency parameters (5th emission class) is up to €4,000.
Gas	CO_2
Indicators	Annual emissions of CO_2
Projection	Not available
Additional impacts	Reduced emissions of air pollutants
Description	Financial support for households to replace obsolete low efficient coal-fired boilers with new more efficient ones (biomass, coal/biomass, coal, gas, heat pump, solar heating) or in the improvement of energy parameters of buildings (measure 6). Both types of measures could be implemented in parallel.
Assumptions	Financing available
Risks	Lack of financing
Steps taken	Implementation of the ENERGY WOOD[64] Programme
Steps envisaged	Coordination with the ENERGY WOOD programme is recommended.
Expected result	Reduction of emissions of CO_2 and of air pollutants.

Number	17
Title	Development of transport infrastructure (highways, motorways, city by-passes)
Scenario	WaM
Priority	High
Time frame	2020
Cost assessment	The total cost is estimated at the level of €800 million.
Gas	CO_2
Indicators	Annual CO_2 emissions
Projection	Not available
Additional impacts	Reduction of air pollutant emissions
Description	Construction of the motorway from Bar to Boljari.
Assumptions	Construction will be completed on time
Risks	Construction will not be completed on time
Steps taken	Construction has started
Steps envisaged	
Expected result	Reduction of emissions of CO_2 and of air pollutants

64 See http://www.energetska-efikasnost.me/

Number	18
Title	Improvement of road transport organisation in cities and the introduction of integrated concepts (SMART cities)
Scenario	WaM
Priority	Medium
Time frame	2020
Cost assessment	Not available
Gas	CO_2
Indicators	Annual CO_2 emissions
Projection	Not available
Additional impacts	Reduction of air pollutant emissions
Description	Introduction of integrated transport systems, telematics, parking policies, intelligent transport systems, support for public transport, and support for cyclists.
Assumptions	Interest of municipalities
Risks	Lack of interest of municipalities
Steps taken	
Steps envisaged	
Expected result	Reduction of emissions of CO_2 and of air pollutants

Number	19
Title	Energy recovery from waste
Scenario	WaM
Priority	Medium
Time frame	2020
Cost assessment	The investment cost in case of forming one region for municipal waste management with building facility for using energy from waste amaunts to 134.690,000 EUR.
Gas	CH_4
Indicators	Annual emissions of CH_4
Projection	Not available.
Additional impacts	Reduction of waste landfilled
Description	The development of a feasibility study at a national level in order to review potential, viable technology and locations for the construction of a plant for the recovery of energy from waste.
Assumptions	Financing available
Risks	Lack of financing.
Steps taken	
Steps envisaged	
Expected result	Reduction of CH_4 emissions.

Number	20
Title	Support for sustainable tourism (eco-tourism)
Scenario	WaM
Priority	Medium
Time frame	Continuing activity

Cost assessment	Low cost measure
Gas	Mainly CO_2
Indicators	Annual CO_2 emissions
Projection	Not available
Additional impacts	Positive environmental, economic and social impact
Description	Administrative and or financial support
Assumptions	Interest of stakeholders
Risks	Lack of interest of stakeholders.
Steps taken	
Steps envisaged	
Expected result	Reduction of CO_2 emissions, positive environmental, economic and social impact.

ANNEX 4:

Criteria for Priority Setting at Project Level

Multicriterial analysis (MCA) is a tool for prioritising Nationally Appropriate Mitigation Actions (NAMAs); it is based on the principle of ranking and of making relative comparisons of criteria which are considered to be important in decision making.

Identified NAMAs are evaluated according to criteria with attributed marks (0-3). In addition, since all criteria is of equal importance, a weighting factor (1-2) is assigned to each criterion based on its relative importance compared to other criteria, and in terms of its importance regarding the success of the implementation of a particular NAMA.

The NAMA prioritisation process is carried out using the criteria for each of the selected NAMA concepts. According to the analysis, the key criteria for the prioritisation of NAMAs are as follows:

1. GHG reduction potential
2. Financial sustainability
3. Political support
4. Institutional readiness for implementation
5. Possibility of MRV
6. Public / social acceptability
7. Additional effects
    a. Economic effects
    b. Social effects
    c. Effects on the environment
    d. Effects on adapting to climate change

The potential reduction of GHG is expressed in estimated annual savings of CO_2 eq, which would be generated annually in the case of the NAMA concept being implemented. Precise CO_2 eq savings will be elaborated upon in detail when a NAMA concept is implemented. This criterion is evaluated by assigning a score from 1 to 10, depending on the number of projects being assessed; thus a NAMA concept that has more potential to reduce GHG is awarded more points. All such calculations are carried out in accordance with the instructions provided in the table MCA Prioritisation Analysis.

Financial sustainability is assessed taking into consideration the following sub-criteria: the means of financing (grant, commercial loan or a combination of both) and financial resources (Green Climate Fund / UNFCCC, multilateral financial institutions, bilateral funds, private investors). The evaluation of all criteria is carried out separately and the mean score expressed as the arithmetic mean score of the individual sub-criteria, in accordance with the instructions provided in the table MCA Prioritisation Analysis.

Political support is assessed by taking into account the following sub-criteria: the inclusion of domestic resources (labour, natural resources, financial and technological capital, production capacity, private sector), and the reduction of imports to ensure the security of energy supplies and supportive technology. The evaluation of all criteria is carried out separately and the mean score expressed as the arithmetic mean score of the individual sub-criteria, in accordance with the instructions provided in the table MCA Prioritisation Analysis.

Institutional readiness for implementation is evaluated using the following sub-criteria: compliance with existing laws and regulations (NAMA policies and / or measures can be implemented more easily if no changes are required in either laws or regulations) and institutional changes - institutional, technical, managerial and human resources (NAMA policies and / or measures can be implemented more easily if no

changes are required in institutional arrangements and if there are sufficient institutional, technical, managerial and human resources). The evaluation of all criteria is carried out separately and the mean score expressed as the arithmetic mean score of the individual sub-criteria, in accordance with the instructions provided in the table MCA Prioritisation Analysis.

The possibility of MRV is assessed by taking into account the way in which MRV is implemented: international MRV, international / national MRV and national MRV. Evaluation of criteria is carried out by assigning one criterion, in accordance with the instructions provided in the table MCA Prioritisation Analysis.

Public / social acceptability is assessed by guaging the level of acceptance of a project by the local population and / or the entire society. The implementation of some projects is met with resistance from a local population; for example, visual effects and noise in the case wind turbines. The implementation of certain projects is unacceptable for the entire society; for example, investment in renewable energy which results in sharp increases in electricity rates. Such criteria is evaluated by looking at whether a project is acceptable to the entire public, part of the public, or whether it is unacceptable in terms of the instructions provided in the table MCA Prioritisation Analysis.

Economic effects are assessed through the following criteria: cost price of NAMA measures implementation (total cost), cost to the state, cost to other users, the relevant time period including both costs and increases in revenue. The evaluation of all criteria is carried out separately and the mean score expressed as the arithmetic mean score of the individual sub-criteria, in accordance with the instructions provided in the table MCA Prioritisation Analysis.

Social effects are assessed through the following criteria: job creation, reduction in poverty and inequality, impact on marginalised parts of society (displacement / further impoverishment), acceptability within the local community, the provision of protection and cultural acceptability. The evaluation of all criteria is carried out separately and the mean score expressed as the arithmetic mean score of the individual sub-criteria, in accordance with the instructions provided in the table MCA Prioritisation Analysis.

Environmental effects are reflected through the following criteria: impact on air quality, impact on biodiversity, impact on water resources, impact on land and waste management. Evaluation of such criteria is carried out by experts; final criteria are assigned for providing ratings, in accordance with the instructions provided in the table MCA Prioritisation Analysis. It should be noted that some projects that contribute to reductions in GHG emissions also increase the emission levels of other pollutants such as biomass power plants, in which biomass combustion causes emissions of particulate matter (PM) and polycyclic aromatic hydrocarbons.

Effects on adaptation to climate change are reflected in the following criteria: improved water availability, reduced soil erosion and reduced deforestation. The evaluation of all criteria is carried out separately and the mean score expressed as the arithmetic mean score of the individual sub-criteria, in accordance with the instructions provided in the table MCA Prioritisation Analysis.

Detailed instructions on the methods used for the prioritisation of measures are attached in the form of an Excel table.

ANNEX 5:

National Emission Inventory, by Sector

ENERGY (CRF SECTOR 1)

The energy sector is the key source of GHG emissions generated by human activity. In Montenegro, the share of energy within total GHG emissions was 75.2% in 2012 and 76.10% in 2013.
The energy sector includes all activities related to fuel combustion in stationary and mobile sources and fugitive emissions. Fugitive emissions are released during the production, transport, refining, storage and distribution of fossil fuels.

Data Sources

The data on consumption, import and distribution of fuels in Montenegro was provided by the Statistical Office – MONSTAT. The data was processed and systematised within energy balances and represents the basis for the estimation of GHG emissions from the Energy sector. For inventory development purposes, the Statistical Office calculated the missing energy balances (period: 1991-1996) and recalculated the existing ones.

The records on the consumption of fossil fuels in large industrial plants that were submitted for analysis were used for inventory verification.

Emission Trends

The estimation of direct GHG emissions from the energy sector was produced in accordance with the 2006 IPCC Guidelines, the Intergovernmental Good Practice Guidance and the Uncertainty Management from 2000. Given the available national data (lower calorific values and specific carbon emissions from fossil fuels), it was possible to apply a Tier 2 approach to estimate emissions.
Estimated emissions in the energy subsectors for the observed period are shown in Tables 5, 6, 7 and 8.

GHG Emissions Expressed in CO_2 eq

Activities relating to electricity and heat production contribute the most to total emissions from the energy sector. A decline in the emissions recorded during the period 1992-1995 and in 2009 was the result of a reduced level of electricity production at TPP 'Pljevlja', a reduction in production levels at the Aluminium Plant Podgorica, and an overall economic crisis in the country.

Emissions in the transport subsector recorded a slow, but steady, growth trend during the afore-mentioned period, which corresponded to an increase in the number of motor vehicles in the country (Table 10).

Table 10 *CO_2eq Emissions From the Energy Sector and Energy Subsectors, 1990 - 2013 (Gg)*

Year	1990	1991	1992	1993	1994	1995	1996	1997
1 – Energy	2,352.61	2,450.28	1,809.33	1,602.90	1,428.09	825.24	1,842.40	1,850.80
1.A– Fuel combustion activities	2,313.79	2,417.45	1,777.01	1,562.59	1,393.84	785.41	1,808.16	1,821.17
1.A.1- Electricity and heat production	1,409.41	1,368.92	1,072.63	977.15	811.40	163.97	1,098.68	1,095.16
1.A.2–Manufacturing industries and construction	274.47	388.05	254.91	192.66	203.33	199.06	238.04	197.83
1.A.3- Transport	341.91	394.64	248.73	192.76	214.83	230.69	284.36	300.06
1.A.4 – Other	269.14	243.95	191.09	193.56	157.81	181.83	177.45	206.65
1.A.5 - Non-specified	18.85	21.89	9.65	6.45	6.48	9.86	9.62	21.46
1.B– Fugitive emissions from fuels	38.82	32.83	32.33	40.32	34.24	39.83	34.24	29.62
1.B.1– Solid Fuels	38.82	32.83	32.33	40.32	34.24	39.83	34.24	29.62
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
1 – Energy	2,259.86	2,332.16	2,427.50	2,013.42	2,517.68	2,427.77	2,388.09	2,200.89
1.A– Fuel combustion activities	2,230.60	2,302.44	2,398.88	1,988.99	2,469.80	2,398.18	2,357.51	2,174.57
1.A.1- Electricity and heat production	1,390.77	1,371.66	1,494.32	1,159.66	1,693.04	1,601.95	1,535.36	1,122.89
1.A.2–Manufacturing industries and construction	180.46	176.85	173.73	185.77	159.81	162.39	145.52	434.53
1.A.3- Transport	421.61	513.92	514.09	447.02	364.55	381.15	432.10	405.25
1.A.4 – Other	208.45	215.06	188.13	177.28	222.71	223.82	222.37	182.91
1.A.5 – Non-specified	29.31	24.95	28.61	19.26	29.69	28.87	22.17	29.00
1.B– Fugitive emissions from fuels	29.27	29.72	28.62	24.43	47.89	29.59	30.58	26.32
1.B.1– Solid fuels	29.27	29.72	28.62	24.43	47.89	29.59	30.58	26.32
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1 – Energy	2,356.22	2,293.34	2,904.72	1,979.14	2,725.54	2,768.15	2,684.24	2,415.87
1.A– Fuel combustion activities	2,325.95	2,269.46	2,872.89	1,961.63	2,690.09	2,732.07	2,651.59	2,384.91
1.A.1- Electricity and heat production	1,273.22	1,004.93	1,530.33	824.71	1,732.17	1,771.79	1,771.51	1,512.68
1.A.2 Manufacturing industries and construction	427.72	453.65	449.88	168.68	82.70	52.47	43.60	75.18
1.A.3- Transport	434.37	528.85	604.01	704.27	612.71	660.40	637.83	608.72
1.A.4 – Other	165.06	249.54	256.60	231.68	230.01	241.13	192.36	116.93
1.A.5 - Non-specified	25.58	32.48	32.08	32.30	32.50	6.28	6.30	71.39
1.B– Fugitive emissions from fuels	30.27	23.89	31.83	17.50	35.45	36.08	32.65	30.96
1.B.1– Solid fuels	30.27	23.89	31.83	17.50	35.45	36.08	32.65	30.96

Total GHG emissions, expressed as CO_2eq., from the energy sector for the period 1990 to 2013 are shown in Figure 19; Figure 20 shows CO_2eq emissions from the energy subsectors.

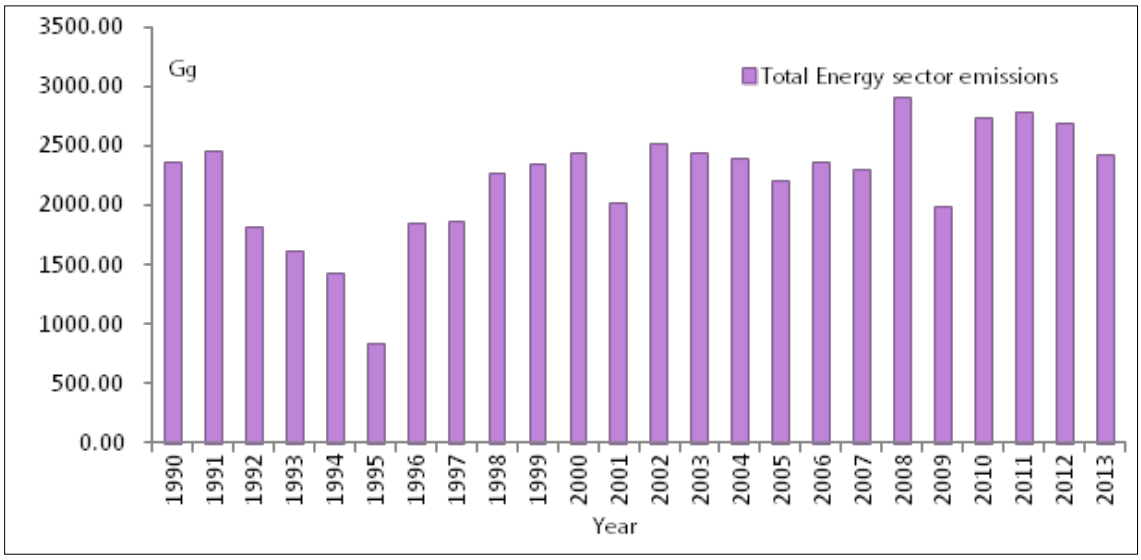


Figure 19 *Total CO_2eq Emissions From the Energy Sector, 1990-2013 (Gg)*

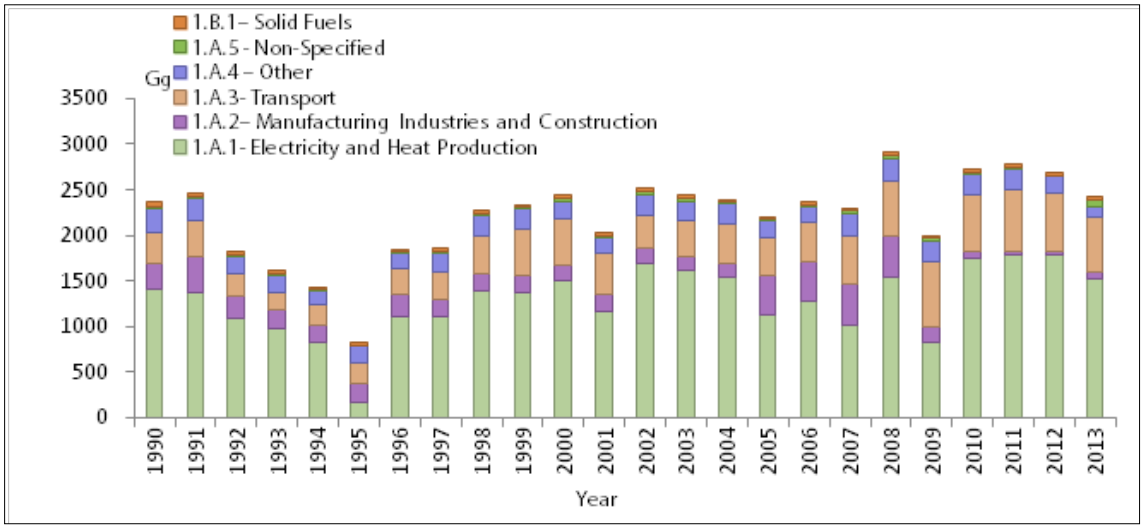


Figure 20 *CO_2 eq Emissions From the Energy Subsectors, 1990-2013 (Gg)*

CO_2 Emissions

Due to lignite combustion at TPP 'Pljevlja', activity 1.A.1- Electricity and Heat Production represents the biggest share of the total CO_2 produced by the energy sector (Table 11 and Figure 21).

