Definition of base year for GHG emissions estimation for Kosovo

June 2022

Author:
Verica Taseska - Gjorgievska

Contents

List of figures

List of tables

Abbreviations

AFOLU	Agriculture, Forestry and Other Land Use
ASK	Kosovo Statistical Agency
CRF	Common Reporting Format
EEA	European Environment Agency
EIONET	European Environment Information and Observation Network
EU	European Union
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GHG	Greenhouse Gas
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
KEPA	Kosovo Environmental Protection Agency
KEK	Kosovo Energy Corporation
KFA	Kosovo Forestry Agency
MAFRD	Ministry of Agriculture Forestry and Rural Development
MESP	Ministry of Environment and Spatial Planning
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America

1 Introduction

The global efforts to reduce greenhouse gas (GHG) emissions, stipulated by the Paris Agreement, have resulted in the countries' plans to transition to a low carbon economy. An essential part of the transition is identifying the sources of GHG emissions and how to minimize them. Therefore, the countries develop emission inventories that provide information on GHG, which policymakers can use to design emission reduction strategies and track progress toward climate change goals.

A reference point is necessary to track the changes in GHG emissions. One possible reference point is a base year, i.e., a year in the past against which current (or future) emissions are compared. A meaningful comparison of emission data requires consistent data over time, which means consistent inventory boundaries between the data sets used for direct comparison. Usually, the base year is selected based on the availability of verifiable emission data.

Different approaches are possible in the base/reference year definition depending on reporting purposes. The EU goals for climate neutrality by the year 2050 relative to 1990, set out with the European Green Deal and incorporated in the European Climate Law, give a new policy framework including approaches to GHG emission reporting and transparency, also aligned with the obligation under the Paris Agreement.

Kosovo is not yet a signatory to the UN Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. However, as a potential candidate for EU membership, the country has made efforts have to align its legislation and policy framework to the EU climate acquis. Which means that Kosovo indirectly will meet the requirements arising from this convention. The Government of Kosovo considers climate change a priority area. The objectives set in the Climate Change Strategy of Kosovo[1] include developing national capacity to meet its future obligations under the UNFCCC and EU and slowing down the growth of greenhouse gas emissions.

This report aims to enable Kosovo to define its base/reference year for GHG emissions for the purpose of reporting requirements derived from the harmonization with EU acquis in energy and climate area.

The observation summarized in this study is based on desk research and initial screening of available data sources related to the GHG inventory. The screening process included meetings with the key stakeholders,

[1] Strategy on Climate Change 2019-2028 and the Action Plan on Climate Change 2019-2021, Ministry of Environment and Spatial Planning, 2018

particularly relevant for mapping the availability of historical emissions data, and it was realized in two phases. The initial step in the first phase was to map the current situation and included meetings with the representatives from the following institutions:

- Ministry of Environment and Spatial Planning (MESP) - Department of Environmental and Water Protection,
- Kosovo Agency for Environmental Protection (KEPA) – Directorate for the State of Environment,
- Ministry of Economy – Department of Energy,
- Ministry of Infrastructure – Department of vehicles, and
- Ministry of Agriculture, Forestry and Rural Development – Department of Forestry (Division of Forest Infrastructure and Management).

In addition, the desk research in the first phase included an online search of the publications containing information that might be used as GHG Inventory input data, i.e. to estimate the historical GHG emissions.

In the second phase, another set of meetings was organized with representatives of the following institutions:

- Kosovo Agency for Environmental Protection (KEPA) – Directorate for the State of Environment,
- Kosovo Agency of Statistics – Department of Environmental Statistics,
- Trepca Mines,
- Kosovo Energy Corporation (KEK).

Along with the meetings, where data availability was discussed, the MESP also sent letters to the Cement factory Sharrcem and the Independent Commission on Mines and Minerals requesting information on historical data availability.

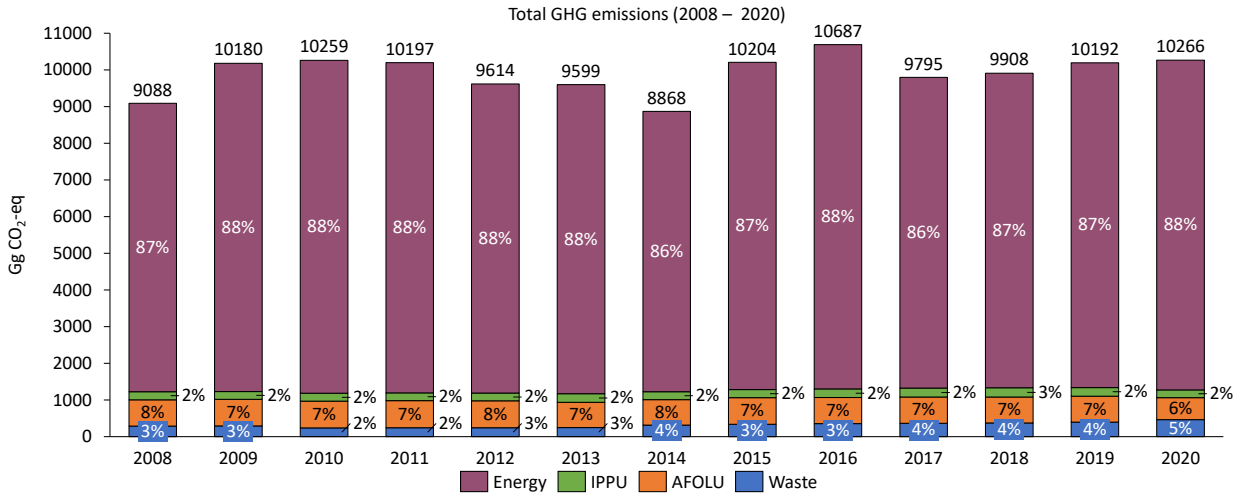
2 GHG emissions in Kosovo – current situation

The designated institution for GHG Inventory management is the Kosovo Environmental Protection Agency (KEPA), as part of the Ministry of Environment and Spatial Planning (MESP). The institution must collect and report the information on GHG emissions to the national institutions (the Government and responsible ministries) and the international institutions, i.e., the European Environmental Agency. The current national GHG Inventory includes consistent emissions estimates for the period 2008 – 2019. So far, KEPA has published the GHG inventory data in two reports. The first report (published in 2015) covered the emissions and removals over the period 2008 - 2013, and the second (published in 2020) covered the period 2014 - 2019. The information on GHG emissions is also updated annually and reported as part of the environmental indicators.

The GHG emissions and removals are estimated in line with the IPCC 2006 Guidelines, grouped under four main sectors: energy, industrial processes and product use (IPPU), agriculture, forestry and other land use (AFOLU), and waste. At sectoral level, the emissions estimates are disaggregated by categories and subcategories, using various available data sources. The main data suppliers are the central institutions such as: Agency of Statistics, Forestry Agency, Cadastral Agency, Kosovo Customs, etc., as well as from various operators and public companies.

The emissions trend shows slight variation during the reported period, showing the lowest emission level in 2014 (8868 Gg CO_2-eq) and the highest level in 2016 (10687 Gg CO_2-eq) (Figure 1). According to the latest inventory, the main contributor is the Energy sector, responsible for 88% of the national emissions in 2020.

Figure 1. Trend of total GHG emissions over period 2008 -2020 and distribution by sector



Source: Reports on GHG emissions in Kosovo for period 2008 – 2013 and 2014 – 2019, and data proved by KEPA.

3 Mapping of data sources relevant for base year definition

In terms of climate change terminology, the most common definition of the base year is the reference point in the time used to compare the emissions reductions achieved in the future. Usually, that is a year in the past for which verifiable data can be obtained. Since this report aims to identify a base year for the GHG emissions in Kosovo, the first step was to determine how far back in time are reliable data available that can be used to develop consistent historical time series of GHG emissions in the county. The analysis is based on desk research of the published information and meetings with the public institutions to identify the existing data for each sector covered by the GHG inventory.

