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Glossary

Aarhus Convention	The United Nations Economic Commission for Europe (UNECE) Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (hereinafter referred to as the Aarhus Convention) was adopted on 25th June 1998
(A)AQD	(Ambient) Air Quality Directive. Refers to: Directive 2008/50/EC on ambient air quality and cleaner air for Europe
AD	Activity data
AFD	Air Framework Directive. Refers to: Directive 2008/50/EC on ambient air quality and cleaner air for Europe
BC	Black carbon (carbon black)
CAFE	Clean Air for Europe. Refers to: Directive 2008/50/EC on ambient air quality and cleaner air for Europe
CAPE	Clean Air Program for Europe (2013)
CEIP	Centre on Emission Inventories and Projections
CLRTAP	Convention on Long Range Transboundary Air Pollution
COP	Conference of the Parties to the UNFCCC
CORINAIR	(EEA / ETC) CORe INventory AIR emissions (software tools)
DCM	Decision of the Council of Ministers (Albania)
E	Emissions
EC	European Commission
EEA	European Environment Agency
EEA / COPERT	EEA software programme to calculate emissions from road transport
EEC	European Economic Community
EF	Emission factor
EIONET	European Environment Information and Observation Network
ELV	Emission limit value
EMEP	European Monitoring and Evaluation programme (under CLRTAP)
E-PRTR	European Pollutant Release and Transfer Register [Regulation (EC) No. 166/2006]
ETC(s)	European Topic Centre(s)
EU	European Union
EU-15 / EU-28	Refers to: former 15 EU Member States / 28 EU Member States
Eurostat	Refers to: European statistics website
GB	EMEP/EEA air pollutant emission inventory guidebook 2016
Gg	Gigagram
GHG(s)	Greenhouse gas(es)
Guidebook 2016	EMEP/EEA air pollutant emission inventory guidebook 2016
GWP	Global warming potential
HCB	Hexachlorobenzene
HDV(s)	Heavy duty vehicle(s)
IBECA	Refers to this project on: Institution Building for Enforcing the Environmental and Climate *Acquis*
IED	Refers to: Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control)
IIR	Informative inventory report
inter alia	"among other things"
IPCC	Intergovernmental Panel on Climate Change
IPPC(D)	Refers to: Directive 2008/1/EC on integrated pollution prevention and control
kWH	Kilowatt hour
LCP(D)	Large Combustion Plant (Directive)
CLRTAP	Convention on Long Range Transboundary Air Pollution
LULUCF	Land use, land use change and forestry
Mg	Megagram
MoTE	Ministry of Tourism and Environment, Albania (formerly Ministry of Environment)
MoTI	(Former) Ministry of Transport and Infrastructure
MS(s)	(EU) Member State(s)
NA	Not applicable - the source exists but relevant emissions are considered not to occur
NE	Not estimated - emissions occur, but have not been estimated or reported
NEA	National Environment Agency (Albania) (formerly the Agency for Environment and Forestry)

NEC(D)	Refers to: Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants (as amended)
NFP(s)	National Focal Point(s)
NFR	Nomenclature for reporting
NIS	National Inventory System
NLC	National Licensing Centre (Albania)
NMVOC(s)	Non-methane volatile organic compounds
No.	Number
NO	Not occurring - a source or process does not exist within the country.
NOx	Oxides of nitrogen
NRC(s)	National Reference Centre(s)
OECD	Organisation for Economic Co-operation and Development
PAH(s)	Polycyclic aromatic hydrocarbon(s)
PCB(s)	Polychlorinated biphenyl(s)
PM_{10}	Particulate matter of 10 microns (or less)
$PM_{2.5}$	Particulate matter of 2.5 microns (or less)
POP(s)	Persistent Organic Pollutant(s)
REA	Regional Environment Agency
QA	Quality assurance
QC	Quality control
REC	Regional Environment Centre
ROD	(EEA / EIONET) Reporting Obligations Database
SAA	Stabilisation Association Agreement
SD	Standard deviation
SED	Solvents Emissions Directive. Refers to: Directive 1999/13/EC on limitation of VOCs due to solvent use in industry
SEIS	Shared Environmental Information System
SOx	Oxides of sulphur
TCCCA	Transparency, Consistency, Completeness, Comparability and Accuracy
TFEIP	Task Force on Emission Inventories and Projections
TPP	Thermal treatment plant
TSP	Total suspended particulates
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change (UNFCCC)
US EPA	United States (of America) Environmental Protection Agency
uv	Ultra violet
VOC(s)	Volatile organic compound(s)
WID	Waste Incineration Directive. Refers to: Directive 2000/76/EC on the incineration of waste
µm	micron
%	Percent(age)

1 EXECUTIVE SUMMARY

The informative inventory report for 2016 is divided into eight sections and presents emission data for macro-pollutants, as discussed in the report.

This executive summary is followed by a background section which addresses country-specific information relevant to sectoral emissions and changing practices in activities and enterprises likely to impact significantly on emission sources and loads during the assessed period.

The background information refers to the changed focus of activities, enterprises and transport during transition from communism to democracy and how the transition affected the industry and energy sectors, in particular, including major transformations associated with the transport and mineral subsectors.

The subsequent section (section 3) deals with the main pieces of EU and international legislation that have been formulated and enacted during recent decades as tools for addressing and facilitating reduction of the adverse impacts of polluting emissions to air. The section refers to the main pollutants and to EU legislation and international treaties, agreements, conventions and protocols focused on air pollution prevention, control and reporting. It discusses the Clean Air Package and Clean Air Programme for Europe and highlights the importance of adherence to key implementing decisions and regulations in order to ensure compliance, normalisation and standardisation of reporting.

Section 4 deals with air pollution prevention and control legislation recently adopted in Albania in compliance with EU and international laws and commitments and refers to a particular need for better control and enforcement of existing national legislation. The section also addresses Albania's emission reporting obligations and deficits with particular reference to selected macro pollutants in air.

Section 5 of the report provides an introduction to the EMEP / EEA 2016 Emission Inventory guidebook. Earlier versions of the guidebook had 11 NFR categories but amalgamation of energy sectors reduced the number of NFR sectors to 6. The main change in the 2016 guidebook relative to the previous version is further isolation of industrial subsectors. It's important for MSs and candidate countries to streamline and standardise reporting so that direct comparisons can be made between country contributions and consequently shape a consensual mechanism for reduction in pollutants as well as providing a platform for assessment of spatial and temporal trends. Although the 2016 guidebook replaces all previous editions, it refers to relevant topics of past issues, requiring reference to previous versions of the guidebook.

Section 6 of the IIR discusses the importance of utilising best quality data. It emphasises the need to comply with TCCCA criteria - **transparency** associated with provision of access to adequate information on polluting emissions that adversely impact on health and the environment and provision of information to the public on these issues; **consistency** and **comparability** of data to identify spatial and temporal trends and allow direct comparison to be made between results from participating countries; **completeness** and

accuracy of data and data sets to ensure totality and correctness of information and QA and QC procedures to compile, certify and report quality data.

Section 7 of the report relates to the methodology used to develop the emission inventory including, planning, identification of key polluting sources, activity data, data sources and completeness of data sets. The section also addresses issues associated with data research, collection, input and storage, manipulation and reporting format.

The final section 8 discusses the main pollutants, their origins and contribution by NFR sector and subsector. It evaluates major gaps in information and the lack of ease of accessibility to emission data which is deemed to be "confidential" by both private and public bodies. It provides comment and evaluation of reported results and emission estimates and makes recommendations to ensure more complete and better quality data in future. The section expounds the results of the emission inventory and identifies shortfalls in available data. It presents tables, charts and graphs to display the results of investigations, annual variations and NFR sector impacts. Comments and remarks associated with inventory data are provided and the section explains possible causes for annual variations in emission loads.

The text of the report is complemented by 4 annexes which provide information on, *inter alia*, activity data, information sources, charts and graphics, sector contributions, emission factors and presents an inventory of emissions in accordance with the EMEP/EEA guidebook 'nomenclature for reporting' format.

Annex 1 is an Excel spreadsheet which contains the NFR sector and subsector emission factors and activity, source, subsector, sector and sum total emission loads. The annex also provides 'in-cell' comments related to data sources, data collection and points of reference.
Annex 2 contains tables, calculations, charts and graphs developed for the inventory report.
Annex 3 gives a breakdown of energy consumption for 'industrial production and product use' subsector.
Annex 4 is the emission inventory for the period from 1990 to 2016. Since the 1990 to 2015 emission inventory was already published in 2017, the inventory has been updated to include only revised and updated data for 2016.

2 BACKGROUND

In the period from 1944 to the first pluralist elections in 1991 Albania's communist government was isolated and esoteric and little was known about either the country's factual industrial production or wealth. The secrecy of the communist period, although rapidly declining, still manifests itself throughout many aspects of Albanian economic activities.

Despite its abundance of mineral wealth, Albania was, and still is deemed to be among the poorest countries in Europe in terms of the level of generic living standards among the working population.

The economy during the Hoxha era (1944 to 1985) was run through a system of centralised planning and state ownership of industrial activities and farming practices which were integrated with food production processes. Production from the agricultural sector continued to be limited mainly to the western part of the country due to relatively high mountain ranges along the eastern part. Fertile arable land is estimated at one-quarter of the total and is limited mainly to a relatively narrow strip along the Adriatic and Ionian coastal plains and in valley areas between mountain ranges. Nonetheless, the government claimed self-sufficiency in grain during the communist period and up to 50 % of the working population depended on farming. In terms of economic production, agriculture was out-performed by the industrial sector during the 1970s and 1980s but slowed down significantly with the advent of democracy in 1992. As ownership of arable land, already limited by mountainous regions, began to return to private possession there were numerous reports in the 1990s and early 2000s of intentional burning of wastelands, scrublands and forests as a means of attaining farming area extensions through illegal arable land reclamation.

Industrial production in the communist era included oil and petroleum products (asphalt and bitumen), food processing, textiles and clothing, lumber, cement, chemicals, basic metals and metallic ores (iron, ferro-nickel, copper, chromium), hydropower, vegetables, fruit and tobacco. From the late 1970s through to 1990[4], it was the principal chromite-producing country in Europe. Prolific production processes allowed Albania to export petroleum and base metals and ores to Italy and neighbouring countries in the Balkans and in Eastern Europe.

The period during and after the transition from communism to democracy (the early 1990s) resulted in major unemployment and increased poverty, as many of the main industrial activities closed or operated with substantially reduced outputs. During the early stages of democracy, the heavy industrial sectors (metal and coal mining, metallurgy, iron and steel, chromium, nickel, copper, etc.) almost collapsed. Nonetheless, the country remains rich in mineral resources and has the largest land-based (on-shore) oil reserves in Europe. However, the rate of oil extraction has decreased since the 1970s. It is estimated that the amount of crude oil extracted during the 1980s varied from 1.2 to 1.5 million tonnes per annum[5]. There were severe reductions in production the 1990s but in recent years production is of the order of 1 million tonnes per year a major part of which is refined outside the country.

[4] http://www.encyclopedia.com/places/spain-portugal-italy-greece-and-balkans/albanian-political-geography/albania#AGRICULTURE
[5] Raymond Zickel and Walter R. Iwaskiw, editors. *Albania: A Country Study*. Washington: GPO for the Library of Congress, 1994.

Albania's coal mines produced about 2.1 million tons in 1987. The coal, was being mined mainly in central Albania. It was lower grade brown lignite which had a low calorific value making the industry unprofitable due to continually reducing internal demand since the early 1990s.

Mineral resources in Albania are located mainly in the mountainous northern part of the country. The main ores extracted are iron, ferrochromium, ferronickel, copper, bitumen, gypsum and salt. Old equipment and rudimentary mining techniques have also impeded progress in mining and metallurgical industries as has the increased cost of extraction and smelting. Instability in the late 1980s and early 1990s caused an economic collapse and led to the closure of many mines and related industries.

In recent years revenue from tourism has stimulated the economy. Currently, the country's main exports are textiles and leather goods, ores, oil and oil products.

Albania's dependency on oil sources for domestic and industrial production was 43 % in 1971 but its reliance on oil steadily decreased over the following 4 decades. In 1980 the country produced 3.6 billion kWH of electricity of which ~21 % was from oil sources (crude oil and refined petroleum products). Production increased to 4.3 billion kWH in 1987, of which ~24 % was from oil sources[6]. In 1988 electric power output from hydropower was estimated at 3,984,000 megawatt hours, although droughts in the late 1980s caused some fluctuations in outputs and necessitated the purchase of back-up energy supply systems for use on industrial production lines and in significant commercial and institutional enterprises including shops, supermarkets, restaurants and hotels. Although the exact number of "company owned" generators used to supplement energy supplies during the 1980s and 1990s is not known, it is estimated that there were several thousand being used. Moreover, most were low efficiency systems with open unfiltered exhausts and their hours of use depended on their locations nationally and the frequency and extent of localised power cuts.

Since 1992 more than 90 % of the Albania's domestic electricity has come from hydropower and there is capacity within the country to readily increase this production three-fold. By 2013 Albania was producing 100 % of its domestic electricity from hydropower making the country unique in Europe in this regard.
With a Mediterranean climate and expansive mountain valleys, the country also has vast untapped potential for solar power, *via* solar panels, wind energy from turbines and geothermal energy. In recent years there has been an increase in the use of solar panels but there is considerable further potential. The use and future expansion of hydropower together with Albania's capacity for exploitation of other means of alternative energy makes it a leader in Europe regarding its potential for non-fossil fuel (alternative) energy production. This places the country in an environmentally enviable position because of its current use and further potential to deliver renewable energy for both national consumption and export.

[6] IEA Statistics © OECD/IEA 2014 (http://www.iea.org/stats/index.asp), subject to https://www.iea.org/t&c/termsandconditions/

3 LEGISLATIVE FRAMEWORK AND COMPLIANCE REQUIREMENTS

3.1 The Geneva Convention

The 1979 Geneva Convention (in force, 1983) referred to as the UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP) was extended by eight protocols from 1984 to 1989 (some of which have since been amended). The Convention and its protocols cover the following eleven substances or groups of substances:

1. sulphur dioxide;
2. oxides of nitrogen;
3. non-methane volatile organic compounds;
4. ammonia;
5. $PM_{2.5}$ (i.e. particulates <2.5 µm);
6. lead;
7. cadmium;
8. mercury;
9. dioxins and furans;
10. polycyclic aromatic hydrocarbons;
11. hexachlorobenzene.

Monitoring and reporting on these substances or groups of substances is required by parties to the Convention. Twice a year the UNECE secretariat, in cooperation with the Centre on Emission Inventories and Projections (CEIP), compiles overview tables of emission data, by pollutant, in relation to the respective emission reduction obligations set for each Party under the **eight** protocols to the CLRTAP. The protocols are:

1. 1984, Geneva Protocol on long-term financing of the CLRTAP EMEP programme;
2. 1985, Helsinki Protocol on SO_2 emission reduction and fluxes;
3. 1988, Sofia Protocol on NO_X emission reduction and fluxes;
4. 1991, Geneva Protocol on VOCs and transboundary fluxes;
5. 1994, Oslo Protocol on further reducing SO_2;
6. 1998, (as amended in 2012); Aarhus Protocol on heavy metals;
7. 1999, (as amended in 2009); Aarhus Protocol on Persistent Organic Pollutants (POPs);
8. 1999, (as amended in 2012); Gothenburg Protocol on abatement of acidification, eutrophication and ground-level ozone.

3.2 The Montreal Protocol and Vienna Convention

The 1987 Montreal Protocol (in force, 1989) is a protocol to the 1985 Vienna Convention (in force, 1988) which is an international treaty devised to protect the ozone layer by phasing out the production of numerous substances that are known to cause ozone depletion. The key substances or groups of substances are: chlorofluorocarbons; halons; carbon tetrachloride; methylchloroform;

hydrobromofluorocarbons; hydrochlorofluorocarbons; methyl bromide and bromochloromethane. Specific monitoring and reporting as well as implementing measures to reduce these substances or groups of substances is required from Parties to the Convention.

3.3 The Gothenburg Protocol

The Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone sets national emission ceilings for four major causative pollutants. These are nitrogen oxides (NO_X) sulphur dioxide (SO_2), volatile organic compounds (VOCs) and ammonia (NH_3). Under the Gothenburg Protocol, Parties are required to report on their emissions once a year and to provide projections of their future emissions.

3.4 The United Nations Framework Convention on Climate Change

The United Nations Framework Convention on Climate Change (UNFCCC) had its origins at the Earth Summit in Rio de Janeiro in 1992. Its objective is to reduce and stabilise anthropogenic greenhouse gas emission at a level that will not adversely impact on the environment. The UNFCCC is an international treaty adopted in May 1992 and opened for signature at the Rio Earth Summit in June 1992. It entered into force in March 1994. Its objective is to stabilise GHG concentrations in the atmosphere at a level that would prevent anthropogenic interference with the climate system. The framework sets non-binding limits on greenhouse gas emissions for individual countries and contains no enforcement mechanisms. The UNFCCC outlines how specific international protocols may be negotiated to specify further action towards the objective of the UNFCCC.

The Parties to the UNFCCC have met annually from 1995 in Conferences of the Parties (COPs) to assess progress. In 1997, the Kyoto Protocol established legally binding obligations for developed countries to reduce their greenhouse gas emissions in the period 2008-2012. The 2010 Cancun agreements state that future global warming should be limited to below 2.0 °C (3.6 °F) relative to the pre-industrial level. The Kyoto Protocol was amended in 2012 to encompass the period 2013-2020 in the Doha Amendment. In 2015 the Paris Agreement was adopted, governing emission reductions from 2020 onward. The Paris Agreement entered into force on 4th November 2016.

The UNFCCC requires signatory nations to establish national greenhouse gas (GHG) inventories, emissions and removals. The amounts reported are related to the 1990 benchmark levels for accession of Annex I countries to the Kyoto Protocol and for the commitment of those countries to GHG reductions. Updated inventories must be submitted annually by Annex I countries.

The UNFCCC Secretariat functions were amplified through the parallel efforts of the IPCC with the aim of getting consensus through meetings and discussions on various implementation strategies.

The ultimate objective of the UNFCCC is to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Consequently, the UNFCCC, as extended by the Kyoto Protocol, requires parties to reduce and stabilise anthropogenic greenhouse gas emissions as a means of addressing global warming.

3.5 The Kyoto Protocol

The Kyoto Protocol (1992) is an international treaty that extends the 1992 UNFCCC and commits Parties to reduce greenhouse gas emissions, based on evidence of the contribution of man-made CO_2 emissions to global warming.

The main greenhouse gasses (GHGs) can be divided into the following substances and groups of substances:

- Water vapour (H_2O);
- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O);
- Ozone (O_3);
- Fluorinated gases: Chlorofluorocarbons (CFCs); Hydrofluorocarbons (including, HCFCs, HFCs); Perfluorocarbons (PFCs); Sulphur hexafluoride (SF_6); Nitrogen trifluoride (NF_3).

The "greenhouse gas effect" of the main greenhouse gasses are significantly different.

Water vapour has an intense infrared absorption spectrum with more and broader absorption bands than CO_2. Its GWP varies due to variations in atmospheric temperatures and pressures and resultant changes in water vapour concentrations. Nonetheless, it is persistent (always present) in the atmosphere, mostly in relatively high concentrations and so is a major contributor to global warming.

Carbon dioxide (CO_2) is the greenhouse gas that is being used as a reference its global warming potential (GWP) is given a value of 1, irrespective of its breakdown period. Nonetheless, the contribution of CO_2 to global warming can last many thousands of years. The GWP of other greenhouse gasses are compared to CO_2, as a baseline reference and results of their impacts are expressed as multiples of the impacts of CO_2 i.e. kg of CO_2 equivalent.

It is estimated that methane (CH_4) has a GWP of 28 - 36 over 100 years, although its breakdown / oxidation in the atmosphere takes about 1 decade. Methane absorbs significantly more energy than CO_2 and its GWP is estimated on a balance between its shorter lifetime in the atmosphere and its substantial energy absorbtion, relative to CO_2.

The GWP of nitrous oxide is estimated at 310 (UNFCCC) over 100 years timescale as it is both a high absorber and persistent in the atmosphere for over 100 years.

Ozone depletion provides a more precise explanation for observed global warming than greenhouse-warming theory[7]. Tropospheric (ground-level) ozone is a greenhouse gas because it instigates and regulates the chemical removal of methane and other hydrocarbons from the atmosphere. Accordingly, it can regulate how long these compounds remain in the air.