Table 11 *CO_2 Emissions From the Energy Sector and Energy Subsectors, 1990 - 2013 (Gg)*

CO_2								
Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
1 - Energy	2,204.49	2,320.54	1,678.75	1,457.59	1,318.21	703.45	1,723.91	1,742.67
1.A– Fuel combustion activities	2,204.49	2,320.54	1,678.75	1,457.59	1,318.21	703.45	1,723.91	1,742.67
1.A.1- Electricity and heat production	1,403.05	1,362.66	1,067.65	972.58	807.65	163.37	1,093.52	1,090.15
1.A.2–Manufacturing industries and construction	273.38	386.67	254.01	191.91	202.64	198.27	237.01	197.03
1.A.3- Transport	334.21	385.95	243.10	188.35	209.98	225.50	278.08	293.34
1.A.4 – Other	175.32	163.57	104.60	98.49	91.67	106.92	105.89	141.17
1.A.5 - Non-specified	18.53	21.67	9.40	6.26	6.26	9.40	9.40	20.98
1.B– Fugitive emissions from fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1– Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
1 - Energy	2,153.94	2,221.57	2,315.93	1,919.25	2,374.76	2,300.77	2,258.28	2,080.15
1.A– Fuel combustion activities	2,153.94	2,221.57	2,315.93	1,919.25	2,374.76	2,300.77	2,258.28	2,080.15
1.A.1- Electricity and heat production	1,384.30	1,365.32	1,487.40	1,154.39	1,685.15	1,594.53	1,528.28	1,117.44
1.A.2–Manufacturing industries and construction	179.63	176.00	172.96	185.13	159.00	161.72	144.84	432.93
1.A.3- Transport	412.34	502.88	503.23	437.70	357.02	373.11	422.99	396.61
1.A.4 – Other	148.63	152.68	124.15	123.24	144.47	143.21	140.50	104.99
1.A.5 - Non-specified	29.04	24.71	28.19	18.79	29.13	28.19	21.67	28.19
1.B– Fugitive emissions from fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1– Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1 - Energy	2,225.84	2,168.26	2,764.97	1,854.97	2,579.93	2,617.78	2,537.04	2,276.41
1.A– Fuel combustion activities	2,225.84	2,168.26	2,764.97	1,854.97	2,579.93	2,617.78	2,537.04	2,276.41
1.A.1- Electricity and heat production	1,267.04	1,000.07	1,522.90	820.72	1,723.76	1,763.19	1,762.92	1,505.30
1.A.2–Manufacturing industries and construction	426.21	452.08	448.34	168.12	82.46	51.52	42.60	74.16
1.A.3- Transport	425.10	518.00	591.90	690.12	599.97	648.15	626.12	597.63
1.A.4 – Other	85.85	169.92	176.78	147.83	142.43	148.71	99.13	28.66
1.A.5 - Non-specified	21.65	28.19	25.05	28.19	31.32	6.21	6.26	70.66
1.B– Fugitive emissions from fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1– Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

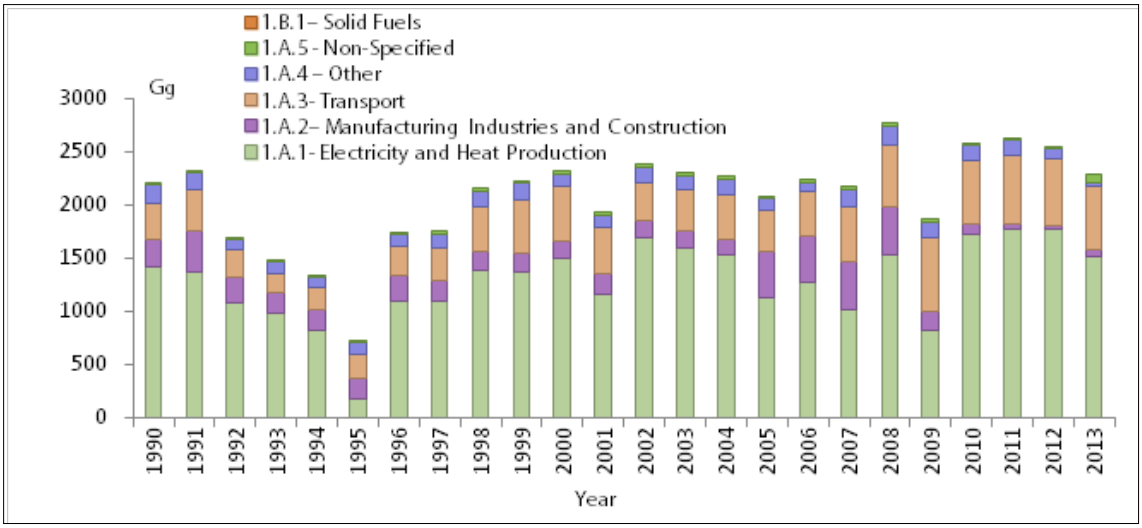


Figure 21 *Total CO_2 Emissions From the Energy Subsectors, 1990-2013 (Gg)*

CH_4 Emissions

By comparing CH_4 emissions with CO_2 emissions, it is possible to conclude that the level of methane emissions from the energy sector is very low and is related to combustion in other energy activities (1.A.4) and fugitive emissions from fuels (1.B) (including fugitive emissions from coal mines) (Table 12 and Figure 22).

Table 12 *CH_4 Emissions From the Energy Sector and Energy Subsectors, 1990 - 2013 (Gg)*

CH_4								
Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
1 - Energy	5.73	4.92	5.09	5.79	4.35	4.97	4.59	4.14
1.A– Fuel combustion activities	3.88	3.35	3.55	3.87	2.72	3.08	2.96	2.73
1.A.1- Electricity and heat production	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.02
1.A.2–Manufacturing industries and construction	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01
1.A.3- Transport	0.11	0.12	0.08	0.06	0.06	0.07	0.08	0.09
1.A.4 – Other	3.73	3.19	3.44	3.78	2.63	2.98	2.85	2.60
1.A.5 - Non-specified	0.01	0.00	0.01	0.01	0.01	0.02	0.01	0.01
1.B– Fugitive emissions from fuels	1.85	1.56	1.54	1.92	1.63	1.90	1.63	1.41
1.B.1– Solid fuels	1.85	1.56	1.54	1.92	1.63	1.90	1.63	1.41
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
1 - Energy	3.93	4.08	4.07	3.46	5.52	4.77	4.86	4.50
1.A– Fuel combustion activities	2.54	2.66	2.71	2.30	3.24	3.36	3.40	3.25
1.A.1- Electricity and heat production	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01
1.A.2–Manufacturing industries and construction	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
1.A.3- Transport	0.13	0.15	0.13	0.11	0.08	0.10	0.10	0.10
1.A.4 – Other	2.38	2.48	2.54	2.15	3.11	3.21	3.26	3.10
1.A.5 - Non-specified	0.00	0.00	0.01	0.01	0.01	0.02	0.01	0.02

1.B– Fugitive emissions from fuels	1.39	1.42	1.36	1.16	2.28	1.41	1.46	1.25
1.B.1– Solid fuels	1.39	1.42	1.36	1.16	2.28	1.41	1.46	1.25
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1 - Energy	4.79	4.60	4.99	4.47	5.36	5.53	5.39	5.11
1.A– Fuel combustion activities	3.34	3.46	3.47	3.64	3.67	3.81	3.84	3.64
1.A.1- Electricity and heat production	0.01	0.01	0.02	0.01	0.02	0.02	0.02	0.02
1.A.2–Manufacturing industries and construction	0.02	0.02	0.02	0.01	0.00	0.02	0.02	0.02
1.A.3- Transport	0.11	0.11	0.11	0.14	0.12	0.10	0.10	0.07
1.A.4 – Other	3.15	3.16	3.17	3.33	3.48	3.67	3.71	3.51
1.A.5 - Non-specified	0.05	0.16	0.16	0.15	0.04	0.00	0.00	0.02
1.B– Fugitive emissions from fuels	1.44	1.14	1.52	0.83	1.69	1.72	1.55	1.47
1.B.1– Solid fuels	1.44	1.14	1.52	0.83	1.69	1.72	1.55	1.47

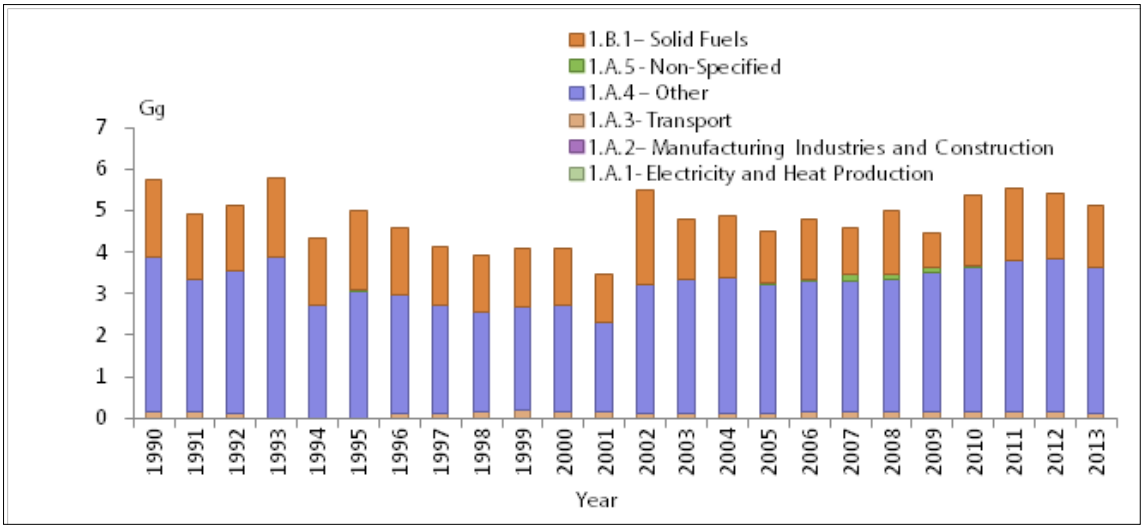


Figure 22 *Total CH_4 Emissions From the Energy Subsectors, 1990-2013 (Gg)*

N_2O Emissions

A low level of N_2O emissions was recorded from the energy sector during the observed period, with the greatest contribution coming from 1.A.4 - Other activities related to fuel combustion and there was also a negligible contribution from the transport sector (Table 13 and Figure 23).

Table 13 *N_2O Emissions From the Energy Sector and Energy Subsectors, 1990 - 2013 (Gg)*

N_2O								
Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
1 - Energy	0.09	0.09	0.08	0.08	0.06	0.06	0.07	0.07
1.A– Fuel combustion activities	0.09	0.09	0.08	0.08	0.06	0.06	0.07	0.07
1.A.1- Electricity and heat production	0.02	0.02	0.02	0.01	0.01	0.00	0.02	0.02
1.A.2–Manufacturing industries and construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3- Transport	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.02
1.A.4 – Other	0.05	0.04	0.05	0.05	0.04	0.04	0.04	0.03
1.A.5 - Non-specified	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B– Fugitive emissions from fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1– Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
1 - Energy	0.08	0.08	0.08	0.07	0.09	0.09	0.09	0.08
1.A– Fuel combustion activities	0.08	0.08	0.08	0.07	0.09	0.09	0.09	0.08
1.A.1- Electricity and heat production	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
1.A.2–Manufacturing industries and construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3- Transport	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02
1.A.4 – Other	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04
1.A.5 - Non-specified	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B– Fugitive emissions from fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1– Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1 - Energy	0.10	0.09	0.11	0.10	0.11	0.11	0.11	0.10
1.A– Fuel combustion activities	0.10	0.09	0.11	0.10	0.11	0.11	0.11	0.10
1.A.1- Electricity and heat production	0.02	0.01	0.02	0.01	0.03	0.03	0.03	0.02
1.A.2–Manufacturing industries and construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3- Transport	0.02	0.03	0.03	0.04	0.03	0.03	0.03	0.03
1.A.4 – Other	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05
1.A.5 - Non-specified	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
1.B– Fugitive emissions from fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1– Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

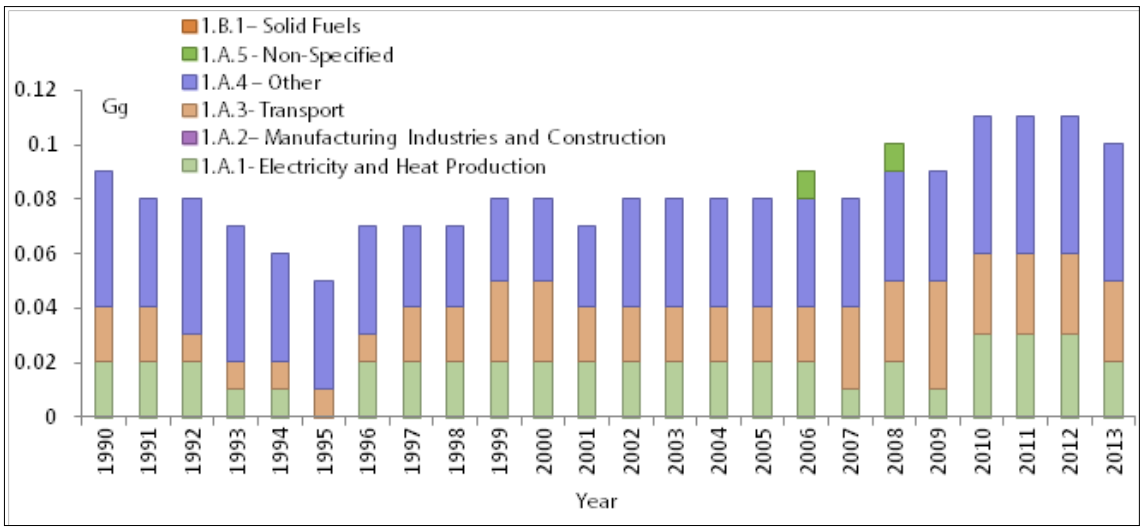


Figure 23 *Total N_2O Emissions From the Energy Sector, 1990-2013 (Gg)*

Activity Indicators and Emission Factors

Data on the consumption, import and distribution of fuel in Montenegro provided by the Statistical Office of Montenegro was used to calculated emissions in this sector. For inventory development purposes, the Statistical Office calculated missing energy balances (period: 1991-1996) and recalculated existing balances.

Emission calculation was performed by applying Tier 2 of the 2006 IPCC methodology. This methodology includes a calculation of national emission factors; it uses national low calorific power and specific carbon emission in fossil fuels for the entire observed period (Table 14). The oxidation factors ranged from 0.9 to 1. The national emission factors for fossil fuels and wood are shown in Table 15.

Table 14 *Lower Calorific Value and Share of Carbon in Fossil Fuels*

Fossil Fuel	Lower Calorific Value	Unit for Lower Calorific Value	Specific Carbon Emissions – C (t /TJ)
Brown coal	16.75	MJ/kg	26.2
Lignite	9.21	MJ/kg	27.6
Wood and wood waste	9.47	MJ/dm3	29.9
Other solid waste	1.00	MJ/MJ	29.9
Industrial waste	1.00	MJ/MJ	29.9
Liquefied petroleum gas	46.15	MJ/kg	17.2
Motor gasoline	44.59	MJ/kg	18.9
Jet gasoline	43.96	MJ/kg	19.5
Diesel fuel	42.71	MJ/kg	20.2
Fuel oil	42.71	MJ/kg	20.2
Fuel oil - mazut, S < 1%	40.19	MJ/kg	21.1
Fuel oil - mazut, S ≥ 1%	40.19	MJ/kg	21.1
Lubricants	33.50	MJ/kg	20.0
Bitumen	33.50	MJ/kg	22.0
Petroleum coke	31.00	MJ/kg	27.5
Other petroleum product	40.19	MJ/kg	20.0

Table 15 *National CO_2 Emission Factors for Fossil Fuels*

Fossil Fuel	CO_2 Emission Factor (kg /TJ)
Brown coal	**96100**
Lignite	**99176**
Wood and wood waste	**107440**
Liquefied petroleum gas	**62436**
Motor gasoline	**68607**
Jet gasoline	**70785**
Diesel fuel	**73326**
Fuel oil	**76593**
Fuel oil - mazut, S < 1%	**76593**
Fuel oil - mazut, S ≥ 1%	**76593**
Petroleum coke	**98817**

Default emission factors from the methodology of the Intergovernmental Panel on Climate Change were used to calculate CH_4 and N_2O emissions (Tables 16 and 17).

Table 16 *CH_4 and N_2O Emission Factors From the Energy Subsectors*

Subsector	Fossil Fuel	CH_4 Emission Factor (kg/TJ)	N_2O Emission Factor (kg/TJ)
1.A.1- Electricity and heat production 1.A.2– Manufacturing industries and construction	Brown coal	10	1.5
	Lignite	10	1.5
	Wood and wood waste	30	4
	Liquefied petroleum gas	3	0.1
	Diesel fuel	3	0.6
	Fuel oil	3	0.6
	Petroleum coke	3	0.6
1.A.3.a.i – International aviation (international bunkers) 1.A.3.a.ii – Domestic aviation	Jet fuel	0.5	2
1.A.3.b – Road transportation	Motor gasoline	33	3.2
	Diesel fuel	3.9	3.9
	LPG	62	0.2
1.A.3.c- Railways	Diesel fuel	4.15	28.6
1.A.3.d.ii – Domestic water-borne navigation	Motor gasoline	7	2
	Diesel fuel	7	2
	Oil fuel	7	2
1.A.4.c.ii – Off-road vehicles and other machinery	Motor gasoline	10	0.6
	Diesel fuel	10	0.6
	Fuel oil	10	0.6
1.A.4.c.i – Stationary	Fuel oil	10	0.6

Subsector	Fossil Fuel	CH_4 Emission Factor (kg/TJ)	N_2O Emission Factor (kg/TJ)
1.A.4.b – Residential	Fuel oil	10	0.6
	LPG	5	0.1
	Brown coal	300	1.5
	Lignite	300	1.5
	Wood and wood waste	300	4
1.A.4.a – Commercial / institutional	Fuel oil	10	0.6
	LPG	5	0.1
	Lignite	10	1.5
	Wood and wood waste	300	4
1.A.5.b.iii – Mobile (other)	Diesel fuel	7	2

Table 17 *CH_4 Emission Factors – Fugitive Emissions*

Subsector Fugitive emissions	Fossil Fuel	CH4 Emission factor (m3/t)	N2O Emission Factor (kg/TJ)
1.B.1.a.i.1 – Coal mining - underground mines	-	18	-
1.B.1.a.i.2 – Post-mining seam gas emissions	-	2.5	-
1.B.1.a.ii.1 - Coal mining - surface mines	-	1.2	-
1.B.1.a.ii.2 - Post-mining seam gas emissions		0.1	-

Table 18 shows data on fossil fuel consumption, used to calculate emissions from the energy sector and presented by CRF categories.

