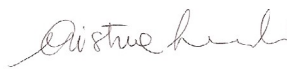



**ALBANIA AIR POLLUTANT EMISSIONS INVENTORY
IN THE FRAME OF THE
CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION
FINAL STUDY REPORT
EXECUTIVE SUMMARY**

Activities carried out for Ministry of Environment, Forestry and Water administration of the Republic of Albania in the frame of the Service Contract of 05/05/2009 “Technical support services for air pollutant emission inventories implementation and air quality planning in Albania”

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1 INTRODUCTION

The Final Study Report (MEA.TS.08 – RF - Ed.2 Rev.0 – July 2010) delivered by Techne Consulting and Krijon to the Ministry of Environment, Forestry and Water Administration of the Republic of Albania on the 8th July 2010 describes the results of the activities carried out in the framework of the Service Contract “Technical support services for air pollutant emission inventories implementation and air quality planning in Albania”.

In particular, it contains a detailed description of the methodology used to compile the national emissions inventory for the period 1990-2008, the list of the input data with the related sources and the emissions levels in the Country for the investigated atmospheric pollutants. In attachment to the Report tables containing total emissions for all pollutants divided by activities according to NFR nomenclature are reported. They will be useful to comply with LRTAP reporting obligations, which request such a format.

The present Summary Report makes an overview on the report contents, with a focus on the emission levels, underlining the main sectors contributing to air pollution in the Country.

2 THE AIR EMISSIONS INVENTORY

2.1 Methodology

The Albanian air emission inventory has been produced according to the Guidelines for Reporting Emission Data under the Convention on Long-Range Transboundary Air Pollution, the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2009 and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

The time interval used as a reference is the year and the investigated period is 1990 – 2008; the territorial level is the national one, as requested for LRTAP Convention.

Activities taken into account are those related to the following 11 groups, according to SNAP classification:

- Combustion in energy and transformation industries,
- Non-industrial combustion plants,
- Combustion in manufacturing industry,
- Production processes,
- Extraction and distribution of fossil fuels and geothermal energy,
- Solvent and other product use,
- Road transport,
- Other mobile sources and machinery,
- Waste treatment and disposal,
- Agriculture,
- Other sources and sinks.

Pollutants included in the inventory are:

- Main air pollutants, namely nitrogen oxides (NO, NO₂, N₂O), sulphur oxides (SO₂, SO₃), non-methane organic compounds (NMVOC), carbon monoxide (CO) and suspended particles with diameter less than 10 µm (PM₁₀) and than 2,5 µm (PM_{2,5});
- Ammonia (NH₃);
- Heavy metals (Arsenic, Cadmium, Nickel, Lead, Chrome, Mercury, Copper, Selenium, Zinc);
- Benzene;
- Aromatic polycyclic hydrocarbons (benzo[b]fluorantene, benzo[k]fluorantene, benzo[a]pyrene, indeno[123cd]pyrene).
- Greenhouse gases: carbon dioxide (CO₂), methane (CH₄) and nitrogen protoxide (N₂O).

The emission thresholds established by the Guidelines for Reporting Emission Data under the Convention on Long-Range Transboundary Air Pollution have been used in order to establish the list of stationary sources to be considered as **Large Point Sources** (LPS).

Emissions from point sources are estimated, where possible, using data collected through a direct survey with the companies.

All other sources whose emissions are below the above mentioned thresholds are treated as **area sources** and are characterized using statistical or survey data on suitable activity indicators.

Emissions from all sources have been estimated using the above mentioned data and the proper emissions factors, with the help of some specific softwares:

- APEX.COM, a software developed by Techne Consulting for emission inventories compilation;
- AIR FOREST.COM and AIR FIRE.COM, which are specific estimation models developed by Techne Consulting on the base of International recognized methodology (EMEP/EEA Task Force on Emission Inventories and, for PM₁₀, United States Environmental Protection Agency methodology) for forests and forest fires emissions estimation.

The applied emissions factors can be found in literature (principally by the EMEP/EEA air pollutant emission inventory guidebook, formerly referred to as the EMEP CORINAIR emission inventory guidebook, or United States Environmental Protection Agency AP42); some changes related to particulate matter and sulphur oxides emissions from oil combustion which depend on sulphur content of each fuel have been introduced in order to take into account the specific characteristics of fuels used in Albania. New emission factors have been calculated applying the methodology described in AP 42, Volume I, Chapter 1: External Combustion Sources.

In order to collect data, estimate emissions and produce the emission inventory the following activities have been carried out:

1. data collection planning, selecting necessary data and possible data owners;
2. official request preparation and sending;
3. informal contacts with all referents and reminders;
4. data collection, analysis and validation;
5. emissions estimation;
6. results validation and elaboration.

The obtained results have been transferred and delivered to the Ministry on CollectER (Collect Emission Register), a software designed by the European Topic Centre on Air Emissions (ETC/AE) to support European countries to collect the relevant air emission data and compile annual emission inventories, in accordance with the requirements of international conventions and European legislation.

2.2 Available data

Among the private companies managing energy or production activities recognized as relevant for the national emission inventory, the following is the list of those that sent us the requested data.