Fluorinated gases are unlike other GHGs in that they do not result from natural sources. They are the result of human-related activities and are emitted through a variety of industrial processes. Although there are significantly less amounts of fluorinated gasses in the atmosphere than the amount of CO_2 and

[7] Author: L. Ward, Peter. Source: Current Physical Chemistry. Volume 6, Number 4, December 2016, pp. 275-296(22). Publisher: bentham Science Publishers.

methane, their GWPs (compared to CO_2) are extremely high because of both their reactivity and persistence.

GWPs of a specific GHG depends on, its absorption of infrared radiation, the wavelengths of its absorbing spectrum and its persistence (lifetime) in the atmosphere. High GWPs correlate with enhanced infrared absorptions, prolonged atmospheric lifespans and optimised absorbing spectra. Fluorinated gases are the most powerful and persistent groups of greenhouse gases emitted as a result of human activities. It is estimated that some PFCs, for example, can remain in the atmosphere for up to 50,000 years.
Based on existing knowledge, groups of fluorinated gasses have been given the following GWPs over a one hundred year period:

HFCs: GWP up to 14,800;
PFCs: GWP 7,390 - 12,200;
NF_3: GWP 17,200;
SF_6: GWP 22,800.

The UNFCCC has listed GWPs for individual fluorinated gasses.
There are some other substances or groups of substances which contribute to the greenhouse gas effect such as carbon monoxide (CO) and hydrogen chloride (HCl) as they also absorb infrared radiation. However, their contributions to the "greenhouse gas effect" are minor as they are reactive and relatively soluble so that their presence in the atmosphere is transient and short-lived.

3.6 The National Emission Ceilings Directive

Under the 2001 National Emission Ceilings Directive (NECD, 2001/81/EC) and the Gothenburg Protocol to the UNECE LRTAP Convention, the European Commission established more stringent emissions ceilings for NO_X, SO_X, NMVOCs and NH_3 in 2010. The revision of the Gothenburg Protocol in May 2012 established stricter emission reduction obligations from 2020. The Protocol has been extended to set emission reductions also for $PM_{2.5}$. The revised NECD sets emission ceilings for 2020 (in line with Gothenburg Protocol ceilings) and further establishes emission ceilings for 2030 for the same suite of air pollutants.

In 2016, a new National Emission Ceilings Directive (NECD, 2016/2284/EU) replaced the older NECD (2001/81/EC). The NECD establishes national emission reduction commitments for both the EU MSs and the Union for five main air pollutants, as follows: nitrogen oxides (NOx), non-methane volatile organic compounds (NMVOCs), sulphur dioxide (SO_2), ammonia (NH_3) and small particulates ($PM_{2.5}$). These are deemed to be the main emissions adversely impacting human health and the environment.

The new NECD sets 2020 and 2030 emission reduction commitments for the five above mentioned macro air pollutants and requires that emission ceilings for 2010 set in the 2001 NECD remain applicable for EU MSs until the end of 2019. The 2016 NECD transposes reduction commitments for 2020 agreed by the EU and its Member States under the revised 2012 Gothenburg Protocol to the 1979 CLRTAP. Reduction commitments agreed for 2030 are designed to reduce the adverse health impacts of air pollution by half compared with 2005. The 2016 Directive also introduces several new reporting requirements for MSs as per Annex I of the Directive. These include, annual information on emissions and projections of additional pollutants, as follows:

- the five main air pollutants NO_x, NMVOCs, SO_2, NH_3 and $PM_{2.5}$ as well as carbon monoxide (CO);
- in addition to $PM_{2.5}$, also PM_{10} particulate matter and, if available, black carbon (BC) and total suspended particulate matter (TSP);
- heavy metals cadmium (Cd), lead (Pb) and mercury (Hg) and, if available, the additional heavy metals arsenic, chromium, copper, nickel, selenium and zinc);
- persistent organic pollutants (POPs) including selected polycyclic aromatic hydrocarbons (PAHs), dioxins and furans, polychlorinated biphenyls (PCBs) and hexachlorobenzene (HCB).

The new (2016) NECD further requires that Member States draw up National Air Pollution Control Programmes that are expected to contribute to the successful implementation of air quality plans established under the EU's 2008 Air Quality Framework Directive (AQFD, 2008/50/EC). The new (2016) National Emission Ceilings Directive requires that EU MSs (and by inference, Candidate countries) and the Union pledge to establishing national emission reduction commitments for each of the five main air pollutants within the scope of the Directive.

3.7 The Industrial Emissions Directive

The Industrial Emissions Directive (IED) rolls seven former standalone directives associated with industrial emissions into one "Industrial Emissions Directive". The seven former directives included in the IED are: The Integrated Pollution Prevention and Control Directive (IPPCD, 2008/1/EC), 3 titanium dioxide directives (78/176/EEC & 82/883/EEC & 92/112/EEC), the Large Combustion Plant Directive (LCPD, 2001/80/EC), the Solvent Emissions Directive (SED, 1999/13/EC) and the Waste Incineration Directive (WID, 2000/76/EC). Annex II of the Industrial Emissions Directive provides a list of 13 main air pollutants or groups of pollutants from larger industrial activities which are listed in Annex I of the Directive. Emission limit values need to be established in accordance with the Directive's Article 14 permit conditions for these polluting emissions. The specified pollutants include, among the 13 Annex II categories, greenhouse gases where emission are likely to exceed specified thresholds.

Within the scope of the IED, emission limit values (ELVs) are required to be established for pollutants listed in its Annex II associated with activities listed in its Annex I. Permits issued in accordance with the IED establish emission limit values (ELVs) for pollutants likely to derive from any activity under the scope of the Directive.

3.8 The European Pollutant Release and Transfer Register

The European Regulation (EC) No. 166/2006 concerning the establishment of a European Pollutant Release and Transfer Register (E-PRTR) was transposed into Albanian law in September 2015 through Decision No. 742 of 09.09.2015.

Annex I of the Regulation refers to 9 sectors of polluting activity and associated sub-sectors. These include 71 categories of emissions to water, 61 categories to land and 60 categories to air with 33 overlapping categories. The E-PRTR Regulation implementation is being dealt with through a parallel technical assistance project in Albania. The E-PRTR Regulation requires MSs and other Parties to report on 91 specific Annex II pollutants to air, water and land, as appropriate, where annual loads exceed the thresholds defined in Annex II of the Regulation for the specific activities listed in its Annex I.

3.9 The Air Quality Framework Directive

In 2008 the Commission consolidated the first Air Framework Directive (96/62/EC) and the first three daughter directives into a single Ambient Air Quality Directive (2008/50/EC) which also set objectives for fine particulate matter ($PM_{2.5}$). Together with the fourth daughter Directive 2004/107/EC, the Ambient Air Quality Directive provides the current framework to characterise the ambient impact of the macro pollutants within its scope and consequently reduce and the concentrations of these pollutants in the EU. The Air Quality Framework Directive (AQFD) is also known as the Air Quality Directive (AQD), the Ambient Air Quality Directive (AAQD) and the Clean Air for Europe (CAFE) Directive. The Directive establishes data quality objectives and requirements for assessment of concentrations of major specified pollutants and their exceedances. The Directive focuses on defining and establishing objectives for ambient air quality designed to avoid, prevent or reduce harmful effects on human health and the environment as a whole, using common assessment methods to curb elevating trends, to facilitate on-going improvements and maintenance, to enhance inter-state cooperation and to make information publicly available.

In compliance with the requirements of the AAQD, the European Parliament and the Council is obliged to establish limit values and alert thresholds for the following list of pollutants:

- sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead;
- benzene and carbon monoxide;
- ozone;
- polycyclic aromatic hydrocarbons (PAH), cadmium, arsenic, nickel and mercury.

In addition, the Directive requires notification on:

- locations where the pollution is excessive;
- the nature, and an assessment, of the pollution;
- the origin of the pollution.

3.10 Clean Air Package and Clean Air Programme for Europe

In 2013 the European Commission adopted a Clean Air Package, including a, Clean Air Programme for Europe (CAPE) setting objectives for 2020 and 2030 and provided accompanying legislative measures. The CAPE reported that if 2013 EU legislation is implemented in full, then premature mortality due to particulate matter and ozone will be reduced by 37 % in 2025. Furthermore, the CAPE foresees a target of 52 % reduction in premature mortality by 2030 compared to the 2005 base year.

In order to achieve the reduction targets for 2030, the CAPE required revision of EU air pollution legislation, particularly revision of National Emission Ceilings Directive (NECD). This led to the old 2001 NECD being replaced by the new NECD in 2016. The CAPE deemed that revision of the Ambient Air Quality Directive (2008/50/EC) was not necessary but rather that policy should focus on achieving compliance by 2020 at the latest.

3.11 Key Implementing Decisions and Regulations

EU Parliament and Council **Decision No. 406/2009/EC** relates to the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020. A Commission Decision of 26th March 2013 determines Member States' annual emission allocations for the period from 2013 to 2020 pursuant to **Decision No. 406/2009/EC**. Commission Implementing Decision of 31st October 2013 relates to the adjustments to Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No. 406/2009/EC.

The view of the Community is that to prevent the overall global annual mean surface temperature from exceeding 2 °C above pre-industrial levels, greenhouse gas emissions should be reduced by at least 50 % below 1990 levels by 2050 and that developed countries, including the EU Member States, should continue to take the lead by committing to collectively reducing their emissions of greenhouse gases in the by 30 % in 2020 compared to 1990.

Decision No. 280/2004/EC related to a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol. It established a framework for monitoring anthropogenic greenhouse gas emissions by sources and greenhouse gas removals by sinks, evaluating progress towards meeting commitments in respect of those emissions and implementing monitoring and reporting requirements under the UNFCCC and the Kyoto Protocol. In order to implement new monitoring and reporting requirements provided for in EU law and to take into account recent and future developments at international level relating to the UNFCCC and the Kyoto Protocol, it was determined that Decision No. 280/2004/EC should be repealed and replaced by Regulation (EU) No. 525/2013.

Regulation (EU) No. 525/2013 establishes a mechanism for monitoring and reporting on greenhouse gas emissions and for reporting other information at national and Union level. This Regulation repeals and replaces Decision No. 280/2004/EC.

Commission Delegated **Regulation (EU) No. 666/2014** establishes substantive requirements for a Union inventory system taking into account changes in the global warming potentials and internationally agreed inventory guidelines pursuant to Regulation (EU) No. 525/2013. The Regulation determines that the mechanism for monitoring and reporting greenhouse gas emissions is necessary to enable the assessment of the actual progress towards meeting the Union's and the Member States' commitments relating to the limitation or reduction of all greenhouse gas emissions under the UNFCCC, approved by Council **Decision 94/69/EC**, its Kyoto Protocol, approved by Council **Decision 2002/358/EC**, and the set of Union legal acts, adopted in 2009, collectively referred to as the **Climate and Energy Package**. This is to establish further rules for quality assurance and quality control of the Union inventory. In order to ensure completeness of the Union's inventory in accordance with the guidelines for preparing the national greenhouse gas inventories it is necessary to provide for the methodologies and the data to be used by the Commission when, in consultation and close cooperation with the Member State concerned, preparing estimates for data missing from a Member State's inventories.

Council Decision (EU) 2015/1339 on the conclusion (on behalf of the European Union) of the Doha Amendment to the Kyoto Protocol to the UNFCCC, following the consent of the European Parliament at the Doha Climate Change Conference, Parties to the Kyoto Protocol (UNFCCC) adopted the Doha Amendment, establishing a second commitment period of the Kyoto Protocol, starting on 1st January 2013

and ending on 31st December 2020. This is referred to as 'the Doha Amendment'. The Doha Amendment has amended Annex B to the Kyoto Protocol which sets out further legally-binding mitigation commitments for parties listed in that Annex for the second commitment period and amending and further laying down provisions on the implementation of parties' mitigation commitments during the second commitment period.

Council **Decision (EU) 2015/1340** establishes an Agreement between the European Union and its Member States concerning Iceland's participation in the joint fulfilment of commitments of the European Union for the second commitment period of the Kyoto Protocol to the UNFCCC.

Commission Implementing **Regulation (EU) No. 749/2014** relates to the structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) No. 525/2013. The 2014 Regulation determines that the information reported to the Commission, pursuant to Regulation (EU) No 525/2013, is necessary to enable the assessment of actual progress towards meeting the Union's and the Member States' commitments related to the limitation or reduction of all greenhouse gas emissions under the UNFCCC and the set of Union legal acts, adopted in 2009, collectively referred to as the Climate and Energy Package. The 2014 implementing Regulation further provides for the preparation of annual reports by the Union in accordance with its obligations under the UNFCCC and the Kyoto Protocol.

4 AIR POLLUTION PREVENTION AND CONTROL LEGISLATION IN ALBANIA

4.1 Recent Albanian air pollution legislation

Albania is obliged to create and maintain the National Inventory System (NIS) to facilitate regular monitoring of its polluting emissions in accordance with the 1992 UNFCCC and the Kyoto Protocol to this Convention (Article 5, paragraph 1).

Legislation was recently largely transposed in Albania to deal with emissions from larger industries as required under the IPPC Directive 2008/1/EC concerning integrated pollution prevention and control, as follows:

- Law No. 60/2014, dated 19.06.2014, amending the Law No. 10448, dated 14.07.2011, "*On permitting*," as amended.
- DCM No. 419, dated 25.06.2014 "*On approval of the special requirements for the review of environmental permit applications of Type A, B and C, for the transfer of permits from one subject to another, the conditions for the respective environmental permits, as well as detailed rules for their review by the competent authorities until the issuance of these permits by NLC*".

A and B type permits are regulated by the NEA while C type permits for less polluting activities are administered by REAs. Inspections are expected to be undertaken by the State Environment and Forestry Inspectorate which is regulated under the Prime Ministers Order No. 37, dated 12.03.2015.

DCM No. 419 entered in force in July 2014. In August 2014 the NEA started to issue the first permits according to the new permitting legislation.

In Albania further progress has been made in the field of air quality management since Law 162/2014, dated 04.12.2014 "On protection of ambient air quality", transposing the AQFD and Directive 2004/107/EC on Heavy Metals in Ambient Air, was adopted. Law 162/2014 entered into force in December 2017, three years after its official publication in the Albanian Official Gazette. This Law is aimed at improving public health and ensuring a high level of environmental protection by integrating ambient air quality issues in other policies as well as establishing requirements for monitoring, assessment and planning while promoting international cooperation.

Seven further DCMs reinforce Law 162/2014. These apply, respectively, to, quality of petrol and diesel fuels; quality of diesel produced through refining; quality of certain fuels for thermal, civil, industrial and water transport use; ambient air quality assessment and requirements for certain related pollutants; control of VOCs associated with the Decopaints Directive (2004/42/EC), the Solvent Emissions Directive (SED, 1999/13/EC), the Petrol Directive, stage I (94/63/EC) related to petrol storage and distribution and the Petrol Directive, stage II (2009/126/EC) associated with filling of vehicles at service station pumps. These four VOC directives are aimed at reducing and controlling emissions of volatile organic compounds to the atmosphere.
The seven DCMs are as follows:

1. DCM No. 147, dated 21.03.2007 "*On the quality of petrol and diesel fuels*";
2. DCM No.781, dated 14.11.2012 "*On the quality of certain liquid fuels for thermal, civil, industrial and water transport use (sea, river and lake)*";
3. DCM No. 352, dated 29.4.2015 "*On ambient air quality assessment and requirements for certain related pollutants*";
4. DCM No. 1075, dated 23.12.2015 "*On measures for the control of VOC emissions resulting from the storage of petroleum and its distribution from terminals to service stations*";
5. DCM No. 907, dated 21.12.2016 "*On the limitation of VOCs due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products*";
6. DCM No. 908, dated 21.12.2016 "*On the measures for the limitation of the VOC emissions from the use of organic solvents in certain activities and installations*";
7. DCM No. 909, dated 21.12.2016 "*On stage II petrol vapour recovery during refuelling of motor vehicles at service stations*".

It should be noted that both the 2008 IPPC Directive and the 1999 SED, which were formerly standalone directives, are now integrated into the Industrial Emissions Directive (IED, 2010/75/EU) together with 5 other former standalone directives.

4.2 Albania's emission reporting requirements and deficits

The pollutants to be reported in accordance with the LRTAP Convention cover anthropogenic emissions, under the scope of the Convention. The reporting requirements were revised under the scope of the amended NECD (which entered into force in EU MSs on 31st December 2016), better aligning the NECD with the LRTAP Convention. Parties to the LRTAP Convention are invited to report annual emission data by 15th February each year and informative inventory reports (IIRs) by 15th March.

The Kyoto Protocol extends the 1992 UNFCCC and commits Parties to the Protocol to reduce greenhouse gas emissions, based on evidence of the contribution of anthropogenic emissions to global warming.

Albania is obliged to create and maintain the National Inventory System (NIS) to facilitate regular monitoring of its polluting emissions in accordance with the UNFCCC and the Kyoto Protocol to this Convention (Article 5, paragraph 1).

Currently, the country has 25 reporting obligations (excluding terminated obligations), associated with air pollution, to authorities specified on the Eionet (ROD) website as well as 3 related to ozone depletion and 5 associated with climate change - under the E-PRTR Regulation, the Montreal Protocol and the UNFCCC.

At present, in Albania, data deficiencies are, to a smaller extent, due to legislation gaps but, to a larger extent, due to the lack of adequate implementation of existing legislation particularly by the MoTE and the NEA, including monitoring, inspection, enforcement and reporting required under existing legislation. There are a variety of reasons, as discussed below, why this is the case.

Although EU law is being gradually and effectively transposed in Albania, particular problems over the years continue to include unacceptably poor implementation of transposed environmental legislation. This is due to inadequate budget and insufficient material resources resulting in ineffective implementation of existing national law. This results in deficiencies in monitoring, control, auditing and enforcement, lack of availability of monitoring data due to unaffordability (within budget constraints) of

monitoring equipment, chemicals, transport and calibration standards. Accordingly, there are significant data gaps and incomplete data sets, anomalies in data comparability from one year to the next and voids in collection and compilation of data from major polluting activities. Lack of resources leads to deficiencies in accuracy and quality control mechanisms, poor means of compliance checking, a lack of consistency and quality assurance for both historical and new data, inadequate data collection processes and deficiencies in data input and manipulation systems. This leads to a large uncertainty of measurement for both industrial reporting and regulatory reporting.

Currently there is a dearth of accurate and coherent data in Albania on sectoral emissions mainly from the energy sector (domestic, industrial, commercial and institutional), industrial production technologies, thresholds and production periods and the waste sector. A major issue is a severe lack of enforcement of existing legislation particularly under the scope of the Industrial Emissions Directive (IED, 2010/75/EU). The process of activity reporting under the E-PRTR Regulation commenced at the start of 2017 during which the competent authority requested emission data from over 180 Albanian enterprises. By the end of the year only four enterprises had returned information on their emissions. These were two cement plants, one oil extraction company and one brick and tile manufacturing industry.

As indicated above, in 2015 and 2016 Albania transposed the Decopaints, Solvents and Petrol directives for activities associated with emissions of volatile organic compounds (VOCs). However, there is currently no information available on solvents consumption / use associated with NMVOCs emissions related to these directives.

Albania's submission to the NECD and the CLRTAP require annual emission estimates presented in Nomenclature for Reporting (NFR) format, for:

- nitrogen oxides [(NO_X (as NO_2)],
- carbon monoxide (CO),
- ammonia (NH_3),
- sulphur dioxide [(SOx (as SO_2)],
- non-methane volatile organic compounds (NMVOCs),
- particulate matter (PM),
- persistent organic pollutants,
- heavy metals.

Albania's IIR for the period 1990 to 2015 was presented to the CEIP in 2017 but there were major omissions from some anthropogenic sectors. Accordingly, data for the years 2009 to 2015 were revised and updated.

Although there remain major gaps, particularly for the solvent sectors (paints, inks, dyes – mixing / manufacture / and use; print industry; surface treatment / coating of metals and other surfaces; footwear manufacture; glues; etc.) and industrial production due mainly to the inability / capacity of the MoTE and the NEA to collect such data, for various reasons, as discussed (budget, resources, capacity, politics, etc.).

Since there is a severe lack of enforcement of legislation by the competent authorities in all industrial sectors and a huge dearth of information on associated industrial emissions, almost all emission loads

were estimated. Accordingly, some of the data presented are based on rounded estimates and are likely to incorporate large uncertainties of measurement. Moreover, the competent authorities responsible for environmental protection in Albania do not collect information regarding the types or efficiencies of technologies employed (e.g. combustion technology) in manufacturing, production and processing industries in the state.