Table 18 *Fossil Fuel Consumption in the Energy Sector, 1990 - 2013 (Gg)*

CRF Category	Fuel (Gg)	1990	1991	1992	1993	1994	1995	1996	1997
1.A.1.a.i Electricity generation	Fuel oil	4.6	4.4	1.9	1.6	1.4	0	1.8	2.4
	Lignite	1,185	1,204	996	930	739	36	1,054	970.3
1.A.1.a.iii - Heat plants	Fuel oil	95.05	76	46	35	38	39	37	61.2
	Lignite	7	9	8	8	9	8	9	2
1.A.1.c.i – Manufacture of solid fuels	Diesel fuel	2.4	2.3	1	1	1	1	1	2
1.A.2.a – Iron and steel	LPG	0	0	0	0	0	0	0	0
	Fuel oil	26.8	40	25	21	20	19	22	14.1
	Petroleum coke	0	0	0	0	0	0	0	0.8
	Lignite	25	21	19	16	16	17	21	34
1.A.2.b – Non-ferrous metals	Diesel fuel	4.9	3	2	1	1	1	1	2.1
	Fuel oil	31.2	60	35	23	30	28	27	16.6
	LPG	0.2	0	0	0	0	0	0	0
1.A.2.c - Chemicals	LPG	0	0	0	0	0	0	0	0
	Brown coal	0	0	0	0	0	0	0	0
1.A.2.d – Pulp, paper and print	Brown coal	0	0	0	0	0	0	9	12
	Lignite	0	0	0	0	0	0	0	0

1.A.2.e – Food processing, beverages and tobacco	Fuel oil	0	0	0	0	0	0	0	0
	LPG	0.5	0.5	0	0	0	0	0	0.8
	Petroleum coke	0	0	0	0	0	0	0	0.8
	Brown coal	1	0	1	1	1	1	1	1
	Lignite	1	0	1	1	1	1	2	1
1.A.2.f – Non-metallic minerals	Fuel oil	0	0	0	0	0	0	0	0
	Brown coal	0	0	0	0	0	0	0	0
1.A.2.i - Mining (excluding fuels) and quarrying	Fuel oil	0	0	0	0	0	0	0	0
1.A.2.j – Wood and wood products	LPG	0	0	0	0	0	0	0	0
	Brown coal	0	0	0	0	0	0	0	0
	Wood and wood waste	0	0	0	0	0	0	0	0
1.A.2.k - Construction	Fuel oil	4.8	0	0	0	0	0	0	0
	brown coal	0	0	0	0	0	0	0	0
1.A.2.l – Textiles and leather	Brown coal	0	0	0	1	1	2	2	2
	Lignite	19	15	14	11	11	11	15	8
1.A.2.m – Non-specified industry	Fuel oil	0	5	5	4	2	3	4	
	LPG	1.1	1	0	0	0	0	0	1.1
	Petroleum coke	0	0	0	0	0	0	0	0
	Brown coal	2	2	2	2	1	1	1	2
	Lignite	15	15	13	10	10	9	15	15
1.A.3.a.i –International aviation (international bunkers)	Jet fuel	12.5	14.3	2	1	1	1	1	0.5
1.A.3.a.ii – Domestic aviation	Jet fuel	0	0	0	0	0	0	0	0
1.A.3.b – Road transportation	Gasoline	68.4	76	50.8	37	41	43	52	57.6
	Diesel fuel	37.6	47	26	22	25	28	36	35.3
	LPG	0	0	0	0	0	0	0	0
1.A.3.c – Railways	Diesel fuel	1.3	1	1	1	1	1	1	1.1
1.A.3.d.ii - Domestic water-borne navigation	Gasoline	0	0	0	0	0	0	0	0
	Diesel fuel	1	1	1	1	1	1	1	1
	Fuel oil	0	0	0	0	0	0	0	0
1.A.4.a - Commercial / institutional	Fuel oil	17.5	16	9	11	9	12	7	12.1
	LPG	1.7	0	0	0	0	0	0	0.1
	Lignite	40.9	36	31	22	21	22	32	48.1
	Wood and wood waste	0	0	0	0	0	0	0	0
1.A.4.b - Residential	Fuel oil	1.2	1.2	1.2	1.2	1.2	1.2	1.2	0.6
	LPG	8.5	11	1	1	0	1	2	0.5
	Petroleum coke	0	0	0	0	0	0	0	0.5
	Brown coal	0	0	0	0	0	0	0	0
	Lignite	25	23	22	21	21	20	26	32
	Wood and wood waste	777.9	665.2	719.6	793.4	547.72	622.13	590.7	534.3
1.A.4.c.i – Stationary	Fuel oil	1	1	1	1	1	1	1	1
1.A.4.c.ii - Off-road vehicles and other machinery	Gasoline	0	0	0	0	0	0	0	0
	Diesel fuel	8	7	6	5	6	7	6	7.2
	Fuel oil	0	0	0	0	0	0	0	0
1.A.5.b.iii – Mobile (other)	Diesel fuel	5.8	6	3	2	2	3	3	6.7
	Petroleum coke	0	0	0	0	0	0	0	0

CRF category	Fuel (Gg)	1998	1999	2000	2001	2002	2003	2004	2005
1.A.1.a.i Electricity generation	Fuel oil	3.1	3.2	3.5	2.5	1.3	1.6	1.3	2.2
	Lignite	1,302	1,258	1,381.4	1,000.8	1,598.4	1,479.9	1,394	1,200.2
1.A.1.a.iii - Heat Plants	Fuel oil	55.7	63.2	63.4	71.8	67.9	71.4	77.6	0
	Lignite	2	2	2	2	3	4	4	4.1
1.A.1.c.i – Manufacture of solid fuels	Diesel fuel	3.9	3.2	5.7	3.1	3	4.6	2.7	3.4
1.A.2.a – Iron and steel	LPG	0.9	1	1	1	1	0	0	1
	Fuel oil	12.9	9.8	7.3	9.9	6.7	4.8	12.2	9.6
	Petroleum coke	0.9	0	0	0	0	0	0	0
	Lignite	27	32	26	22	33	33	28	25
1.A.2.b – Non-ferrous metals	Diesel fuel	1.5	1.8	2.8	3	2.3	2	2.2	0
	Fuel oil	16	16.7	26.4	27.1	29.8	29.5	27	95.8
	LPG	0.2	0	0	0	0	0	0	0
1.A.2.c - Chemicals	LPG	0	0	0	0	0	0	0	0
	Brown coal	0	0	0	0	0	0	0	2
1.A.2.d – Pulp, paper and print	brown coal	0	0	0	0	0	0	0	0
	Lignite	15	12	7	6	3	2	2	2
1.A.2.e – Food processing, beverages and tobacco	Fuel oil	0	0	0	0	0	0	0	4.8
	LPG	0	0	0	0	0	0	0	0
	Petroleum coke	0.6	0.6	0	0	0	0	0	0
	Brown coal	0	2	0	1	2	1	1	2
	Lignite	2	2	2	1	1	0	0	0
1.A.2.f – Non-metallic minerals	Fuel oil	0	0	0	0	0	0	0	1
	Brown coal	0	0	0	0	0	0	0	1
1.A.2.i - Mining (excluding fuels) and quarrying	Fuel oil	0	0	0	0	0	0	0	1
1.A.2.j – Wood and wood products	LPG	0	0	0	0	0	0	0	0
	Brown coal	0	0	0	0	0	0	0	0
	Wood and wood waste	0	0	0	0	0	0	0	0
1.A.2.k - Construction	Fuel oil	0	0	0	0	0	0	0	0
	Brown coal	0	2	0	3	2	2	2	1
1.A.2.l – Textiles and leather	Brown coal	0	2	0	2	3	0	0	14
	Lignite	9	7	5	3	3	1	0	0
1.A.2.m – Non-specified industry	Fuel oil	0	0	0	0	0	0	0	3.7
	LPG	0.6	1	0	1	1	1	1	4
	Petroleum coke	1	0	0	0	0	0	0	0
	Brown coal	0	2	0	0	1	0	0	0
	Lignite	28	22	23	19	13	7	6	6
1.A.3.a.i –International aviation (international bunkers)	Jet fuel	4.4	13	12.9	14	10.6	8.3	7.3	13
1.A.3.a.ii – Domestic aviation	Jet fuel	0.6	0.3	0.4	1.9	4.2	4.7	0	2.4
1.A.3.b – Road transportation	Gasoline	79	91.7	78.2	65.9	50.4	61.5	61.6	52
	Diesel fuel	51.8	69.1	81.4	70.8	57.7	51.4	71.8	65.7
	LPG	0	0	0	0	0.1	0.1	0.1	3
1.A.3.c – Railways	Diesel fuel	1.1	0.8	1.2	1.1	1	1	1.2	2
1.A.3.d.ii - Domestic water-borne navigation	Gasoline	0	0	0	0	0	0	0	0
	Diesel fuel	1	0.8	1.3	1.6	1.8	1.9	1.8	3
	Fuel oil	0	0	0	0	0	0	0	0

1.A.4.a - Commercial / institutional	Fuel oil	12.7	13.4	15.4	15.3	17.6	17	17.9	15.7
	LPG	0	0	0	0	0	0	0	0
	Lignite	48.7	53.2	30	30	35	32.5	27	12
	Wood and wood waste	0	0	0	0	0	0	0	0
1.A.4.b - Residential	Fuel oil	0.7	0.7	0.8	0.9	1	1.1	1.2	2.4
	LPG	1.1	0	0	0	0.9	2	3	0
	Petroleum coke	1.1	0.5	0	0	0	0	0	0
	Brown coal	0	0	0	0	0	0	0	0
	Lignite	35.3	41.8	24	26.7	34	33	29	18
	Wood and wood waste	484.28	502.52	526.25	440.46	641.75	662.54	675.5	648.81
1.A.4.c.i – Stationary	Fuel oil	1.1	0.5	0	0	0	0	0	0
1.A.4.c.ii - Off-road vehicles and other machines	Gasoline	0.3	0	1	0	0	0	0	0
	Diesel fuel	6.7	6	6.1	5.9	6	6	6	6
	Fuel oil	0	0	0	0	0	0	0	0
1.A.5.b.iii – Mobile (other)	Diesel fuel	8	7.4	9	6	9.3	9	6	9
	Petroleum coke	1.3	0.5	0	0	0	0	0	0
CRF Category	**Fuel (Gg)**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1.A.1.a.i Electricity generation	Fuel oil	1.4	3.2	2.7	1.4	3	3	3.3	0
	Lignite	1,363	1,065	1,636	875	1,856.2	1,900	1,900.4	1,648
1.A.1.a.iii - Heat plants	Fuel oil	0	0	0	0	0	0	0	0
	Lignite	4	4	4	2	2	0	0	0
1.A.1.c.i – Manufacture of solid fuels	Diesel fuel	4.5	4.4	5.3	4.9	5.5	5.9	5.4	0
1.A.2.a – Iron and steel	LPG	0	2.1	0	4	2	2	2	2
	Fuel oil	9.7	11.1	13.6	0	7.6	0	0	3
	Petroleum coke	0	0	0	0	0	0	0	0
	Lignite	22	14	16	13	9	12	12	10
1.A.2.b – Non-ferrous metals	Diesel fuel	0	0	0	0	0	0	0	0
	Fuel oil	101.4	99.6	95.2	37.4	4.2	0	0	0
	LPG	0	0	0	0	0	0	0	0
1.A.2.c - Chemicals	LPG	0	0	0	0	0	5	4	0
	Brown coal	1	2	1	0	0	0	0	0
1.A.2.d – Pulp, paper and print	Brown coal	0	0	0	0	0	0	0	0
	Lignite	1	1	2	0	0	0	0	0
1.A.2.e – Food processing, beverages and tobacco	Fuel oil	1.7	4.2	5.3	1.3	1.3	0	0	0
	LPG	0	0	1	0	0	0	0	1
	Petroleum coke	0	0	0	0	0	0	0	0
	Brown coal	1	4	2	0	0	0	0	0
	Lignite	0	0	0	0	0	2	2	1
1.A.2.f – Non-metallic minerals	Fuel oil	1	1	1	1.1	1	0	0	1
	Brown coal	1	2	2	0	0	0	0	0
1.A.2.i - Mining (excluding fuels) and quarrying	Fuel oil	1	1	1	1.3	1	0	0	0
1.A.2.j – Wood and wood products	LPG	0	0	0	0	0	0	0	2
	Brown coal	0	0	4	0	0	0	0	0
	Wood and wood waste	0	0	0	0	0	28.23	30.05	28.24

1.A.2.k - Construction	Fuel oil	0	0	0	0	0	0	0	0
	Brown coal	0	0	0	0	0	0	0	0
1.A.2.l – Textiles and leather	Brown coal	6.5	2	1	0	0	0	0	0
	Lignite	0	0	0	0	0	0	0	0
1.A.2.m – Non-specified Industry	Fuel oil	1.8	9.2	8.6	0	0	0	0	5
	LPG	7	6	8	4	7	6	4	7
	Petroleum coke	0	0	0	0	0	0	0	0
	Brown coal	3	7	4	3	0	0	0	0
	Lignite	7	0	0	2	2	1	1	2
1.A.3.a.i –International aviation (international bunkers)	Jet fuel	15	10.6	14	1.8	2	10	12	13
1.A.3.a.ii – Domestic aviation	Jet fuel	1.5	0	0	0	0	0	0	0
1.A.3.b – Road transportation	Gasoline	54	54	50	64	57	40	34	31
	Diesel fuel	71.5	101.4	128.5	145.2	123.1	159	155	156.6
	LPG	5	5.2	5	6.1	6.3	6	7	0
1.A.3.c – Railways	Diesel fuel	2.1	2	2.2	2.2	3	0	0	0
1.A.3.d.ii - Domestic water-borne navigation	Gasoline	0	0	0	0	0	2	2	0
	Diesel fuel	3.3	3.4	3.5	3.3	4	1	1	1
	Fuel oil	0	0	0	0	0	0	2	3
1.A.4.a - Commercial / institutional	Fuel oil	2	33	35	26	29	33	23	0
	LPG	0	0	0	0	0	0	0	0
	Lignite	27	13	11	18	0	0	0	0
	Wood and wood waste	0	0	0	0	0	26.94	26.54	29.08
1.A.4.b - Residential	Fuel oil	2.1	2.7	2.7	3	2.7	2	2	2
	LPG	1	0	0	0	0	0	0	0
	Petroleum coke	0	0	0	0	0	0	0	0
	Brown coal	0	0	1	0	0	0	0	0
	Lignite	26	15	16	22	25	14	14	11
	Wood and wood waste	656.62	661.91	661.95	695.35	726.067	745.34	754.79	714.73
1.A.4.c.i – Stationary	Fuel oil	0	4	4	0	0	0	0	0
1.A.4.c.ii - Off-road vehicles and other machines	Gasoline	0	0	0	0	0	1	1	1
	Diesel fuel	6	7	7	7	7	8	2	3
	Fuel oil	1	0	0	0	0	0	0	0
1.A.5.b.iii – Mobile (other)	Diesel fuel	7	9	8	9	10	1	2	1
	Petroleum coke	0	0	0	0	0	0	0	0

Table 19 shows data on the quantities of coal exploited.

Table 19 *Quantities of Coal Exploited in Montenegro, 1990-2013 (t)*

CRF Category	Quantities of Coal (t)							
1.B.1.a.i. – Coal mining - underground mines	1990	1991	1992	1993	1994	1995	1996	1997
	25,000	4,000	3,000	51,000	43,000	27,100	43,000	20,900
1.B.1.a.ii. - Coal mining - surface mines	1,728,000	1,732,000	1,720,000	1,400,000	1,194,000	1,750,000	1,194,000	1,290,000
1.B.1.a.i. – Coal mining - underground mines	1998	1999	2000	2001	2002	2003	2004	2005
	NO	7,300	NO	9,900	55,000	NO	10,000	8,800
1.B.1.a.ii. - Coal mining - surface mines	1,600,000	1,510,000	1,564,700	1,179,500	1,750,700	1,617,800	1,514,300	1,300,000
1.B.1.a.i. – Coal mining - underground mines	2006	2007	2008	2009	2010	2011	2012	2013
	9,700	7,000	NO	NO	NO	NO	NO	NO
1.B.1.a.ii. - Coal mining - surface mines	1,502,000	1,195,500	1,740,000	957,000	1,938,000	1,972,700	1,785,000	1,692,500

Table 20 *CO_2 Emissions, Reference and Sectoral Approach, 1990, 2012 and 2013*

Year	Fuel Type	Reference Approach		Sectoral Approach		Difference	
		Fuel Consumption (Excluding non-energy consumption) (TJ)	CO_2 Emissions (Gg)	Fuel Consumption (Excluding non-energy consumption) (TJ)	CO_2 Emissions (Gg)	Fuel Consumption (Excluding non-energy consumption) (%)	CO_2 Emissions (%)
1990	Liquid	15,623.52	1,000.54	13,529.68	995.61	15.47	**0.5**
	Solid	12,176.64	1,207.40	12,191.79	1,208.88	-0.12	**-0.12**
	Total	27,800.16	2,207.95	25,721.47	2,204.49	8.1	**0.16**
2012	Liquid	12,410.13	801.87	10,717.79	774.70	15.79	**3.5**
	Solid	17,766.09	1,761.97	17,769.77	1,762.34	-0.02	**-0.02**
	Total	30,176.22	2,563.84	28,487.56	2,537.04	5.9	**1.05**
2013	Liquid	11,901.68	788.03	10,335.42	749.18	15.5	**5.2**
	Solid	15,399.12	1,527.22	15,399.12	1,527.22	0	**0**
	Total	27,300.8	2,315.25	25,734.54	2,276.4	6.08	**1.7**

Uncertainty Assessment for the Energy Sector

For the purposes of this report, uncertainty assessments were prepared for the 2012 and 2013 inventories. The calculations were made by using the methodology of the Intergovernmental Panel on Climate Change (IPCC)[65]. Uncertainty for all subsectors was calculated by applying a Tier 1 approach, as set by the methodology; this facilitated an uncertainty calculation for each gas.

IPCC default values were used to assess the uncertainty of input data, as well as of emission factors.
The values of activity data and emission factors used in the uncertainty assessment for the Energy sector are shown in Table 21.