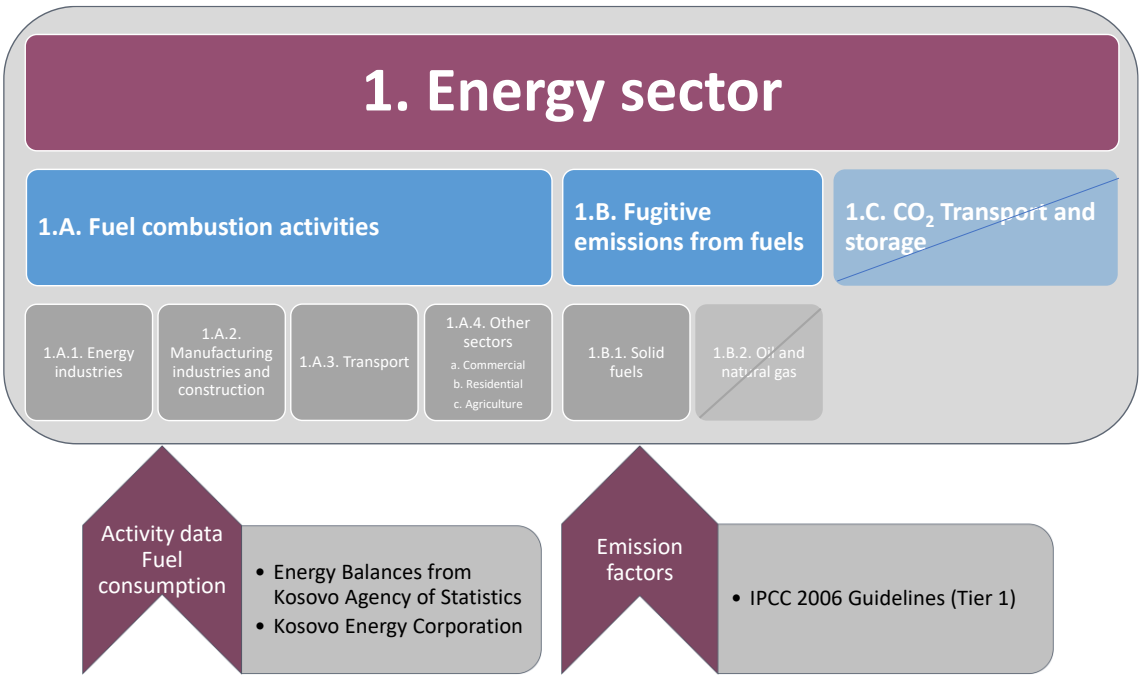
This chapter summarizes the initial findings by sector.

3.1 Energy Sector

The energy sector is the largest emitter of GHGs in Kosovo. It accounts for the GHG emissions released because of fuel combustion activities (CRF category 1.A), as well as the fugitive emissions from extraction of solid fuels (CRF category 1.B). Emission from CO_2 transport and storage (CRF category 1.C) does not occur in the country (Figure 2). The fuel combustion activities contribute the most to the energy emissions and derive from several categories:

- Energy Industries
- Manufacturing Industries and Construction,
- Transport,
- Other Sectors (Commercial/Institutional, Residential and Agriculture/Forestry/Fishing)

Figure 2. Energy sector of the GHG inventory - categories reported, input data and data sources



Source: Report on GHG emissions in Kosovo, KEPA, 2020

Activity data used for energy sector emissions estimation is the fuel consumption in each source category identified in the IPCC GHG Inventory Guidelines. In Kosovo, the primary source of information for the activity data is the energy balances developed by the national statistical office. Also, the Kosovo Energy Corporation is one of the data providers for this sector.

Besides the emissions reported in the GHG inventory for the period 2008 – 2019, specifically for the energy sector, the emissions are calculated for the previous years back to 2000 (i.e., for the period 2000 – 2007) as part of the information reported to European Environmental Agency (EEA), using the common reporting format (CRF) tables. These emissions were estimated by applying Tier 1 method, i.e., using the default emissions factors for fuels provided in the 2006 IPCC Guidelines on the National GHG Inventories.

Furthermore, during the scoping activity in this study, several documents and databases were identified as potential data sources for the energy sector. The identified sources of information are listed in Table 1, which contains the following information: the name of the document/database, responsible institution, type of data available, the period for which the data is available, and accessibility to the data. In terms of the type of data, the listed sources contain either calculated GHG emissions or activity data relevant for calculating the emissions.

In the second phase of this activity, following the meeting with the KEK representative, the institution provided data on the lignite used in Kosovo thermal power plants from 1990 to 2021.

In addition to the listed data sources, several documents, like the Statistical Yearbooks of Serbia (annual publications for the period 1990 -2000), were also considered, attempting to find useful information to estimate the GHG emission for the other subcategories in the energy sector, for the years before 2000. However, no such information could be found for Kosovo.

According to the current GHG inventory, most of the identified key categories with the highest shares in total emissions are from the energy sector. Therefore, to reduce the uncertainties in the GHG estimations, a consistent time-series of activity data must be obtained. The scoping activity showed that a consistent time-series of GHG emission estimations exists for the energy sector over the period 2000 – 2020. Considering that the energy sector contributes about 86% to 88% of the total GHG emissions from 2008 to 2020 (Figure 1), the focus of this activity was to find as much as possible activity data to estimate the GHG emissions from this sector prior 2000.

Table 1. List of mapped data sources relevant for GHG emissions from the energy sector

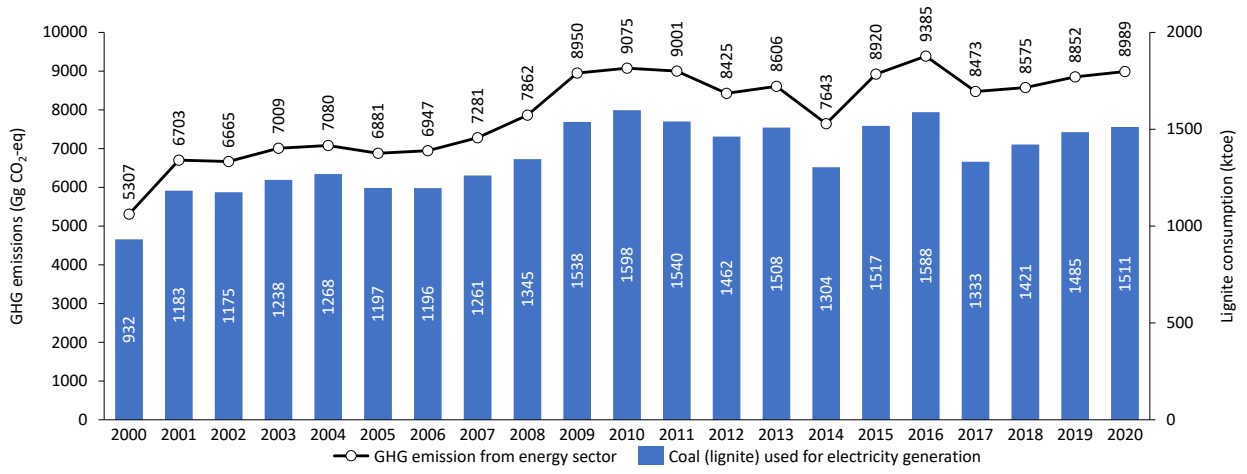
Document/Database	*Institution*	*Data available*	*Period covered*	*Access*
Report on GHG emissions in Kosovo (GHG Inventory): – *First report published 2015* – *Second report published 2020*	KEPA (MESP)	GHG emissions by category	2008 – 2019 – first report: 2008 – 2013 – second report: 2014 - 2019	Reports available online at KEPA website – First report – Second report
Greenhouse gas inventories (UNFCCC) *– EIONET Portal*	EEA/KEPA	GHG emissions by category	2000 - 2020	Excel file available online (with limited access) on EIONET website
Kosovo Environment 2020 - Report of environmental indicators	KEPA	Total GHG emissions by sector (same data as GHG Inventory)	2014 - 2019	Report available online at KEPA website