Table 1 – Companies that sent data on their activity

| Company name | Municipality |
|-------------------------------|---------------------|
| 1. Albanian Chrome | Tirane |
| 2. ECF Cement Factory | Elbasan |
| 3. Fushe Kruja Cement factory | Fushe – Kruje |
| 4. Kurum- International | Tirane |
| 5. Somet* | Durres |
| 6. TEC- Fier | Fier |
| 7. Technoservis | Durres |
| 8. Vol-Alba | Tirane |

* Technoservis sent the filled in questionnaire related to Somet

Partial information was sent also by Milis and Dyrrahium. Emissions from some biggest companies which did not answer to the request were estimated through other sources, because they are essential for a correct representation of the national emission situation by industrial sources (Ballsh Deep Oil Refinery, Thermal Power Plant of Ballsh - TEC, Fier Oil Refinery, Copper Factory – Rubik).

Finally, the following is the list of the 9 plants considered as **LPS** in the air emissions inventory.

Table 2 – List of Large Point Sources

| Company name | Municipality |
|--|---------------------|
| T.E.C - Fier Njesia e Prodhimit | Fier |
| Fushe-Kruja Cement Factory | Fushe - Kruje |
| ECF Cement Factory | Elbasan |
| Kurum International - Steel Production Complex | Tirane |
| Albanian Chrome | Tirane |
| Ballsh Deep Oil Refinery | Ballsh |
| UPN-Fier Oil Refinery | Fier |
| Copper Factory – Rubik | Rubik |
| Thermal Power Plant of Ballsh (TEC) | Ballsh |

Regarding data on **area sources**, the following is the list of public institutions involved in the survey:

- Ministry of Agriculture, Food and Consumer Protection
- Ministry of Economy, Trade and Energy
- Ministry of Environment, Forestry and Water Administration
- Ministry of Public Works, Transport and Telecommunication
- General Directorate of Civil Aviation
- Railway Inspectorate
- General Directorate of Road Transportation Services
- General Port Authority
- Institute of Statistics

The following table summarises missing data and information related to sectors which seem to be more relevant in order to make complete estimations on the atmospheric emissions in the Country.

Table 3 – Main missing or not complete data

| Type of source | Sector | Missing or not complete data |
|---------------------------------|----------------------|---|
| Point sources | Energy | The man point sources that did not give information are one termopower plant and two refineries of the same industrial group |
| Area sources (excluding mobile) | Fuels | Complete data on fuel consumptions divided by type of fuel and sectors for the whole investigated period; fuels distribution over the territory |
| | Waste | Information on waste management (number of landfills/dumps, amount of burnt waste, agricultural/industrial/hospital waste management) |
| | Industry/Extractions | Not complete data on industrial productions and extractions (only some sectors and a few years covered) |
| | Products use | Official data on solvent, inks, paint consumptions |
| Mobile sources | Forests and fires | Not complete data on distribution of different specie over the territory and no register of burnt areas |
| | Road transport | Details about vehicles engine capacity, technology, fuel, age, average mileage driven. Number of mopeds and motorcycles. Daily Average Vehicle count on major roads |
| | Air/Sea transport | Distribution of different types of arrived/left ships and LTO cycles for different types of aircrafts |

3 SUMMARY OF RESULTS

The present chapter summarizes the estimated total national emissions for the different classes of pollutants divided by macrosectors. Results are shown in graphs reporting emissions for the whole investigated period (1990 – 2008), accompanied by some comments.

Information on the main point sources contributing to the levels of the main pollutants is also supplied.

Pollutants are organized according to the following classes:

- Main pollutants, which are sulphur oxides (SO_x), nitrogen oxides (NO_x), particulate matter (PM₁₀ and PM_{2,5}), carbon monoxide (CO) and Volatile Organic Compounds (VOC)
- Ammonia (NH₃) and Benzene (C₆H₆);
- Greenhouse gases, which are carbon dioxide (CO₂), methane (CH₄) and nitrogen protoxide (N₂O)
- Heavy metals (Arsenic, Cadmium, Nickel, Lead, Chrome, Mercury, Copper, Selenium, Zinc);
- Other aromatic hydrocarbons, which are benzo[b]fluorantene (BBF), benzo[k]fluorantene (BKF), benzo[a]pyrene (BAP), indeno[123cd]pyrene (INP), polychlorobiphenyl (PCB), hexachlorobiphenyl (HCB).

3.1 Main pollutants

The following diagrams show the contribution of the different sectors to total national emissions of the main pollutants in Albania, for the period 1990 – 2008.

All emissions are reported in Megagrams.

As it appears from Figure 1, total emissions of SO_x are mainly due to combustion activities; in particular, to the Energy sector (*Combustion in energy and transformation industry*), whose contribution during the years is quite high, in the range of 36-56%, excluded only 2008 when it is lower (27%) for the inactivity of the main power plant. The remaining part of emissions comes mainly from *Non industrial combustion plants* (25-46%). It can be noticed an increasing trend of emissions from the macrosector *Other mobile sources and machinery*, due to a rise of air and sea traffic. High values of sulphur oxides emissions are to be attributed to the high content of sulphur of used fuels.

Regarding NO_x (Figure 2), the major contribution comes from *Road transport* (41-63% over the whole period). Also in this case there is a gradual increase in emissions from the sector *Other mobile sources and machinery*, that starting from 1995 and contributes to total NO_x emissions with 24-37%. High values of nitrogen oxides appear also for the first years, 1990-1993, for the sector *Combustion in manufacturing industry*; this contribution falls out in the following years due to the economic crisis of the early nineties.