Table 21 *Uncertainty of Input Data and Emission Factors, 2012 i 2013 (%)*

65 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories

Category	Gas	Activity Data Uncertainty (%)	Emission Factor Uncertainty (%)	Combined Uncertainty (%)
1.A - Fuel Combustion Activities				
1.A.1.a.i - Electricity Generation - Liquid Fuels	CO_2	5	5	7.07
1.A.1.a.i - Electricity Generation - Liquid Fuels	CH_4	5	50	50.25
1.A.1.a.i - Electricity Generation - Liquid Fuels	N_2O	5	200	200.06
1.A.1.a.i - Electricity Generation - Solid Fuels	CO_2	5	5	7.07
1.A.1.a.i - Electricity Generation - Solid Fuels	CH_4	5	50	50.25
1.A.1.a.i - Electricity Generation - Solid Fuels	N_2O	5	200	200.06
1.A.1.c.i - Manufacture of Solid Fuels - Liquid Fuels	CO_2	5	5	7.07
1.A.1.c.i - Manufacture of Solid Fuels - Liquid Fuels	CH_4	5	50	50.25
1.A.1.c.i - Manufacture of Solid Fuels - Liquid Fuels	N_2O	5	200	200.06
1.A.2.a - Iron and Steel - Liquid Fuels	CO_2	5	5	7.07
1.A.2.a - Iron and Steel - Liquid Fuels	CH_4	5	50	50.25
1.A.2.a - Iron and Steel - Liquid Fuels	N_2O	5	200	200.06
1.A.2.a - Iron and Steel - Solid Fuels	CO_2	5	5	7.07
1.A.2.a - Iron and Steel - Solid Fuels	CH_4	5	50	50.25
1.A.2.a - Iron and Steel - Solid Fuels	N_2O	5	200	200.06
1.A.2.c - Chemicals - Liquid Fuels	CO_2	5	5	7.07
1.A.2.c - Chemicals - Liquid Fuels	CH_4	5	5	7.07
1.A.2.c - Chemicals - Liquid Fuels	N_2O	5	5	7.07
1.A.2.e - Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	5	5	7.07
1.A.2.e - Food Processing, Beverages and Tobacco - Solid Fuels	CH_4	5	50	50.25
1.A.2.e - Food Processing, Beverages and Tobacco - Solid Fuels	N_2O	5	200	200.06
1.A.2.j - Wood and Wood Products – Biomass	CO_2	5	5	7.07
1.A.2.j - Wood and Wood Products – Biomass	CH_4	5	5	7.07
1.A.2.j - Wood and Wood Products – Biomass	N_2O	5	5	7.07
1.A.2.m - Non-specified Industry - Liquid Fuels	CO_2	5	5	7.07
1.A.2.m - Non-specified Industry - Liquid Fuels	CH_4	5	50	50.25
1.A.2.m - Non-specified Industry - Liquid Fuels	N_2O	5	200	200.06
1.A.2.m - Non-specified Industry - Solid Fuels	CO_2	5	5	7.07
1.A.2.m - Non-specified Industry - Solid Fuels	CH_4	5	50	50.25
1.A.2.m - Non-specified Industry - Solid Fuels	N_2O	5	200	200.06
1.A.3.a.i - International Aviation (International Bunkers) - Liquid Fuels	CO_2	5	5	7.07
1.A.3.a.i - International Aviation (International Bunkers) - Liquid Fuels	CH_4	5	50	50.25
1.A.3.a.i - International Aviation (International Bunkers) - Liquid Fuels	N_2O	5	200	200.06
1.A.3.b - Road Transportation - Liquid Fuels	CO_2	5	5	7.07
1.A.3.b - Road Transportation - Liquid Fuels	CH_4	5	50	50.25
1.A.3.b - Road Transportation - Liquid Fuels	N_2O	5	200	200.06
1.A.3.d.ii - Domestic Water-borne Navigation - Liquid Fuels	CO_2	5	5	7.07
1.A.3.b - Road Transportation - Liquid Fuels	CH_4	5	50	50.25
1.A.3.b - Road Transportation - Liquid Fuels	N_2O	5	200	200.06
11.A.3.d.ii - Domestic Water-borne Navigation - Liquid Fuels	CO_2	5	5	7.07
1.A.3.d.ii - Domestic Water-borne Navigation - Liquid Fuels	CH_4	5	50	50.25
1.A.3.d.ii - Domestic Water-borne Navigation - Liquid Fuels	N_2O	5	200	200.06
1.A.4.a - Commercial/Institutional - Liquid Fuels	CO_2	5	5	7.07
1.A.4.a - Commercial/Institutional - Liquid Fuels	CH_4	5	50	50.25
1.A.4.a - Commercial/Institutional - Liquid Fuels	N_2O	5	200	200.06

Category	Gas	Activity Data Uncertainty (%)	Emission Factor Uncertainty (%)	Combined Uncertainty (%)
1.A.4.a - Commercial/Institutional - Biomass	CO_2	5	5	7.07
1.A.4.a - Commercial/Institutional - Biomass	CH_4	5	50	50.25
1.A.4.a - Commercial/Institutional - Biomass	N_2O	5	200	200.06
1.A.4.b - Residential - Liquid Fuels	CO_2	5	5	7.07
1.A.4.b - Residential - Liquid Fuels	CH_4	5	50	50.25
1.A.4.b - Residential - Liquid Fuels	N_2O	5	200	200.06
1.A.4.b - Residential - Solid Fuels	CO_2	5	5	7.07
1.A.4.b - Residential - Solid Fuels	CH_4	5	50	50.25
1.A.4.b - Residential - Solid Fuels	N_2O	5	200	200.06
1.A.4.b - Residential - Biomass	CO_2	5	5	7.07
1.A.4.b - Residential - Biomass	CH_4	5	50	50.25
1.A.4.b - Residential - Biomass	N_2O	5	200	200.06
1.A.4.c.ii - Off-road Vehicles and Other Machinery - Liquid Fuels	CO_2	5	5	7.07
1.A.4.c.ii - Off-road Vehicles and Other Machinery - Liquid Fuels	CH_4	5	50	50.25
1.A.4.c.ii - Off-road Vehicles and Other Machinery - Liquid Fuels	N_2O	5	200	200.06
1.A.5.b.iii - Mobile (Other) - Liquid Fuels	CO_2	5	5	7.07
1.A.5.b.iii - Mobile (Other) - Liquid Fuels	CH_4	5	50	50.25
1.A.5.b.iii - Mobile (Other) - Liquid Fuels	N_2O	5	200	200.06
1.B.1.a.i. – Coal mining - Underground Mines	CH_4	5	200	200.06
1.B.1.a.ii. - Coal mining - Surface Mines	CH_4	5	200	200.06

Mining and the metal industry are key branches of industrial production in Montenegro. The production of aluminium and steel are the most important branches of the metal industry. Other industrial capacities include the production of food, beverages, tobacco, textiles, lime, leather products, paper, medicines, and rubber and plastic products.

Until 1991, the economic development of Montenegro was characterised by intensive industrial production, and therefore the share of GHG emissions represented by industry in the total emissions in 1991 was 49%. After that period, industrial production recorded a continuous decline, and consequently the share of emissions reduced to 11.2% in 2012 and to 8.9% in 2013.

INDUSTRY (CRF SECTOR 2)

Data Source

Data on industrial production was provided by the Statistical Office – MONSTAT, the Montenegrin Electric Enterprise (EPCG), the Montenegrin Electricity Transmission System (Elektroprenosni sistem Crne Gore), the Environmental Protection Agency, the Aluminium Plant Podgorica, the Alloyed Engineering Steel Nikšić and the Coal Mine at Pljevlja.

Official statistics from the Statistical Office were used to estimate emissions from this sector, while records of industrial producers, submitted for analysis, were used for inventory verification.

Emission Trends

The estimate of direct GHG emissions from the industry sector was produced in accordance with the 2006 IPCC Guidelines and Intergovernmental Good Practice Guidance and Uncertainty Management from 2000.

GHG Emissions Expressed in CO_2eq

Estimated CO_2eq emissions from industrial subsectors for the observed period are presented in Table 22 and Figure 24. In all of the industrial subsectors, the level of GHG emissions strictly follows the level of industrial production during the period 1990-2013.

Table 22 *CO_2eq Emissions From Industrial Subsectors, 1990-2013 (Gg)*

Year	1990	1991	1992	1993	1994	1995	1996	1997
2 - Industrial Processes and Product Use	2,272.87	2,909.18	1,891.39	709.60	94.12	2,272.87	294.48	1,547.59
2.A - Mineral Industry	24.75	23.25	16.50	0.00	0.00	24.75	3.00	6.00
2.A.2 Lime Production	24.75	23.25	16.50	0.00	0.00	24.75	3.00	6.00
2.C – Metal Industry	2,244.54	2,882.26	1,871.37	706.25	90.64	2,244.54	287.95	1,538.62
2.C.1- Iron and Steel Production	16.65	15.75	11.47	9.27	8.99	16.65	7.13	10.62
2.C.3 – Aluminium Production	2,227.88	2,866.51	1,859.91	696.98	81.65	2,227.88	280.82	1,528.01
2.D – Non-Energy Products from Fuels and Solvent Use	2.21	2.21	2.21	2.21	2.21	2.21	2.21	1.67
2.D.1 – Lubricant Use	2.21	2.21	2.21	2.21	2.21	2.21	2.21	1.67
2.F – Product Uses as Substitutes for Ozone Depleting Substances	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1 – Refrigeration and Air Conditioning	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G – Other Product Manufacture and Use	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
2.G.1 – Electrical Equipment	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
2.H – Other	0.56	0.64	0.49	0.32	0.45	0.56	0.50	0.48
2.H.2 – Food and Beverages Industry	0.56	0.64	0.49	0.32	0.45	0.56	0.50	0.48
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
2 - Industrial Processes and Product Use	1471.88	1648.27	2046.92	2173.09	2223.86	1846.00	1665.62	1544.11
2.A - Mineral Industry	6.00	6.00	5.33	9.74	8.34	6.10	7.94	4.51
2.A.2 Lime Production	6.00	6.00	5.33	9.74	8.34	6.10	7.94	4.51
2.C – Metal Industry	1,462.69	1,638.97	2,038.08	2,159.78	2,212.19	1,836.14	1,653.72	1,536.98
2.C.1- Iron and Steel Production	11.35	7.06	6.80	8.80	6.64	4.74	12.04	8.20

2.C.3 – Aluminium Production	1,451.35	1,631.91	2,031.27	2,150.98	2,205.55	1,831.41	1,641.67	1,528.77
2.D – Non-Energy Products from Fuels and Solvent Use	1.77	1.77	1.82	1.87	1.87	1.92	1.97	0.49
2.D.1 – Lubricant Use	1.77	1.77	1.82	1.87	1.87	1.92	1.97	0.49
2.F – Product Uses as Substitutes for Ozone Depleting Substances	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1 – Refrigeration and Air Conditioning	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G – Other Product Manufacture and Use	0.89	0.89	0.97	0.97	1.01	1.21	1.40	1.50
2.G.1 – Electrical Equipment	0.89	0.89	0.97	0.97	1.01	1.21	1.40	1.50
2.H – Other	0.53	0.65	0.72	0.72	0.45	0.63	0.60	0.64
2.H.2 – Food and Beverages Industry	0.53	0.65	0.72	0.72	0.45	0.63	0.60	0.64
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
2 - Industrial Processes and Product Use	1,635.67	1,769.81	930.08	572.38	722.66	765.59	398.94	282.93
2.A - Mineral Industry	6.09	5.32	7.38	3.37	0.63	2.59	0.00	0.00
2.A.2 Lime Production	6.09	5.32	7.38	3.37	0.63	2.59	0.00	0.00
2.C – Metal Industry	1,626.33	1,761.68	919.87	566.36	719.45	721.53	344.06	218.25
2.C.1- Iron and Steel Production	12.94	13.95	16.18	8.30	3.87	4.91	2.27	1.62
2.C.3 – Aluminium Production	1,613.39	1,747.73	903.69	558.06	715.57	716.62	341.79	216.63
2.D – Non-Energy Products from Fuels and Solvent Use	1.03	0.59	0.54	0.44	0.39	0.25	0.25	2.21
2.D.1 – Lubricant use	1.03	0.59	0.54	0.44	0.39	0.25	0.25	2.21
2.F – Product Uses as Substitutes for Ozone Depleting Substances	0.00	0.00	0.00	0.00	0.00	39.04	52.00	59.68
2.F.1 – Refrigeration and Air Conditioning	0.00	0.00	0.00	0.00	0.00	39.04	52.00	59.68
2.G – Other Product Manufacture and Use	1.56	1.56	1.60	1.61	1.63	1.67	2.10	2.29
2.G.1 – Electrical Equipment	1.56	1.56	1.60	1.61	1.63	1.67	2.10	2.29
2.H – Other	0.66	0.67	0.69	0.59	0.56	0.52	0.53	0.49
2.H.2 – Food and Beverages Industry	0.66	0.67	0.69	0.59	0.56	0.52	0.53	0.49

The share of CO_2eq emissions from aluminium production predominated within the total emissions produced by the industry sector; it ranged from 76.5% to 99% during the observed period.

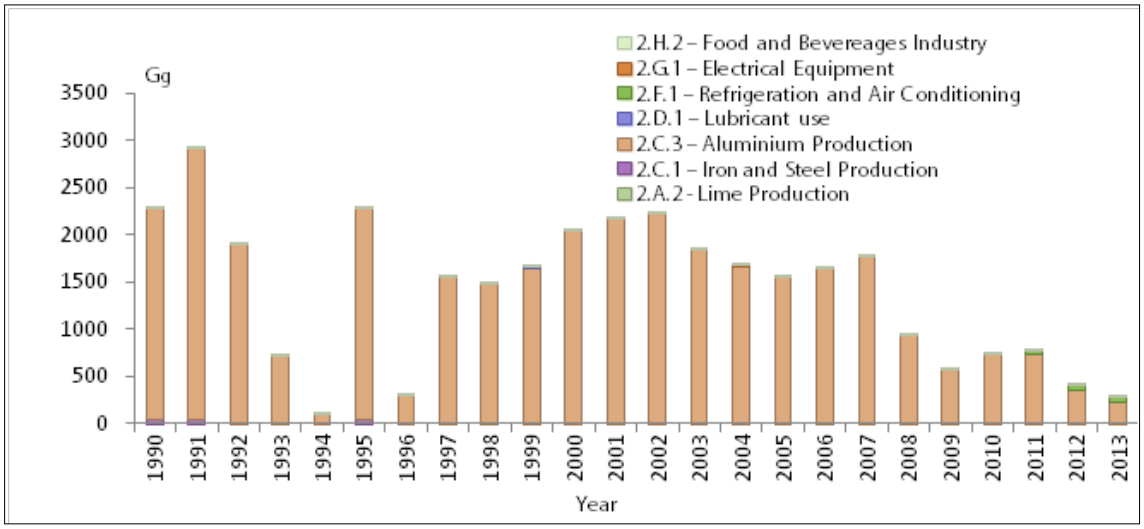


Figure 24 *Total CO_2eq Emissions From the Industry Sector, 1990-2013 (Gg)*

CO_2 Emissions

Estimated CO_2 emissions from industrial subsectors for the observed period are shown in Table 23 and Figure 25.

Table 23 *CO_2 Emissions From Industrial Subsectors, 1990-2013 (Gg)*

Year	1990	1991	1992	1993	1994	1995	1996	1997
2 - Industrial Processes and Product Use	212.80	205.54	173.29	72.72	30.00	212.80	54.51	147.70
2.A - Mineral Industry	24.75	23.25	16.50	0.00	0.00	24.75	3.00	6.00
2.A.2 Lime Production	24.75	23.25	16.50	0.00	0.00	24.75	3.00	6.00
2.C – Metal Industry	185.28	179.43	154.08	70.19	27.34	185.28	48.80	139.55
2.C.1- Iron and Steel Production	16.61	15.71	11.42	9.22	8.95	16.61	7.09	10.59
2.C.3 – Aluminium Production	168.67	163.73	142.66	60.97	18.39	168.67	41.71	128.96
2.D – Non-Energy Products from Fuels and Solvent Use	2.21	2.21	2.21	2.21	2.21	2.21	2.21	1.67
2.D.1 – Lubricant Use	2.21	2.21	2.21	2.21	2.21	2.21	2.21	1.67
2.F – Product Uses as Substitutes for Ozone Depleting Substances	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1 – Refrigeration and Air Conditioning								
2.G – Other Product Manufacture and Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 – Electrical Equipment								
2.H – Other	0.56	0.64	0.49	0.32	0.45	0.56	0.50	0.48
2.H.2 – Food and Beverages Industry	0.56	0.64	0.49	0.32	0.45	0.56	0.50	0.48
Year	1998	1999	2000	2001	2002	2003	2004	2005
2 - Industrial Processes and Product Use	142.10	144.93	167.50	194.11	203.66	205.71	215.80	206.42
2.A - Mineral Industry	6.00	6.00	5.33	9.74	8.34	6.10	7.94	4.51
2.A.2 Lime Production	6.00	6.00	5.33	9.74	8.34	6.10	7.94	4.51
2.C – Metal Industry	133.81	136.51	159.62	181.78	193.00	197.06	205.29	200.79
2.C.1- Iron and Steel Production	11.32	7.04	6.78	8.78	6.63	4.72	12.01	8.18
2.C.3 – Aluminium Production	122.49	129.47	152.84	173.00	186.37	192.34	193.28	192.61
2.D – Non-Energy Products from Fuels and Solvent Use	1.77	1.77	1.82	1.87	1.87	1.92	1.97	0.49
2.D.1 – Lubricant Use	1.77	1.77	1.82	1.87	1.87	1.92	1.97	0.49
2.F – Product Use as a Substitute for Ozone Depleting Substances	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1 – Refrigeration and Air Conditioning								
2.G – Other Product Manufacture and Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 – Electrical Equipment								
2.H – Other	0.53	0.65	0.72	0.72	0.45	0.63	0.60	0.64
2.H.2 – Food and Beverages Industry	0.53	0.65	0.72	0.72	0.45	0.63	0.60	0.64
Year	2006	2007	2008	2009	2010	2011	2012	2013
2 - Industrial Processes and Product Use	215.57	219.26	202.90	114.09	137.54	157.43	122.05	81.60
2.A - Mineral Industry	6.09	5.32	7.38	3.37	0.63	2.59	0.00	0.00
2.A.2 Lime Production	6.09	5.32	7.38	3.37	0.63	2.59	0.00	0.00
2.C – Metal Industry	207.78	212.68	194.29	109.68	135.96	154.08	121.27	78.90
2.C.1- Iron and Steel Production	12.91	13.91	16.14	8.28	3.86	4.89	2.25	1.58
2.C.3 – Aluminium Production	194.88	198.77	178.15	101.41	132.10	149.19	119.02	77.32
2.D – Non-Energy Products from Fuels and Solvent Use	1.03	0.59	0.54	0.44	0.39	0.25	0.25	2.21
2.D.1 – Lubricant Use	1.03	0.59	0.54	0.44	0.39	0.25	0.25	2.21
2.F – Product Use as a Substitute for Ozone Depleting Substances	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1 – Refrigeration and Air Conditioning								
2.G – Other Product Manufacture and Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 – Electrical Equipment								
2.H – Other	0.66	0.67	0.69	0.59	0.56	0.52	0.53	0.49
2.H.2 – Food and Beverages Industry	0.66	0.67	0.69	0.59	0.56	0.52	0.53	0.49

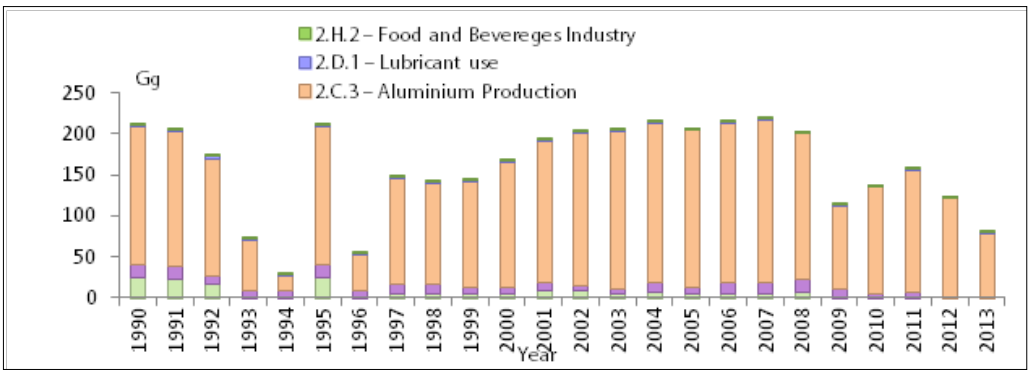


Figure 25 *Total CO_2 Emissions From the Industry Sector, 1990-2013 (Gg)*

The share of CO_2 emissions represented by aluminium production within the total emissions produced by the industry sector predominates and ranges from 61.3% to 97.5% during the observed period. Emissions produced by other sectors relate to the production of steel and lime and to the food industry.