Document/Database	Institution	Data available	Period covered	Access
Annual report on state of Environment, 2020	KEPA	Total GHG emissions by sector (same data as GHG Inventory)	2014 - 2019	Report available online at KEPA website
Kosovo greenhouse gas emissions 2008 - 2009	KEPA (MESP)	GHG emissions by category	2008 -2009	Report available online at KEPA website
Greenhouse Gas Emissions in Kosovo 2014-2015	Kosovo Agency of Statistics (ASK)	GHG emissions by category	2014 - 2015	Report available online at ASK website
Annual Energy Balance in Kosovo	ASK	Fuel consumption in energy sector	2013 - 2021	Available online at ASK website
Energy Balances - EUROSTAT database	Eurostat	Fuel consumption in energy sector	2000 - 2020	Database available online at EUROSTAT website
World Energy Balances - IEA	IEA	Fuel consumption in energy sector	2000 - 2019	Database available online only by subscription at IEA website
National Energy Balances	Ministry of Economy (Department of Energy)	Fuel consumption in energy sector	2000 - 2013	Not available
Lignite consumption for electricity generation	Kosovo Energy Corporation (KEK)	Lignite consumption (in tones)	1990 – 2020	Provided by request
Imported oil derivatives	Customs of Kosovo	Amount of imported oil derivatives	2005 – 2021	Provided by request

Note: EEA = European Environment Agency; EIONET = European Environment Information and Observation Network, IEA – International Energy Agency.

By comparing the data on GHG emissions from the energy sector from 2000 to 2020 provided by KEPA (from the CRF tables reported to the Europan Environment Agency) and the amount of coal, particularly lignite, used for electricity production as per the Eurostat Energy Balances for Kosovo, one can observe a similar pattern in the trend (Figure 3). Therefore, coal-based electricity generation could be considered the primary driver of GHG emissions in the energy sector.

Figure 3. Total GHG emissions from energy sector (in Gg CO_2-eq) and coal used for electricity generation (in ktoe) over period 2000 -2020



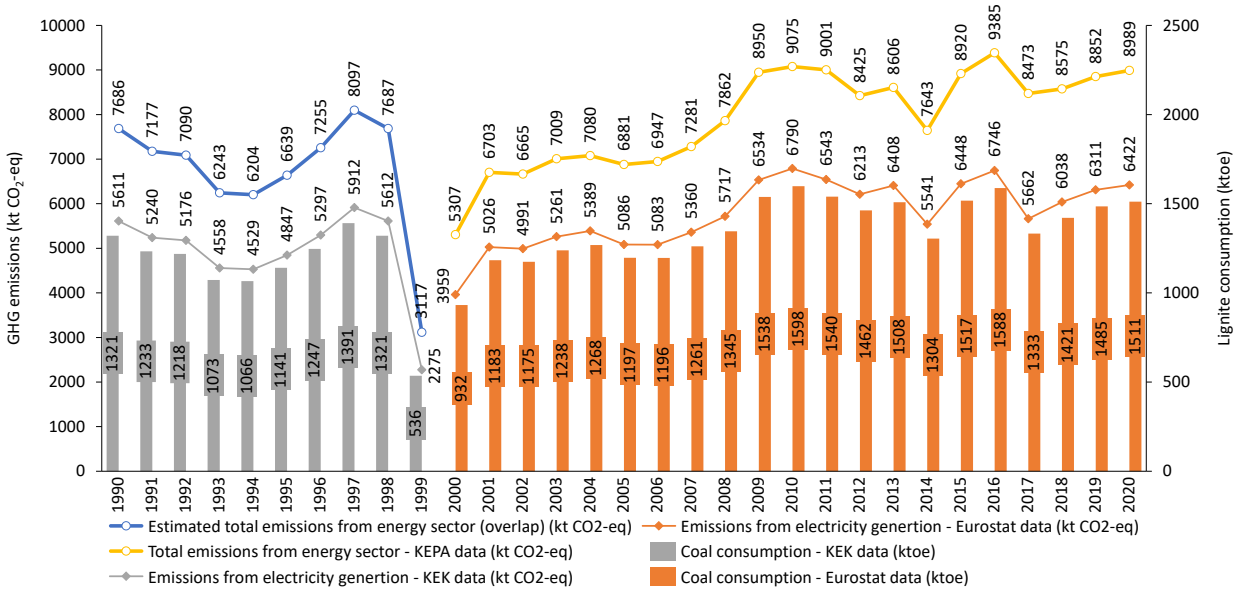
Source: GHG emissions estimation from KEPA, Coal consumtion from Eurostat Energy Balances

In this study, a detailed analysis of the GHG emissions from the subcategory electricity production was performed to get a consistent time series from 1990 using the data gathered as part of the scoping activity.

Hence, **for the period 1990 - 1999, the GHG emissions from the electricity production were calculated using the data on coal consumption in thermal power plants provided by KEK, and for the period 2000 - 2020, the data on coal consumption from Eurostat were used**. The calculated emissions are presented in Figure 4 (with gray and orange lines), together with the data on the coal (lignite) consumption in thermal power plants (shown with gray and orange bars). The total emissions from the energy sector estimated by KEPA (from the CRF tables reported to EEA) are presented with the yellow line. Since data on fossil fuels consumption in the other categories of the energy sector are not available for the period before 2000, to complete the time series of total emissions from the energy sector back to 1990, one of the splicing techniques described in the 2006 IPCC Guidelines[2] was used. According to the IPCC Guidelines, these techniques can be used to combine methods to minimize the potential inconsistencies in the time series. In this case, the overlap technique was applied as most appropriate for this situation, using the complete time series of estimated GHG emissions from the electricity generation (from 1990 to 2020) and the estimated total emissions from the energy sector (from 2000 to 2020). The estimated total GHG emissions from the energy sector from 1990 to 1999, using the overlap method, are depicted in Figure 4 with the blue line.

Conidering the entire time series of GHG emission from the energy sector over period of 30 years, it is evident that the highest emissions occured in 2016 estimated to 9835 Gg CO_2-eq.

Figure 4. Estimation of the total GHG emissions from energy sector and GHG emissions from electricity generation (in Gg CO_2-eq), and coal used for electricity generation (in ktoe) over period 1990 – 2020



[2] 2006 IPCC Guidelines on National GHG Inventories - Volume 1 General Guidance and Reporting: Chapter 5. Time Series Consistency

The research for the energy sector performed during this project activity revealed that a consistent time-series of GHG emissions in Kosovo and activity data for calculating emissions are already available for 2000 – 2020. The data on GHG emissions are available in the GHG inventory developed by KEPA. For the activity data, the Eurostat database has complete data set of energy balances which can be easily used since their structure is like the reporting structure of the energy sector in the IPCC GHG Inventory Guidelines. Nevertheless, using the data on coal consumption in thermal power plants provided by KEK during this project activity and the data from the Eurostat Energy Balances, a consistent time series of GHG emissions from the subcategory ***electricity generation*** *can be calculated from 1990 to 2020. Combined with the estimates of total GHG emissions from the energy sector developed by KEPA, these calculations are used to complete the time series of energy sector emissions from 1990. The results show that* ***over the 30 years, the highest emissions in the energy sector occurred in 2016, estimated to be 9835 Gg CO2-eq****.*