High contributions to the levels of particulate matter (Figure 3 and Figure 3 – Contributions of different sectors on PM₁₀ emissions, years 1990 – 2008

) come from *Non industrial combustion plants*, with a share of 14-56% of PM₁₀ and 15-77% of PM_{2.5}. Relevant emissions derive also from the *Production processes*, with 7-21% of PM₁₀ and 5-18% of PM_{2.5} and from *Road transport* starting from 1998 (9-14% of PM₁₀ and 12-18% of PM_{2.5}). It has to be notice that also for PM higher levels are estimated for the first years (1990-1993) for *Combustion in manufacturing industry* (14-28% and 9-15% of PM₁₀ and PM_{2.5}, respectively). High levels of these pollutants are associated to the macrosector *Other sources and sinks* in the years 2000, 2003, 2007 and 2008; it is due to forest fires happened in those years in the Country.

Analysing obtained results for carbon monoxide (Figure 4 – Contributions of different sectors on PM_{2.5} emissions, years 1990 – 2008

), the highest contributions come from *Non industrial combustion plant* (32-72%); the second contributor is *Road transport*: emissions coming from this sector gradually increased over the years, passing from 16% to 52%. Since CO is a good indicator of emissions from road traffic, the estimated levels seem to be in accordance to the real increasing of road traffic during the investigated period. Some contributions come also from *Production processes* and it appears the influence of forest fires in the above mentioned years: 2000, 2003, 2007 and 2008.

Finally, regarding VOCs (Figure 6), as expected the main contributor is the macrosector *Other sources and sinks*: emissions from vegetation represent 62-82% of total emissions in the Country. Relevant levels appear also from *Non industrial combustion plants* especially for the first years, while in the last years a contribution of 6-8% comes from *Solvent and other product use*.

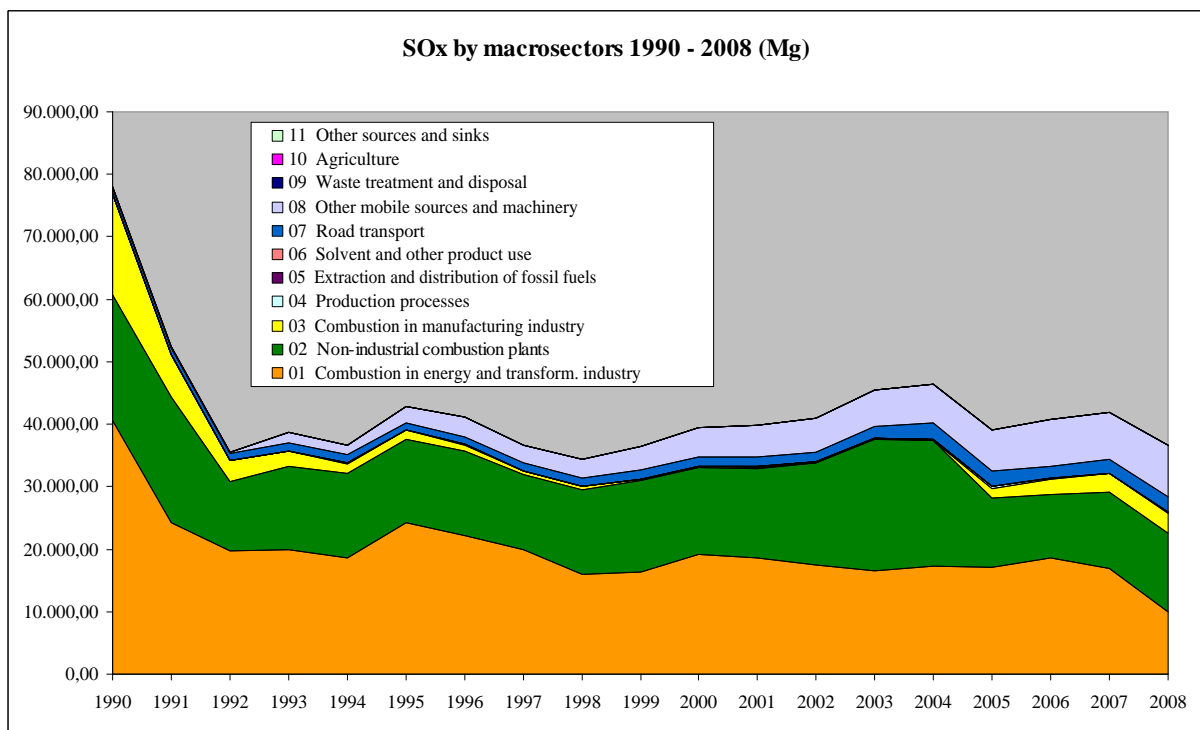


Figure 1 – Contributions of different sectors on SO_x emissions, years 1990 – 2008