CH_4 Emissions

Estimated CH_4 emissions from industrial subsectors for the observed period are shown in Table 24 and Figure 26. Total estimated methane emissions from this sector originate from the iron and steel industry.

Table 24 *CH_4 Emissions From Industrial Subsectors, 1990-2013 (Gg)*

Year	1990	1991	1992	1993	1994	1995	1996	1997
2 - Industrial Processes and Product Use	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0013
2.C – Metal Industry	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0013
2.C.1 – Iron and Steel Production	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0013
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
2 - Industrial Processes and Product Use	0.0014	0.0009	0.0008	0.0011	0.0008	0.0006	0.0015	0.001
2.C – Metal Industry	0.0014	0.0009	0.0008	0.0011	0.0008	0.0006	0.0015	0.001
2.C.1 – Iron and Steel Production	0.0014	0.0009	0.0008	0.0011	0.0008	0.0006	0.0015	0.001
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
2 - Industrial Processes and Product Use	0.0016	0.0017	0.0020	0.001	0.0005	0.0006	0.0006	0.002076
2.C – Metal Industry	0.0016	0.0017	0.0020	0.001	0.0005	0.0006	0.0006	0.002076
2.C.1 – Iron and Steel Production	0.0016	0.0017	0.0020	0.001	0.0005	0.0006	0.0006	0.002076

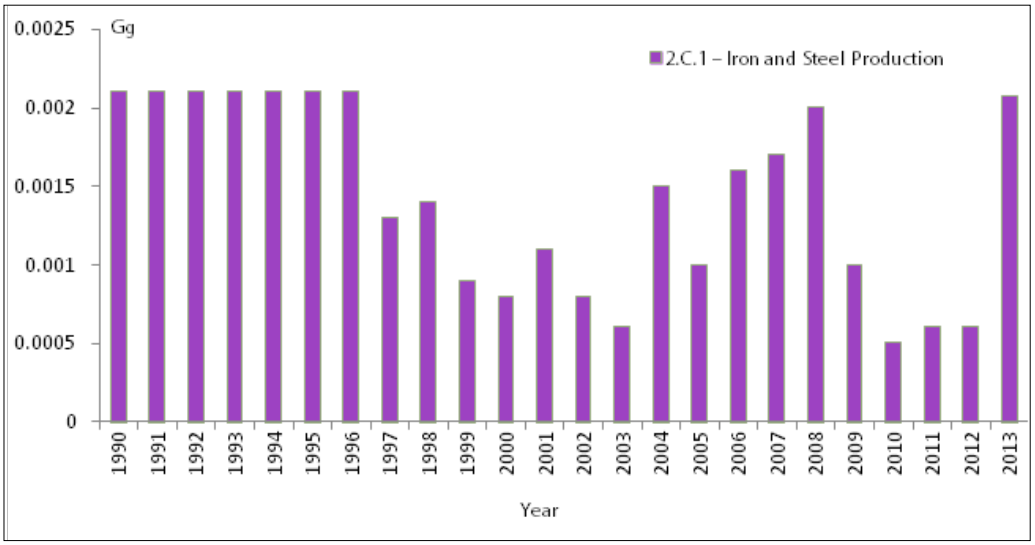


Figure 26 *Total CH_4 Emissions From the Industry Sector, 1990-2013 (Gg)*

PFC, SF_6 and HFC Emissions

Estimated PFC, SF_6 and HFC emissions from industrial subsectors for the observed period are shown in Tables 25, 26 and 27 and in Figures 27, 28 and 29.

Table 25 *PFC Emissions From Industrial Subsectors, 1990-2013 (Gg)*

Year	1990	1991	1992	1993	1994	1995	1996	1997
2 – Industrial Processes and Product Use	2,059.22	2,702.78	1,717.24	636.01	63.26	2,059.22	239.10	1,399.05
2.C – Metal Industry	2,059.22	2,702.78	1,717.24	636.01	63.26	2,059.22	239.10	1,399.05
2.C.3 – Aluminium Production	2,059.22	2,702.78	1,717.24	636.01	63.26	2,059.22	239.10	1,399.05
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
2 – Industrial Processes and Product Use	1,328.86	1,502.44	1,878.43	1,977.98	2,019.18	1,639.07	1,448.40	1,336.17
2.C – Metal Industry	1,328.86	1,502.44	1,878.43	1,977.98	2,019.18	1,639.07	1,448.40	1,336.17
2.C.3 – Aluminium Production	1,328.86	1,502.44	1,878.43	1,977.98	2,019.18	1,639.07	1,448.40	1,336.17
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
2 – Industrial Processes and Product Use	1,418.51	1,548.96	725.54	456.65	583.48	567.43	222.78	139.31
2.C – Metal Industry	1,418.51	1,548.96	725.54	456.65	583.48	567.43	222.78	139.31
2.C.3 – Aluminium Production	1,418.51	1,548.96	725.54	456.65	583.48	567.43	222.78	139.31

As shown in Figure 27, the total estimated amount of emissions from PFC substances in this sector originate from the aluminium industry (the electrolysis plant).

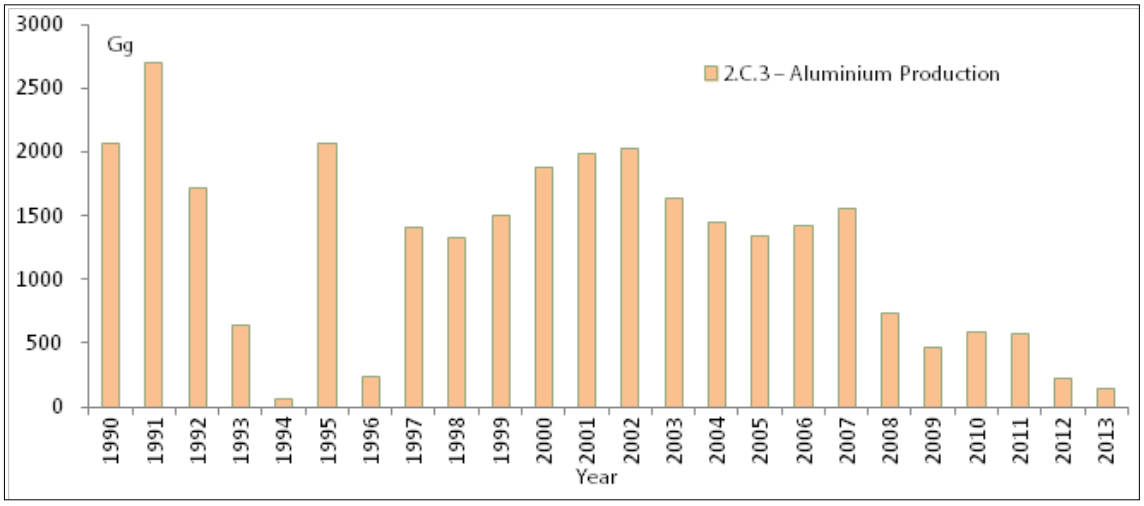


Figure 27 *Total PFC Emissions From the Industry Sector, 1990-2013 (Gg)*

Table 26 *SF_6 Emissions From Industrial Subsectors, 1990-2013 (Gg)*

Year	1990	1991	1992	1993	1994	1995	1996	1997
2 – Industrial Processes and Product Use	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
2.G – Other Product Manufacture and Use	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
2.G.1 – Electrical Equipment	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
2 – Industrial Processes and Product Use	0.89	0.89	0.97	0.97	1.01	1.21	1.40	1.50
2.G – Other Product Manufacture and Use	0.89	0.89	0.97	0.97	1.01	1.21	1.40	1.50
2.G.1 – Electrical Equipment	0.89	0.89	0.97	0.97	1.01	1.21	1.40	1.50
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
2 – Industrial Processes and Product Use	1.56	1.56	1.60	1.61	1.63	1.67	2.10	2.29
2.G – Other Product Manufacture and Use	1.56	1.56	1.60	1.61	1.63	1.67	2.10	2.29
2.G.1 – Electrical Equipment	1.56	1.56	1.60	1.61	1.63	1.67	2.10	2.29

As shown in Figure 28, the total estimated SF_6 emissions from this sector originate from the use of electrical equipment where these substances are used as refrigerants.

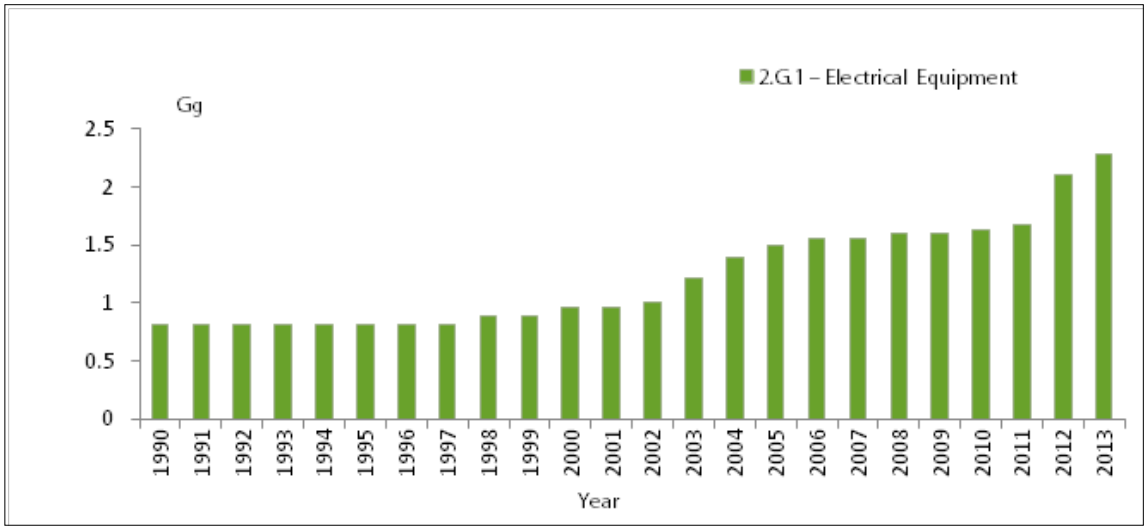


Figure 28 *Total SF_6 Emissions From the Industry Subsector, 1990-2013 (Gg)*

Table 27 *HFC Emissions From Industrial Subsectors, 1990-2013 (Gg)*

Year	2011	2012	2013
2.F – Product Use as a Substitute for Ozone Depleting Substances	39.04	52.00	59.68
2.F.1 – Refrigeration and Air Conditioning	39.04	52.00	59.68

Based on the available data, HFC emissions were estimated for the period 2011-2013. Records of the Agency for Environmental Protection on imports of substitutes and statistical data on import of refrigerators and air conditioners (MONSTAT) were available. While recalculating data for 2011, an omission in the assessment of activity data regarding the quantity of substitutes used for refilling air conditioners was noticed. This data was replaced with the data defined by the IPCC 2006 Guidance, and which is consistent with the experience of air conditioning repair technicians. Thus the emission estimates presented below (Figure 29) are significantly higher than those in the previous inventory in 2011.

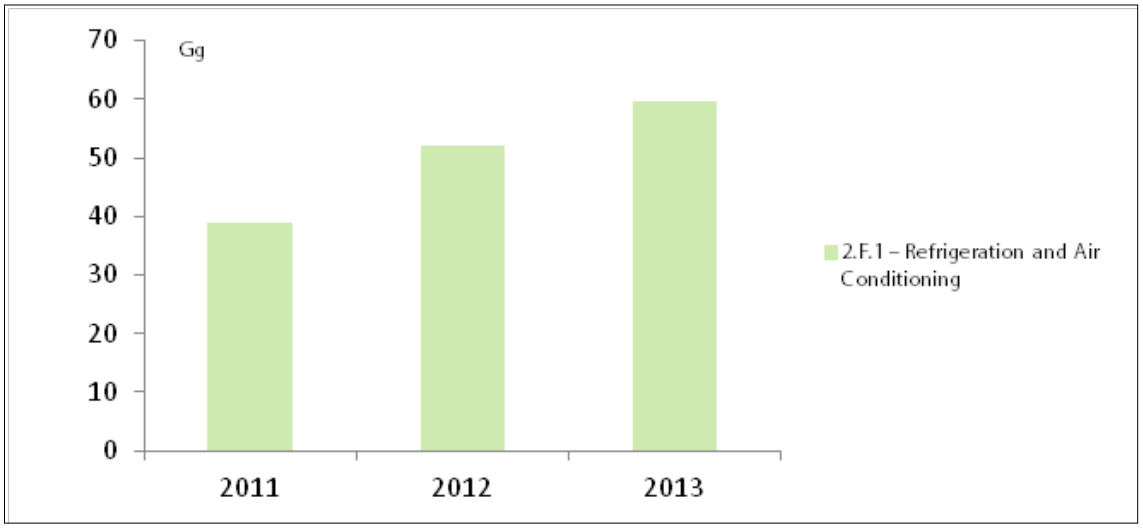


Figure 29 *Total HFC Emissions From the Industry Sector, 1990-2013 (Gg)*

The estimates of direct GHG emissions from the industry sector were produced in accordance with the 2006 IPCC Guidelines and Intergovernmental Good Practice Guidance and Uncertainty Management from 2000.

Activity Indicators and Emission Factors

In line with available national data, it was possible to apply a Tier 2 approach to estimate emissions from the aluminium industry. Estimates of other GHG emissions from industrial processes were produced according to a Tier 1 approach.

Table 28 shows activity indicators for the industry sector. In Table 29, emission factors were used.

Table 28 *Activity Indicators for the Industry Sector, 1990-2013*

Year	Unit	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
2.A.2 Lime Production	T	33,000	31,000	22,000	0	0	33,000	4,000	8,000
2.C.1 – Iron and Steel Production	T	207,642	196,365	142,775	115,301	111,821	207,642	88,591	132,362
2.C.3 – Aluminium Production	t	105,416.9	102,328.4	89,164.2	38,104.1	11,496.2	105,416.9	26,071.3	80,600.4
2.H.2 – Food and Beverages Industry – Beer	hl	662,000	607,000	418,000	217,000	365,000	662,000	421,000	398,000
2.H.2 – Food and Beverages Industry – Bread	t	0	21,823	21,838	21,853	21,869	0	21,884	21,914
2.H.2 – Food and Beverages Industry – Wine	hl	33,230	24,166	25,222	17,261	26,788	33,230	35,374	28,759
Year	Unit	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
2.A.2 Lime Production	t	8,000	8,000	7,113	12,989	11,123	8,136	10,591	6,008
2.C.1 – Iron and Steel Production	t	141,445	88,002	84,789	109,757	82,832	59,036	150,165	102,247
2.C.3 – Aluminium Production	t	76,556.7	80,916.1	95,525.7	108,122.9	116,482.4	120,212.7	120,796.9	120,379.4
2.H.2 – Food and Beverages Industry – Beer	hl	453,000	594,000	675,532	675,532	301,213	553,282	491,189	515,332
2.H.2 – Food and Beverages Industry – Bread	t	21,929	21,944	21,053	21,053	20,247	18,640	20,746	22,787
2.H.2 – Food and Beverages Industry – Wine	hl	35,989	49,202	66,249	66,249	100,269	86,517	93,872	100,704
Year	Unit	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
2.A.2 Lime Production	t	8,118	7,089	9,839	4,497	839	3,448	0	0
2.C.1 – Iron and Steel Production	t	161,333	173,913	201,690	103,479	48,272	61,164	28,161	19,723
2.C.3 – Aluminium Production	t	121,798	124,229.8	111,344.3	63,379	82,560	93,242	74,384.6	48,323.7
2.H.2 – Food and Beverages Industry – Beer	hl	516,942	534,386	556,521	456,896	423,799	404,396	433,880	400,720
2.H.2 – Food and Beverages Industry – Bread	t	24,166	25,229	25,246	22,733	21,596	17,858	16,335	15,407
2.H.2 – Food and Beverages Industry – Wine	hl	121,701	110,158	111,381	105,916	105,586	104,436	102,966	93,011

Table 29 *Emission Factors for the Industry Sector, 1990-2013*

Industry Sector	CO_2 Emission Factor	Unit	CH_4 Emission Factor	Unit
2.A.2 Lime Production	0.75	t/t	NA	
2.C.1 – Iron and Steel production	0.08	t/t	0.01	kg/t
2.C.3 – Aluminium Production	1.6	t/t	NA	
2.D.1 – Lubricant Use	20	t C/TJ	NA	
2.H.2 – Food and Beverages Industry – Beer	8×10^{-9}	t/t	NA	
2.H.2 – Food and Beverages Industry – Bread	6.15×10^{-6}	t/t	NA	
2.H.2 – Food and Beverages Industry – Wine	8.3×10^{-9}	t/t	NA	

Table 30 *Emission Factors for PFC From 2.C.3 - Aluminium Production (Electrolysis Plant), 1990-2013 (kg/t)*

Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
PFC-14 (CF_4) Emission Factor	2.63	3.56	2.60	2.25	0.74	2.63	1.24	2.34
PFC-116 (C_2F_6) Emission Factor	0.26	0.36	0.26	0.22	0.07	0.26	0.12	0.23
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
PFC-14 (CF_4) Emission Factor	2.34	2.50	2.65	2.47	2.34	1.84	1.62	1.50
PFC-116 (C_2F_6) Emission Factor	0.23	0.25	0.27	0.25	0.23	0.18	0.16	0.15
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
PFC-14 (CF_4) Emission Factor	1.57	1.68	0.88	0.97	0.95	0.82	0.40	0.40
PFC-116 (C_2F_6) Emission Factor	0.16	0.17	0.09	0.10	0.10	0.08	0.04	0.03

Uncertainty Assessment in the Industry Sector

Regarding the industry sector, the uncertainty of inventory estimates for 2012 and 2013 were calculated. Calculations were made using the methodology of the Intergovernmental Panel on Climate Change (IPCC)[66]. Uncertainty was calculated for all of the subsectors by applying a Tier 1 approach, as set out in the methodology; this which facilitate the calculation of uncertainty for each gas.