3.2 Industrial Processes and Product Use (IPPU) Sector

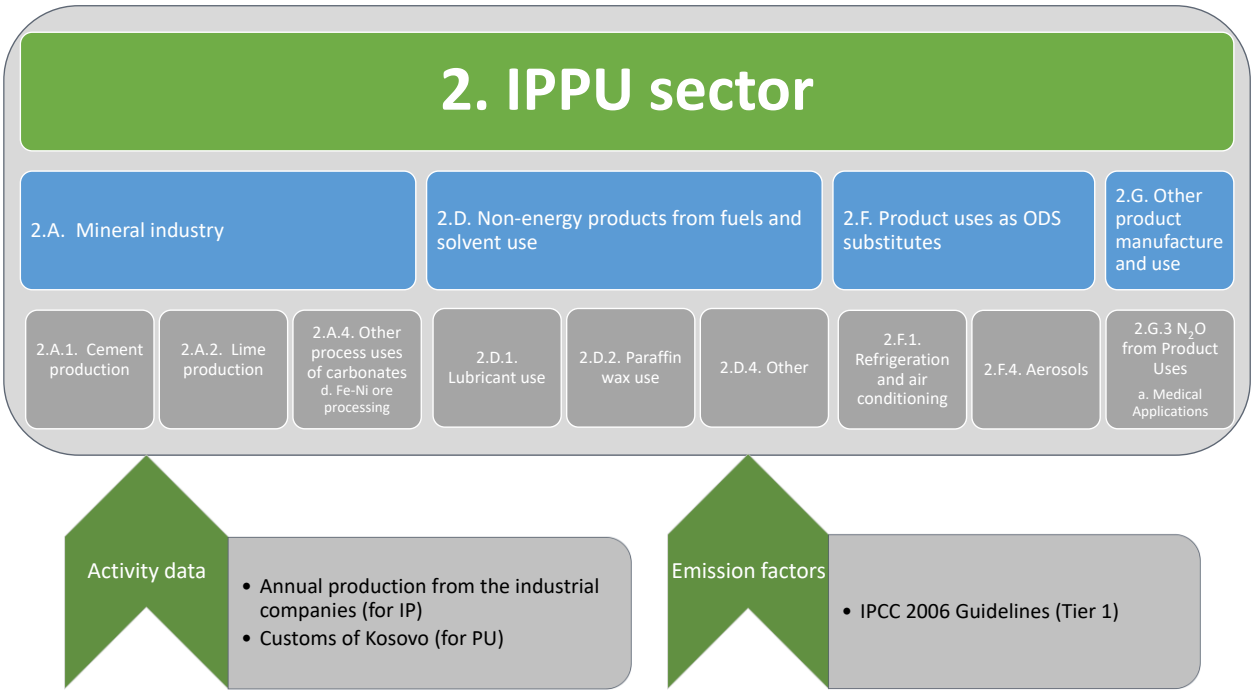
The industrial processes and product use sector represents about 1% of the total GHG emissions in Kosovo in 2019. According to the IPCC Guidelines, the sector includes emissions from several categories that can be grouped into two components, industrial processes and the use of products. The first component covers the GHG emissions resulting from industrial processes that chemically or physically transform various materials. In the case of Kosovo, the industrial processes emissions come from the Mineral industry, i.e., from the production of cement and limestone and ferronickel ore processing (Figure 5).

The rest of the greenhouse emissions in the country come from the usage of various products, such as non-energy products from fuels and solvents, substitutes for ozone-depleting substances (ODS) for refrigeration and air-conditioning and nitrogen oxides (N_2O) in medical applications (anesthetics), divided by subcategories (Figure 5).

The current GHG inventory reports on the emissions from the IPPU sector over the period 2008 – 2019. The activity data used for the industrial processes are the annual amount of clinker production, the annual amount of lime production, and the annual amount of ferronickel ore procession, taken from the environmental reports of economic operators (Sharrcem, NewCo FeroNikal and Limestone Factory in Kacanik). The activity data for the usage of products are the imported amounts of the products provided by the Customs of Kosovo.

The scoping activity for the IPPU sector was focused on an online search of the available data for the pre-2008 period. A few documents were identified during this phase, counting information on activity data for industrial processes in Kosovo (listed in Table 2).

Figure 5. IPPU sector of the GHG inventory - categories reported, input data and data sources



Source: Report on GHG emissions in Kosovo, KEPA, 2020

Table 2. List of mapped data sources relevant for GHG emissions from the IPPU sector

Document/Database	*Institution*	*Data available*	*Period covered*	*Access*
Report on GHG emissions in Kosovo (GHG Inventory): – *First report published 2015* *Second report published 2020*	KEPA (MESP)	GHG emissions by category	2008 – 2019 – first report: 2008 – 2013 – second report: 2014 - 2019	Reports available online at KEPA website – First report – Second report
Annual Corporate Social Responsibility (CSR) and Sustainability Report	Sharrcem cement factory	Cement production and cement to clinker ratio	2013 – 2020	Reports published online at the Sharrcem company website
Annual reports of the Independent Commission for Mines and Minerals (2017 – 2019)	Independent Commission for Mines and Minerals (ICMM)	Realized production of metallic (Fe-Ni) and non-metallic (limestone) minerals	2012 - 2019	Reports published online at ICMM website
Kosovo Mineral Yearbooks - The Mineral Industry of Kosovo (2015, 2016, 2017-18)	U.S. Geological Survey (USGS), U.S. Department of Interior	Estimates on mineral production (cement, limestone) and metal production (Fe-Ni)	2011-2018	Reports available online at USGS website
Indicators of performance of the Sharrcem cement factor	Sharrcem cement factory	Cement production, clinker production, total CO_2 emission	1990, 2000, 2003, 2018, 2019, 2020, 2021	Provided by request

For the cement production, activity data are available online as part of the annual reports of the economic operator, but only for the period 2013 – 2020. During the second phase of this activity, upon request of MESP, the cement factory Sharrcem has sent some information on the clinker and cement production and CO2 emissions, but only for seven years (Table 2), which was not enough to consistently extend the

emissions estimations from this category. For limestone production and ferronickel ore processing activities, the realized production quantities are available for the period after 2012 as part of the annual reports of the Independent Commission for Mines and Minerals. According to the Mining Strategy of Kosovo (2012- 2025)[3], the ferronickel factory stopped operating after 1997. The utilization of the mines commenced in 2007 when the industry was privatized in 2006 by NewCo Ferronikeli Complex L.L.C.

In addition, the Statistical Yearbook of the Kosovo Agency of Statistics was considered, but it does not include any information on the actual production of the industrial capacities.

There are no published data on the imported amounts in the country for the categories that emit GHG because of product use.

Based on the initial desk research for the IPPU sector, it can be concluded that a consistent time series of GHG emissions in Kosovo for the period 2008 – 2019 is reported in the GHG inventory developed by KEPA. For the activity data, the identified data sources contain information for the period after 2011, which overlaps the period reported in the GHG inventory. Before 2008, no available data could be found for the IPPU sector. Since this sector does not contribute significantly to the total GHG emissions, some of the splicing techniques presented in the IPCC Guidelines could be used to develop a consistent time series, if necessary. However, in the next phase, an attempt could be made to contact the Statistical Agency, the Customs office, and the identified economic operators for the possibility of providing the activity data for the period before 2008 to the extent possible.