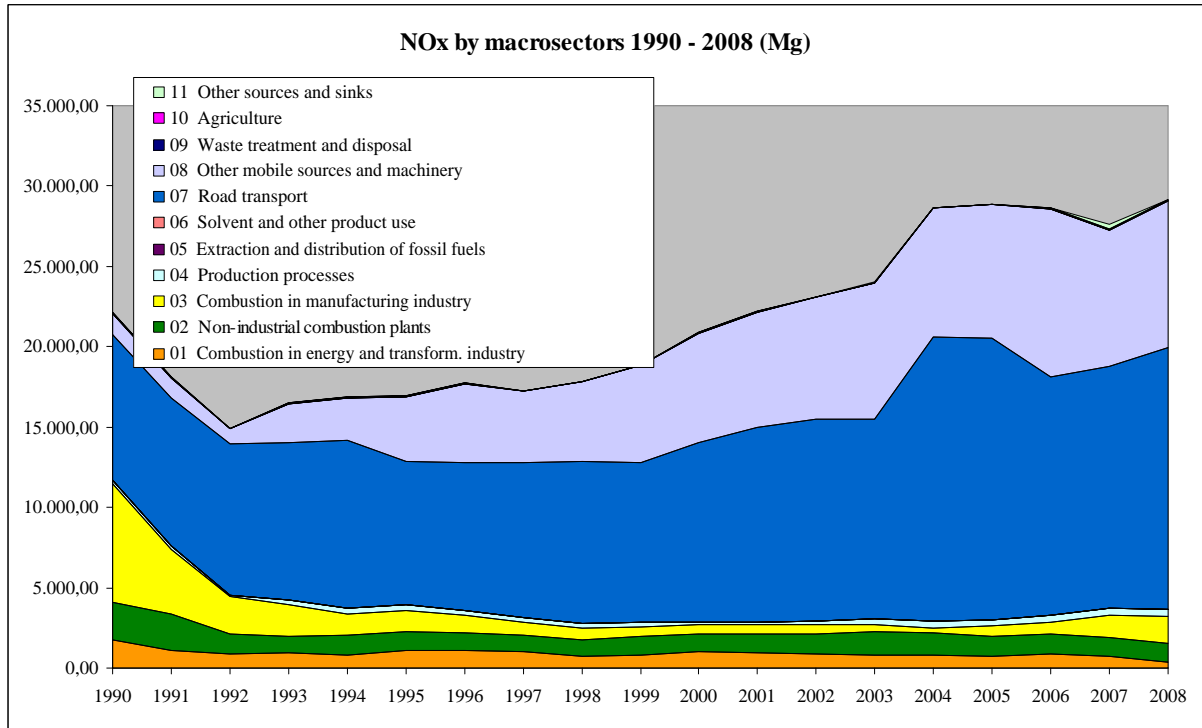


Figure 2 – Contributions of different sectors on NO_x emissions, years 1990 – 2008

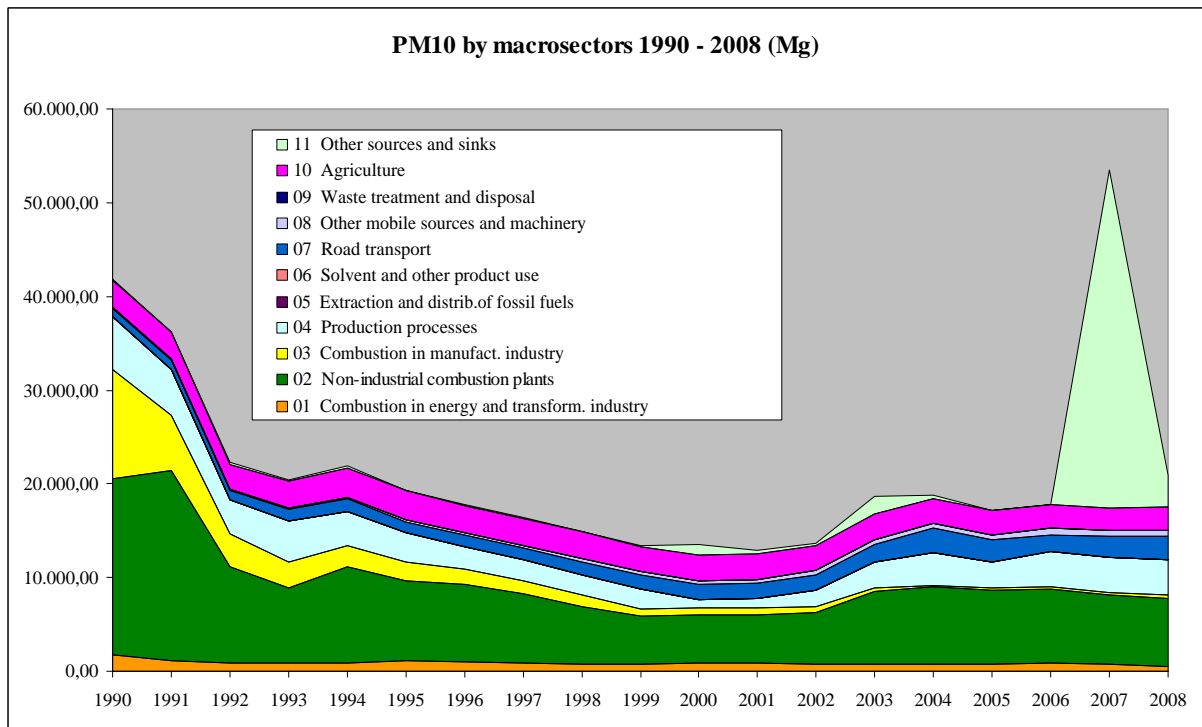


Figure 3 – Contributions of different sectors on PM₁₀ emissions, years 1990 – 2008