In Albania there is currently no routine measurement of emissions of heavy metals, benzene or PAHs either by competent authorities or by industrial activities resulting in a dearth of national information on these pollutants and the emission inventory improvises with previous estimates of these pollutants.

Data for Albania previously reported for the period from 1990 to 2015, that included information from the pre-1990s communist era and did not reflect the following significant changes particularly since the advent of democracy in 1992:

- Industrial production almost came to a standstill and resulted in the closure of many major industries after at the end of the Hoxha era. There were significant over-estimates in previously reported data wherein momentous reductions in industrial activity after the end of the Hoxha era and in the early 1990 do not appear to be fully in estimates. Industries which showed enormous decline in the early 1990s were mining, metallurgy and related metal processing and production industries (iron and steel, copper, chromium, ferro-chrome and nickel).
- Since the early 1990s there has been a significant annual increase in the number of road transport vehicles from less than 7,000 in at the beginning of the 1990s, (due to a previous ban on private cars), to over 460,000 in 2017. The increased use of private cars has given rise to corresponding vast increases in NOx and PM_{10} emissions from the road transport sector since the early 1990s as a significant number of cars currently in use in Albania are relatively old vehicles with poor emission controls;
- Albania is unique in Europe as it currently produces more than 98 - 100 % of domestic electricity from alternative energy (mainly hydropower) and has a reported capacity to triple its output. This has resulted in an enormous reduction in the use of fossil fuels for production of electricity and a resultant significant reduction in emissions of PM_{10}, NOx and SOx, associated with fossil fuels. A SEEC investigative report (November 2013) on energy generation in the Balkans conveyed that: *"Approximately 98 % of the electricity production is coming from the hydro power plants (with 65 % of hydro potential still unexploited. Nine TPP units have been decommissioned in the past and only the TPP in Vlora is in operation at present. TPP Vlora is an oil and gas-fired combined cycle power plant, with one shaft turbine-generator set, consisting of one gas turbine, one steam turbine and a generator in a single shaft arrangement. The plant was commissioned in October 2011 and, due to severe defects, it was stopped and put in reserve operation in January 2012. The TPP Vlora is a new plant, designed according to contemporary technology, with a net plant efficiency exceeding 50 %. The plant is designed to meet the emission standards of the IED. All other thermal power plants in Albania have been decommissioned".* The last of Albania's nine TTPs was decommissioned by 2008.
- A major upheaval has been evident in the domestic fuel consumption / combustion pattern in recent years when firewood replaced other fuel sources, particularly in rural areas, as a fuel source for domestic heating. Rural households which had previously used coal for domestic heating changed over to firewood resulting in an almost 7-fold increase in firewood consumption / combustion from 2010 to the present. Albanian forestry statistics show that firewood

production in 2010 was less than 60,000 tonnes but that this increased to more than 450,000 tonnes by 2016.

- Low calorific value lignite (brown coal), mined in Albania, was used abundantly during the communist period but in the 2000's decade coal mining declined rapidly, at first, and later ceased. Thereafter, some 60,000 to 80,000 tonnes of higher grade coal were imported, mainly for industrial and commercial purposes. After ownership of the coal mines passed on from the Albanian government to private enterprises on long-term contracts, coal mining has started up again during the past few years to compensate for energy losses from hydropower plants during water scarcity periods (as a result of reduced river flows during dry spells).

5 EMEP/EEA AIR POLLUTANT EMISSION INVENTORY GUIDEBOOK (2016)

5.1 Guidebook sectors and subsectors

The EMEP/EEA emission inventory guidebook provides technical guidance on how to prepare national emission inventories. In earlier versions of the guidebook polluting anthropogenic emissions were subdivided into 11 main groups. For example, in the 2007 version of the guidebook the NFR main sectors were classified into groups from 1 to 11, as indicated in table 1.

Table 1: 2007 guidebook sectors	
EMEP/CORINAIR Emission Inventory Guidebook - 2007 (NFRs from 2002)	
Eleven main sectors	
Group 1	Combustion in energy and transformation industries
Group 2	Non-industrial combustion plants
Group 3	Combustion in manufacturing industry
Group 4	Production processes
Group 5	Extraction and distribution of fossil fuels and geothermal energy
Group 6	Solvent and other product us
Group 7	Road transport
Group 8	Other mobile sources and machinery
Group 9	Waste treatment and disposal
Group 10	Agriculture
Group 11	Other sources and sinks

Subsequently energy consumption and production activities, both stationary and mobile, were grouped together to include energy production and consumption associated with the energy, industry and transport sectors. Similarly, industrial production and manufacturing activities were grouped together. Consequently, the 2016 version of the guidebook, as indicated in table 2, has 6 main NFR sectors.

Table 2: 2016 guidebook sectors	
EMEP/CORINAIR Emission Inventory Guidebook – 2016 sectors	
Six main sectors	
Group 1	Energy
Group 2	Industrial processes and product use
Group 3	Agriculture
Group 5	Waste
Group 6	Other sources
Group 11	Natural sources

The guidebook includes a revision chart indicating recent addendums and corrections. The revision chart continues to be updated since the 2016 guidebook was released. Further revisions are expected in future in consideration of additional knowledge and improved technical information. Table 3, below, gives a further breakdown of the 6 NFR main sectors into their related subsectors in accordance with the 2016 guidebook.

Table 3: NFR sectors and sub-sectors (2016 guidebook)	
Nomenclature for reporting (NFR) and related sub-sector activity description	
NFR	**Sector / sub-sector / activity**
1	**ENERGY (2)**
1.A	**Combustion**
1.A.1	Energy industries [fuel type]
1.A.2	Manufacturing industries and construction [fuel type]
1.A.3.a	Aviation [domestic, cruise, LTO]
1.A.3.b.i-iv	Exhaust emissions from road transport [road transport sectors, engine sizes, fuel type]
1.A.3.b.v	Gasoline evaporation [petrol, stage II]
1.A.3.b.vi-vii	Road vehicle tyre and brake wear, road surface wear
1.A.3.c	Railways
1.A.3.d	Navigation (shipping) [fuel type]
1.A.3.e.i	Pipeline transport [fuel type]
1.A.4	Small combustion [fuel type]
1.A.4	Other non-road mobile sources and machinery [fuel type]
1.B	**Fugitive emissions from fuels**
1.B.1.a	Fugitive emissions from solid fuels: Coal mining and handling
1.B.1.b	Fugitive emissions from solid fuels: Solid fuel transformation
1.B.1.c	Other fugitive emissions from solid fuels
1.B.2.a.i, 1.B.2.b	Fugitive emissions: Exploration, production and transport of oil and natural gas
1.B.2.a.iv	Fugitive emissions oil: Refining and storage
1.B.2.a.v	Distribution of oil products
1.B.2.c	Venting and flaring [significant sub-categories]
1.B.2.d	Other fugitive emissions from energy production
2	**INDUSTRIAL PROCESSES AND PRODUCT USE (9)**
2.A	**Mineral products**
2.A.1	Cement production
2.A.2	Lime production
2.A.3	Glass production
2.A.5.a	Quarrying and mining of minerals other than coal
2.A.5.b	Construction and demolition
2.A.5.c	Storage, handling and transport of mineral products
2.A.6	Other mineral products [significant sub-categories]
2.B	**Chemical industry**
2.B	Chemical industry [significant sub-categories]
2.B.7	Soda ash production (2.A.4, 2009)
2.C	**Metal production**
2.C.1	Iron and steel production
2.C.2	Ferroalloys production
2.C.3	Aluminium production
2.C.4	Magnesium production
2.C.5	Lead production
2.C.6	Zinc production
2.C.7.a	Copper production
2.C.7.b	Nickel production
2.C.7.c	Other metal production [significant sub-categories]
2.C.7.d	Storage, handling and transport of metal products [significant sub-categories]
2.D	**Solvent and product use**
2.D.3.a	Domestic solvent use including fungicides
2.D.3.b	Road paving with asphalt
2.D.3.c	Asphalt roofing
2.D.3.d	Coating applications
2.D.3.e	Degreasing
2.D.3.f	Dry cleaning
2.D.3.g	Chemical products
2.D.3.h	Printing
2.D.3.i, **2G**	Other solvent and product use [significant sub-categories]
2.H	**Other industry production**
2.H.1	Pulp and paper industry
2.H.2	Food and beverages industry
2.H.3	Other industrial processes
2.I	**Wood processing**
2.J	**Production of POPs**
2.K	**Consumption of POPs and heavy metals**
2.L	**Other production, consumption, storage, transportation or handling of bulk products**
3	**AGRICULTURE (4)**
3.B	**Manure management** [significant sub-categories]
3.D	**Crop production and agricultural soils**
3.D.f, 3.I	**Agriculture other including use of pesticides** [significant sub-categories]
3.F	**Field burning of agricultural wastes**

Table 3: NFR sectors and sub-sectors (2016 guidebook)	
Nomenclature for reporting (NFR) and related sub-sector activity description	
NFR	**Sector / sub-sector / activity**
5	**WASTE**
5.A	**Biological treatment of waste: Solid waste disposal on land**
5.B.1	**Biological treatment of waste: Composting**
5.B.2	**Biological treatment of waste: Anaerobic digestion at biogas facilities**
5.C.1.a	**Municipal waste incineration**
5.C.1.b	**Industrial waste incineration including hazardous waste and sewage sludge** [significant sub-categories]
5.C.1.b.iii	**Clinical waste incineration**
5.C.1.b.v	**Cremation**
5.C.2	**Open burning of waste**
5.D	**Wastewater handling**
5.E	**Other waste** [significant sub-categories]
6	**OTHER SOURCES**
6.A	**Other sources** [significant sub-categories]
11	**NATURAL SOURCES**
11.A	**Volcanoes**
11.B	**Forest fires**
11.C	**Other natural sources (Non-managed and managed forests, Natural grassland and other vegetation, Wetlands and waters, Animals, Geological seepage, Lightening, Forest and grassland soils, Changes in forest and other woody biomass stock, Forest and grassland conversion, Abandonment of managed land, CO_2 emissions from or removal into soil, Other)**

The guidebook facilitates the generation and availability of high quality data on polluting emissions to air. The data produced helps MSs and participating countries to identify environmental priorities and appraise and assess the effectiveness of policy interventions as well as contributing to the improvement of air quality models.

The guidebook has been developed in accordance with the 'Guidelines for Reporting Emissions and Projections Data' under the United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution (CLRTAP) to provide focused guidance on how to compile an atmospheric emissions inventory.

The guidebook was prepared by the Convention's Task Force on Emission Inventories and Projections (TFEIP), with detailed work by the Task Force's expert panels and the European Environment Agency (EEA). The 2016 version of the guidebook is published by the EEA and it states that it replaces all earlier versions. This updated version of the guidebook is compatible with, and complementary to, the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

6 DATA QUALITY

6.1 Quality Assurance and Quality Control (QA/QC)

The process of data collection and emission inventory compilation has adhered to internal quality standard operating procedures. Internal meetings were convened between project team members and regulatory officials to verify existing published data and discuss likely access to missing source data. Project experts engaged available data providers and statisticians in discussions to help ensure that the inventory contained the best available, most reliable and most complete data. Meetings included face to face liaisons with public servants, statisticians as well as correspondence by phone and email.

QA/QC procedures were aimed at the identification and reduction of errors, deficiencies and omissions and incorporated optimisation of the relative coherence of the procedures for the preparation and documentation of the inventory and facilitation of review procedures.

After the inventory was compiled, procedures to improve the quality of data were implemented and the data was verified and revised accordingly. One of the main problems that arose in the phase of data collection was data reliability. Data reliability is compromised when information is incomplete or unverifiable. When data were missing, default values or rounded estimates, specific for the type and nature of emissions being considered, were used.

Checks were carried out for NFR categories, in so far as data was available, to avoid inaccuracies in data logging, manipulation, calculations, estimations and extrapolations. Controls, carried out during the compilation of the inventory, ensured the completeness, in so far as was verifiable, of the source categories and corroborated better quality control on data obtained at the end of the estimation and verification processes.

6.2 TCCCA and Uncertainty of measurement

Transparency stems from open, clear and accurate disclosure of information and is a requirement of good communication and accountability, particularly expected from democratic governments and other associated public servants. As such, government employees and connected public servants and competent authorities should make concerted pro-active on-going efforts to provide the public with any relevant information that may impact on their lives, health, lifestyle or environment. Transparency is less discernible in Eastern European countries, where, in the recent past both private and public sector enterprises tended to be more reticent. Nonetheless, transparency in public affairs forms a large part of the Aarhus Convention and both public and private authorities need to become less inclusive and more transparent particularly in relation to pollution prevention. The project encountered an unwillingness on the part of public servants, in some cases, to provide essential data as sanction was not forthcoming from their department head.

Consistency ensures achievement of a measurable level of performance which should not vary greatly in quality over time. The 2016 guidebook provides a chapter on time series consistency. The chapter describes good practice in ensuring time series consistency and on common situations in which time

series consistency could be difficult to achieve, such as, when carrying out recalculations, while adding new categories and when accounting for technological change. The chapter describes techniques for combining or 'splicing' different methods or data sets to compensate for incomplete or missing data.
In Albania there have been dramatic changes in emissions associated with NRF sectors and subsectors in recent decades, as discussed above, particularly in the energy sector related to industrial production and road and rail transport.

Completeness relevant to the emission inventories ensures that there are no holes or gaps in the data or data sets needed. Emission source categories and subcategories have been refined within updated successive emission inventory guidebooks to assist MSs and participating countries to close data gaps and present more all-inclusive emission inventories. In candidate countries, such as Albania, it is expected that data sets will become more complete when competent authorities become more knowledgeable about the amount, type and extent of the emissions data they need.

Comparability allows authorities to compare data or data sets with those of prior periods and those of other authorities or countries. This is facilitated by strict adherence to guidebook NFR sector and subsector notation and consequential requirements. Before data from different systems can be combined, compared or aggregated, the data elements in all systems must be the same. They must represent the same entity or attribute with the same definition and be collected by applying a consistent methodology. If methodology is improved, the improvements must be taken on board and comparisons re-evaluated accordingly. In Albania it is difficult to compare the NOx emissions from a 30 year old vehicle with those of a new hybrid vehicle without having access to engine efficiency, age and condition and control information.

Accuracy related to a specific polluting emission can be defined by how well the "reported" result matches the "true" value. Better accuracy related to emissions can be achieved through systematic measurement rather than by calculations and estimations which normally contribute to higher levels of uncertainty and adversely impact on the trueness of reported results. It is expected that there are numerous inaccuracies in the emission inventory results for Albania as most are based on calculations and estimations with extrapolation often necessary to fill the gaps for activities for which no reliable data exists. This, together with an absence of activity-specific information had led to frequent utilisation of tier 1 emission factors with a higher level of uncertainty, leading to less accurate results.

Uncertainty of measurement: Quantitative estimates of the uncertainties of measurement in the emission inventory were not undertaken.

The lack of measured data associated with industrial emissions adds to the level of uncertainty of measurement and most data were based on best estimates.

In almost all cases it was not possible to determine estimates using tier 3 evaluation. There are major gaps in data from the solvents sectors, including fugitive emissions.

There is varying uncertainty of measurement for the following macro pollutants:

- **Ammonia** emission estimates from livestock (which is by far the largest ammonia emissions source) generally have a higher degree of uncertainty than those for SOx (as SO_2), NOx (as NO_2) and NMVOC, largely due to the nature of major agricultural sources of these pollutants. Emissions depend on animal type, age, weight, diet, housing systems, manure type (solid or slurry) management and storage techniques and animal housing periods. This large number of impacting factors makes interpretation of statistical data difficult and emission estimates have a relatively

high level of uncertainty. Nonetheless, generally, information on livestock units is reviewed and updated annually. Unlike data on industrial production, the basic facts associated with agricultural activities in Albania are contemporary.

- **Carbon monoxide (CO)** emission estimates from small and medium-sized installations are derived from emission factors based on relatively few measurements of emissions from different types of boiler. As a result of the high uncertainty in emission data for major sources, emission estimates for CO have a greater level of uncertainty than for other pollutants such as NOx (as NO_2) and SOx (as SO_2) which are also emitted mainly from combustion processes.
- **Particulate Matter (PM_{10})** emission estimates are subject to a high level of uncertainty. This stems from uncertainties in the emission factors themselves together with the activity data with which they are combined to quantify the emissions. Many sources of particulate matter are diffuse or fugitive in nature, e.g. emissions from coke ovens, metal processing or quarries. These emissions are difficult to measure, and in Albania, measurements have never been made, so emission estimates for these sources have a high level of uncertainty.
- **Oxides of sulphur (SOx)** emissions can be estimated with the most confidence when the level of sulphur in fuels is known. In the past high sulphur fuels were used in Albania but there have been some improvements in fuel quality in recent years. Hence, the inventory, which is based mainly on known combustion of coals and fuel oils, contains relatively accurate emission estimates for the key activity sectors. More complete information on the exact sulphur content of fuels used in specific activities would decrease the level of uncertainty. Generally, SOx emissions have a lower level of uncertainty than the others.
- **Nitrogen oxides (NOx)** emission estimates are less accurate than SOx because, although they are calculated using provided emission factors, the emission factors can vary much more with combustion conditions. Besides, emission factors given in the literature for combustion sources show large NOx variations.
- **Non-Methane Volatile Organic Compound (NMVOC)** inventory data has a higher level of uncertainty than those of SOx (as SO_2) and NOx (as NO_2). This is due in part to the difficulty in obtaining good emission factors or emission estimates for some industrial processes and natural sources and partly due to the absence of good activity data for some sources. Due to the volatility of VOCs, as with fine particulates, they are major contributors to fugitive emissions, which require more scrutiny.

Uncertainty information is not intended to dispute the validity of the inventory estimates, but to help prioritise efforts to improve the accuracy of inventories in the future and guide decisions on methodological choice. All measurements are associated with a degree of uncertainty and results can qualified by a statement of uncertainty.

The following table 4 summarises missing data and information related to sectors which seem to be more relevant in order to make a more complete estimation of atmospheric emissions in Albania and in data management systems final results are provided together with uncertainty of measurement to contribute to more accurate reporting of the true value.

Table 4: Missing / incomplete data	
Sector	**Missing / incomplete data**
Industry	Emissions data by plant, hours of operation, technology employed, mining and related technology employed; mine spoil / waste; metal processing; quarrying and gravel extraction
Energy	Complete data on fuel consumptions divided by type of fuel and sectors; fuels distribution over the territory, combustion technology. Transport: Details about vehicles engine capacity, technology, fuel, age, average mileage driven; engine sizes and ages of mopeds and motorcycles and annual travel distance; navigation – leisure and fishing boats, fuels used, hours of operation, agricultural, forestry and construction stationary and mobile machinery – age, type, hours of use, etc.
Agriculture	More complete breakdown of livestock types; manure storage; animal housing vs. grazing; solid manure or slurry; agricultural burning; intensive land use
Waste	Complete information on waste management (number of landfills/dumps, amount of burnt waste, agricultural/industrial/hospital waste management); waste burning
Other	Forest and vegetation fires by year; land conversion

6.3 NFR sector and subsector data

It was necessary research to gather information and undertake research on the following NFR sectors to identify the amounts of one or more of the six macro-pollutants, (NOx, SOx, NH_3, CO, NMVOC and PM_{10}) being investigated covering the period from 2009 to 2016:

1) Energy, including mainly industrial processes and production (coal and mineral mining, quarrying and sand gravel extraction, gypsum, crude oil extraction and refining, oils, gas, gasoil, diesel, coal, coke, firewood, iron and steel, ferrochrome, copper, nickel, ammonia, cement, lime, coke, bricks and tiles, institutional and commercial, domestic, etc. Emissions determined from the transport (energy) sub-sector includes, passenger vehicles (petrol cars, diesel cars), motorcycles, light trucks, heavy duty trucks, railways, stationary and mobile machinery used in road and building construction, agriculture and horticulture, forestry, leisure boats and navigation, fishing and pipeline transport;
2) Aside from energy consumption in industry, emissions from industrial processes and product use include, *inter alia*, quarrying and extraction of sand and gravel, cement, lime, metallic mineral mining, storage, public works, building (roads and houses), chemical production, metal processing and conversion, solvent and product use, paper food, spirits, wood products, transport and storage.
3) In the Agricultural sector emissions determined result from, *inter alia*, manure production and management, cattle (dairy, buffalo, others), sheep, pigs, goats, horses, mules and asses, hens, other poultry, beehives, fertiliser handling and application, pesticide use, cultivated crops.
4) In the waste sector emissions arise from its generation, collection, treatment and storage and also from waste waters.
5) Other sources of emission were taken together with natural sources and include, *inter alia*, emissions from forest and vegetation fires, unmanaged forests and grasslands, wetlands, land conversion and geological processes.