3.3 Agriculture, Forestry and Other Land Use (AFOLU) Sector

The AFOLU sector accounts for around 8% of Kosovo's total greenhouse gas emissions in 2019. According to the IPCC Guidelines, this sector consists of three other categories:

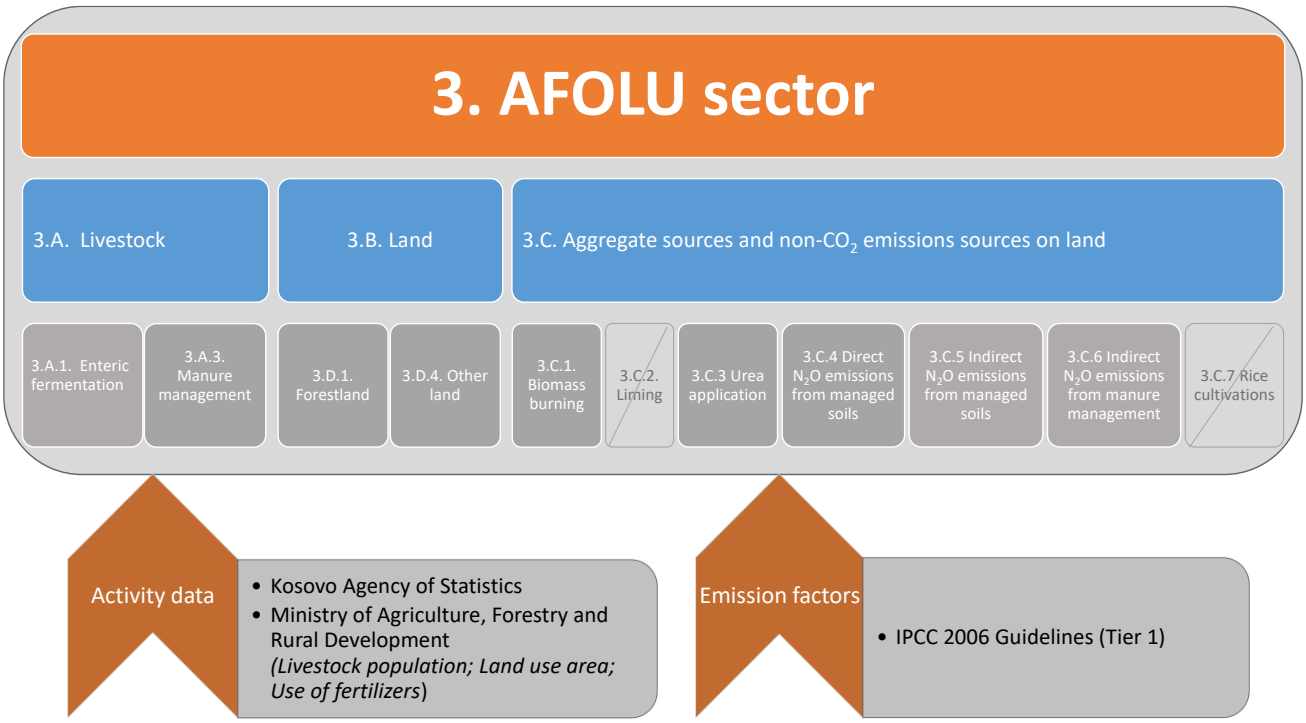
- 3.A. Livestock
- 3.B. Land
- 3.C. Aggregate sources and non-CO_2 emissions sources on land

Each of the categories is divided to subcategories, as presented in Figure 6, showing structure of the AFOLU sector covered with the GHG inventory of Kosovo. The first category (3.A) includes emissions from enteric fermentation (animal digestive process) and emissions from manure management, and it is the largest emitter in the AFOLU sector (~77% of total sectoral emissions). The second category (3.B) incorporates the estimations of the absorbed CO_2 by forestland, and the CO_2 emission for other land uses and land use changes, resulting mainly with reduction of the net CO_2 emissions (in case no significant

[3] Mining Strategy of the Republic of Kosovo 2012 – 2025, Ministry of Economic Development, 2012

disturbances, like wildfires, occurred in the forestland). The category aggregates the emissions from soil fertilization and from biomass burning on land.

Figure 6. AFOLU sector of the GHG inventory - categories reported, input data and data sources



Source: Report on GHG emissions in Kosovo, KEPA, 2020

The primary sources of information (activity data providers) for estimation of the AFOLU sector emissions are the Kosovo Agency of Statistics and the Ministry of Agriculture, Forestry and Rural Development (MAFRD), which contain comprehensive data on livestock population, land use areas, and land fertilization. Another relevant data source is the second Kosovo Forest Inventory, where detailed information on the forest area and composition is provided.

The latest inventory report emphasized that the AFOLU sector is the most challenging in terms of the methodology, data requirements, data sources, and uncertainties regarding emission estimates. The lack of experience for this sector and the absence of the specific annual data required for each category under this sector are the main issues requiring inter-institutional cooperation and engagement of sectoral experts to improve emissions estimation and reporting.

The mapping activity of the available data for the AFOLU sector for the period not covered by the current GHG inventory included a meeting with the representative from the Division for Forest Policy Managements and Forest resources of MAFRD and an analysis of the data published online. The mapped data sources are listed in Table 3. The Kosovo Agency of Statistics publishes the most detailed information for this sector containing results from the agricultural household surveys dating back to 2000.

Table 3. List of mapped data sources relevant for GHG emissions from the AFOLU sector

Document/Database	Institution	Data available	Period covered	Access
Report on GHG emissions in Kosovo (GHG Inventory): – *First report published 2015* *Second report published 2020*	KEPA (MESP)	GHG emissions by category	2008 – 2019 – first report: 2008 – 2013 – second report: 2014 - 2019	Reports available online at KEPA website – First report – Second report
Agricultural census 2014	Kosovo Agency of Statistics (ASK)	- Arable land area - Number of animals	2014	Available online at ASKDATA Platform
Agricultural Household Survey (AHS)	ASK	- Land use - Livestock - Use of fertilizers	2004 - 2020	Available online at ASK website and ASKDATA Platform
Statistics on agriculture in Kosovo	ASK, FAO, Ministry of Agriculture, Forestry and Rural Development (MAFRD)	- Land use - Number of animals	- '80s, '81, '86, '89, 1993, 1995, 1996,2000 – 2002 - 2000 and 2002	Report available at ASK website
Statistical Yearbooks of Kosovo (online publications)	ASK	- Arable land area - Number of animals *(Based on data from AHS)*	2005 – 2021 *(available online)*	Available online at ASK website
Green Reports	MAFRD	- Land use - Livestock *(Based on data from AHS)*	- 2010 – 2021 - 2007 – 2021 *(available online)*	Reports published online at MAFRD website
Kosovo National Forest Inventory, 2012	MAFRD	- Land use area by classes - Forest area by forest composition and stand structure - Carbon stock - Damage to growing stock by tree species group and cause of damage - Annual increment and drain of wood	2000 and 2012	Report available online
Statistical Yearbooks of Serbia (publications)	Statistical Office of R. Serbia (SORS)	Livestock data - number of heads	1990-1999	Reports available online at SORS website

In the mapping process, the Statistical Yearbooks of the Republic of Serbia were also investigated where data on livestock population in Kosovo were found for the period 1990 – 1999.