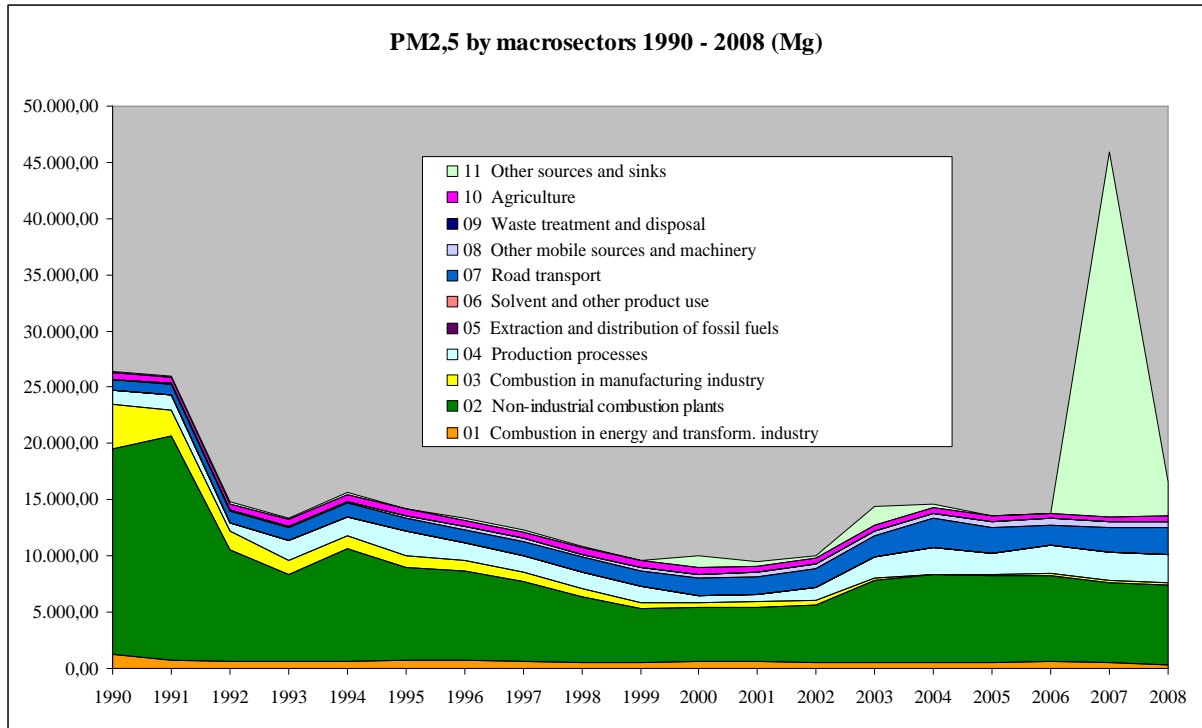


Figure 4 – Contributions of different sectors on PM_{2,5} emissions, years 1990 – 2008