The updated inventory for the 2009-2016 period does include data on $PM_{2.5}$, heavy metals (arsenic, cadmium, nickel, lead, chromium, mercury, copper, selenium, zinc); $PM_{2.5}$, benzene; Polycyclic Aromatic

Hydrocarbons (PAH: benzo[b]fluorantene, benzo[k]fluorantene, benzo[a]pyrene, indeno[123cd]pyrene) and greenhouse gases, carbon dioxide (CO_2), methane (CH_4) and nitrogen protoxide (N_2O). Accordingly, data for these pollutants were not updated for the reassessed period.

6.4 NFR sector analysis and pattern of change

Energy

In 2007 Albania imported 70 % of its electricity needs but by 2009 this figure had dropped to 11 %.
The largest of Albania's nine coal / oil / gas-fired TPPs was decommissioned in 2007 having expended its lifespan. It was located in Fier and had a capacity of 186 MW. All nine such TTPs are now out of operation. The plants employed out-dated Russian and Chinese combustion technology and it was not practical, viable or profitable to update the Fier TPP or the others.

Construction of a gas-fired thermal power plant in Vlora was completed and commissioned in October 2011. It's a modern plant with an operational capacity of ~100 MW and is designed to fully comply with IED, BAT and LCPD emission standards and requirements. The plant comprises a combined cycle gas turbine (CCGT) with a one shaft turbine-generator set, consisting of one gas turbine, one steam turbine and a generator in a single shaft arrangement that uses natural gas or distillate fuel oil as a fuel. It is expected to use about 500 tonnes per day of gas oil. It was in operation for a short period in late 2011 and early 2012, after which time it was closed down due to some technical failures in the cooling water offshore pipeline and issues with the high cost of power generation.

Hydropower: Albania currently relies almost solely on hydro power plants to cover its electricity needs. Hydropower produces 1,446 MW out of a total of 1,541 MW being generated. Three of the main hydropower plants are at Komani, Fierza and Vau i Dejes MW with respective capacities of 600 MW, 500 MW and 250 MW. The three main plants are built on the cascade of the Drini river, and account for 86% of total generation. There are eight small hydro power plants in operation. In 2009 hydropower accounted for 99.8% of production, with thermal (ex-oil) accounting 0.2% (source: Enerdata).

The 11 main hydropower plants combined currently provide about 99 % of annual production. However, the electric system is unable to provide customers with quality service (free from outages) throughout the year and satisfy complete demands during peak periods. There were 83 smaller hydropower plants built prior to 1988 with capacities between 30 and 5,000 kW. Electricity production is almost entirely hydro-electric.
It has been estimated that hydropower in Albania could be optimised to produce 65 % more electricity. In November 2017 the Albanian government announced that it was planning to offer public private partnership incentives for the construction of two new hydro and liquid gas-fired thermal power plants (TPPs) to be built in the southeast region of Korca and the southwest town of Kucova, as part of the framework of the Trans Adriatic Pipeline (TAP) project.

Since the fall of communism in 1990, demand for power in Albania has risen by more than 10 percent a year on average. Because of increasing demand the country has been a net power importer except for 2016, when it briefly became a net exporter. Albania's almost 100 % dependancy on domestic electricity from hydropower is adversely impacted by lack of rainfall, particularly during peak periods. The dependancy on rainfall is a key disadvantage of hydropower. In 2017 the net power produced was 36.6 %

lower than in 2016 down from 7,136 GWh in 2016 to 4,525 GWh in 2017 due to reduced rainfall. In parallel the country's related exports decreased by 73.9 % from 1,869 GWh in 2016 to 488 GWh in 2017.

Crude Oil: In 2009 740,000 tonnes of crude oil was extracted in Albania. Approximately 28 % was refined in the country and the remainder exported for refining abroad.

In the following five years production increased gradually to a peak of 1,368,000 tonnes in 2014. Approximately 300,000 tonnes of the extracted crude were refined in the country in 2 refineries in Ballsh and Fier, which have limited capacity.

Between 1986 and 1989 Albania produced and consumed an average of 2 thousand barrels of kerosene per year. Production slowed down significantly to less than half of that amount in the early 1990s. From 1995 onwards, production and consumption increased again to meet a growing demand. By 2001, production slowed down significantly to a fraction of peak production and by 2010 had almost dwindled to zero.

Coal: During the Hoxha era (1944-1985) there was a significant amount of coal mined in Albania. It was used for energy production for industrial, commercial and domestic purposes as well as for production of coke. The quality of the coal was low-grade lignite with reduced calorific value. By 2005 coal mines were producing around 12,000 tons per annum compared to 2 million tons produced in the 1990s. Ownership of the coal mines was passed on from the Albanian government to private enterprises with long-term contracts. In 2009 and 2010 there was between 2,000 and 2,500 tonnes mined in Albania, but this decreased to 1,200 tonnes in 2011. Albania imports higher grade coal, mainly for industrial and commercial purposes. The imported amount is relatively small and varied from 65,200 tonnes in 2009 to 88,200 tonnes in 2016. During the past few years hydropower outages due to lack of rain has seen the resurrection of coal mining to meet demands.

Firewood / biomass: The means of production of domestic heating, particularly in rural households, has changed considerably during the past 15 years. Since, the cessation of coal mining within the country and the added cost of imported coal there has been a dramatic changeover to the use of firewood. In 2010 households burned an estimated 58,000 tonnes of firewood. By 2016 consumption had risen to more than 450,000 tonnes. Most of the firewood is burned in household stoves. It is difficult to evaluate the efficiency of the variety of stoves used but they are significantly more efficient than open fires.

Energy consumption in transport: Rail transport has been declining steadily in Albania since 2009. Railways carried more than 50 million tonnes / km of goods in 2008 but a radical decline started in 2009. The World Bank reports that rail passenger numbers in Albania were estimated at 125 million in 2000 but by the end of the decade the numbers had reduced by 80 %. Both passenger and goods transport by rail have decreased drastically in recent years, to the extent that almost all inland goods and passengers travel is by road. In 2003 Albanian railways carried 520,000 tonnes of goods but by 2012 this had reduced to 142,000 tonnes.

Road transport: Air pollutant emissions from transport are major contributors to poor air quality in Europe and beyond. Emissions of particulate matter (PM), nitrogen oxides, unburnt hydrocarbons (HC) and carbon monoxide (CO) are regulated in the EU through a broad suite of legislation.

During the communist Hoxha era when there was an embargo in Albania on private car ownership there were less than 7,000 private passenger cars in the country. Since the advent of capitalism and democracy in 1992 the situation has changed significantly year-on-year.

The Ministry of Transport and Infrastructure reported that there were 563,106 passenger and freight vehicles in Albania in 2016, an increase of 30 % over 5 years. In the agricultural sector the number of tractors is currently about 600. However, details of tractors' engine capacities and their sizes and ages are not readily available.

Instat statistics for Albania show that transport is the main energy sector user in Albania and has been responsible for 41 % of the country's total energy consumption for the 5-year period from 2012 to 2016, fluctuating between 39.4 % in 2014 to 43.2 % in 2016. For 2015, Eurostat reported that the transport subsector consumed more than 42 % of the total energy with road transport responsible for 95 % of this.

Industrial processes and product use

More than 85 % the country's oil and gas comes from the Pathos-Marinza oil fields.
Mineral fuels accounted for more than 25 % of Albania's total exports in 2014.
In the mineral industry, the oil sector is followed by iron and steel with over 8 % of the market share, aluminium with about 2 %, copper 1.0 %, and lesser amounts of lead. Despite the presence of metallic ores and instate metal production, the importation of mineral products is the most expensive import category in Albania (in the order of $800 million).

The information available from the industrial sector is largely incomplete. There is no proper permitting system in force to allow the regulatory authorities to measure, determine, collect or analyse data from industries (i.e. no permits with enforced ELVs for macro pollutants). Inspection, monitoring and enforcement is deficient. Almost all the inventory is based on import and export data with a large degree of uncertainty. Production data in terms of economic value is reported by Instat. Other industrial production data has been obtained from outside research publications. The data deficit is exacerbated by a severe lack of monetary resources provided to competent authorities to allow them to undertake basic environmental monitoring, auditing, control and enforcement duties and collect related data and reports. Moreover, "confidentially" issues which prevail between polluters and competent authorities and prevent key environmental impact information from being made readily available.

Textiles, leather goods and shoes are produced in Albania, but the amounts generated are deemed to be "confidential", although Instat publishes information on the export value (in Albanian Lek) of the goods. In terms of exports, the leather, footwear and textiles industries combined are the largest export sector after minerals but there are no specific records of their solvent usage or the amount or type of energy consumed in their production. Accordingly, energy consumption and associated emissions as well as solvent use in the sector are largely based on default or energy balance values related to production.

As previously indicated, there is a severe dearth of information on the solvents-use sector in general (paints/varnishes/inks manufacture/mixing; printing – ink and solvent use; surface cleaning and metal surface coating; vehicle coating; leather and footwear manufacture – amount and process used; general use of adhesives; vegetable oil and animal fat extraction, etc.). There is also no information available on

fugitive emissions from the use of solvents, in particular, used in industrial processing / manufacturing / production and product use.

Several of the metallurgically-related industries that were whole-time operational during past years now operate on a part-time basis but their work periods and the extent of their work processes are not fully defined or readily available.

Agriculture

The Ministry of Agriculture and Rural Development, *via* Instat, has provided data on the numbers of livestock and poultry (dairy cows, other cattle, sheep, pigs, horses, asses, mules, broilers, other poultry, beehives, etc.). The information is updated annually and is largely complete for calculation of emissions. In general, however, some data refinement is needed to increase accuracy and reduce uncertainty of measurement. These include, better sub-division of livestock type, manure storage, manure production and application (solid or slurry manure) and periods of housing versus outdoor.
In addition, the Ministry has provided annually updated data on fertiliser use and application and the amount of land area tilled / cropped, in grassland and land conversion.

Waste

Most of the domestic generated waste in Albania is land-filled but there is a significant amount dumped illegally in rivers, on river banks and on the outskirts of major towns. The emissions from poorly managed waste are difficult to determine accurately but there is still a major issue concerning basic waste management.

Other sources and Natural sources

Other sources of emission were taken together with natural sources and include, *inter alia*, emissions from forest and vegetation fires, unmanaged forests and grasslands, wetlands, land conversion and geological processes. Forest fires in Albania destroyed 4,781 hectares per year from 2004 to 2013. There is also over 1 million hectares of managed and unmanaged forests.

7 METHODOLOGY

7.1 Data collection

In so far as possible, the report and accompanying inventory was prepared in line with the EMEP / EEA air pollutant emission inventory guidebook (2016) which provides methodology for application of a tiered system for developing better estimates of polluting emissions. Calculations of emission concentrations and loads have been undertaken in accordance with procedures and methodology laid out in the guidebook. Older versions of the guidebook were used to compile previous Albanian CEIP emission inventories and need to be aligned with the 2016 edition to ensure direct comparison of sectoral contributions and impacts.

Preparation for amassing the emission inventory involved the following stages: planning, data collection, data processing, manipulation and compilation.

Planning of the inventory included:

- identification of the relevant sources of pollution;
- identification of the related data sources;
- data collection process;
- research of documents containing related information;
- internet searches.

Any data which had been directly provided *via* national official energy, industry, trade, economic, transport, agriculture, waste and statistics reports were scrutinised prior to being used during the preparation of the inventory; firstly, to check the relevance of the information therein and, secondly, to check the quality and consistency of data. Data collection was carried out with the involvement of sector experts and through frequent contacts with appropriate public institutions in order to obtain and assess available pertinent information and draw a realistic and wholistic picture of the emissions situation in the country. Sector experts provided comment and feedback on their perceived 'goodness of fit' of the data before it was used in the emission inventory.

Research was made to gather information on NFR sectors and related subsectors including, energy production and combustion; industrial processes and product use - iron and steel, ferrochrome, other metals, non-metallic minerals, cement, lime, bitumen, etc., transport – railways, cars (gasoline), cars (diesel), trucks (light duty) gasoline, trucks and buses (heavy duty); agriculture and land use, fertilisers, livestock, etc.; waste; other sources and natural sources.

Major sources of emissions were considered individually, such as any single identifiable major source of pollution from 'Energy' and 'Industry' sectors. Little data have been provided from statutory returns by company operators to regulators. Further statistical data projections, estimations and extrapolations were used to compensate for lack of subsector-specific data or gaps in the information.

NFR sectors, related subsectors, sources and individual activities and enterprises were investigated relative to their liability to emit one or more of the following six macro-pollutants, NOx, SOx, NH_3, CO, NMVOC and PM_{10} during the years from 2009 to 2016, inclusive.

The data collection and evaluation processes involved the compilation of all appropriate data together with corresponding concentrations and emission loads coupled with appropriate emission factors. These were fed into Excel spreadsheets at first. The Nomenclature for Reporting (NFR) source sector and subsector classification system was adhered to by sector experts, and finally QA/QC procedures were carried out, in so far as possible, before the data was compiled.

The initial Excel storage and calculation process, as shown in Annex 1, formed the basis for an inventory database. The database developed through the project stores data sources and results. These are documented for future use and can be readily reconstructed in the future to improve the overall quality of the inventory and to comply with future updates. The developed database is a fully integrated inventory compilation and reporting tool, based on the combined source categorisations of the UNFCCC and the LRTAP Convention and is compatible with those used in the EU GHG Monitoring Mechanism and the National Emission Ceilings Directive. The system is flexible and can be easily adjusted to new storage, manipulation and reporting requirements.

Data processing methodologies were applied to calculations or estimations, as well as the selection of emission factors based on the EMEP/EEA air pollutant emission inventory guidebook 2016.

The guidebook requires energy consumption to be expressed in different units according to the specified emission factor (e.g. g /GJ, g / tonne, kg / tonne, g / Mg, etc.). The following conversion table from the IAEA is a useful reference for such conversions in the absence of country-specific emission factors.

Heat values of various fuels[8]

Table 5: Heat values (calorific values) of various fuels

Fuel	Heat value	% carbon	CO_2
Hydrogen (H_2)	120-142 MJ/kg	0	0
Methane (CH_4)	50-55 MJ/kg		
Methanol (CH_3OH)	22.7 MJ/kg	37	
	18 MJ/L		
Dimethyl ether - DME (CH_3OCH_3)	29 MJ/kg		
	19 MJ/L		
Petrol/gasoline	44-46 MJ/kg		
	32 MJ/L		
Diesel fuel	45 MJ/kg		
	39 MJ/L		
Crude oil	42-44 MJ/kg	89	70-73 g/MJ
	37-39 MJ/L		
Liquefied Petroleum Gas (LPG)	49 MJ/kg	81	59 g/MJ
Natural gas (UK, USA, Australia)	38-39 MJ/m^3	76	51 g/MJ
Natural gas (Canada)	37 MJ/m^3		
Natural gas (Russia)	34 MJ/m^3		
Natural gas as LNG (Australia)	55 MJ/kg		
Hard black coal (IEA definition)	>23.9 MJ/kg		

[8] Heat values of various fuels. World Nuclear Association. September 2016.

Table 5: Heat values (calorific values) of various fuels			
Fuel	**Heat value**	**% carbon**	**CO_2**
Hard black coal (Australia & Canada)	c 25.5 MJ/kg	67	90 g/MJ
Sub-bituminous coal (IEA definition)	17.4-23.9 MJ/kg		
Sub-bituminous coal (Australia & Canada)	c 18 MJ/kg		
Lignite/brown coal (IEA definition)	<17.4 MJ/kg		
Lignite/brown coal (Australia, electricity)	c 10 MJ/kg	25	1.25 kg/kWh
Firewood (dry)	16 MJ/kg	42	94 g/MJ
Natural uranium, in LWR (normal reactor)	500 GJ/kg	0	0
Natural uranium, in LWR with U & Pu recycle	650 GJ/kg	0	0
Natural uranium, in FNR	28,000 GJ/kg	0	0
Uranium enriched to 3.5%, in LWR	3900 GJ/kg	0	0

Uranium figures are based on 45,000 MWd /t burn-up of 3.5 % enriched U in LWR
MJ = 10^6 Joule, GJ = 10^9 J;
% carbon is by mass; mass CO_2 = 3.667 mass C
MJ to kWh @ 33% efficiency: x 0.0926
One tonne of oil equivalent (toe) is equal to 41.868 GJ
Sources:
OECD/IEA Electricity Information 2008, for coal;
Australian Energy Consumption and Production, historical trends and projections,
ABARE Research Report 1999.

7.2 Data Sources

For area sources a major amount of activity data has been extracted from Statistical Yearbooks produced by Instat and from ministries and public bodies within Albania as well as from other internal and external sources listed in tables 6 and 7. Internet searches, UN, FAO, WB documents and other external published data were also referenced.

The main sources of data in Albanian are from public institutions listed in table 6.

Table 6: Public data sources
(Former) Ministry of Transport and Infrastructure (MoTI), Albania
Ministry of Tourism and Environment (MoTE)
National Environment Agency (NEA)
Union of Chambers of Commerce and Industry of Albania (UCCIAL)
Ministry of Infrastructure and Energy (MoIE)
Ministry of Agriculture and Rural Development (MoARD)
Ministry of Health (MoH)
Ministry of Finance and Economy (MoFE)
Statistics Directorate of the State Plan Commission of the Socialist Popular Republic of Albania (SDSPCSPRA) - Annual Statistical Books from 1981 and 1988
Institute of Statistics (INSTAT)

Available information was also obtained from external institutions listed in table 7.

Table 7: Other data sources
Bunkers oil reports
Sector engineers' reports
Eurostat reports
USGS yearbooks
Knoema published data
Index mundi
CEIC data
Trade statistics
Economic statistics
World bank and FAO reports

UN reports
Nations encyclopaedias
Published data on Albanian industry, agriculture, transport and waste generation
Internet searches

In addition, an electronic copy of Annex 1 of this report incorporates cell comments that indicate the sources of information for the data included in the Excel table and other relevant remarks and information.

Albania's IIR for the period 1990 to 2015 was presented to the CEIP in 2017 but there were major omissions from some anthropogenic subsectors. Accordingly, data for the years from2009 to 2016 were revised and updated. Although there remain major gaps, particularly for the solvent sectors and industrial production due mainly to the inability / capacity of the MoTE and the NEA to collect such data for various reasons (budget, resources, capacity, politics, etc.). For example, during 2017 over 180 industrial activities were required to report their anthropogenic emissions for E-PRTR to the competent authority. Only 4 of those had reported by the year end. There is a severe lack of enforcement of legislation by the competent authorities in all industrial sectors and a huge dearth of information on industrial emissions from all industrial subsectors but more particularly on the 'solvents-use' subsector.

An industrial permitting process introduced by the competent authority for (IPPC/IED) industrial activities has not set emission limit values on industrial permits. Neither is there any compliance or check monitoring or measurement of emissions from such activities by competent authorities. This is mainly due to insufficient monetary resources, which for, many years, have been deemed totally inadequate. Cosequently, some of the data presented in this report are based on rounded estimates and are likely to incorporate large uncertainties of measurement. Moreover, the competent authorities responsible for environmental protection in Albania do not have information regarding the type or efficiencies of technologies employed (e.g. combustion technology) in manufacturing, production and processing industries in the state.

7.3 Determination of emissions

Albania's submission to the NECD and the CLRTAP require annual emission estimates presented in Nomenclature for Reporting (NFR) format, for: Nitrogen oxides [(NO_X (as NO_2)], carbon monoxide (CO), ammonia (NH_3), sulphur dioxide [(SOx (as SO_2)], non-methane volatile organic compounds (NMVOCs), particulate matter (PM), persistent organic pollutants, and heavy metals.

The updated emission inventory for the period from 2009 to 2016, inclusive, includes the following pollutants under CLRTAP: nitrogen oxides (NO_x), sulphur oxides (SO_x), ammonia (NH_3); non-Methane Volatile Organic Compounds (NMVOC), carbon monoxide (CO) and PM_{10} (suspended particles with diameter less than 10µm).

Table 8 provides a synopsis of the main anthropogenic sources of the six assessed pollutants.

Table 8: Synopsis of emission origin of the six macro-pollutants determined
Oxides of nitrogen (NOx): The main sources of NOx from anthropogenic sources are from combustion of fossil fuels and biomass burning and road transport. It may react with volatile organic compounds in the atmosphere, catalysed by UV light (sunlight) to produce harmful levels of ozone. Nitric oxide (NO) and nitrogen dioxide (NO_2) are the two principal oxides of nitrogen formed during fuel combustion. NO_X is formed in the combustion process through two primary mechanisms, namely, conversion of nitrogen contained in fuel and thermal NO_X, or formation of NO_X from nitrogen contained in the air. As liquid and gaseous fuels contain low to negligible amounts of nitrogen, thermal NO_X is the primary mechanism for NO_X formation from these fuels.