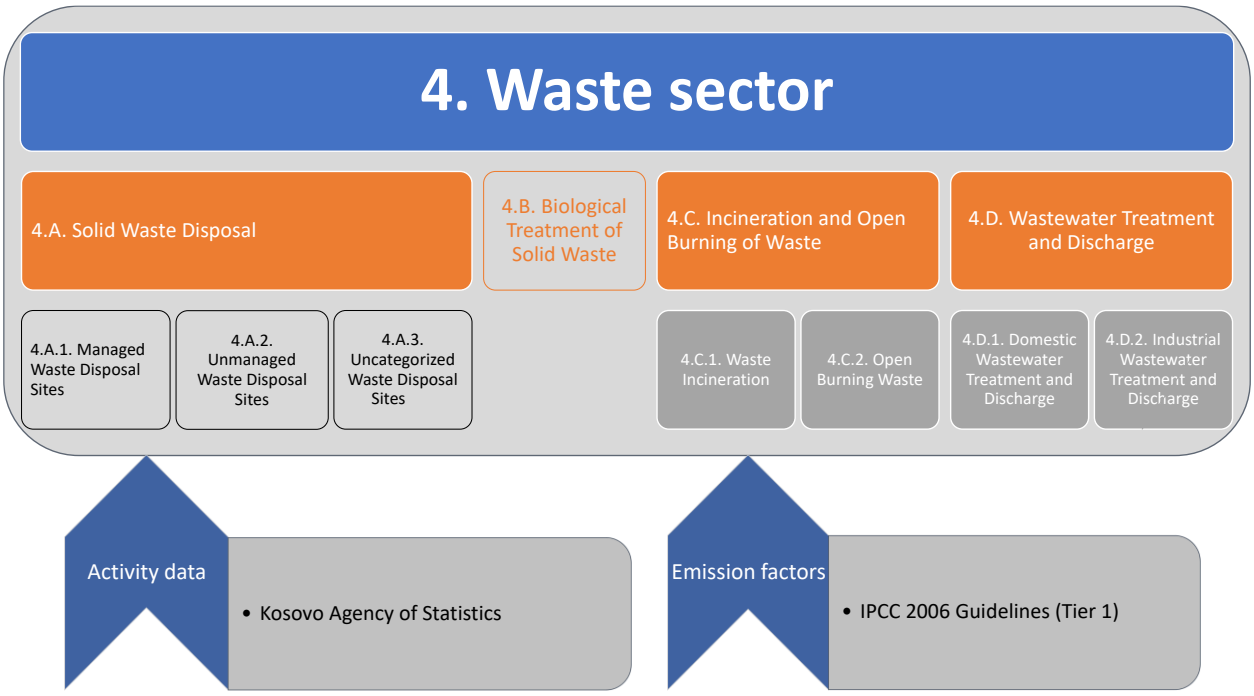
The desk research of the identified data sources showed that detailed information on activity data is available for the AFOLU sector that could be used to develop a consistent time series of emissions back to the year 2000. Most of the data are published by the Agency of Statistics. Data are also available on the land use and livestock population for some years before 2000. However, the gaps in data for specific categories (like land use) and the different sources of information might lead to higher uncertainties in emissions estimates for the period before 2000. Considering that the AFOLU sector is data-intensive and higher levels of uncertainty are already identified in the GHG inventory, the calculation of the historical emissions from this sector should be conducted in collaboration with sectoral experts.

3.4 Waste Sector

The waste sector contributed about 5% to the total greenhouse gas emissions in 2019. According to the IPCC 2006 Inventory Guidelines, the sector consists of four categories: solid waste disposal, biological treatment of solid waste, waste incineration and open burning of waste, and wastewater treatment and discharge (Figure 7). In the case of Kosovo, emissions from the second category do not occur. Most of the emissions in the waste sector originate from solid waste disposal. Second by contribution to the waste emissions is the category wastewater treatment and discharge, which represent the emissions only from the domestic wastewater due to the lack of data for the industrial wastewater treatment and discharge. For the third category, the emissions from incineration of clinical waste are estimated.

As stated in the inventory report, most of the data used to calculate the waste sector emissions are obtained from the Kosovo Agency of Statistics. However, expert judgment is considered in the absence of data in some cases.

Figure 7. Waste sector of the GHG inventory - categories reported, input data and data sources



During the scoping activity for the waste sector, several publications from KEPA were identified tackling municipal waste management, listed in Table 4. These publications contain data on the waste generation, collection, and disposal quantities back to year 2007. Most of them are already considered in the current inventory version, where the emission estimates for 2008 - 2019 are reported. In case there are historical data available at KEPA that are not published on their website, another meeting could be organized with their representatives to determine whether it is possible to obtain such data.

Table 4. List of mapped data sources relevant for GHG emissions from the Waste sector

Document/Database	Institution	Data available	Period covered	Access
Report on GHG emissions in Kosovo (GHG Inventory): – *First report published 2015 Second report published 2020*	KEPA (MESP)	GHG emissions by category	2008 – 2019 – first report: 2008 – 2013 – second report: 2014 - 2019	Reports available online at KEPA website – First report – Second report
Industrial Waste Survey	Kosovo Agency of Statistics (ASK)	- Total quantity of industrial waste generated and processed	- 2015 – 2020	Available online at ASKDATA Platform
Municipal Waste Survey	ASK	- Municipal waste generated - Municipal waste collected - Municipal waste disposed	2007 - 2020 2016 – 2020 2015 – 2017, 2019 - 2020	Available online at ASKDATA Platform
Waste Treatment Survey	ASK	- Waste treated	- 2017, 2019, 2020	Available online at ASKDATA Platform
Kosovo Municipal Waste Management Report	KEPA (MESP)	- Municipal waste generated - Municipal waste collected	2017 – 2020	Available online at KEPA website
Municipal Waste Management in Kosovo, Status report	KEPA (MESP)	- Amount of landfilled waste - Amount of collected and disposed waste	2016 - 2017	Report available online at KEPA website
Report on the Environment Situation	KEPA (MESP)	- Waste generation quantities - Average waste generation rate per capita	2006 - 2007	Report available online at KEPA website
State of Waste in Kosovo	KEPA (MESP)	- Municipal waste – produced, collected, and disposed quantities - Population - Coverage of waste collection services	2007 - 2008	Report available online at KEPA website
The State on Environment	KEPA (MESP)	- Municipal waste generated - Municipal waste collected	2008 - 2010	Report available online at KEPA website
The state of waste and chemicals report	KEPA (MESP)	- Waste generation (municipal and industrial) - Waste composition - State of landfills	2009 - 2013	Report available online at KEPA website

The mapping activity showed limited data (available online) for the waste sector for the period not covered by the current GHG inventory. Most of the identified data sources are already considered in the inventory. Based on the reports developed by KEPA, it is evident that there is a solid database for waste management in the institution. However, if necessary, there might be a possibility to estimate the historical emission of waste using the population and GDP data, combined with specific data from the national reports (waste composition and waste generation rate) or with the default values from the IPCC 2006 Guidelines.

4 Proposal for base year for the GHG emissions

Determining the appropriate base year as a reference point to track the changes in GHG emissions requires confidence in estimated GHG inventory trends. Usually, the base year is selected based on the availability of verifiable emission data. The base year selection also depends on whether the historical changes in the GHG emissions are analyzed or whether the future efforts to reduce GHG emissions are evaluated. In the first case, the base year is usually the country's national GHG inventory starting year. In the second case, the base year could be another representative year, e.g., a year with the highest emissions estimations, a year when a specific policy is implemented, etc. Nevertheless, having a consistent time series of emissions estimates is essential in both cases.

The outcome of the scoping activity under this assignment is twofold. It provides information on the data availability and the possibility of consistently extending the current GHG inventory of Kosovo and gives an insight into the level of emissions for the energy sector as the most significant contributor to the national GHG emissions.

Considering the expanding the historical emissions, in the case of Kosovo, the lack of reliable data for the years before 2000 that could be used to calculate a consistent time series of GHG emissions for all sectors over the period 1990 – 1999 eliminates the possibility of considering the year 1990 to be a starting year of the national GHG inventory.

There is a possibility to estimate the GHG emissions for 2000 but expanding the current inventory database for seven years backward (in a consistent manner) requires additional efforts and time. For some of the categories, however small their contribution is to the total emissions, the historical emissions trends could be extended by using some of the splicing techniques given in the IPCC 2006 Inventory Guidelines. For example, under this activity, the GHG emission estimations from the energy sector were extended starting from 1990 by applying the overlap technique. The extension was performed by combining the complete time series of GHG emissions from the electricity generation (from 1990 to 2020) with the currently available time series of the energy sector's emission estimations (from 2000 to 2020) reported to EEA. As the main driver of the energy sector's emissions, the emissions from electricity generation were calculated using the data on coal consumption gathered under this activity.