IPCC default values were used to assess the uncertainty of input data, as well as emission factors.
The values of activity data and emission factors used for the uncertainty assessment in the industry sector are presented in Table 31.

Table 31 *Assessment of the Uncertainty of Activity Data and Emission Factors, 1990-2013 (%)*

Category	Gas	Activity Data Uncertainty (%)	Emission Factor Uncertainty (%)	Combined Uncertainty (%)
2.C.1 - Iron and Steel Production	CO_2	10	25	26.93
2.C.1 - iron and Steel Production	CH_4	10	25	26.93
2.C.3 - Aluminium Production	CO_2	2	10	10.20
2.C.3 - Aluminium Production	CF_4	2	30	30.07
2.C.3 - Aluminium Production	C_2F_6	2	30	30.07
2.D.1 - Lubricant Use	CO_2	10	50	50.99
2.F.1.a - Refrigeration and Air Conditioning	CH_2F_2	50	50	70.71
2.F.1.a - Refrigeration and Air Conditioning	CHF_2CF_3	50	50	70.71
2.F.1.a - Refrigeration and Air Conditioning	CH_2FCF_3	50	50	70.71
2.F.1.a - Refrigeration and Air Conditioning	CF_3CH_3	50	50	70.71
2.G.1.b - Use of Electrical Equipment	SF_6	30	30	42.43

66 *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*

AGRICULTURE AND LAND USE (CRF SECTOR 3)

According to MONSTAT data, the surface area of agricultural land in Montenegro was 517.136 ha in 1990, while in the surface area of used agricultural land was 223 131 ha in 2013.

Of all the big agricultural producers owned by the state, 13. jul Plantaže a.d, with its vine and peach plantations, along with its processing facilities, is the only one that is still remaining.

Data from the statistical yearbook (MONSTAT), records from the Forestry Administration of Montenegro and data from the National Forest Inventory of Montenegro (2010) were used to estimate sinks.

The National Forest Inventory of Montenegro is the first professional record that provides data on forestry in Montenegro, in accordance with the standards of countries that have a long tradition in forestry management. The key quantitative findings of the NFI are that forests cover 59.9% of the total land area, that forest land covers 9.8% of total land area, and that forests and forest land together cover 69.7% of the total land area of Montenegro.

Data Sources

MONSTAT data was used to assess GHG emissions from the agriculture sector.

The introduction in the Statistical Yearbook describes the methodology for data collection and the method used for processing in agricultural production, including livestock breeding and crop production.

After the agricultural census in 2010 (MONSTAT, 2010), conditions were created to commence the alignment of crop production and livestock breeding statistics with EUROSTAT recommendations and EU standards.

Late in 2012, MONSTAT launched a project for drafting a new methodology and forms for the collection and statistical processing of data. The new methodology brought about significant changes in the data recorded for 2012 and 2013; a recalculation of data for the time series based on the 2010 agricultural census data is planned for the forthcoming period.

Data from the statistical yearbook (MONSTAT), records from the Forestry Administration of Montenegro, as well as data from the National Forest Inventory of Montenegro (2010) were used to estimate sinks.

Sink estimates for 2010-2013 were calculated entirely in accordance with NFI data (2010), while sinks for previous years were estimated approximately, in cooperation with an external consultant. Historical statistics for forests (MONSTAT) were used during approximation, taking into account some quantitative differences between data in the Statistical Yearbook (2010 and 2011) and in the NFI. In line with the relevant methodology, data on forest felling for the observed period (1990-2013) was also used to estimate sinks.

Emission Trends

GHG emissions from the agriculture sector recorded a decline in almost all segments during the observed period, due to a decline in livestock breeding and crop production.

Sources and Sinks of GHG Emissions Expressed as CO2 eq

Total emissions, including sinks from the agriculture and land use sectors, ranged from -999.11 Gg CO_2 eq. in 1990 to -2172.37 Gg in 2002.

Data for 1990 were calculated by estimation method, while data for 2013. were calculated by sampling method.

The high level of CO_2 eq. sinks is the result of large forested areas in Montenegro and the incomplete estimation of emissions from the agriculture sector, due to a lack of statistical data.

EU methodology for statistical data processing was applied during the agricultural census in 2010, while the Statistical Office – MONSTAT agreed to recalculate the entire time series. Recalculated data, as well as the data on land use change, was not available for the purposes of the 1990-2013 GHG inventory development.

Table 32 and Figure 30 show sources and sinks of GHG emissions from the agriculture and land use sectors expressed as CO_2 eq.

Table 32 *Sources and Sinks of GHG Emissions, Expressed as CO_2 eq From the Agriculture and Land Use Subsectors, 1990-2013 (Gg)*

Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
3 - Agriculture, Forestry and Other Land Use	-987.83	-691.16	-1,504.53	-1,974.81	-1,946.76	-1,263.66	-1,592.61	-1,855.69
3.A - Livestock	505.72	504.35	473.66	455.91	464.67	478.97	477.59	466.03
3.A.1 – Enteric Fermentation	400.79	399.71	375.19	361.08	368.00	379.57	378.42	368.06
3.A.2 – Manure Management	104.93	104.63	98.47	94.83	96.67	99.40	99.17	97.97
3.B - Land	-1,581.25	-1,282.22	-2,058.12	-2,505.51	-2,486.45	-1,827.91	-2,152.27	-2,395.49
3.B.1 – Forest Land	-1,471.46	-1,172.42	-1,948.32	-2,395.41	-2,376.35	-1,717.44	-2,041.98	-2,283.60
3.B.2 – Cropland	-109.79	-109.80	-109.79	-110.10	-110.10	-110.46	-110.29	-111.90
3.C - Aggregate Sources and Non-CO2 Emissions Sources on Land	87.70	86.71	79.93	74.79	75.02	85.27	82.07	73.78
3.C.1 – Emissions From Biomass Burning	3.28	1.89	4.58	4.28	2.48	4.29	4.67	1.66
3.C.4 – Direct N2O Emissions From Managed Soils	43.89	44.21	38.32	35.45	36.66	42.45	39.82	35.84
3.C.5 - Indirect N2O Emissions From Managed Soils	22.52	22.62	20.12	18.87	19.36	21.52	20.60	18.87
3.C.6 – Indirect N2O Emissions From Manure Management	18.01	17.99	16.91	16.20	16.52	17.01	16.99	17.41
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
3 - Agriculture, Forestry and Other Land Use	-1,882.02	-1,895.22	-1,921.70	-1,831.38	-2,171.93	-1,771.35	-1,367.44	-1,730.85
3.A - Livestock	460.02	462.89	451.15	442.25	452.26	446.31	432.20	308.53
3.A.1 – Enteric Fermentation	364.29	366.51	357.58	350.35	358.20	352.80	341.43	244.55
3.A.2 – Manure Management	95.72	96.38	93.58	91.91	94.06	93.50	90.78	63.99
3.B - Land	-2,415.11	-2,428.31	-2,467.04	-2,346.33	-2,691.81	-2,298.33	-1,871.54	-2,090.20
3.B.1 – Forest Land	-2,303.07	-2,315.58	-2,354.24	-2,243.21	-2,588.62	-2,194.81	-1,766.69	-1,973.26
3.B.2 – Cropland	-112.04	-112.73	-112.80	-103.12	-103.19	-103.52	-104.85	-116.94
3.C - Aggregate Sources and Non-CO2 Emissions Sources on Land	73.08	70.21	94.19	72.70	67.61	80.67	71.89	50.81
3.C.1 – Emissions From Biomass Burning	5.07	0.78	22.20	1.72	1.46	11.88	4.25	0.52
3.C.4 – Direct N2O Emissions From Managed Soils	32.97	34.20	36.29	35.95	33.10	34.87	34.04	26.18
3.C.5 - Indirect N2O Emissions From Managed Soils	17.53	17.71	18.29	17.79	16.96	17.52	17.11	13.12
3.C.6 – Indirect N2O Emissions From Manure Management	17.50	17.53	17.41	17.24	16.09	16.40	16.49	10.99
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
3 - Agriculture, Forestry and Other Land Use	-1,044.51	-2,042.20	-1,907.74	-2,080.66	-1,725.92	-1,583.79	-1,754.26	-1,941.39
3.A - Livestock	298.80	279.82	273.97	223.18	217.95	233.15	229.93	237.80
3.A.1 – Enteric Fermentation	237.29	221.82	217.10	175.49	172.32	183.73	180.85	187.13
3.A.2 – Manure Management	61.51	58.00	56.87	47.69	45.63	49.42	49.08	50.67
3.B - Land	-1,392.17	-2,423.38	-2,240.05	-2,348.20	-1,989.02	-1,870.53	-2,042.53	-2,221.61

3.B.1 – Forest Land	-1,268.14	-2,298.63	-2,115.23	-2,222.80	-1,863.04	-1,744.21	-2,011.22	-2,185.60
3.B.2 – Cropland	-124.02	-124.75	-124.82	-125.39	-125.98	-126.33	-31.31	-36.01
3.C - Aggregate Sources and Non-CO2 Emissions Sources on Land	48.85	101.36	58.34	44.36	45.14	53.59	58.34	42.43
3.C.1 – Emissions From Biomass Burning	0.82	53.41	10.75	0.48	1.61	12.02	16.81	0.64
3.C.4 – Direct N2O Emissions From Managed Soils	24.91	24.98	25.08	23.19	24.38	22.00	21.93	22.32
3.C.5 - Indirect N2O Emissions From Managed Soils	12.48	12.22	12.10	12.08	11.00	10.62	10.55	10.65
3.C.6 – Indirect N2O Emissions From Manure Management	10.63	10.75	10.40	8.61	8.15	8.96	9.04	8.82

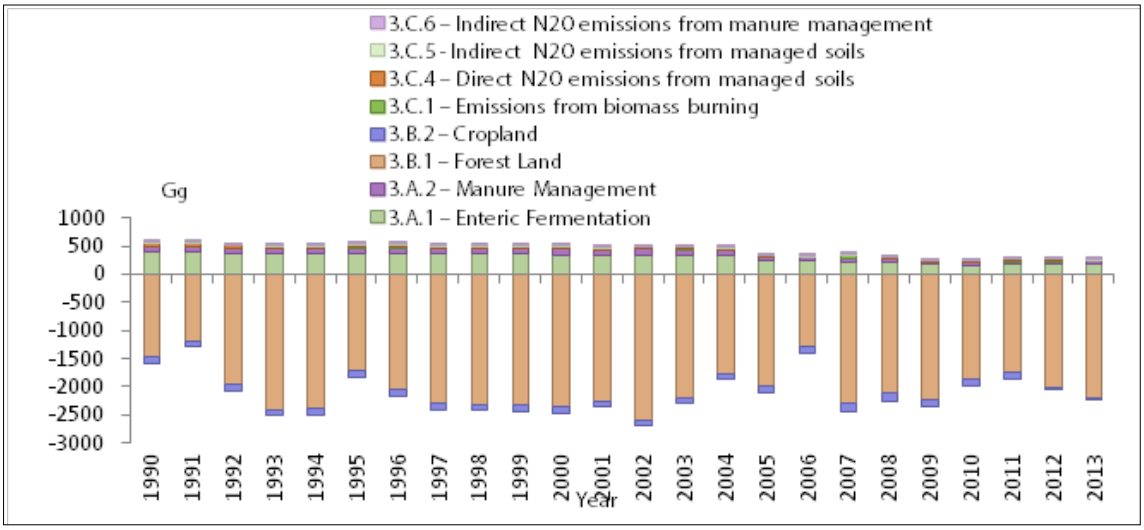


Figure 30 *Sources and Sinks of GHG Emissions Expressed as CO_2eq From the Agriculture and Land Use Subsectors, 1990-2013 (Gg)*

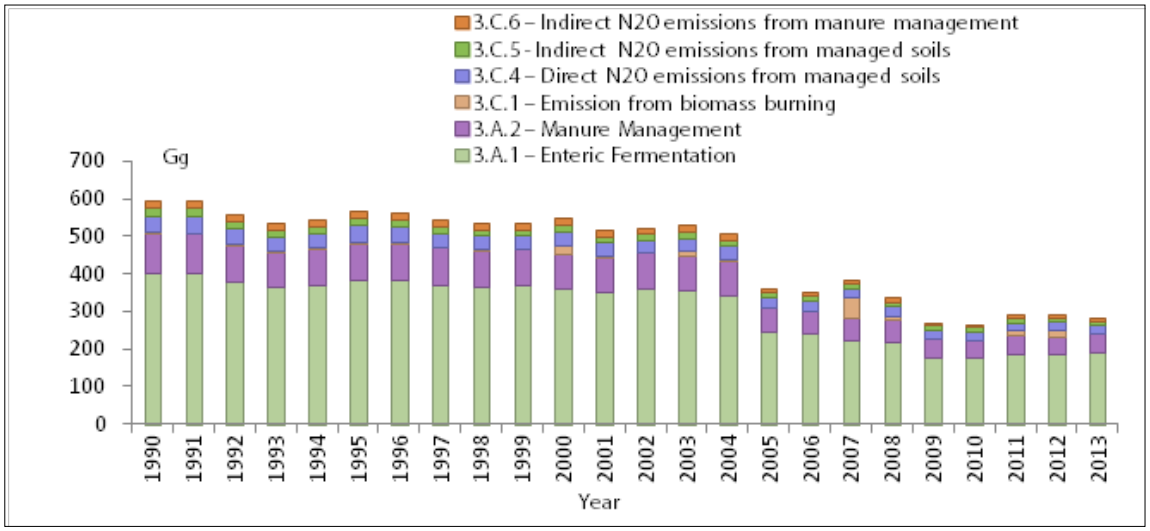


Figure 31 *CO_2eq Emissions From the Agriculture and Land Use Subsectors, 1990-2013 (Gg)*

Enteric fermentation (58.8-68.9%) and manure management (15.4-18.3%) represent the greatest share in the total emissions from the agriculture sector (Figure 24).

CH_4 Emissions

CH_4 emissions from the agriculture and land use subsectors are shown in Table 33 and Figure 32. The share of emissions generated from enteric fermentation in the livestock subsector is the greatest and ranges from 72% to 84.8 % of the total CH_4 emissions, followed by manure management, which represents between 12.9% and 15.5% and biomass burning which represents between 0.2% and 15.1%.

Table 33 *CH_4 Emissions From the Agriculture and Land Use Subsectors, 1990-2013 (Gg)*

Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
3 - Agriculture, Forestry and Other Land Use	22.56	22.45	21.20	20.41	20.73	21.43	21.40	20.73
3.A - Livestock	22.44	22.37	21.02	20.23	20.63	21.26	21.21	20.67
3.A.1 – Enteric Fermentation	19.09	19.03	17.87	17.19	17.52	18.07	18.02	17.53
3.A.2 – Manure Management	3.35	3.34	3.15	3.04	3.11	3.19	3.19	3.14
3.B - Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C - Aggregate Sources and Non-CO2 Emissions Sources on Land	0.13	0.07	0.18	0.17	0.10	0.17	0.19	0.06
3.C.1 – Emissions From Biomass Burning	0.13	0.07	0.18	0.17	0.10	0.17	0.19	0.06
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
3 - Agriculture, Forestry and Other Land Use	20.70	20.68	21.05	19.83	20.28	20.43	19.48	13.74
3.A - Livestock	20.50	20.65	20.13	19.77	20.22	19.94	19.30	13.72
3.A.1 – Enteric Fermentation	17.35	17.45	17.03	16.68	17.06	16.80	16.26	11.65
3.A.2 – Manure Management	3.15	3.20	3.10	3.08	3.16	3.14	3.04	2.08
3.B - Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C - Aggregate Sources and Non-CO2 Emissions sources on land	0.21	0.03	0.92	0.07	0.06	0.49	0.17	0.02
3.C.1 – Emissions From Biomass Burning	0.21	0.03	0.92	0.07	0.06	0.49	0.17	0.02
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
3 - Agriculture, Forestry and Other land Use	13.36	14.67	12.64	9.92	9.74	10.81	10.87	10.56
3.A - Livestock	13.32	12.45	12.20	9.90	9.68	10.32	10.17	10.53
3.A.1 – Enteric Fermentation	11.30	10.56	10.34	8.36	8.21	8.75	8.61	8.91
3.A.2 – Manure Management	2.02	1.89	1.86	1.54	1.47	1.57	1.56	1.62
3.B - Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C - Aggregate Sources and Non-CO2 Emissions Sources on Land	0.03	2.22	0.45	0.02	0.07	0.50	0.70	0.02
3.C.1 – Emissions From Biomass Burning	0.03	2.22	0.45	0.02	0.07	0.50	0.70	0.02

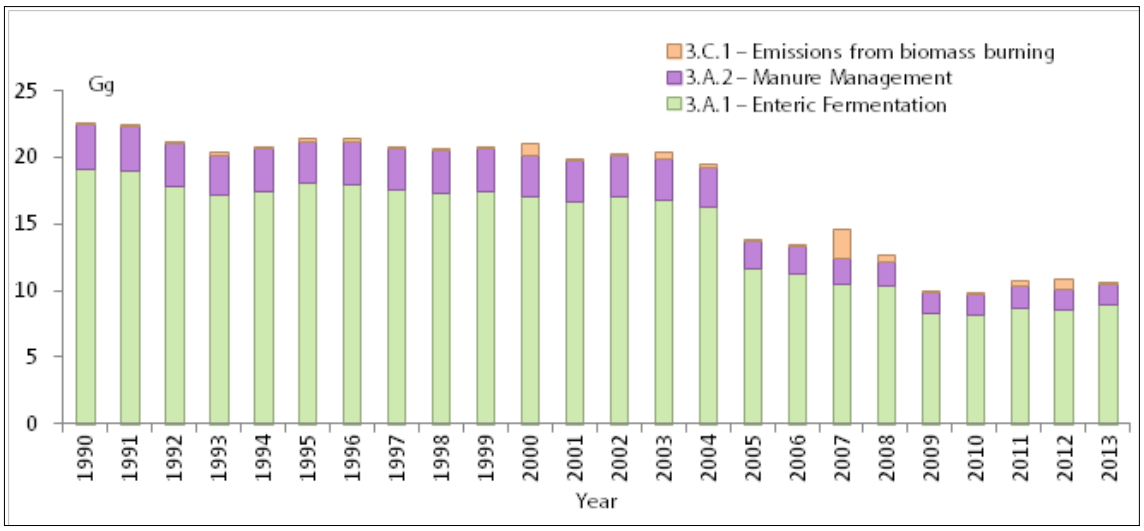


Figure 32 *CH_4 Emissions From the Agriculture and Land Use Subsectors, 1990-2013 (Gg)*

N_2O Emissions

Table 34 and Figure 33 show N_2O emissions from the agriculture and land use subsectors. These emissions are generated directly from managed soils; within the total amount of N_2O emissions, this is the greatest amount and ranges from 27.8% to 32.3 %.