Oxides of sulphur (SOx): A major part of anthropogenic SOx emissions result from the burning of fossil fuels in energy production plants and during industrial production. Burning of coal, oil and gas in domestic and commercial enterprises may also give rise to significant amounts of anthropogenic SOx. SOx levels are elevated when the fuels burned have a high sulphur content. Excessive levels of oxides of sulphur, nitrogen and carbon oxides have been found to cause severe adverse impacts on water bodies (e.g. acidification and eutrophication) with the subsequent reduction and loss of valuable flora and fauna.
Ammonia (NH_3): The main ammonia emissions from anthropogenic sources originate in the agricultural sector from manures, slurries and fertiliser use, ammonia and urea application and manufacture of nitric acid and ammonium salts. Ammonia is also generated from lithogenic processes associated with volatilization from ocean surfaces and soils.
Particulate matter less than 10 microns in diameter (PM_{10}): Atmospheric dust is constituted of particulate matter having various mixed sizes of particles. PM_{10} particles (which are less than 10 microns in mean diameter) consist of both, coarse primary particles emitted directly from combustion / energy utilisation processes and secondary particles in the form of aerosols. Finer $PM_{2.5}$ particles (with mean diameter less than 2.5 microns) result from combustion and other anthropogenic processes and activities. Lithogenic reactions and interactions add to the dust mass. Synergistic, antagonistic and additive atmospheric reactions may further facilitate dust formation or interact / react with existing particles to form additional particles and other substances and mixtures. Furthermore, particles present in the atmosphere may act as absorption, adsorption or interactive sites that may compound adverse impacts. Emissions of gaseous pollutants, such as oxides of sulphur (SOx) oxides of nitrogen (NO_X) and non-methane volatile organic compounds (NMVOCs) may be significantly altered through chemical reaction in the atmosphere and increase both particulate mass and harmfulness. There are many sources of PM_{10} (and $PM_{2.5}$). The main sources of these fine particles are from fossil fuels which are not fully combusted, aerosols, abrasion of roads, tyres and brakes, dust generated by mining, waste handling, mineral dust from metals. Lithogenic sources include sea salt, exposed land surfaces, etc.
Carbon monoxide (CO): Anthropogenic CO is produced due to incomplete combustion of all fossil fuels – coal, peat, gas, oil, firewood. Transport is also a major source of CO emissions. Its production is elevated in low efficiency combustion processes.
Non-methane volatile organic compounds (NMVOCs): The main anthropogenic sources of NMVOCs are, fossil fuels – coal, peat, gas, oil, firewood as well as production and use of organic solvents, petroleum products, paint, ink and dye manufacture and use. Vegetation is a significant lithogenic source of NMVOC. Ground level (tropospheric) ozone is formed in the atmosphere by a reaction between volatile organic compounds (VOC) and NOx in the presence of sunlight. Ozone occurs naturally in the stratosphere and in the troposphere, but in those areas, it is formed by different chemical processes. Ozone in the stratosphere is valuable as it protects the ecosystem from ultraviolet radiation, however, tropospheric ozone near ground level is harmful to ecosystems, human health and agriculture. Most air pollutants react with each other in the atmosphere to form new substances which may be significantly more polluting, harmful, disruptive and destructive that the original primary emissions that gave rise to them.

8 RESULTS

This Informative Inventory report provides some general information on the methodology used to compile the inventory, in particular, data sources, emission factors and emission calculations, as well as data collection procedures.

The 2016 guidebook describes a three-tiered methodology for estimating emissions wherein, tier 1 emission factors relate to the sources and substances which the countries that have ratified international conventions and protocols need to report on. More developed tier 2 applications are used for key categories and still more advanced tier 3 factors can be applied for key categories where suitable specific methods are available.

In many cases tier 1 emission factors were used to estimate emission loads in Albania rather than tiers 2 and 3. The dearth of more precise information on, *inter alia*, manufacturing and production systems, applied production processes, efficiency of combustion technologies, fuels used in individual enterprises, emission monitoring, etc. is likely to result in larger levels of uncertainty in emission concentrations and loads than if more precise information was available on operational and production processes.

Tier 1 has the least level of accuracy and highest level of uncertainty, in general. It involves multiplying available bulk statistical data with default emission factors (EFs) from the guidebook. Tier 2 introduces more advanced knowledge about the combustion process, type of burner / boiler used during combustion or In so far as possible, the report and accompanying inventory was prepared in line with the EMEP / EEA air pollutant emission inventory guidebook (2016) which provides methodology for application of a tiered system for developing better estimates of polluting emissions. Calculations of emission concentrations and loads have been undertaken in accordance with procedures and methodology laid out in the guidebook. Older versions of the guidebook were used to compile previous Albanian CEIP emission inventories and need to be aligned with the 2016 edition to ensure direct comparison of sector contributions or the technological process being used. Tier 3 aims at getting more accurate emission results with a lesser degree of uncertainty and can involve calculation models, better and more inclusive evaluations of fugitive emissions and more advanced information about applicable technological processes. Tier 3 also provides for the application of country-specific emission factors and associated data data.

For most of the data contained in this report, as displayed in Annex 1 we were unable to apply a system beyond Tier 2 as there is not enough comprehensive information on combustion technologies or ongoing regular measurement of polluting emissions from major point sources. In addition, there is still a mindset in the country which makes it difficult for competent authorities and the public to get reliable technical data from the majority of industries and operators of other polluting sources. This requires a better enforcement system and a series of appropriate sanctions for uncooperative activity operators. Coupled with this there is an acute lack of compliance monitoring and environmental enforcement.

8.1 Emission estimates

The Albanian air pollution emission inventory contains information on the following air pollution sources:

- **Stationary sources**, called point sources.
- **Mobile sources (diffuse pollution)**, related to all on-road vehicles such as automobiles and trucks and off-road vehicles such as trains, ships, aircraft; and mobile farm, fisheries, forestry, gardening, institutional and construction equipment.

Calculation of emissions was undertaken in accordance with recommended guidebook application methodology where emission sources are divided into point sources, mobile sources and area sources.

Polluting Emissions (E) are calculated by multiplying information on the extent to which a human activity takes place, called activity data (AD) by the coefficient that quantifies the emissions or removals per unit activity, called the emission factor (EF).

The basic equation is: E = AD x EF

When data was collected, emission loads were calculated by coalescing activity data with emission factors for each activity, sub-sector and main sector to provide best estimates of polluting emissions emanating from each NFR sector and associated subsector. Direct measurements of polluting emissions to air were generally not available. Accordingly, the calculation was based on the formula:

$$\textbf{Emissions}_{NOX,\,SOX} = \Sigma(AR_{activity} \times EF_{pollutant,activity})$$

As an example, from the transport sector, fuel consumption would constitute activity data and mass of NO_X emitted per unit of fuel consumed would be an emission factor.

In this report calculation of emissions is aligned with procedures and methodology as laid out in the EMEP/EEA air pollutant emission inventory guidebook 2016, which replaces previous versions.
The 2016 guidebook describes a three-tiered methodology for estimating emissions wherein, tier 1 methods are given for all the sources and substances which the countries that have ratified Convention protocols need to report on; more developed tier 2 methods are given for key categories and still more advanced tier 3 applications can be applied for key categories where suitable specific methods are available.

In many cases tier 1 emission factors were used to estimate emission loads rather than tiers 2 or 3. The dearth of more precise technological data is likely to incorporate a larger level of uncertainty in emission results than if more information was available on operational processes and emission loads.

8.2 Macro pollutants

8.2.1 Oxides of nitrogen

Table 9, below, shows the national loads (in Gg) of NOx reported for each year from 1990 to 2008 generated from the four main NFR sectors.

From 1990 to 2008 and further through to 2016 the main source of NOx emissions to the environment was the energy sector. During the 19-year period the total NOx loads varied from a low of 16.0 Gg in 1994

to a high of 25.2 Gg in 2004 with a mean of 19.6 Gg for the period. The energy sector alone accounted for 98.3 % of the total NOx loads for the assessed period. The energy source sector includes emissions from large combustion plants, small combustion plants, energy used in industry, energy used for domestic, commercial and institutional buildings and fuel used for trains, passenger cars, motorcycles, light commercial and heavy duty vehicles, buses and minibuses, navigation vessels, fishery and leisure boats and stationary and mobile machinery used in agriculture, horticulture forestry, gardening, road, rail and building construction and refurbishment and demolition.

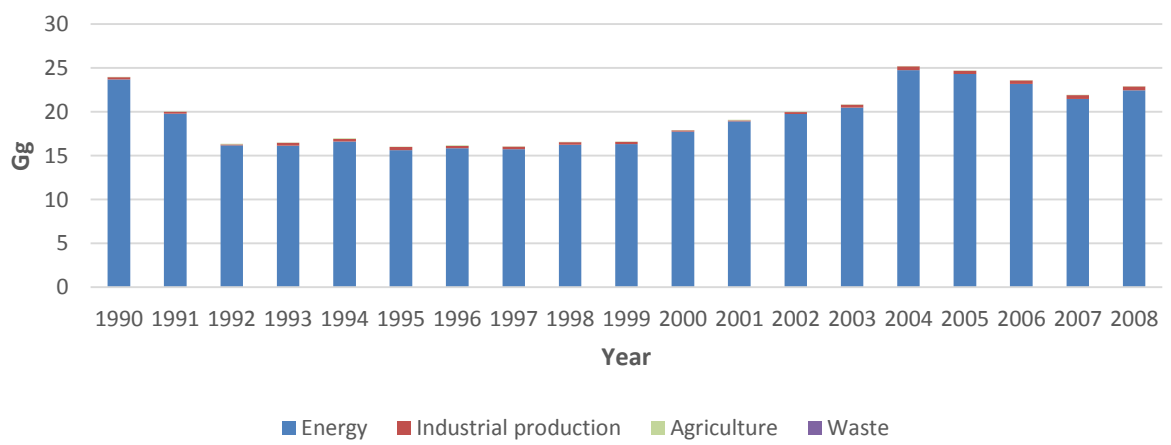
Table 9: Gg NOx (as NO_2) for the period from 1990 to 2008

	Gg NOx (as NO2)																		
Sector / Year >	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Energy	23.707	19.78	16.164	16.15	16.625	15.624	15.846	15.751	16.269	16.329	17.763	18.927	19.769	20.481	24.752	24.323	23.181	21.467	22.461
Industrial production	0.232	0.225	0.137	0.309	0.3	0.375	0.274	0.276	0.265	0.251	0.117	0.113	0.209	0.34	0.426	0.344	0.422	0.426	0.435
Agriculture	0.053	0.052	0.043	0.05	0.049	0.048	0.047	0.052	0.052	0.044	0.044	0.041	0.039	0.038	0.035	0.036	0.035	0.033	0.037
Waste	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Due to low industrial production in Albania (compared to EU MSs), the industrial processes sector, as distinct from the combustion of energy for industrial processes together with the agricultural sector contributes less than 1 % of NOx (discounting natural emissions and agricultural field burning which may contribute a further ~1 %).

Figure 1 indicates that there was a comparative downward trend in NOx emissions from 1990 to 1997 due to a general slump in industrial production during this period. Part of the NOx emission reductions from industry were counteracted by a significant growth in road transport numbers during the period. Energy used in industry is included in the blue shaded area. Industrial processes and product use is represented by the maroon shaded area and generates only a fraction of the NOx generated through industrial combustion.

Figure 1: Gg NOx (as NO_2) for 4 NFR sectors 1990-2008



Annex 2 of this report provides updated emission inventory data for the period from 2009 to 2016. The graphs and charts provided here have been compiled through accessing the sector emission inventory sum totals contained in the annex. Previously, some gaps had been identified in contributory subsectors and the update endeavours to address the shortfalls. Notwithstanding inclusion of revised data, the energy production / consumption sector is still responsible for almost all of the national total NOx

emissions. NOx is expressed as Mg rather than Gg in table 10, below, to avoid zeros in the minor contributing sectors.

Table 10: NOx (Mg as NO_2) 2009-2016

NFR sector	2009	2010	2011	2012	2013	2014	2015	2016	Sum 2009-2016
Energy	32,684	34,915	40,302	34,480	35,825	38,615	38,631	40,557	**296,009**
Industrial Processes	16	15	16	15	15	15	15	15	**120**
Agriculture	195	194	198	199	195	201	196	199	**1,576**
Waste	-	-	-	-	-	-	-	-	**-**
Natural & Other	478	478	478	478	478	478	478	478	**3,825**
Year total >	**33,373**	**35,603**	**40,993**	**35,172**	**36,513**	**39,308**	**39,319**	**41,249**	**301,530**
Road transport	**12,967**	**13,486**	**17,616**	**15,188**	**16,688**	**17,815**	**18,697**	**20,001**	
% NOx from road transport	**38.9**	**37.9**	**43.0**	**43.2**	**45.7**	**45.3**	**47.6**	**48.5**	**Mean % 43.7**

A revision and update of data for 2009 and subsequent years indicates a substantial increase on the 2008 emission load for NOx. The estimated emission load for the energy sector in 2009 increased by by 27 % on the 2008 load. This is not due to a 27 % increase in NOx emissions but rather due, in part, to a more complete data set for 2009 and because fuel used in industrial production in previous years may have been included in sector 2, "industrial processes and product use", as sector 2 showed a significant decrease from 2008 to 2009. Annual NOx variation are illustrated graphically in figure 2.

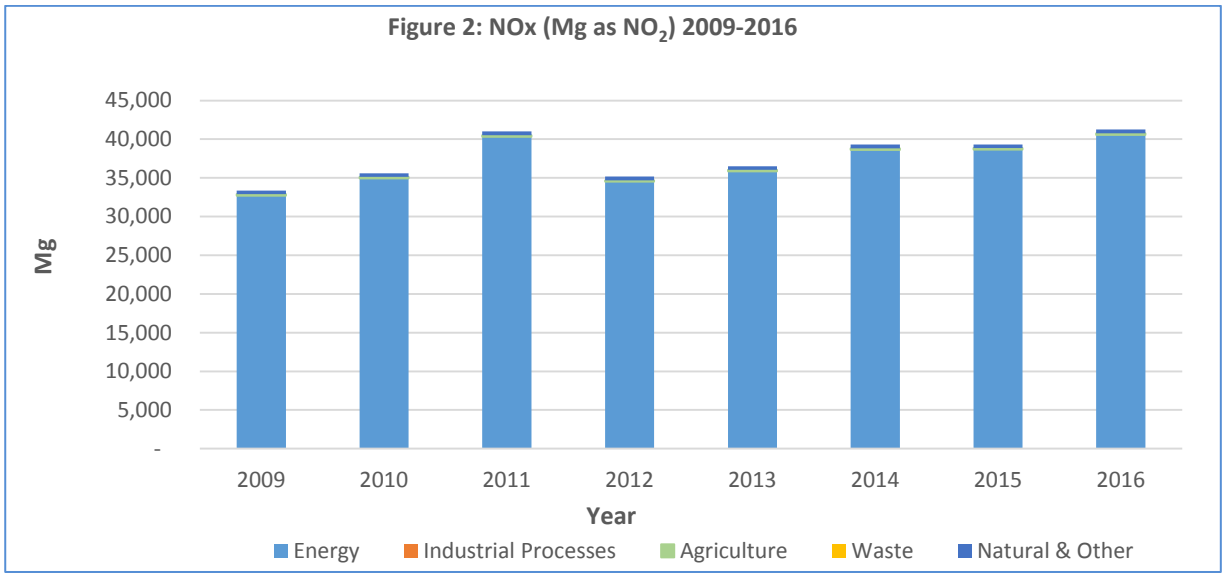


Figure 3, below, shows the contribution to NOx emissions made by each NFR sector for the 8-year period from 2009 to 2016. As before the energy sector is by far the largest contributor during this period with a 98 % contribution. The source of the data is found in Annex 2 of this report. Figure 3 does not distinguish between combustion of fuel in industry, transport and combustion in small and large combustion plants and stoves for domestic, commercial and institutional heating, rather, the breakdown is related to the main NFR sectors and displays national energy use *per se*.

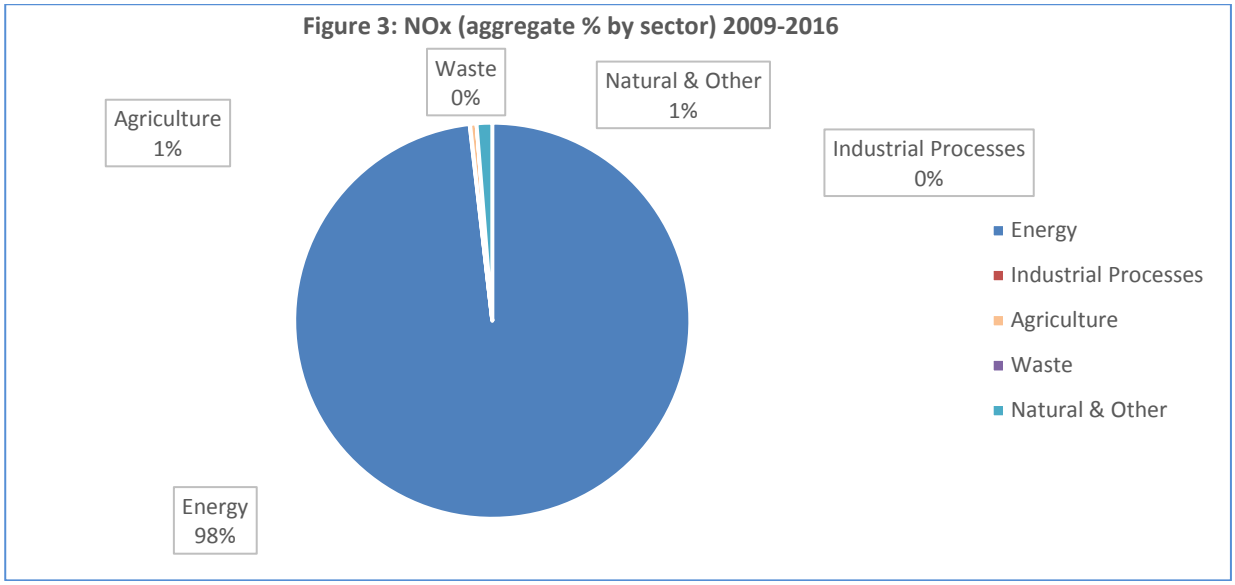
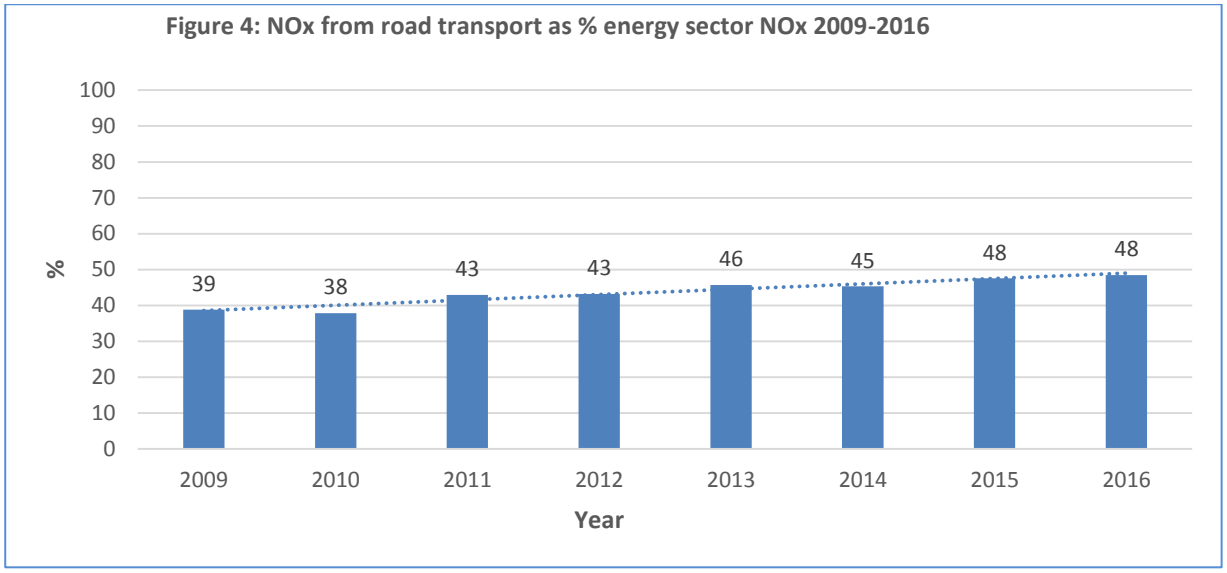


Figure 4 illustrates the NOx contribution from the road transport fuel consumption sub-sector as a percentage of total NOx emissions for the country for the identified period from 2009 to 2016. During the assessed period NOx from the road transport subsector alone accounted for 43.7 % of the total national NOx emission load, varying from a low of 38.9 % in 2009 to 48.5 % in 2016. The figure shows a generally increasing trend in the contribution of the road transport sector to NOx emissions since 2009. The percentage increase is due mainly to an increase in the number of road transport vehicles during the assessed period. The contribution by the road transport subsector to national NOx emissions in 2016, at 48.5 %, was almost half of all of Albania's NOx emissions for the year.