The analysis made for this report showed that there are available activity data to extend the emissions time series from 2000 for most of the categories in the energy and AFOLU sectors, which together account for 96% of the total GHG emissions in the country. For the waste sector, a solid waste management database exists in KEPA. Hence, the estimation of historical emissions from some of the waste categories (e.g., solid waste disposal sites) is possible by using the population and GDP data, combined with specific data from the national reports (such as waste composition and waste generation rate) or with the default values from the IPCC 2006 Guidelines. For the IPPU sector, another attempt to acquire factual activity data back to 2000 could be made in future GHG inventory activities. Still, currently, the only available estimations are those in the national GHG inventory from 2008. Nevertheless, such an extension of the current GHG inventory demands additional efforts and sectoral expertise. Therefore, it is recommended to be considered, to the extent possible, in some of the future GHG inventory updates.

Even though the extension of the GHG inventory was not performed as part of this study, an attempt was made to develop a consistent time series of the GHG emissions from the energy sector as the main contributor to the total GHG emissions, starting from 1990 to 2020. As described in detail in section 3.1, **the assessments made using the overlap method showed that the highest emissions from the energy sector occurred in 2016, estimated to be 9835 Gg CO_2-eq** (Figure 4). The same also applies to the total national GHG emissions, considering that the energy sector, on average, contributes to 87% of the total emissions. Hence, **based on the data from the national GHG inventory, the highest value estimated for the total GHG emissions was 10687 Gg CO_2-eq in 2016**.

As mentioned previously, the definition of the base year depends on reporting purposes. According to the requirements in the UNFCCC guidelines on reporting the annual national GHG emissions[4], most EU countries use 1990 as the base year, except Bulgaria, Hungary, Poland, Romania, and Slovenia (as countries with emerging economies). Also, in their future long-term strategies on climate action, again, most of the EU countries assessed their emission reductions against 1990 as a base year, except Belgium, Portugal, and Slovenia, which evaluated their emission reduction relative to the emissions level in 2005, and France compared to 2015.

Even though Kosovo is not a signatory to the Framework Convention on Climate Change (UNFCCC), as a potential candidate for EU membership, the country indirectly will have to meet the requirements arising from this convention. Considering climate change as a priority area, the government has set as objective in its strategic documents to develop the national capacity to meet the obligations that will arise from aligning its legislation with the EU climate acquis.

In terms of determining the base year of the GHG emissions for Kosovo, it is challenging to obtain verifiable estimations for 1990. Also, the research performed in this study showed that the extension of the current GHG inventory is possible for a few years backward but requires additional effort and time. Therefore, the definition of the base year in this report is made in terms of future efforts to slow down the greenhouse gas emissions growth. Based on the currently available GHG emissions estimates for all sectors, and considering the assessments made for the energy sector in this report, **the most appropriate base year for GHG emissions is 2016 as the year with the highest GHG emissions at the national level**.

[4] Decision 24/CP.19, UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to the Convention

5 Proposal for improvement of the National GHG Inventory

According to the 2006 IPCC Guidelines on GHG inventories, the underlying principles that a quality national GHG inventory must adhere to are Transparency, Accuracy, Completeness, Comparability, and Consistency (TACCC principles). The principles mean that:

- The inventory should provide sufficient and clear documentation on assumptions and methodologies used to estimate the emissions to facilitate replication of the assessments.
- The estimates in the inventory must be systematically neither over nor under actual emissions/removals, as far as can be judged according to the available data and information.
- Within the national greenhouse gas inventory scope, the estimates should be reported for all relevant categories of sources, sinks, and all gases, and the absence of some elements should be documented together with a justification for the exclusion.
- The estimates must be comparable with other countries by applying agreed methodologies and formats
- Ensuring the time series consistency of inventory estimates is essential for establishing confidence in reported inventory trends, which means the inventory boundaries, the applied methodologies, and data sources should be kept the same in all years.

Even though Kosovo has no regular obligation to report its GHG emissions, the country has compiled a GHG Inventory for the period 2008 – 2020. KEPA develops the GHG inventory as the institution responsible for collecting data and reporting them to the European Environment Agency. So far, two inventory reports have been published, which mainly provide the most relevant information on the GHG emissions in the country.

However, to fulfill the TACCC principles, based on the scoping activity performed in this report, the following recommendations for improvement of GHG inventory can be summarized:

- **Updating the sectoral estimations of the GHG emissions.** The mapped data sources indicate that activity data are available to extend the time series of emissions for some sectors (e.g., for the waste and AFOLU sector, consistent time series of emissions can be developed starting from 2000). Therefore, each inventory process should include revising the input data, considering data gaps and areas needing improvement identified in the previous inventory reports. If necessary (i.e., if more accurate activity data becomes available), the current reported years' emissions could be recalculated. All significant changes, such as improvements and recalculations, should be elaborated on in a separate chapter in the inventory report, contributing to the transparency and accuracy of the inventory process. The inventory developers should strive to present information which is as complete as possible, and if numerical data are not provided a the notation keys should be used as indicated in the IPCC Guidelines. Additionally, the information on the precursors and indirect emissions (i.e., emissions of carbon monoxide (CO), oxides of nitrogen (NOx), non-methane volatile organic compounds (NMVOCs), and sulphur dioxide (SO2)) can be included in the GHG inventory, to the extent possible, in line with the EMEP/EEA guidelines.

- **Improved documenting and archiving.** For each sector covered, the inventory report should provide information on the methodologies and background data used in the estimations, including a brief explanation of the sources of emission factors and activity data (with links wherever possible). This information can be summarized in a tabular format in a separate section of the sectoral chapters. The data documentation can also be included in the tools used for emission calculation (e.g., in the sectoral excel spreadsheets or as remarks in the IPCC Inventory software tool). Also, providing links to the appropriate data source will enable newcomers to the inventory process or relevant stakeholders to understand the data collection process and rationale behind selecting appropriate emission factors across the inventory. Such documenting procedure increases the long-term sustainability and transparency of the inventory process.

- **Implementing higher Tiers (more sophisticated methods) for emissions calculation wherever possible**. Implementing higher Tier methods, such as country-specific emission factors for the key source categories, is encouraged. Since most of the emissions originate from fossil fuel combustion activities, i.e., electricity generation using domestic coal, the development of country-specific emission factors for this category is recommended. A specific program for developing country-specific factors for the coal produced in Kosovo can be established in collaboration with the company responsible for the coal mining.

- **Establishing collaboration with other institutions.** Involving all relevant stakeholders from both the public and the private sector in the development of the GHG inventory will increase access to information, thus providing pertinent data for introducing higher Tier methodology and developing of country-specific emission factors, mainly since significant emitters of greenhouse gasses are source-point installations.

- **Developing a Quality assurance/Quality control (QA/QC) plan.** According to the IPCC guidelines, the QA/QC plan should be an internal document developed to organize and implement QA/QC and verification activities that ensure the inventory is fit for purpose and allow for improvement. Quality assurance and quality control measures are two distinct types of activities. The IPCC defines the Quality Assurance (QA) as a planned system of review procedures conducted by personnel NOT involved in the inventory development process. On the other hand, Quality Control (QC) is a system of routine technical activities implemented by the inventory development team to measure and control the quality of the inventory as it is prepared. The main elements of an effective QA/QC plan are: Personnel involved in QA/QC activities, General QC activities and procedures, Source-specific QC activities and procedures (optional, as resources allow), and QA review procedures. The development of the QA/QC plan should be based on in-depth analyses of the current practices of the inventory compilation in the country and the relevant international best practices. Once established, the QA/QC plan can be employed in subsequent inventory preparation or modified as appropriate (mainly when changes in processes occur) to improve the quality of the GHG Inventory prepared.