Table 34 *N_2O Emissions From the Agriculture and Land Use Subsectors, 1990-2013 (Gg)*

Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
3 - Agriculture, Forestry and Other Land Use	0.39	0.39	0.35	0.33	0.34	0.37	0.36	0.34
3.A - Livestock	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10
3.A.2 – Manure Management	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10
3.B - Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C - Aggregate Sources and Non-CO2 Emissions Sources on Land	0.27	0.27	0.25	0.23	0.24	0.26	0.26	0.23
3.C.1 – Emissions From Biomass Burning	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.4 – Direct N2O Emissions From Managed Soils	0.14	0.14	0.12	0.11	0.12	0.14	0.13	0.12
3.C.5 - Indirect N2O Emissions From Managed Soils	0.07	0.07	0.06	0.06	0.06	0.07	0.07	0.06
3.C.6 – Indirect N2O Emissions From Manure Management	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.06
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
3 - Agriculture, Forestry and Other Land Use	0.32	0.32	0.33	0.32	0.30	0.32	0.31	0.23
3.A - Livestock	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.07
3.A.2 – Manure Management	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.07
3.B - Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C - Aggregate Sources and Non-CO2 Emissions Sources on Land	0.22	0.22	0.24	0.23	0.21	0.23	0.22	0.16
3.C.1 – Emissions From Biomass Burning	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
3.C.4 – Direct N2O Emissions From Managed Soils	0.11	0.11	0.12	0.12	0.11	0.11	0.11	0.08
3.C.5 - Indirect N2O Emissions from Managed Soils	0.06	0.06	0.06	0.06	0.05	0.06	0.06	0.04
3.C.6 – Indirect N2O Emissions From Manure Management	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.04

Year	2006	2007	2008	2009	2010	2011	2012	2013
3 - Agriculture, Forestry and Other Land Use	0.22	0.24	0.22	0.19	0.19	0.19	0.19	0.19
3.A - Livestock	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05
3.A.2 – Manure Management	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05
3.B - Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C - Aggregate Sources and Non-CO2 Emissions Sources on Land	0.16	0.18	0.16	0.14	0.14	0.14	0.14	0.14
3.C.1 – Emissions From Biomass Burning	0.00	0.02	0.00	0.00	0.00	0.01	0.01	0.00
3.C.4 – Direct N2O Emissions From Managed Soils	0.08	0.08	0.08	0.07	0.08	0.07	0.07	0.07
3.C.5 - Indirect N2O Emissions From Managed Soils	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03
3.C.6 – Indirect N2O Emissions From Manure Management	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03

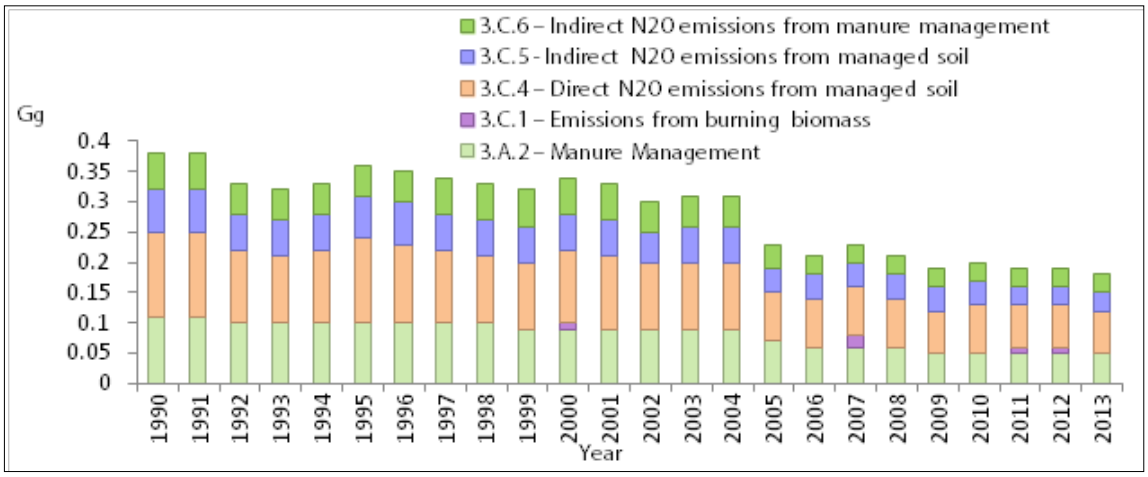


Figure 33 *N_2O Emissions From the Agriculture and Land Use Subsectors, 1990-2013 (Gg)*

Activity Indicators and Emission Factors

Data from MONSTAT, records from the Ministry of Agriculture and Rural Development, records from the Forestry Administration of Montenegro and data from the National Forest Inventory of Montenegro (2010) were used to estimate GHG emissions for agriculture and land use sector.

An estimate of GHG emissions and sinks in the agriculture and land use sector was produced in accordance with the 2006 IPCC Guidelines, the Intergovernmental Good Practice Guidance and Uncertainty Management from 2000, and the Good Practice Guidance for Land Use, Land-Use Change and Forestry from 2003[67].
In line with available data, it was possible to apply a Tier 1 approach to estimate emissions.
Livestock numbers are activity indicators for the enteric fermentation and manure management subsectors.
Table 35 provides data on livestock numbers for the period 1990-2013.

67 *Good Practice Guidance for Land Use, Land-Use Change and Forestry, 2003*

Table 35 *Livestock Numbers for the Enteric Fermentation and Manure Management Subsectors, 1990-2013 (Number of Heads)*

Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
3.A.1 – Enteric Fermentation	719,285	717,988	665,909	638,183	642,167	665,584	656,751	606,734
3.A.1.a - Cattle	188,509	187,906	176,946	169,324	172,839	179,524	179,581	176,043
3.A.1.a.i – Dairy	130,144	129,926	122,763	119,702	122,704	124,567	124,457	123,473
3.A.1.a.ii – Other Cattle	58,365	57,980	54,183	49,622	50,135	54,957	55,124	52,570
3.A.1.c - Sheep	486,634	487,500	448,543	430,498	430,847	447,909	438,881	392,058
3.A.1.d - Goats	NE	NE	NE	NE	NE	NE	NE	NE
3.A.1.f - Horses	19,914	19,318	16,864	16,160	16,209	16,327	15,812	14,997
3.A.1.h - Swine	24,228	23,264	23,556	22,201	22,272	21,824	22,477	23,636
3.A.2 – Manure Management	1,636,369	1,671,261	1,525,452	1,432,618	1,448,363	1,446,849	1,427,577	1,356,808
3.A.2.a - Cattle	188,509	187,906	176,946	169,324	172,839	179,524	179,581	176,043
3.A.2.a.i – Dairy Cows	130,144	129,926	122,763	119,702	122,704	124,567	124,457	123,473
3.A.2.a.ii – Other Cattle	58,365	57,980	54,183	49,622	50,135	54,957	55,124	52,570
3.A.2.c - Sheep	486,634	487,500	448,543	430,498	430,847	447,909	438,881	392,058
3.A.2.d - Goats	NE	NE	NE	NE	NE	NE	NE	NE
3.A.2.f - Horses	19,914	19,318	16,864	16,160	16,209	16,327	15,812	14,997
3.A.2.h - Swine	24,228	23,264	23,556	22,201	22,272	21,824	22,477	23,636
3.A.2.i - Poultry	917,084	953,273	859,543	794,435	806,196	781,265	770,826	750,074
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
3.A.1 – Enteric Fermentation	547,312	519,403	502,237	452,430	454,696	459,868	458,434	390,556
3.A.1.a - Cattle	177,693	179,706	179,071	178,064	182,680	174,954	169,340	117,842
3.A.1.a.i – Dairy	124,373	128,179	121,060	120,427	123,534	126,987	122,035	82,851
3.A.1.a.ii – Other Cattle	53,320	51,527	58,011	57,637	59,146	47,967	47,305	34,991
3.A.1.c - Sheep	332,795	305,707	293,197	243,524	240,531	252,007	254,406	254,898
3.A.1.d - Goats	NE	NE	NE	NE	NE	NE	NE	NE
3.A.1.f - Horses	14,182	12,474	10,703	9,967	9,568	9,028	7,447	7,119
3.A.1.h - Swine	22,642	21,516	19,266	20,875	21,917	23,879	27,241	10,697
3.A.2 – Manure Management	1,360,670	1,264,20	1,292,814	1,269,875	1,292,238	1,349,913	1,258,273	852,705
3.A.2.a - Cattle	177,693	179,706	179,071	178,064	182,680	174,954	169,340	117,842
3.A.2.a.i – Dairy Cows	124,373	128,179	121,060	120,427	123,534	126,987	122,035	82,851
3.A.2.a.ii – Other Cattle	53,320	51,527	58,011	57,637	59,146	47,967	47,305	34,991
3.A.2.c - Sheep	332,795	305,707	293,197	243,524	240,531	252,007	254,406	254,898
3.A.2.d - Goats								
3.A.2.f - Horses	14,182	12,474	10,703	9,967	9,568	9,028	7,447	7,119
3.A.2.h - Swine	22,642	21,516	19,266	20,875	21,917	23,879	27,241	10,697
3.A.2.i - Poultry	813,358	745,017	790,577	817,445	837,542	890,045	799,839	462,149
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
3.A.1 – Enteric Fermentation	383,757	347,459	330,989	308,342	288,629	341,152	337,377	335,006
3.A.1.a - Cattle	114,922	109,378	106,494	84,046	79,797	87,173	84,701	89,058
3.A.1.a.i – Dairy	79,553	73,142	73,477	58,495	60,133	59,532	59,972	61,830
3.A.1.a.ii – Other Cattle	35,369	36,236	33,017	25,551	19,664	27,641	24,729	27,228
3.A.1.c - Sheep	249,281	222,244	209,354	180,228	177,808	208,771	207,047	190,843

3.A.1.d - Goats	NE	NE	NE	16,175	14,427	23,660	23,273	29,675
3.A.1.f - Horses	6,260	5,463	5,124	4,342	7,904	4,035	3,905	4,858
3.A.1.h - Swine	13,294	10,374	10,017	23,551	8,693	17,513	18,451	20,572
3.A.2 – Manure Management	832,259	852,814	763,253	725,079	795,149	786,211	1,069,467	955,370
3.A.2.a - Cattle	114,922	109,378	106,494	84,046	79,797	87,173	84,701	89,058
3.A.2.a.i – Dairy Cows	79,553	73,142	73,477	58,495	60,133	59,532	59,972	61,830
3.A.2.a.ii – Other Cattle	35,369	36,236	33,017	25,551	19,664	27,641	24,729	27,228
3.A.2.c - Sheep	249,281	222,244	209,354	180,228	177,808	208,771	207,047	190,843
3.A.2.d - Goats				16,175	14,427	23,660	23,273	29,675
3.A.2.f - Horses	6,260	5,463	5,124	4,342	7,904	4,035	3,905	4,858
3.A.2.h - Swine	13,294	10,374	10,017	23,551	8,693	17,513	18,451	20,572
3.A.2.i - Poultry	448,502	505,355	432,264	416,737	506,520	445,059	732,090	620,364

Table 36 shows activity data for the forestland and cropland subsectors, as well as the data on forest logging, for the observed period.

Table 36 *Forest Land and Cropland (ha) and Losses From Forest Felling (m^3) for the Land Use Subsectors, 1990-2013*

Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
3.B - Land	668,997.8	666,331.8	666,330.8	662,849.8	664,880.8	660,342.8	659,874.8	659,025.8
3.B.1 – Forest Land	630,701.8	630,701.8	630,701.8	630,701.8	630,701.8	630,701.8	630,701.8	630,701.8
3.B.1.a – Forest Land Remaining Forest Land	630,701.8	630,701.8	630,701.8	630,701.8	630,701.8	630,701.8	630,701.8	630,701.8
3.B.1.a – Forest Land Remaining Forest Land - Losses From Felling	1,256,594	1,300,734	1,075,706	904,851	973,745	1,197,262	1,041,282	980,784
3.B.1.a – Forest Land Remaining Forest Land – Losses From Felling for Fuel Wood	476,412	603,797	383,774	298,184	240,224	394,649	364,478	286,387
3.B.2 – Cropland	38,296.0	35,630	35,629	32,148	34,179	29,641	29,173	28,324
3.B.2.a - Cropland Remaining Cropland	38,296.0	35,630	35,629	32,148	34,179	29,641	29,173	28,324
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
3.B - Land	657,519.8	655,114.8	655,012.8	652,187.8	651,197.8	650,665.8	650,255.8	735,741.4
3.B.1 – Forest Land	630,701.8	630,701.8	630,701.8	630,701.8	630,701.8	630,701.8	630,701.8	715,336.4
3.B.1.a – Forest Land Remaining Forest Land	630,701.8	630,701.8	630,701.8	630,701.8	630,701.8	630,701.8	630,701.8	715,336.4
3.B.1.a – Forest Land Remaining Forest Land - Losses From Felling	780,000	772,825	888,952	891,684	779,378	885,585	1,024,055	1,181,019
3.B.1.a – Forest Land Remaining Forest Land – Losses From Felling for Fuel Wood	476,000	476,000	337,699	398,651	312,835	432,512	539,609	616,987
3.B.2 – Cropland	26,818	24,413	24,311	21,486	20,496	19,964	19,554	20,405
3.B.2.a - Cropland Remaining Cropland	26,818	24,413	24,311	21,486	20,496	19,964	19,554	20,405
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
3.B - Land	736,544.4	736,738.4	736,619.4	736,870.4	748,498	748,705	735,239.2	737,613.8
3.B.1 – Forest Land	715,336.441	715,336.441	715,336.441	715,336.441	727,125	727,125	727,125	727,125
3.B.1.a – Forest Land Remaining Forest Land	715,336.4	715,336.4	715,336.4	715,336.4	727,125	727,125	727,125	727,125
3.B.1.a – Forest Land Remaining Forest Land - Losses From Felling	1,417,869	1,064,006	1,130,975	1,034,732	1,181,675	1,249,075	1,095,913	1,162,600.3

3.B.1.a – Forest Land Remaining Forest Land – Losses From Felling for Fuel Wood	784,583	547,369	585,597	620,136	728,695	729,455	729,460	562,751
3.B.2 – Cropland	21,208	21,402	21,283	21,534	21,373	21,580	8,114.2	10,488.8
3.B.2.a - Cropland Remaining Cropland	21,208	21,402	21,283	21,534	21,373	21,580	8,114.2	10,488.8

Table 37 shows activity data for activities 3.C.5: indirect N_2O emissions from managed soils and quantities of nitrogen fertilisers used during the observed period

Table 37 *Quantities of Nitrogen Fertilisers Used for the Observed Period 1990-2013 (t)*

Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
3.C.5 - Indirect N_2O Emissions from Managed Soils	1,750	1,750	1,750	1,750	1,750	1,750	1,750	571
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
3.C.5 - Indirect N_2O Emissions From Managed Soils	NE	197	776	789	68	482	480	521
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
3.C.5 - 3.C.5 - Indirect N_2O Emissions From Managed Soils	569	620	710	693	1,270	563	1,750	1,750

Table 38 shows emission factors in the enteric fermentation and manure management subsectors, for the observed period.

Table 38 *Emission Factors for Subsectors 3.A.1 Enteric Fermentation and 3.A.2 Manure Management 1990-2013 (kg CH_4/head)*

Activity	CH_4 Emission Factor (kg CH4/head)	Activity	CH_4 Emission Factor (kg CH4/head)	Activity	N_2O Emission Factor (kg N_2O/head)*
3.A.1 – Enteric Fermentation		3.A.2 – Manure Management		3.A.2 – Manure Management	
3.A.1.a.i – Dairy Cows	99	3.A.2.a.i – Dairy Cows	20	3.A.2.a.i – Dairy Cows	0.005 - 0.02
3.A.1.a.ii – Other Cattle	58	3.A.2.a.ii – Other Cattle	9	3.A.2.a.ii – Other Cattle	0.005 - 0.02
3.A.1.c - Sheep	5	3.A.2.c - Sheep	0.15	3.A.2.c - Sheep	0.002 - 0.005*
3.A.1.d - Goat	5	3.A.2.d - Goats	0.17	3.A.2.d - Goats	0.02
3.A.1.f - Horses	18	3.A.2.f - Horses	1.64	3.A.2.f - Horses	0.005 -0.02*
3.A.1.h - Swine	1	3.A.2.h – Swine -pigs	4	3.A.2.h – Swine -pigs	0.002 - 0.005*
		3.A.2.h – Swine - sows	6	3.A.2.h – Swine - sows	0.002 - 0.005*
		3.A.2.i - Poultry	0.02	3.A.2.i - Poultry	0.005

*N_2O emission factors depend on the method of manure management

Tables 39 and 40 show the N_2O emission factors for the following activities: biomass burning on forest land, direct and indirect N_2O emissions from managed soils and indirect N_2O emissions from manure management, for the observed period.