Published details are available on transport vehicle number and are updated annually but little information is available on engine condition, efficiency, vehicle age, fuel consumption and annual distance travelled. As a result, data are likely to incorporate large uncertainty of measurement.

Within the energy consumption and combustion sector, the transport sub-sector, in terms of overall NOx contributions, is followed by consumption in households and in commercial and institutional establishments with 28.5 % while industrial consumption is lagging far behind and agriculture and fisheries activities were responsible for relatively small percentages of the total. In the agricultural sector the number of tractors is currently about 600. However, details of tractors and their size, ages and working hours are not readily available and, as a result, uncertainty of measurement (estimation) is heightened. A similar situation pertains for the construction, fishing and forestry activities. For fuel consumption and emission purposes, an estimate of the number of fishing boats was made, in consultation with local fisheries experts, as well as their means of propulsion (petrol or diesel). Emissions associated with road and building construction was determined with reference to the constructed areas.



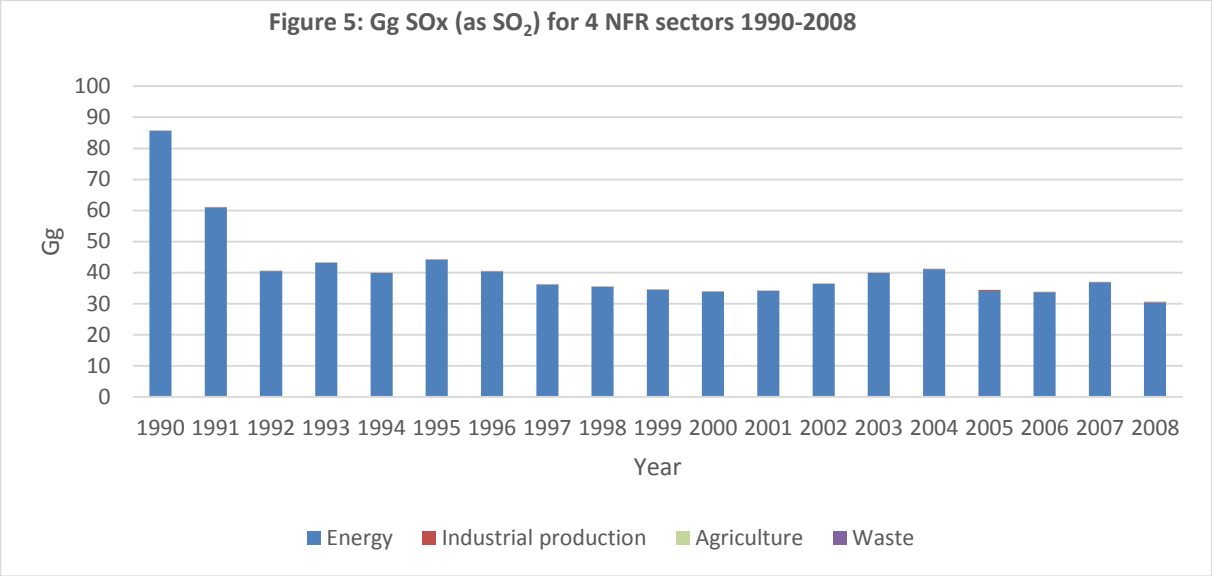
8.3 Oxides of sulphur (SOx)

Both NOx and SOx arise mainly from the fuel combustion process. Consequently, SOx emissions from the energy sector are by far the biggest contributor to overall SOx emissions in Albania and contributed over 99 % of national SOx emissions during the period from 1990 to 2008.

Table 11: Gg SOx (as SO_2) for the period from 1990 to 2008

	Gg SOx (as SO2)																		
Sector / Year >	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Energy	85.625	60.962	40.476	43.179	39.876	44.247	40.416	36.203	35.438	34.521	33.927	34.161	36.395	39.893	41.106	34.106	33.698	36.86	30.436
Industrial production	0.121	0.107	0.073	0.114	0.103	0.107	0.078	0.079	0.076	0.073	0.035	0.034	0.061	0.099	0.124	0.29	0.13	0.132	0.142
Agriculture	0.009	0.009	0.007	0.009	0.008	0.008	0.008	0.009	0.009	0.008	0.008	0.007	0.007	0.007	0.006	0.006	0.006	0.006	0.006
Waste	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The general downward trend in national SOx emissions is illustrated in figure 5. Estimations indicate a significant reduction in SOx from the energy sector from 1990 to 2008 with a reduction of almost 50 % after 3 years and reducing by 65 % over the 19-year period. The reduction was not due to controls of SOx emissions from point source but rather due, *inter alia*, to a slow down in industrial processes and increased hydropower generation, as discussed above.

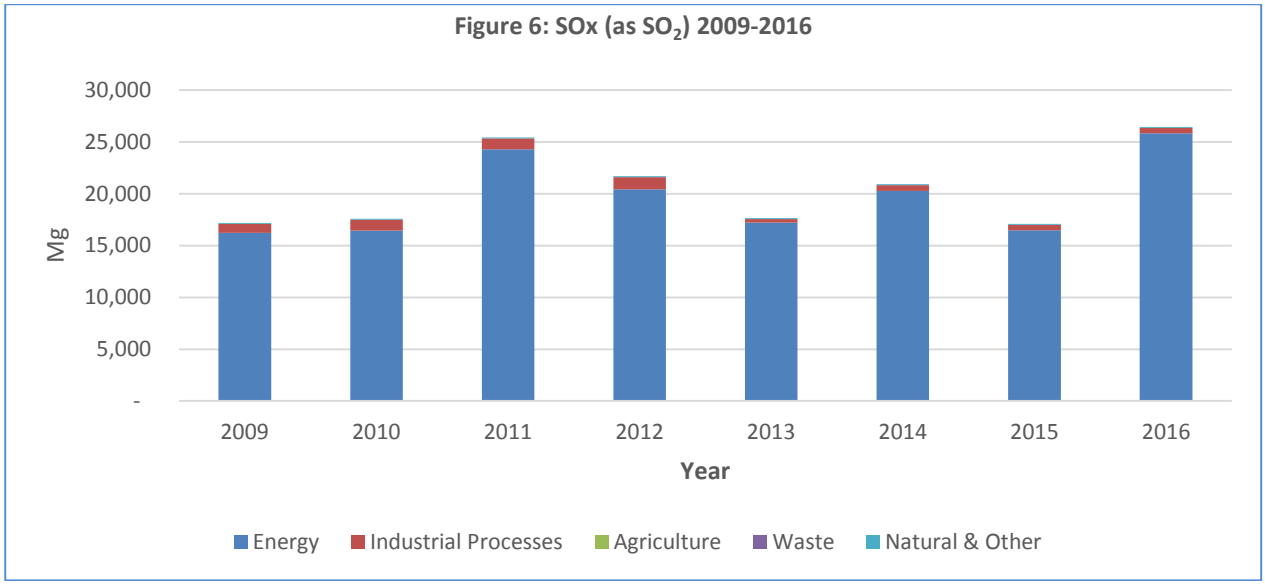


There is a significant difference between national SOx loads for the period from 2009 to 2016 compared to the previous period and an immense discrepancy between the estimated SOx loads for the period from 1990 to 2008 compared to the period from 2009 to 2016. There is no consistency in data continuity. Given that almost all of Albania's domestic electricity is generated from hydropower and rural houses use, almost exclusively, firewood for heating, the SOx emissions the country at 30 Gg of SOx in 2008 seem inordinately inflated. In addition, there was a vast reduction in state coal (lignite) mining as evident from USGS yearbooks, Instat and Eurostat reports. Electronic calculations for SOx emissions for the period from 2009 to 2016 are presented in Annex 2 of this report.

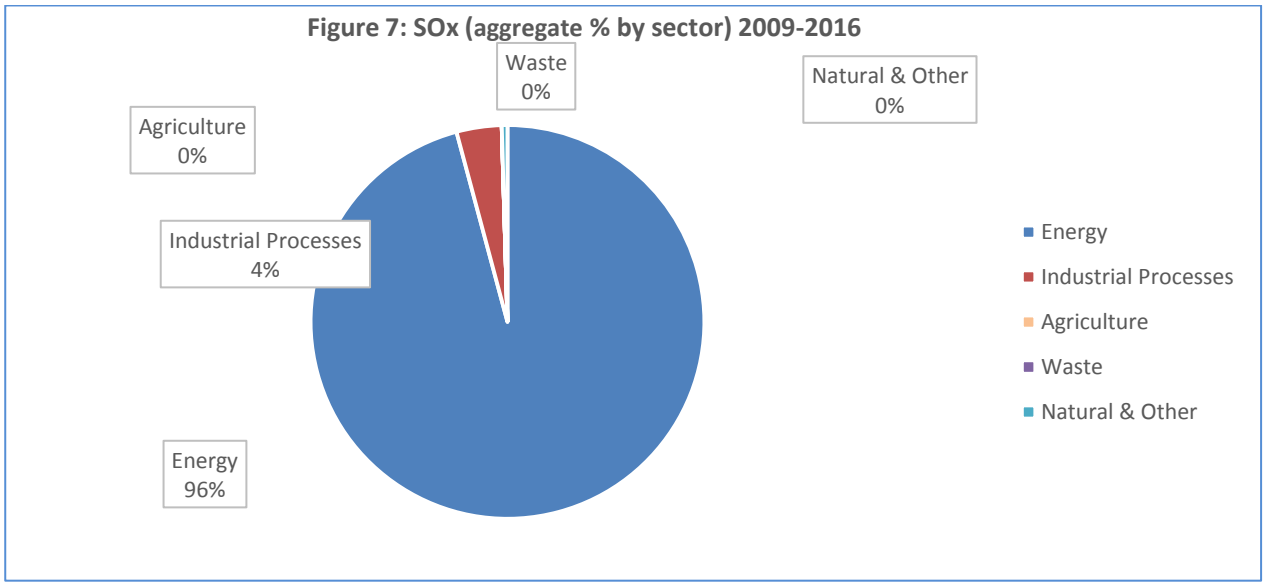
Table 12: SOx (Mg as SO_2) 2009-2016

NFR sector	2009	2010	2011	2012	2013	2014	2015	2016	Sum 2009-2016
Energy	16,224	16,446	24,297	20,438	17,218	20,291	16,483	25,830	**157,227**
Industrial Processes	877	1,048	1,056	1,181	330	530	530	531	**6,083**
Agriculture	-	-	-	-	-	-	-	-	**-**
Waste	-	-	-	-	-	-	-	-	**-**
Natural & Other	96	96	96	96	96	96	96	96	**765**
Year total >	**17,196**	**17,590**	**25,448**	**21,714**	**17,643**	**20,917**	**17,109**	**26,456**	**164,074**

Table 12 gives a NFR sectoral breakdown of SOx emissions for the period from 2009 to 2016 as well as the total emission load for the identified period, with almost 96 % of the national SOx total emissions emanating from the energy sector and almost all of the remainder from the industrial processes and product use sector with relatively insignificant amounts emanating from natural and other sources, agriculture and waste. Figure 6 illustrates annual variations in SOx emissions.



The pie-chart in figure 7 displays the SOx emission loads by sector for the assessed period. As expected, energy is the major contributor followed by industrial processes and product use.



8.4 Ammonia

Table 13 shows that the main contributor to pollution from ammonia in Albania is the agricultural sector. While many EU countries were able to reduce SOx by 90 % since 1990 and NOx has been reduced by 70 % in the EU since 1990, the same level of diminution has not been achieved with ammonia where reductions have been of the order of about 10 %. It is proving very difficult to maintain the agricultural sector at its present level of intensity and manage to reduce ammonia from the sector.

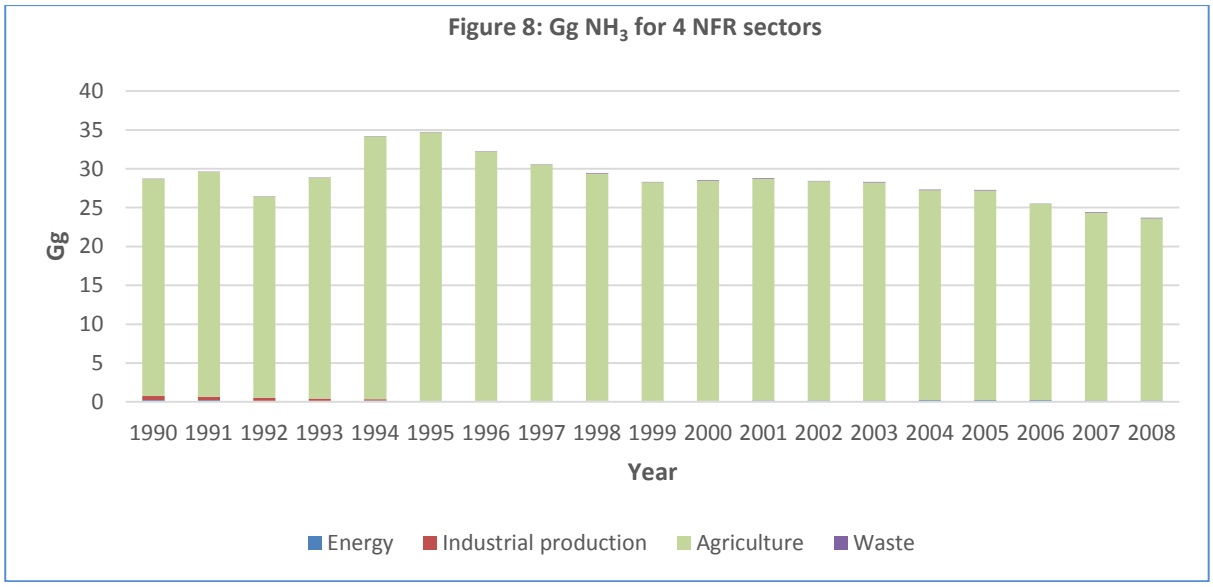
Some ammonia reductions took place in the agricultural sector (to both air and water) since the start of implementation of the EU Nitrates Directive (91/676/EEC) with the establishment of nitrate vulnerable zones and nitrates action programmes. These resulted in significantly less inorganic fertiliser (ammonium nitrate, urea nitrogen and N-P-K) being applied. There were also some reductions in the agricultural sector due to incorporation of good agricultural practice, including, better cattle housing, better storage

of animal manure which prevents volatilisation of product ammonia and by better field application processes, which curtail ammonia volatilisation. Nonetheless, achieving sizeable ammonia reduction is still a significant challenge for the agricultural sector in European Union MSs.

Table 13: Ammonia (Gg) for the period from 1990 to 2008

	Gg NH3																		
Sector / Year >	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Energy	0.211	0.219	0.154	0.145	0.165	0.149	0.151	0.149	0.149	0.132	0.148	0.162	0.176	0.162	0.213	0.228	0.228	0.192	0.196
Industrial production	0.563	0.469	0.375	0.281	0.188	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	27.929	28.896	25.872	28.439	33.829	34.544	32.077	30.373	29.257	28.137	28.347	28.579	28.226	28.088	27.04	26.987	25.233	24.154	23.43
Waste	0.031	0.032	0.034	0.035	0.037	0.039	0.041	0.043	0.046	0.049	0.052	0.054	0.057	0.061	0.065	0.069	0.073	0.078	0.082

Table 13, above shows the sectoral loads of ammonia from 1990 to 2008. While there have been some fluctuations from year to year, in general, more than 98 % of ammonia emissions emanated from the agricultural sector throughout the period. The ammonia loads which were generated by industrial sector in the early 1990s reduced significantly in the following years. This was not due to treatment of emissions but rather to a slump in industrial activities that were emitting ammonia. In Albania, ammonia is manufactured but the amount, relative to that stemming from the agricultural sector, is relatively insignificant. Since 1995 there has been a downward trend in ammonia loads emitted nationally. Traditionally, prior to the start of the implementation of the Nitrates Directive farmers tended to overapply inorganic nitrogen and discount the nutrient value of animal manure as fertiliser. In later years nitrogen and ammonia containing fertilisers tended to be used more efficiently and applied according to soil and crop requirements utilising better application practices. Figure 8, below presents a graphic illustration of the variation in ammonia emissions between 1990 and 2008. Estimated national total ammonia emissions varied from a high of 35.7 Gg in 1995 to a low of 23.7 Gg in 2008.



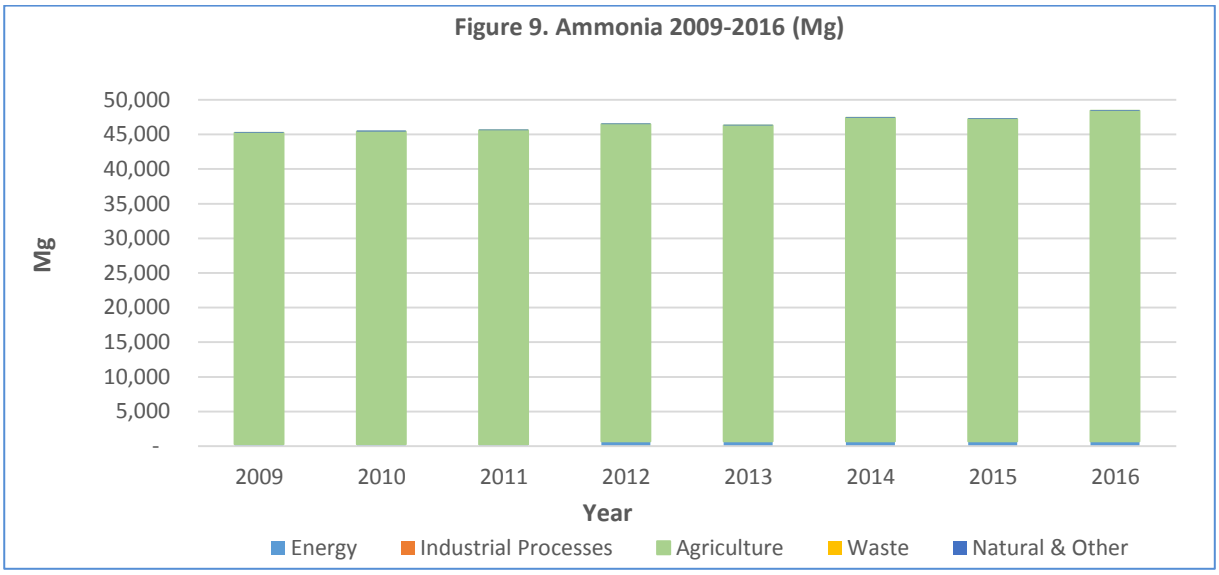
As with SOx, there is are inconsistencies in ammonia data estimates for the period from 1990 to 2008 and for the period from 2009 to 2016. In 2008 it was estimated that the total ammonia emissions generated nationally was 23.7 Gg. However, revised estimates, in accordance with the 2016 guidebook for the period from 2009 to 2016 indicate that previous estimates were too low. The main reason for this is that more NFR sub-sector information has been included in the updated estimations. Calculations associated with the 2009-2016 are provided in Annex 2 of this report.