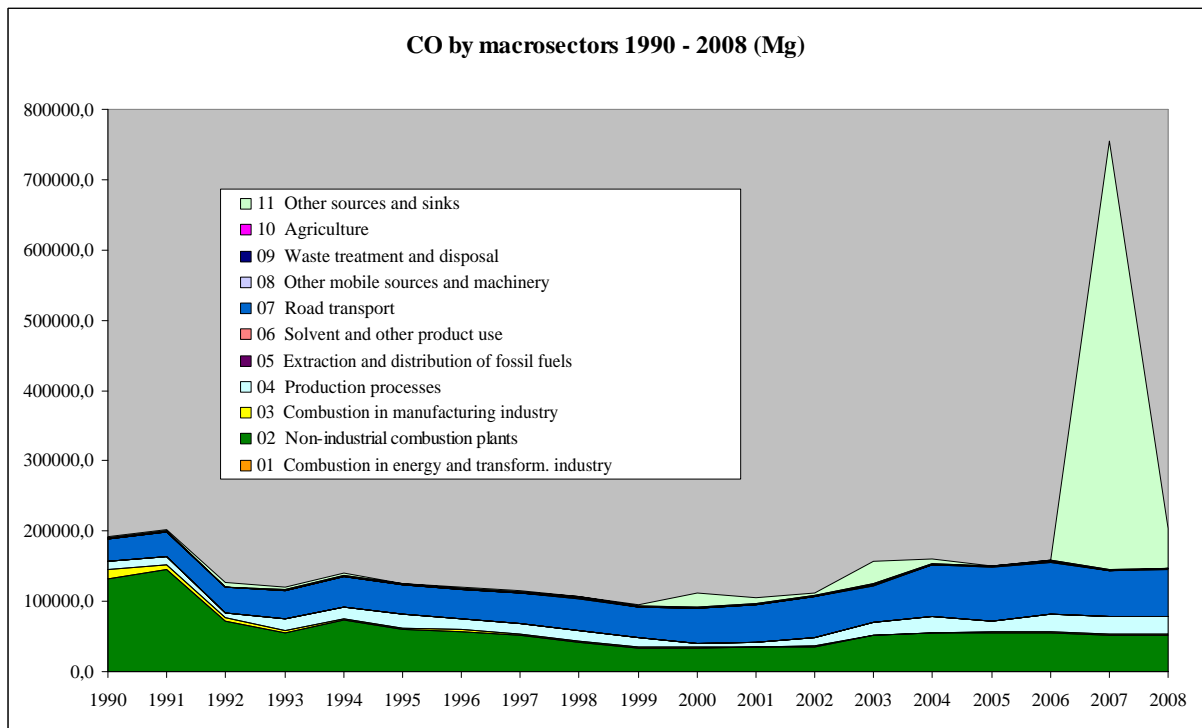


Figure 5 – Contributions of different sectors on CO emissions, years 1990 – 2008

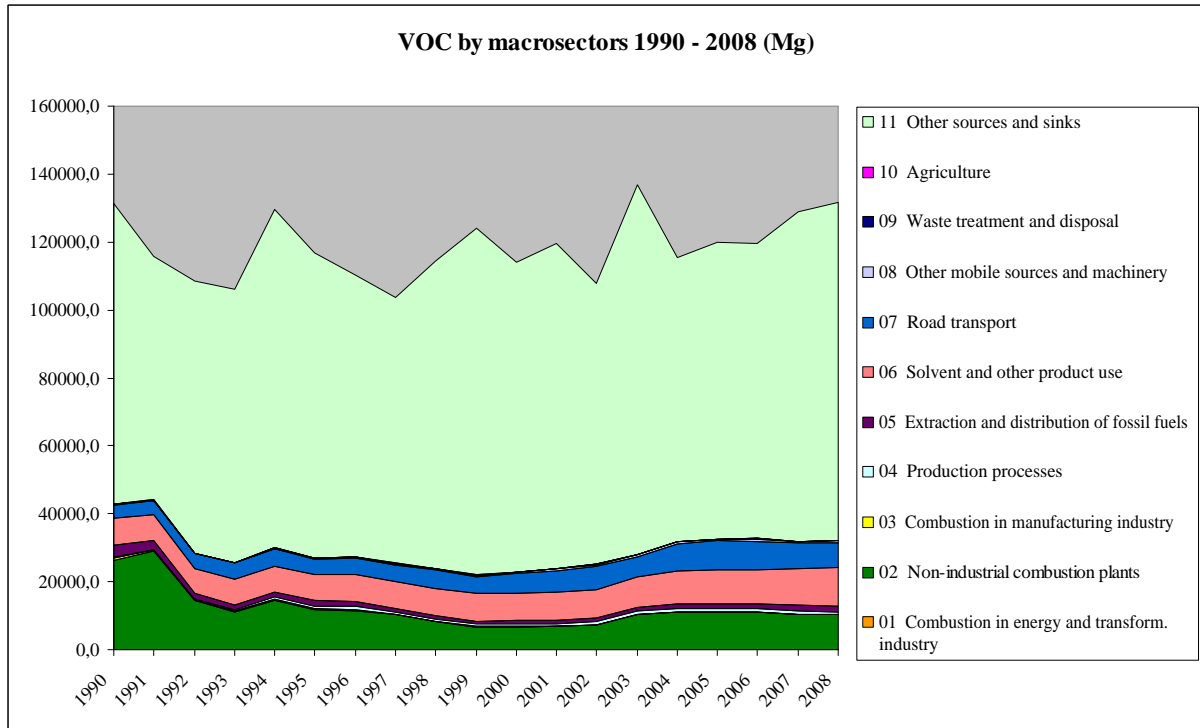


Figure 6 – Contributions of different sectors on VOC emissions, years 1990 – 2008

3.2 Benzene and ammonia

The following diagrams show the contribution of the different sectors to total national emissions of benzene (Figure 7) and ammonia (Figure 8) in Albania, for the period 1990 – 2008.

Two sectors are mainly responsible for benzene emissions: *Combustion in manufacturing industry* (16-68%) and *Extraction and distribution of fossil fuels* (21-64%).

As expected, almost all (97-99%) of NH₃ emissions are due to the *Agriculture* sector.