  Once the QA/QC Personnel is appointed, the general QC activities and procedures should focus on generic quality checks related to data gathering, input, handling, documentation, and emissions calculation, that apply to all inventory source and sink categories. The source-specific QC activities and procedures, if used, require knowledge of the specific category, the types of data available, and the parameters associated with emissions or removals and are usually applied on a case-by-case basis focusing on key categories. The QA procedures should include reviews and

audits to assess the inventory's quality, determine the adequacy and conformity of the procedures taken, and identify areas where improvements could be made. This process should involve reviewers who can conduct an unbiased inventory review, usually independent experts from other agencies or national or international experts not closely connected with the national inventory compilation, e.g., inventory experts from other countries.

Implementation of some of the proposed improvements would require additional training of the inventory team, preferably through sharing the experiences of some EU countries that have overcome similar obstacles in their GHG inventory process.

6 Appendix: Data received from institutions and companies as part of the project activity

6.1 Energy sector

Table 5. Coal consumption in thermal power plants (KEK data)

Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Coal consumption (t)	7088779	6619424	6539041	5758341	5721901	6123635	6691783	7468513	7089852	2874577
Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Coal consumption (t)	3143535	4332253	5348843	6052196	5636311	5802919	5915786	6671075	7328168	8103059
Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Coal consumption (t)	8250377	8291678	8307993	7898382	7152777	8145395	8538257	7857724	7618145	8384561
Year	**2020**	**2021**								
Coal consumption (t)	9055012	8737723								

Source: Kosovo Energy Corporation (KEK) (provided upon request by MESP)

Estimation of GHG emissions

Table 6. Estimated emissions from electricity generation in thermal power plants (using KEK data)

Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
CO_2 ($GgCO_2$-eq)	5584.5	5214.8	5151.5	4536.4	4507.7	4824.2	5271.8	5883.7	5585.4	2264.6
CH_4 ($GgCO_2$-eq)	1.2	1.1	1.1	0.9	0.9	1.0	1.1	1.2	1.2	0.5
N_2O ($GgCO_2$-eq)	25.7	24.0	23.7	20.9	20.8	22.2	24.3	27.1	25.7	10.4
Total ($GgCO_2$-eq)	**5611.4**	**5239.9**	**5176.2**	**4558.2**	**4529.4**	**4847.4**	**5297.2**	**5912.0**	**5612.3**	**2275.5**
Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
CO_2 ($GgCO_2$-eq)	2476.5	3412.9	4213.8	4767.9	4440.3	4571.5	4660.5	5255.5	5773.1	6383.6
CH_4 ($GgCO_2$-eq)	0.5	0.7	0.9	1.0	0.9	1.0	1.0	1.1	1.2	1.3
N_2O ($GgCO_2$-eq)	11.4	15.7	19.4	22.0	20.4	21.0	21.5	24.2	26.6	29.4
Total ($GgCO_2$-eq)	**2488.4**	**3429.4**	**4234.1**	**4790.9**	**4461.7**	**4593.5**	**4682.9**	**5280.8**	**5800.9**	**6414.3**
Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
CO_2 ($GgCO_2$-eq)	6499.6	6532.2	6545.0	6222.3	5635.0	6416.9	6726.4	6190.3	6001.6	6605.4
CH_4 ($GgCO_2$-eq)	1.4	1.4	1.4	1.3	1.2	1.3	1.4	1.3	1.2	1.4
N_2O ($GgCO_2$-eq)	29.9	30.1	30.1	28.6	25.9	29.5	31.0	28.5	27.6	30.4
Total ($GgCO_2$-eq)	**6530.9**	**6563.6**	**6576.5**	**6252.3**	**5662.1**	**6447.8**	**6758.8**	**6220.1**	**6030.5**	**6637.1**
Year	**2020**	**2021**								
CO_2 ($GgCO_2$-eq)	7133.5	6883.6								
CH_4 ($GgCO_2$-eq)	1.5	1.4								
N_2O ($GgCO_2$-eq)	32.8	31.7								
Total ($GgCO_2$-eq)	**7167.9**	**6916.7**								

Note: Average calorific value of lignite – 7800 kJ/kg; Default emissions factors: CO_2 – 101000 kg/TJ, CH_4 – 1 kg/TJ, N_2O – 1.5 kg/TJ; Global Warming Potentials (GWP) from IPCC SAR: CH_4 – 21 kg CO_2-eq/kg, N_2O – 310 kg CO_2-eq/kg

Source: Activity data form Kosovo Energy Corporation (KEK) (provided upon request by MESP)

Table 7. Coal consumption in thermal power plants (Eurostat data)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Coal consumption (ktoe)	931.7	1182.9	1174.7	1238.3	1268.3	1196.9	1196.2	1261.4	1345.4	1537.7
Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Coal consumption (ktoe)	1597.9	1540.0	1462.3	1508.1	1304.1	1517.4	1587.7	1332.5	1421.1	1485.2
Year	**2020**									
Coal consumption (ktoe)	1511.5									

Source: Eurostat – Energy Balances

Table 8. Estimated emissions from electricity generation in thermal power plants (using Eurostat data)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
CO_2 (Gg CO_2-eq)	3940.0	5002.2	4967.6	5236.3	5363.1	5061.3	5058.2	5334.0	5689.4	6502.6
CH_4 (Gg CO_2-eq)	0.8	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.2	1.4
N_2O (Gg CO_2-eq)	18.1	23.0	22.9	24.1	24.7	23.3	23.3	24.6	26.2	29.9
Total ($GgCO_2$-eq)	**3959.0**	**5026.3**	**4991.5**	**5261.5**	**5389.0**	**5085.7**	**5082.5**	**5359.7**	**5716.7**	**6533.9**
Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
CO_2 ($GgCO_2$-eq)	6757.1	6512.0	6183.5	6377.3	5514.4	6416.7	6713.8	5634.7	6009.6	6280.3
CH_4 ($GgCO_2$-eq)	1.4	1.4	1.3	1.3	1.1	1.3	1.4	1.2	1.2	1.3
N_2O ($GgCO_2$-eq)	31.1	30.0	28.5	29.4	25.4	29.5	30.9	25.9	27.7	28.9
Total ($GgCO_2$-eq)	**6789.6**	**6543.4**	**6213.2**	**6408.0**	**5541.0**	**6447.6**	**6746.1**	**5661.8**	**6038.5**	**6310.6**
Year	**2020**									
CO_2 ($GgCO_2$-eq)	6391.4									
CH_4 ($GgCO_2$-eq)	1.3									
N_2O ($GgCO_2$-eq)	29.4									
Total ($GgCO_2$-eq)	**6422.2**									

Note: Default emissions factors: CO_2 – 101000 kg/TJ, CH_4 – 1 kg/TJ, N_2O – 1.5 kg/TJ; Global Warming Potentials (GWP) from IPCC SAR: CH_4 – 21 kg CO_2-eq/kg, N_2O – 310 kg CO_2-eq/kg

Source: Eurostat – Energy Balances

6.2 IPPU Sector

Table 9. Key indicators of performance – data provided by Sharrcem

- INDIKATORET E PERFORMANCES	1990	2000	2003	2018	2019	2020	2021
CLINKER PRODUCTION [t/Y]	233,641	86,660	221,630	450,889	431,342	365,140	346,682
CEMENT PRODUCED [t/Y]	310,611	91,627	373,310	756,002	697,104	599,067	628,869
TOTAL CO_2 EMISSION [t CO_2/Year]	197,841	83,870	191,683	408,332	393,692	331,231	318,605
SPECIFIC CO2 EMISSION [kgCO2/t cement]	631	775	583	610	604	597	578
ELECTRICAL ENERGYCONSUMPTION [MWh/yr]	40,000	30,579	45,679	74,295	69,585	56,852	56,647
KILN SPECIFIC THERMAL ENERGY CONSUMPTION (STEC),MJ/kgclink]	993	1,367	1,004	816	829	809	843
SPECIFIC ELECTRICAL ENERGY CONSUMPTION (SEEC), [kWh/t cem]	129	334	122	98.3	99.8	94.9	90

Source: Sharrcem cement factory (provided upon request by MESP)