Table 14: Ammonia (Mg) 2009-2016

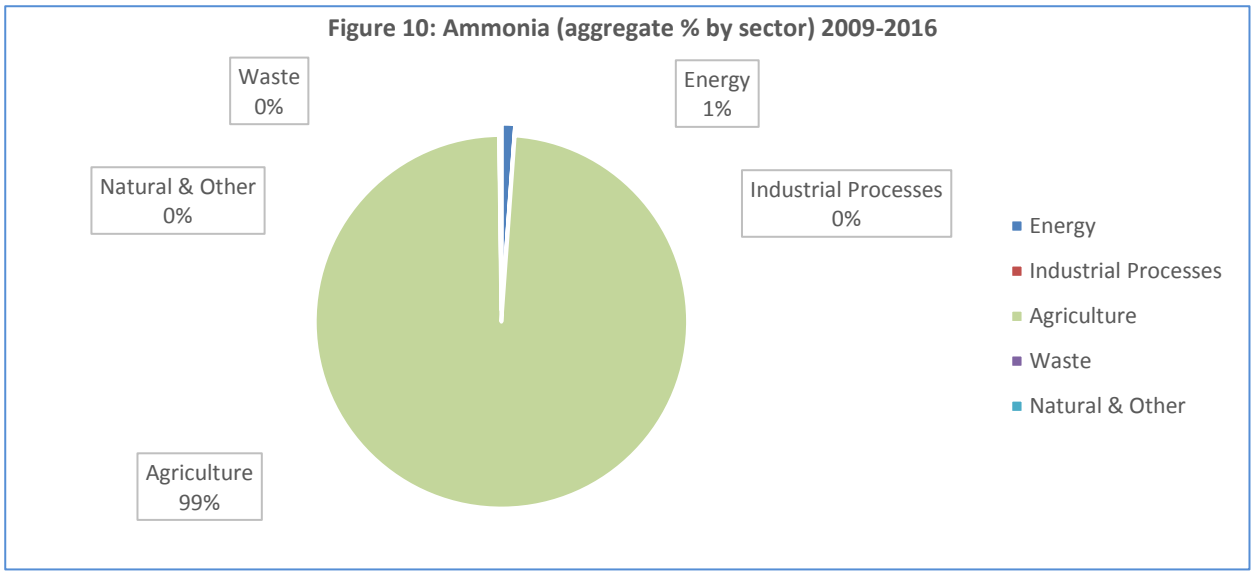
NFR sector	2009	2010	2011	2012	2013	2014	2015	2016	Sum 2009-2016
Energy	272	285	232	684	716	696	683	691	**4,260**
Industrial Processes	0	0	0	0	0	0	0	0	**1**
Agriculture	44,969	45,161	45,397	45,820	45,594	46,698	46,551	47,718	**367,907**
Waste	-	-	-	-	-	-	-	-	**-**
Natural & Other	96	96	96	96	96	96	96	96	**765**
Year total >	**45,337**	**45,542**	**45,725**	**46,600**	**46,406**	**47,490**	**47,329**	**48,505**	**372,934**

Table 14 provides the NFR sector total ammonia emissions estimated for the period from 2009 to 2016. The slight increase in ammonia over the period reflects changes in livestock numbers and types, devolved horticultural and agricultural practices, fertiliser application and fruit and vegetable production over the assessment period. The key issue to be addressed is that there has been a general upward trend in ammonia emissions. This is an issue which needs to be confronted.

Figure 9 presents a graphic illustration of NFR sectors responsible for ammonia emissions over the 8-year period from 2009 to 2016. The general trend is upwards.



Data contained in table 14 and figure 9 (abstracted from the Annex 2 inventory) show that for each year between 2009 and 2016 more than 98 % of the total national ammonia emissions emanate from the agricultural sector. The sectoral contribution for the assessed period was 99 %, as shown in figure 10, with the remainder emanating mainly from the energy sector.



8.5 Particulate matter less than 10 microns (PM_{10})

Particulate matter is ubiquitous and of many different forms and organic, inorganic and mixed constitution. In combustion process, fine particles (PM_{10} and $PM_{2.5}$) result from partially incombustible material and residues. Even with best assessment processes there may be huge uncertainty of measurement in results reflecting the complexity of accurate reporting for this parametric measurement. For example, in coal mining, particulate emissions from exposed or uncovered stock piles or exposed storage areas can vary by orders of magnitude from windy to calm conditions.

Key PM_{10} particle sources are stationary combustion systems for energy production (industrial, domestic, commercial, institutional), iron and steel manufacturing and other metal processes, quarrying and mining, mineral production (cement, lime, bricks and tiles, gypsum, etc.), road, rail, generators, navigation and air transport, agricultural, forestry, fishery and construction machinery, site preparation, road and building construction development, natural processes (e.g. volcanic eruptions), aerosols, waste, exposed land, sea surfaces, forestry and vegetation.

Table 15: Gg PM_{10} for the period from 1990 to 2008

	Gg PM10																		
Sector / Year >	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Energy	33.655	28.909	16.157	13.348	15.118	13.177	12.477	11.179	9.891	8.451	8.408	8.579	8.866	11.054	12.085	11.648	11.138	10.919	10.818
Industrial production	5.649	4.928	3.535	4.354	3.66	3.127	2.277	2.275	2.191	2.065	0.963	0.938	1.71	2.79	3.493	2.717	3.739	3.792	3.865
Agriculture	3.213	3.175	2.954	3.187	3.418	3.4	3.194	3.14	3.174	3.018	3.033	3.011	2.963	2.971	2.892	2.904	2.814	2.749	2.746
Waste	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 15 presents PM_{10} data for Albania for the period from 1990 to 2008. As shown in the table, the energy sector, the industrial production and product use sector and the agricultural sector are all very significant contributors to PM_{10} emissions, with the energy sector contributing 68.8 % of the national total and the industrial production and product use sectors contributing a further ~15.5 % each with a much less significant contribution from the agricultural sector. There is an inordinate reduction in PM_{10} emissions during the decade from 1990 to 2000 during which time PM_{10} estimated emissions decreased

by 75 %. The reason why there was such a drastic increase is not apparent, given that there was a significant increase in road transport during this period.

While there were some general fluctuations within and between years, the dramatic decrease in estimated PM_{10} emissions from 1990 to 2000 showed a gradual upward trend thereafter before levelling off. Fluctuations, and in general the downward trend, are the result of both a slowdown in metallic mining and changes in production and industry types rather than any environmental protection processes being put in place to address emission at source. As there was a significant increase in road transport during the period it was likely that PM_{10} from diesel engines and from road and brake abrasion contributed to substantial increase in PM_{10} associated with the road transport sector. Nonetheless, PM_{10} from the energy sector, as a whole decreased by two-thirds over the assessed period.

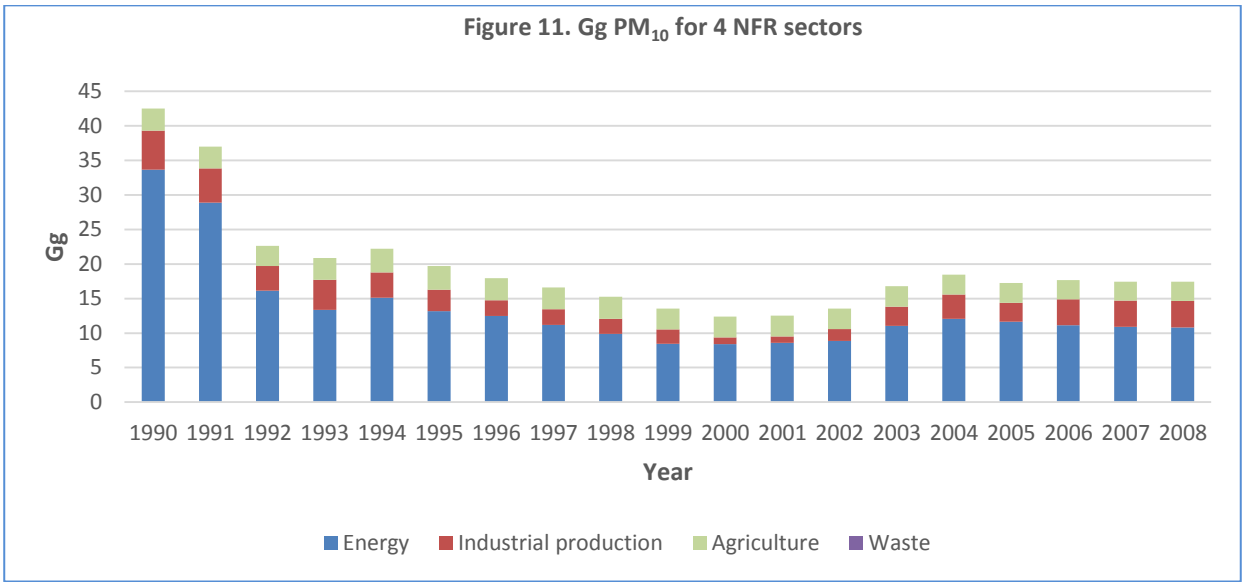


Table 16, as illustrated in figure 12, presents a revised estimate for PM_{10} for the 8-year period from 2009 to 2016. Calculations for PM_{10} sector contributions are presented in Annex 2. Due to changes in the energy production sector as previously discussed, it indicates that, rather than the energy sector, the main contributor to PM_{10} was the industrial processes and product use sector. This may be partially attributable to the significance of the use of hydropower for domestic electricity generation.

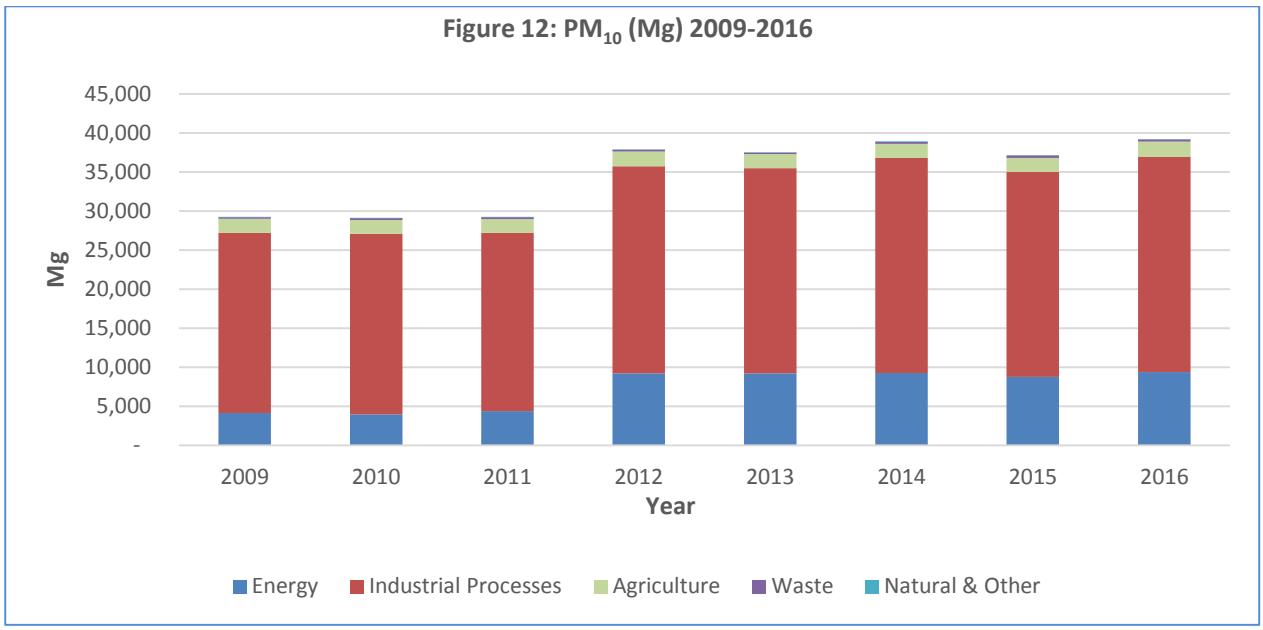
Table 16: PM10 (Mg) 2009-2016

NFR sector	2009	2010	2011	2012	2013	2014	2015	2016	Sum 2009-2016
Energy	4,111	3,954	4,391	9,215	9,195	9,262	8,758	9,375	**58,262**
Industrial Processes	23,078	23,134	22,808	26,516	26,279	27,506	26,229	27,516	**203,067**
Agriculture	1,828	1,764	1,761	1,855	1,800	1,808	1,806	1,976	**14,599**
Waste	188	234	236	249	205	269	309	285	**1,976**
Natural & Other	53	53	53	53	53	53	53	53	**421**
Year total >	**29,258**	**29,139**	**29,249**	**37,889**	**37,532**	**38,897**	**37,156**	**39,205**	**278,324**

Annex 2 of this report provides information of NFR sub-sectors pertaining to PM_{10} emissions that were not heretofore included in the emission inventory. Emission estimates show that the industrial processes

and product use sector contributed almost three-quarters of estimated PM_{10} emissions with energy sector contributing approximately one-fifth and lesser contributions from other NFR sectors. In the industrial processes and product use sector significant amounts of PM_{10} arise from cement and lime manufacture, quarrying and excavation of sand and gravel, construction and demolition, road asphalt, iron and steel production, ferro-alloy production, other metal production. In the agricultural sector large amounts emanate from cultivated land and livestock.

The inclusion of PM_{10} emissions from a variety of subsectors presents an overall annual figure for PM_{10} generation in 2009 that is 2.6 times that estimated for 2008, while the total PM_{10} estimate for 2016 is 3.5 times greater than the 2008 estimate. Calculation of estimates and emission factors for the assessed NFR sub-sectors for the period from 2009 to 2016 are presented in Annex 2.



As indicated in figure 12, PM_{10} emissions per NFR sector each year of the assessment period is consistent with the emissions from the industrial processes and product use sector increasing in tandem with the energy sector, while the contribution from the agricultural sector is relatively constant throughout the assessed period.

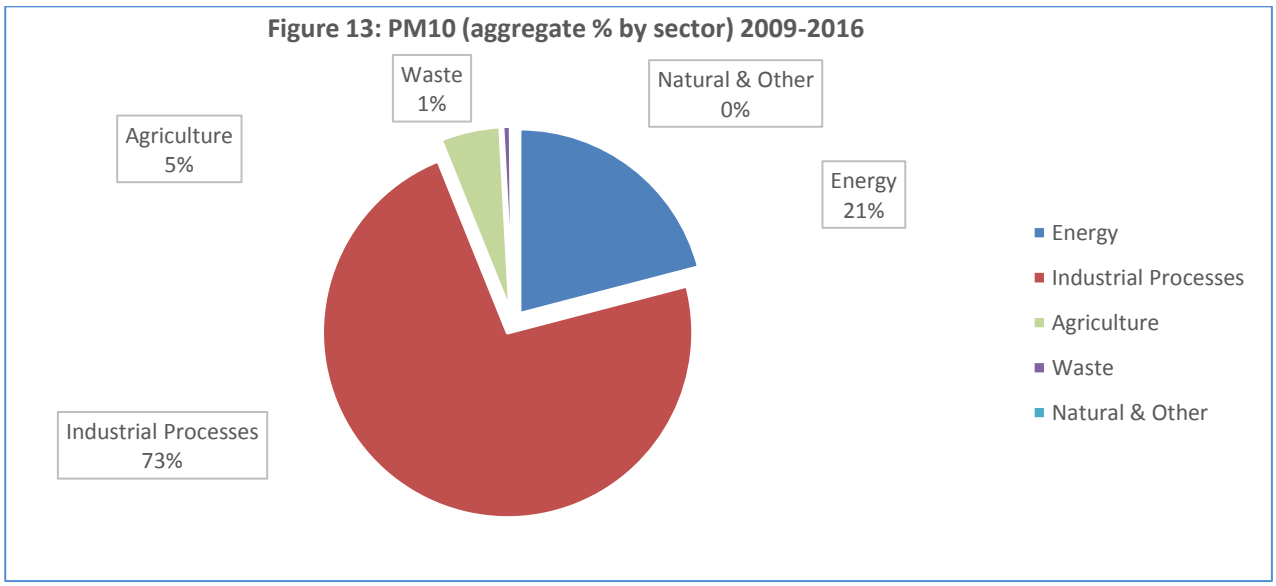


Figure 13 presents the NFR sectoral contribution for the 8-year period from 2009 to 2016. The biggest PM_{10} contributor is the industrial process and product use sector which contributes 73 %, followed by the energy sector with 21 % and agricultural sector with 5 %. Waste and other sources make up the other ~1 %.

8.5 Carbon monoxide

Table 17 gives a breakdown on emission loads of carbon monoxide for the 4 specified NFR sectors for the 19-year period from 1990 to 2008, inclusive. As indicated and expected, the energy sector is the main contributor since anthropogenic CO is produced due to incomplete combustion of fossil fuels such as heavy oil, gas oil, coal, peat, coal, gas, oil, firewood. Carbon monoxide levels tend to be higher in low efficiency burners. Transport is a major source of CO emissions, particularly combustion in diesel engines. Its production is elevated in low efficiency combustion processes. In 1990 the energy sector was estimated to contribute 93 % of the national CO emissions total with a further 6.1 % from the industrial process and product use sector and minor contributions from other NFR sectors. By 2008 total CO emissions were estimated to have decreased by ~23 %, with the energy sector contributing 82 % and the industrial process and product use sector contributing a further 17.6 % with minor contributions from other NFR sectors.

Table 17: Gg CO for the period from 1990 to 2008

	Gg CO																		
Sector / Year >	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Energy	178.236	187.917	113.017	99.75	119.169	103.481	102.615	97.619	90.746	79.294	84.547	90.519	96.577	106.016	130.042	134.497	131.676	118.429	120.647
Industrial production	11.618	11.906	7.141	16.67	16.201	20.479	14.871	14.993	14.428	13.466	6.059	5.791	10.988	18.134	22.856	15.739	25.891	25.942	26.061
Agriculture	1.37	1.343	1.12	1.288	1.261	1.234	1.206	1.349	1.344	1.133	1.134	1.055	1.003	0.975	0.916	0.94	0.91	0.842	0.949
Waste	0	0	0	0	0	0	0	0	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Figure 14 illustrates graphically the data contained in table 17 indicating major contributions to CO emissions from the energy sector.

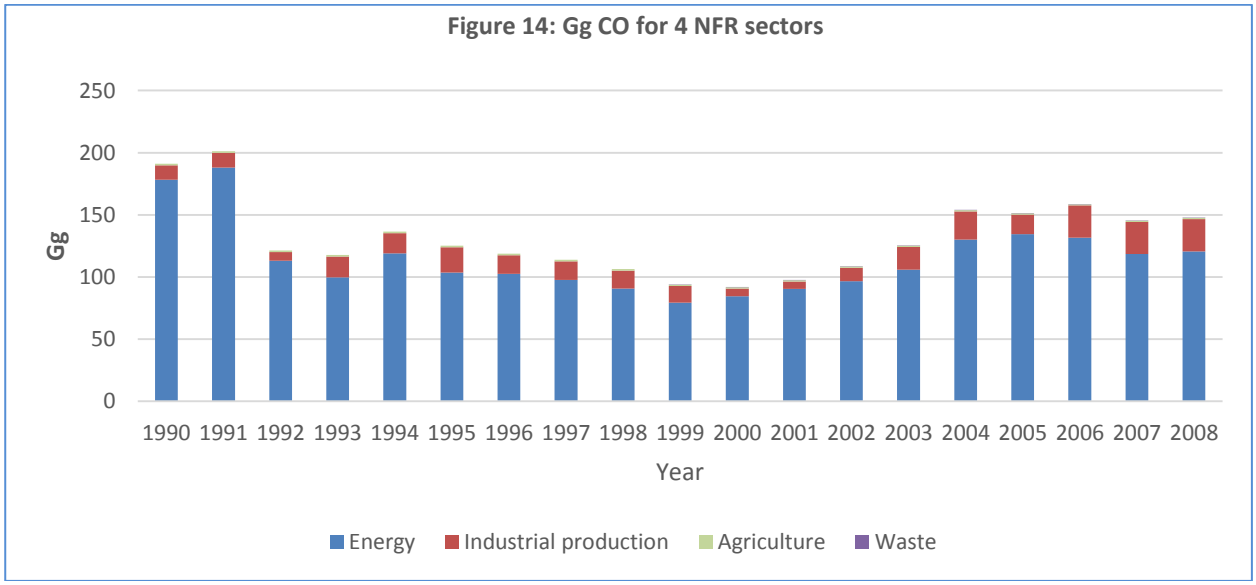


Figure 14 shows a general decrease, with some fluctuations, in CO estimated emissions during the decade from 1990 to 2000 with an upward trend for a few years before levelling off in recent years.

Table 18, as illustrated in figure 15, shows that although the energy sector was still the largest contributor to carbon monoxide emissions, the estimated overall contribution from this sector reduced significantly compared to its contribution in 2008. In addition, CO from industrial processes and product use was estimated to have a much reduced input. Estimations were also included for the contribution of CO from forest fires as a REC forest fires country report indicated that, in Albania an average of 4,781 hectares of forest and vegetation were burned each year in Albania between 2004 and 2013.