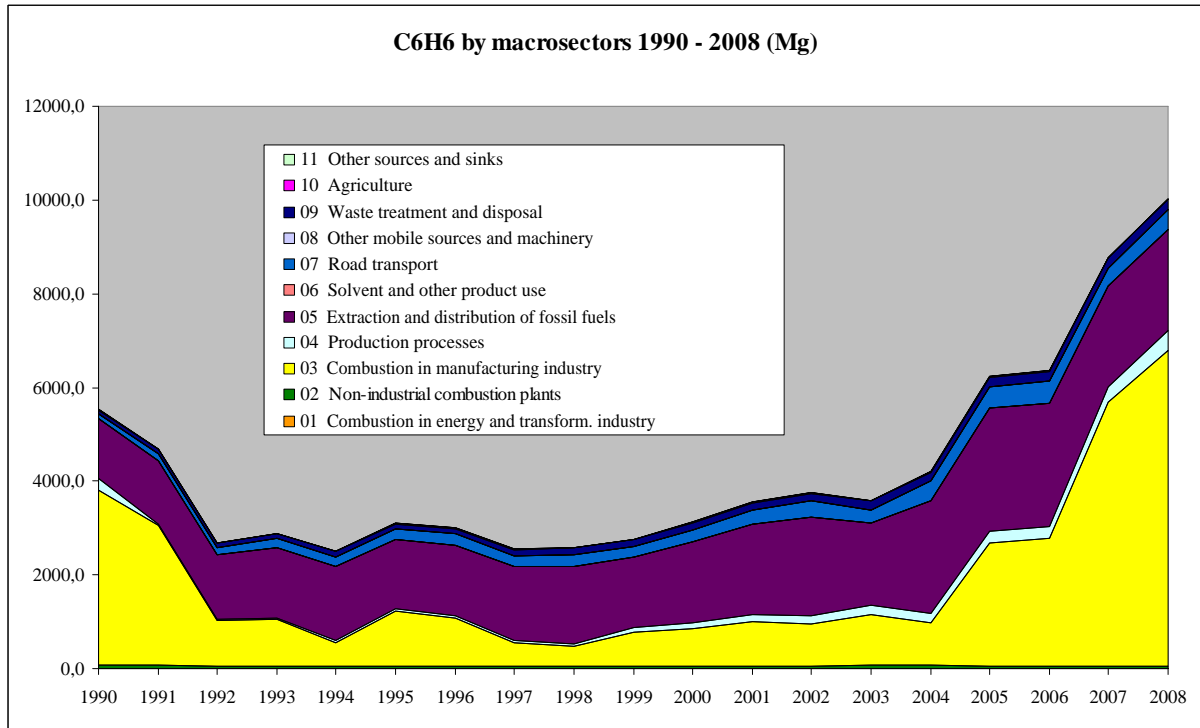


Figure 7 – Contributions of different sectors on benzene emissions, years 1990 – 2008

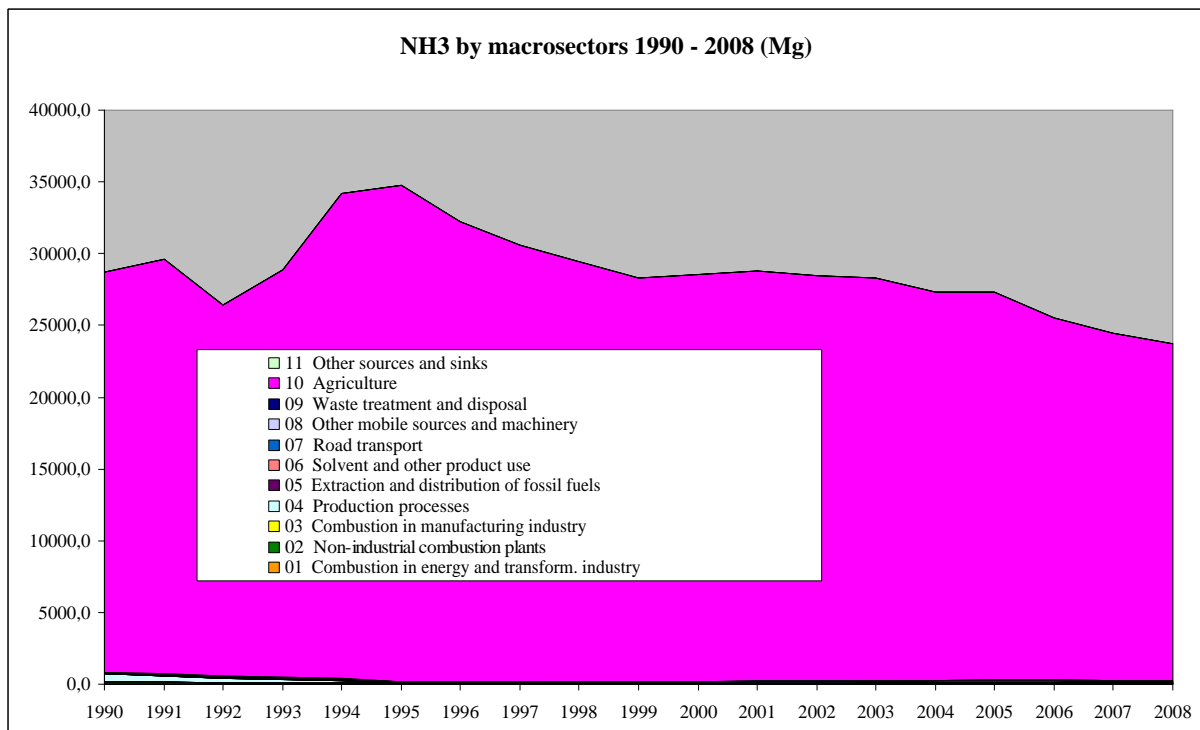


Figure 8 – Contributions of different sectors on NH₃ emissions, years 1990 – 2008

3.3 Greenhouse gases

The following diagrams show the contribution of the different sectors to total national emissions of greenhouse gases in Albania, for the period 1990 – 2008.

Major contribution to CO₂ (Figure 9) emissions comes from *Non industrial combustion plants* (11-44%). It is clear a gradual increase of emissions due to *Road transport*, approximately from 15 to 50%. Relevant contributions come also from *Combustion in energy and transformation industry* and *Combustion in manufacturing industry*, which starts with shares of 24-37% in 1990 – 1993 and then gradually decreases. An exception are the high levels of CO₂ coming from macrosector *Other sources and sinks*, due to forest fires, especially in 2007 and 2008.

As expected (Figure 10), the main source of methane emissions is *Agriculture* (54-87% over the years). A contribution comes also from *Non industrial combustion plants* and *Waste management*; in particular, methane emissions from Waste sector are gradually increasing, passing from 4 to 12%.

Nitrogen protoxide emissions (Figure 10 – Contributions of different sectors on CH₄ emissions, years 1990 – 2008

) are almost completely due to *Agriculture* (93-97%).