Table 39 *Emission Factors for Biomass Burning on Forest Land, Direct N_2O Emissions From Managed Soils and Indirect N_2O Emissions From Managed Soils, 1990-2013*

Activity	Unit	Emission Factor
3.C.1.a – Biomass burning on forest land	N_2O emission factor (g GHG / (kg burnt dry matter))	0.06
3.C.4 - Direct N_2O emissions from managed soils - cattle, poultry and swine	kg N_2O-N / kg N input	0.02
3.C.4 - Direct N_2O emissions from managed soils – sheep and other animals	kg N_2O-N / kg N input	0.01
3.C.5 - Indirect N_2O emissions from managed soils	kg N_2O-N/(kg NH_3-N+NO_x-N)	0.01

Table 40 *Emission Factors for Indirect N_2O Emissions From Manure Management, 1990-2013*

3.C.6 – Indirect N_2O emissions from manure management	Manure management system	Emission factor (kg N_2O-N / (kg NH_3-N + NO_x-N volatile)
3.C.6 – Indirect N_2O emissions from manure management	Daily cover	0.01
3.C.6 – Indirect N_2O emissions from manure management	Solid manure storage	0.01
3.C.6 – Indirect N_2O emissions from manure management	Liquid system	0.01
3.C.6 – Indirect N_2O emissions from manure management	Other systems	0.01
3.C.6 – Indirect N_2O emissions from manure management	Storage in pits under stables	0.01
3.C.6 – Indirect N_2O emissions from manure management	Dry manure storage	0.01
3.C.6 – Indirect N_2O emissions from manure management	Open anaerobic lagoons	0.01

Uncertainty Assessment in the Agriculture Sector

IPCC default values were used to assess the uncertainty of input data, as well as emission factors. The values used for activity data and emission factors regarding uncertainty assessment in the agriculture sector, related to enteric fermentation and manure management, are shown in Table 41.

Table 41 *Activity Data and Emission Factor Uncertainty Assessment: Enteric Fermentation and Manure Management, 1990-2013, (%)*

Category	Gas	Activity Data Uncertainty (%)	Emission Factor Uncertainty (%)	Combined Uncertainty (%)
3.A.1.a.i – Dairy Cows	CH_4	20	40	44.72
3.A.1.a.ii – Other Cattle	CH_4	20	40	44.72
3.A.1.c - Sheep	CH_4	20	40	44.72
3.A.1.d - Goats	CH_4	20	40	44.72
3.A.1.f - Horses	CH_4	20	40	44.72
3.A.1.h - Swine	CH_4	20	40	44.72
3.A.2.a.i – Dairy Cows	N_2O	20	50	53.85
3.A.2.a.ii – Other Cattle	N_2O	20	50	53.85
3.A.2.c - Sheep	N_2O	20	50	53.85
3.A.2.d - Goats	N_2O	20	50	53.85

3.A.2.f - Horses	N_2O	20	50	53.85
3.A.2.h - Swine	N_2O	20	50	53.85
3.A.2.i - Poultry	N_2O	20	50	53.85
3.A.2.a.i – Dairy Cows	CH_4	20	30	36.06
3.A.2.a.ii – Other Cattle	CH_4	20	30	36.06
3.A.2.c - Sheep	CH_4	20	30	36.06
3.A.2.d - Goats	CH_4	20	30	36.06
3.A.2.f - Horses	CH_4	20	30	36.06
3.A.2.h - Swine	CH_4	20	30	36.06
3.A.2.i - Poultry	CH_4	20	30	36.06

WASTE (CRF SECTOR 4)

The waste sector produces GHG emissions as a result of the disposal and treatment of municipal solid waste, wastewater management and waste incineration.

The CH_4 and N_2O emissions resulting from the disposal and treatment of municipal solid waste and wastewater discharge were estimated.

The Kinetic First Order Decay Model (Tier 2, FOD model, IPCC – 2006 Guidance) was used to calculate annual methane emissions from solid municipal waste landfills.

Data Sources

Recalculated statistical data (MONSTAT) derived from the most recent demoFigureic data, and data on generated quantities of municipal waste along with its composition were used to estimate emissions from the waste sector.

The statistical data from MONSTAT, according to which 42% of Montenegrin households are connected to septic tanks, was used to estimate emissions from wastewater discharge.

Emission Trends

GHG emissions from the waste sector recorded a slight, but steady, increase (Figure 27) during the observed period (1990-2013). The solid waste disposal subsector represented the greatest share of estimated emissions in this sector.

GHG Emissions Expressed in CO_2eq

The Kinetic First Order Decay Model was used to calculate annual CH_4 emissions from municipal solid waste landfills. The model assumes that the total quantity of organic carbon will not degrade with a one year period, but that degradation will take place over a much longer period of time, due to potentially non-degradable carbon found in deposited waste. In line with the methodology, approximately 50- 60% is degradable organic carbon from waste; 55% of the carbon present, however, is degraded and transformed into landfill gas. Total GHG emissions expressed as CO_2eq from the waste subsector are shown in Table 42 and Figure 34.

Table 42 *Total GHG Emissions Expressed as CO_2 eq From the Waste Subsector, 1990-2013 (Gg)*

Year	1990	1991	1992	1993	1994	1995	1996	1997
4 - Waste	11.91	34.96	45.41	57.43	68.97	80.39	91.69	105.17
4.A - Solid Waste Disposal	11.91	13.11	25.66	37.62	49.10	60.47	71.71	82.77
4.D - Wastewater Treatment and Discharge	0.00	21.85	19.75	19.81	19.87	19.92	19.98	22.40
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
4 - Waste	116.04	126.57	136.79	146.02	154.39	161.92	168.61	174.48
4.A - Solid Waste Disposal	93.55	103.99	114.12	123.26	131.54	138.97	145.63	151.46
4.D - Wastewater Treatment and Discharge	22.49	22.58	22.67	22.76	22.86	22.95	22.99	23.02
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
4 - Waste	179.63	184.25	188.21	190.26	193.65	197.41	200.49	199.26
4.A - Solid Waste Disposal	156.58	161.17	164.46	167.08	170.43	174.17	177.23	178.24
4.D - Wastewater Treatment and Discharge	23.05	23.08	23.12	23.17	23.22	23.24	23.26	21.01

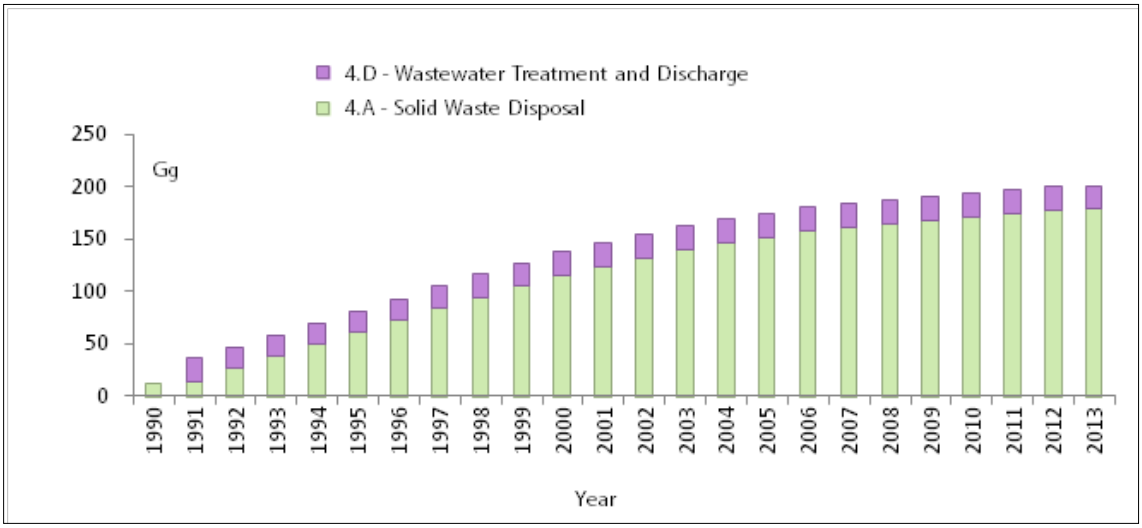


Figure 34 *GHG Emissions Expressed in CO_2eq From the Waste Subsector, 1990-2013 (Gg)*

CH_4 Emissions

CH_4 emissions from the waste sector recorded a slight, but steady, increase (Figure 35 and Table 43). Within the total emissions estimated for this sector, CH_4 emissions represented between 77.63% and 96.96% during the observed period. Solid waste disposal produces the greatest amount of CH_4 emissions in the waste sector (Figure 35).

Table 43 *CH_4 Emissions From the Waste Sector, 1990-2013 (Gg)*

Year	1990	1991	1992	1993	1994	1995	1996	1997
4 - Waste	0.57	1.29	1.89	2.47	3.02	3.56	4.10	4.63
4.A - Solid Waste Disposal	0.57	0.62	1.22	1.79	2.34	2.88	3.41	3.94
4.D - Wastewater Treatment and Discharge	NE	0.67	0.67	0.67	0.68	0.68	0.68	0.69
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
4 - Waste	5.14	5.64	6.13	6.57	6.96	7.32	7.64	7.92
4.A - Solid Waste Disposal	4.45	4.95	5.43	5.87	6.26	6.62	6.93	7.21
4.D - Wastewater Treatment and Discharge	0.69	0.69	0.69	0.70	0.70	0.70	0.70	0.70
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
4 - Waste	8.16	8.38	8.57	8.67	8.83	9.00	9.15	9.20
4.A - Solid Waste Disposal	7.46	7.67	7.83	7.96	8.12	8.29	8.44	8.49
4.D - Wastewater Treatment and Discharge	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71

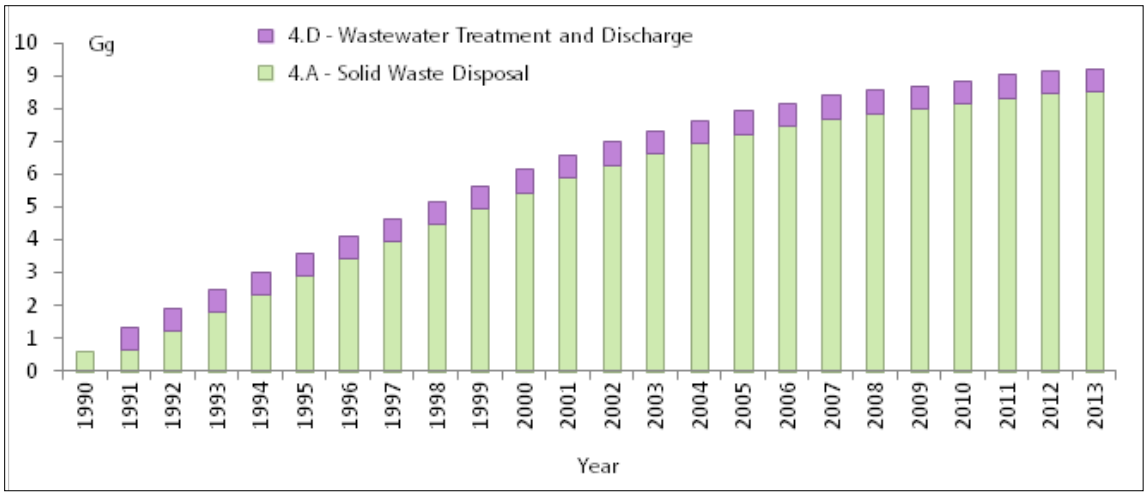


Figure 35 *CH_4 Emissions From the Waste Subsector, 1990-2013 (Gg)*

N_2O Emissions

Given insignificant demographic fluctuation along with changes within the sewerage infrastructure, N_2O emissions recorded a small increase during the observed period (Table 44 and Figure 36).

Table 44 *N_2O From the Waste Subsector, 1990-2013 (Gg)*

Year	1990	1991	1992	1993	1994	1995	1996	1997
4. Waste	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0258
4.D - Wastewater Treatment and Discharge	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0251	0.0258
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
4. Waste	0.0259	0.0260	0.0261	0.0262	0.0264	0.0265	0.0265	0.0265
4.D - Wastewater Treatment and Discharge	0.0259	0.0260	0.0261	0.0262	0.0264	0.0265	0.0265	0.0265
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
4. Waste	0.0266	0.0266	0.0267	0.0267	0.0268	0.0268	0.0268	0.0268
4.D - Wastewater Treatment and Discharge	0.0266	0.0266	0.0267	0.0267	0.0268	0.0268	0.0268	0.0195

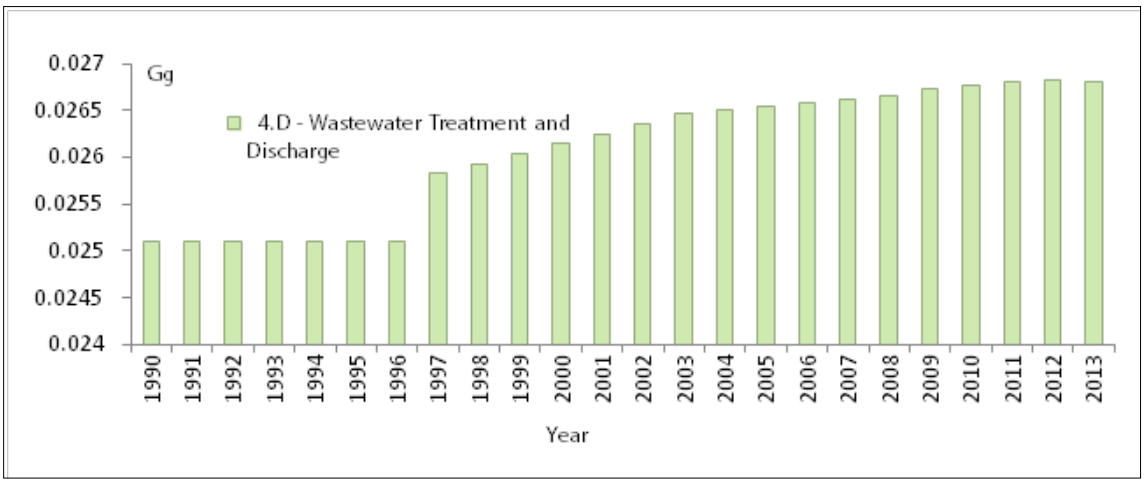


Figure 36 *N_2O Emissions From the Waste Subsector, 1990-2013 (Gg)*

Activity Indicators and Emission Factors

For the purposes of updating the 1990-2013 GHG inventory, and according to the 2006 IPCC methodology, the Statistical Office provided new demographic data; this included data on municipal waste quantities as well as on its composition.

The new data included annual information on the quantities of municipal waste generated per capita and on its composition, in accordance with the methodology. The data used for previous reporting purposes was approximate and represented the entire time series; there were no major differences in either quantity or composition.

According to statistical data on the sewerage infrastructure, 42% households are connected to septic tanks. This data was used to estimate emissions from wastewater treatment, along with discharge activity, for the entire period; this was possible due to insignificant demographic fluctuations and changes in the sewerage infrastructure in Montenegro.

Tables 45 and 46 show data on municipal waste quantities generated annually along with its composition during the observed period.

Table 45 *Quantities of Generated Municipal Waste, 1990-2013*

Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Population (millions)	0.5799	0.5830	0.5854	0.5879	0.5903	0.5928	0.5952	0.5976
Quantities of waste per capita (kg/capita)	416.16	420.54	423.92	429.82	446.80	463.79	479.46	490.96
Total municipal waste (Gg)	241.33	245.17	248.18	252.68	263.75	274.91	285.37	293.41
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Population (millions)	0.6001	0.6025	0.6050	0.6074	0.6098	0.6123	0.6134	0.6143
Quantities of waste per capita (kg/capita)	501.14	511.32	498.05	487.51	475.61	463.71	450.58	439.91
Total municipal waste (Gg)	300.72	308.08	301.30	296.11	290.04	283.91	276.36	270.22
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Population (millions)	0.6150	0.6159	0.6170	0.6183	0.6194	0.6201	0.6206	0.6212
Quantities of waste per capita (kg/capita)	428.01	474.52	442.57	453.19	422.23	402.69	397.25	400.26
Total municipal waste (Gg)	263.24	292.25	273.05	280.20	261.54	249.70	246.53	248.64

Table 46 *Municipal Waste Composition, 1990-2013 (%)*

Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Food	31.2	30.4	29.7	28.9	28.2	27.4	26.7	25.9
Organic waste	13.8	13.6	13.4	13.2	13.1	12.9	12.7	12.5
Paper	27.3	27.2	27.1	27	26.9	26.8	26.7	26.6
Textiles	2.9	2.9	2.8	2.8	2.7	2.7	2.6	2.6
Plastic	24.8	25.9	27	28.1	29.1	30.2	31.3	32.4
Total	100	100	100	100	100	100	100	100
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Food	25.2	24.4	23.7	22.9	22.2	21.4	20.7	19.9
Organic waste	12.3	12.1	11.9	11.8	11.5	11.4	11.2	11
Paper	26.5	26.4	26.3	26.1	26.1	26	25.9	25.8
Textiles	2.5	2.5	2.4	2.4	2.3	2.3	2.2	2.2
Plastic	33.5	34.6	35.7	36.8	37.9	38.9	40	41.1
Total	100	100	100	100	100	100	100	100
Food	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Organic waste	19.9	18.4	18.7	17.9	17.2	16.4	15.7	13.9
Paper	11	12.2	13.2	12.7	13.9	14.7	10.4	13.1
Textiles	25.8	23.7	22.8	22.5	22.4	22.8	22.8	21.3
Plastic	2.2	3.7	4.1	4.3	5	4.7	2.9	2
Total	41.1	42	41.2	42.6	41.5	41.4	48.2	49.7
Food	100	100	100	100	100	100	100	100

Uncertainty Assessment in the Waste Sector

IPCC default values were used to assess the uncertainty of input data, as well as emission factors. Activity data and emission factor values in the uncertainty assessment for the Waste sector related to the disposal of municipal waste, wastewater treatment and discharge as shown in Table 47.

Table 47 *Activity Data and the Uncertainty Assessment of Emission Factors for the Following Activities: Solid Waste Disposal, Wastewater Treatment and Discharge 1990-2013 (%)*

Category	Gas	Activity Data Uncertainty (%)	Emission Factor Uncertainty (%)	Combined Uncertainty (%)
4.A - Solid waste disposal	CH_4	60	50	78.10
4.D - Wastewater treatment and discharge	CH_4	60	60	84.85
4.D - Wastewater treatment and discharge	N_2O	60	500	503.59

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