Table 18: CO (Mg) 2009-2016

NFR sector	2009	2010	2011	2012	2013	2014	2015	2016	Sum 2009-2016
Energy	50,247	50,128	49,500	74,783	75,263	77,282	75,575	77,596	**530,375**
Industrial Processes	1,547	1,372	1,629	1,343	1,099	1,092	1,092	1,092	**10,266**
Agriculture	-	-	-	-	-	-	-	-	**-**
Waste	-	-	-	-	-	-	-	-	**-**
Natural & Other	14,343	14,343	14,343	14,343	14,343	14,343	14,343	14,343	**114,744**
Year total >	**66,137**	**65,843**	**65,472**	**90,469**	**90,705**	**92,718**	**91,010**	**93,031**	**655,385**

It was determined that the carbon monoxide contributions from agriculture and waste sectors between 2009 and 2016 were negligible when compared to the other 3 NFR sectors evaluated. Figure 15 illustrates, graphically, the relative sectoral contributions to CO emissions which are mainly from the energy sector and burning of forestry and vegetation. It has been reported that forestry land in Albania has been burned intentionally as a means of reclaiming arable land for cropping. Arable land is relatively scarce as only about one quarter of the country is suitable for productive farming due to high mountain ranges along the eastern side of the country.

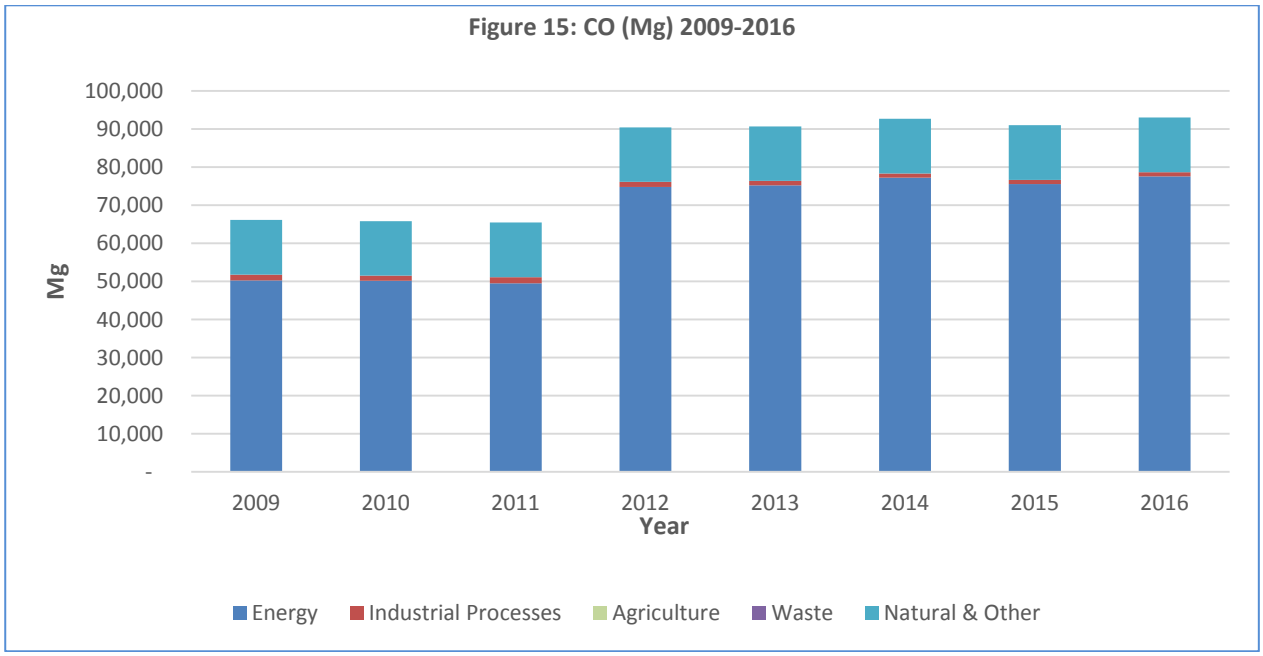
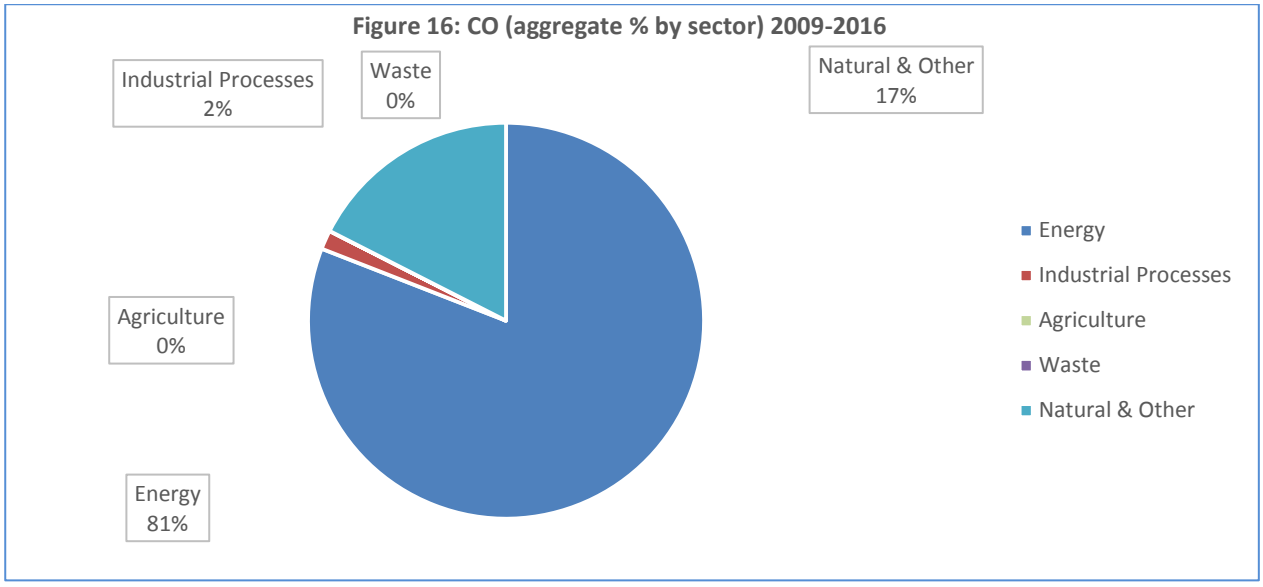


Figure 16 provides a breakdown of NFR sector contributions to carbon monoxide emissions. Almost 80 % of CO emissions emanate from the energy sector with most of the remainder coming from other sources (forest fires) and minor amounts from industrial processes and product use, agriculture and waste.



8.6 Non-methane volatile organic compounds (NMVOCs)

Table 19, below, displays data for NFR category NMVOC contributions to national total NMVOC emissions in Albania for the period from 1990 to 2008.

The data are illustrated graphically in figure 17. Estimates determined that the energy sector is the main NMVOC contributor throughout the 19-year assessment period with industrial processes and product use the second biggest contributor. Minor contributions come from the remaining NFR sectors. In 1980, it was estimated that the energy sector contributed 34.9 Gg NMVOC while the industrial processes and product use sector was responsible for 8.9 Gg. By 2008 NMVOC emissions from the energy sector had reduced significantly by 43 % from 34.9 Gg in 1990 to 19.8 Gg in 2008. Moreover, there was an estimated significant change in the ratio of emissions between the two major contributing sectors.

In the same period NMVOCs for the industrial processes and product use sector increased by 43 % from 8.9 Gg to 12.7 Gg. There was an overall reduction of 25.5 % in NMVOC emissions over the 19-year assessment period.

Table 19: Gg NMVOC for the period from 2009 to 2016

	Gg NMVOC																		
Sector / Year >	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Energy	34.867	36.585	21.017	17.956	21.674	18.599	18.248	16.829	15.333	13.137	13.819	14.67	15.474	18.037	21.194	21.686	21.731	19.683	19.788
Industrial production	8.868	8.396	8.173	8.498	9.022	9.209	9.669	9.222	9.064	9.346	9.484	9.782	10.205	10.56	11.134	11.432	11.465	12.695	12.725
Agriculture	0.063	0.061	0.051	0.059	0.058	0.056	0.055	0.062	0.061	0.052	0.052	0.048	0.046	0.045	0.042	0.043	0.042	0.038	0.043
Waste	0.039	0.041	0.043	0.045	0.047	0.05	0.052	0.055	0.059	0.062	0.066	0.069	0.073	0.078	0.082	0.088	0.093	0.099	0.105

Figure 17 illustrates the steadily increasing contribution of NMVOC from the industrial process and product use sector as a percentage of the national total NMVOC loads and significant fluctuations in NMVOC emission loads from the energy sector over the assessment period.

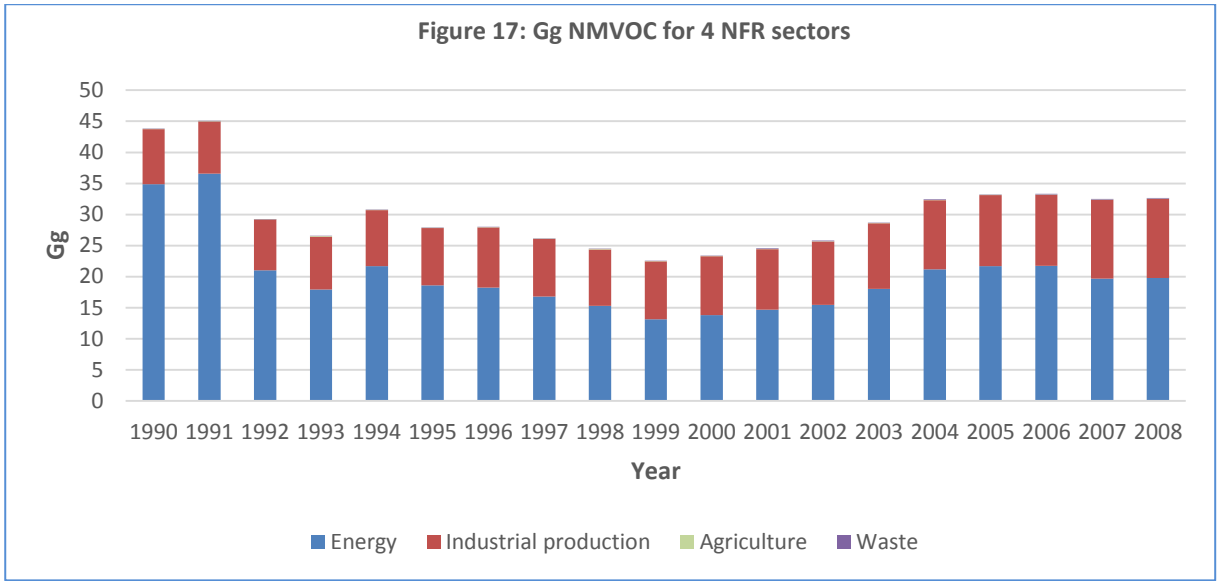


Table 20 provides best estimates of NMVOC emission amounts for the period from 2009 to 2016. The data conflicts with that estimated for the previous period from 1990 to 2008 in that the industrial processes and product use sector far outweighs the energy sector in terms of NMVOC emissions contributions while agriculture, which was deemed to have a minor contribution for the previous period (1990-2008) has been estimated to make a significant contribution mainly because vegetation burning was included.

In the absence of any significant information from regulatory authorities on the 'solvents use' subsector associated with the industrial processes and product use NFR sector, NMVOCs were estimated for the subsector by taking an average NMVOC per capita value from the 1999 guidebook.

Table 20: NMVOC (Mg) 2009-2016

NFR sector	2009	2010	2011	2012	2013	2014	2015	2016	Sum 2009-2016
Energy	17,158	16,065	16,593	21,606	24,670	24,295	24,689	24,460	**169,537**
Industrial Processes	45,253	43,749	43,933	44,827	47,180	45,928	46,419	46,398	**363,688**
Agriculture	11,135	10,931	10,910	11,284	11,029	11,185	11,149	11,604	**89,226**
Waste	1,337	1,668	1,682	1,773	1,463	1,917	2,205	2,029	**14,074**
Natural & Other	1,434	1,434	1,434	1,434	1,434	1,434	1,434	1,434	**11,474**
Year total >	**76,318**	**73,847**	**74,551**	**80,925**	**85,775**	**84,760**	**85,897**	**85,925**	**647,998**

The main reason why the industrial processes and product use sector shows increased values is because more sub-sector data was accessible. A large contributing sub-sector to the industrial process and product use sector in terms of NMVOC emissions is solvent sectors [(as covered by the Solvent Emissions Directive, SED, 1999/13/EC) – now part of the IED (2010/75/EU)]. In the absence of specific information from competent authorities on solvent use activities another approach was taken to estimate emissions from the sector.

A value of 14.4 kg NMVOC per person per year was used to estimate NMVOCs from the main household sources. This value, an annual estimate for Western Europe (1999), was taken from the 1999 guidebook. The figure is multiplied by the country's annual population to determine the annual load of NMVOCs

associated with solvent exposure in households (from paints and inks, aerosols, cosmetics, degreasing, cleaning agents and other household products). The guidebook comments that the "uncertainty of the resulting overall (per capita) emission for a country will be a factor 1.25 to 2". As before, refer to Annex 2 for subdivision and calculations associated with the NFR sector annual totals.

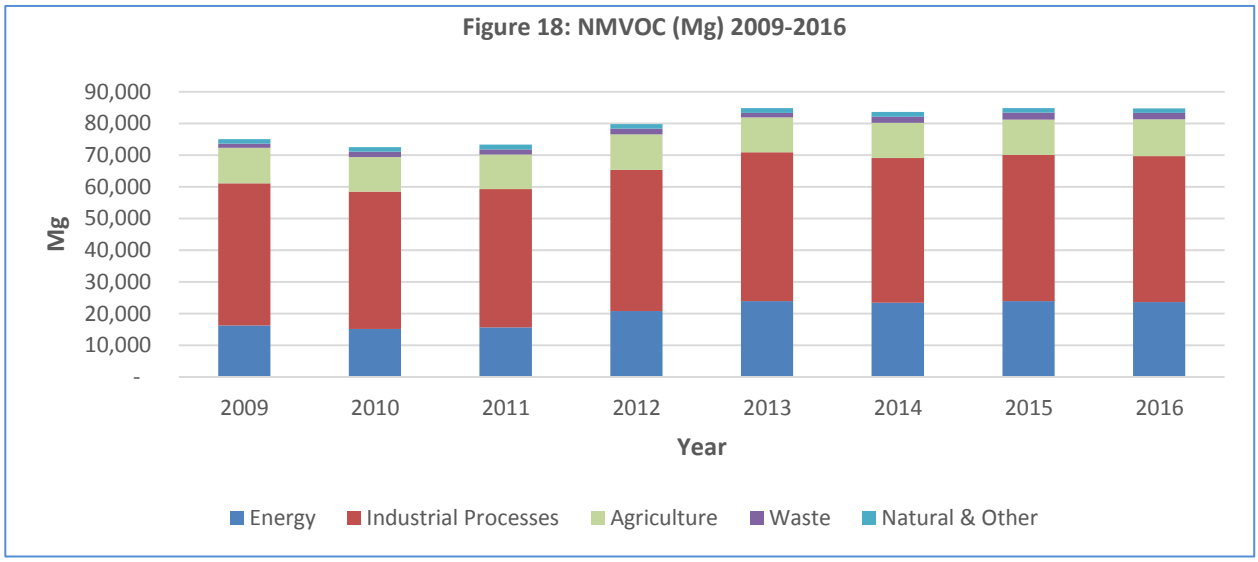
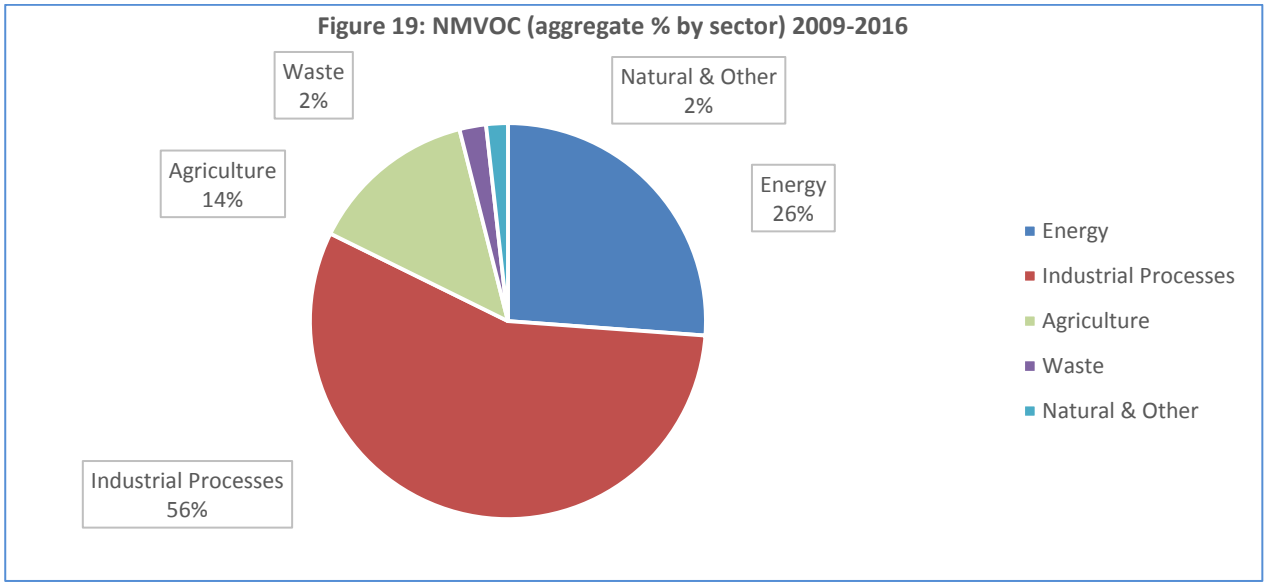


Figure 18 graphically displays the relative annual NFR sector contributions to national NMVOC emissions in Albania from2009 to 2016, inclusive. In recent years the comparative contributions from evaluated NFR sectors are relatively consistent.

Figure 19 provides a breakdown of NMVOC emission loads per NFR sector. The biggest contributing sector is industrial processes and product use with a contribution of 56 % of the national total. This is followed by the energy sector which contributes 26 %. Agriculture is responsible for a further 14 % while waste and other sources are each responsible for 2 % of NMVOC emissions.



9 INVENTORY COMMENTS AND QUESTIONS FOR IMPROVEMENT

There is no routine or periodic measurement of emissions of NOx, SOx, PM_{10}, NH_3, CO, NMVOCs, heavy metals, benzene, PAHs either by competent authorities or by industrial activity operators – this needs to be addressed.

It has been reported that decline in industrial production in metallurgical industries has resulted in reduced times of industrial operation – what are current production thresholds and operational periods (days per week, hours per day, etc.)?

Why do public institutions not provide industry information relevant to polluting emissions and why do they treat such data as 'confidential'?

Why do competent authorities not control emissions via ELVs on permits and request AERs as a means of collecting emission data?

Is there any emission data or monitoring of solvent use sectors (printing, painting, car respraying and crash repairs, surface cleaning, etc.)?

How many pairs of shoes are made per year in Alania?

Taxis are painted yellow? Where? How much paint is used? Is it high solvent paint? Car body repairs shops operate? How many? How much paint is used?

Competent authorities should amass information on efficiencies of production and combustion technologies in major industries and amount and type of fuel used;

It is not relevant to compare energy use and consumption data from the 1990 to that of 2016 for many reasons:

An increase in road transport vehicle numbers by more than 90 % and in passenger cars by over 95 %;

A decline in industrial production, metallurgy and mining;

A move from fossil fuels to hydroelectric power with the closure of 9 TTPs;

Rapid transition to firewood for home heating in rural areas; (Albanian forestry statistics show that firewood production in 2010 was less than 60,000 tonnes but that this increased to more than 450,000 tonnes by 2016. Why was there such an enormous transition?);

Why did gas consumption in Albania decrease by 90 % from 1990 to 1995 (Eurostat)?

Why did Albania use 630 ktoe of coal in 1990 and only 19 ktoe in 1995?

Why did the gross inland consumption of fuel change from 2,592 ktoe in 1990 to 1300 ktoe in 1995?

ANNEXES

This report is complemented by 4 annexes, as follows:

- Annex 1 is an Excel spreadsheet which displays the NFR sectors and sub-sectors in accordance with the 2016 emission inventory guidebook.
- Annex 2 provides the data and charts used for calculations and graphics illustrated in this report.
- Annex 3 provides data on energy consumption per main subsector for the 'industrial processes and product use' NFR sector.
- Annex 4 is an updated inventory for the period from 1990 to 2016.