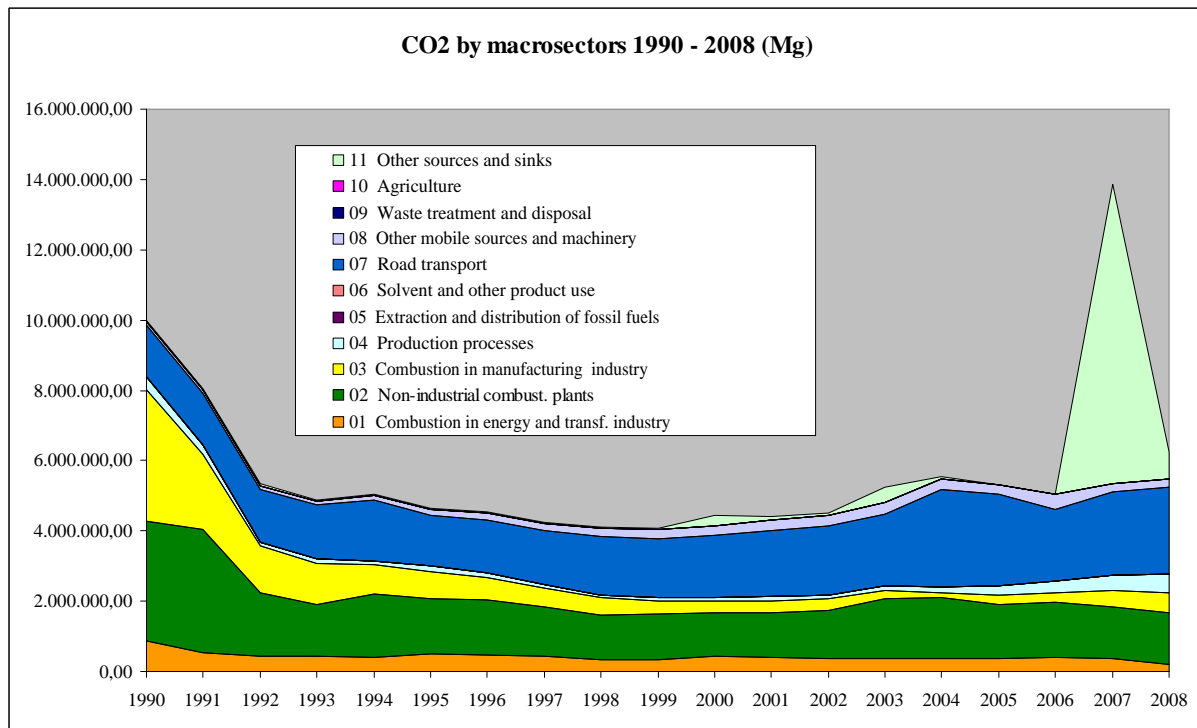


Figure 9 – Contributions of different sectors on CO₂ emissions, years 1990 – 2008

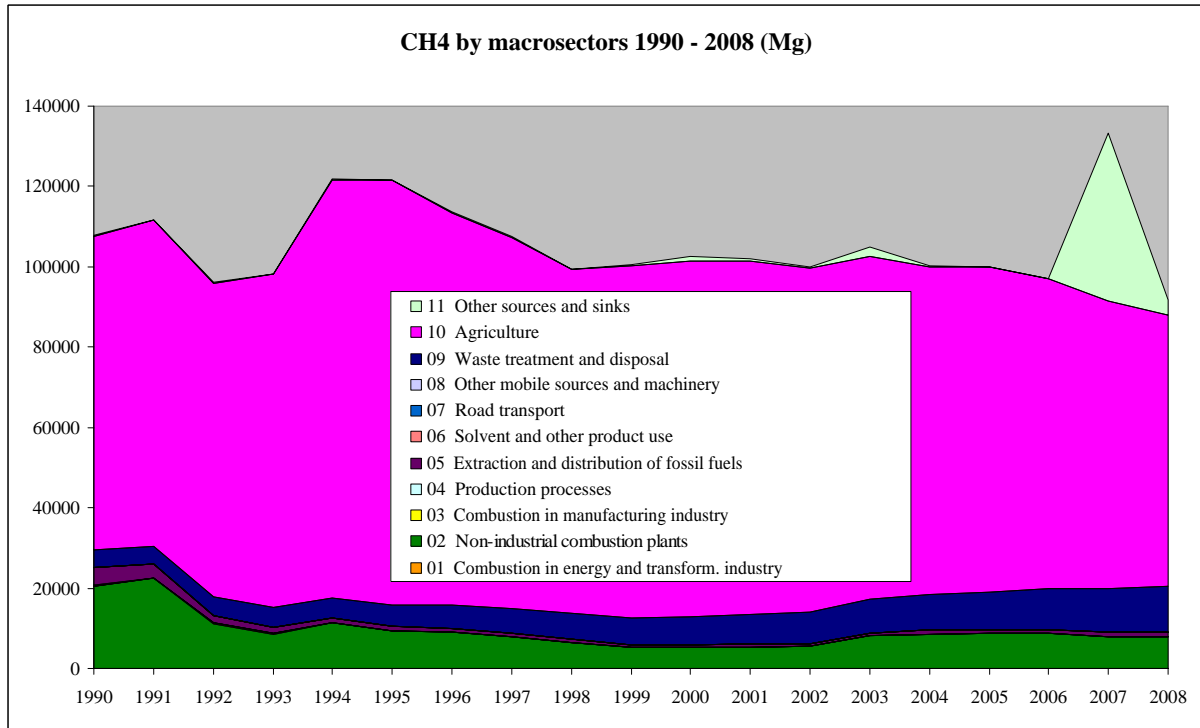


Figure 10 – Contributions of different sectors on CH₄ emissions, years 1990 – 2008

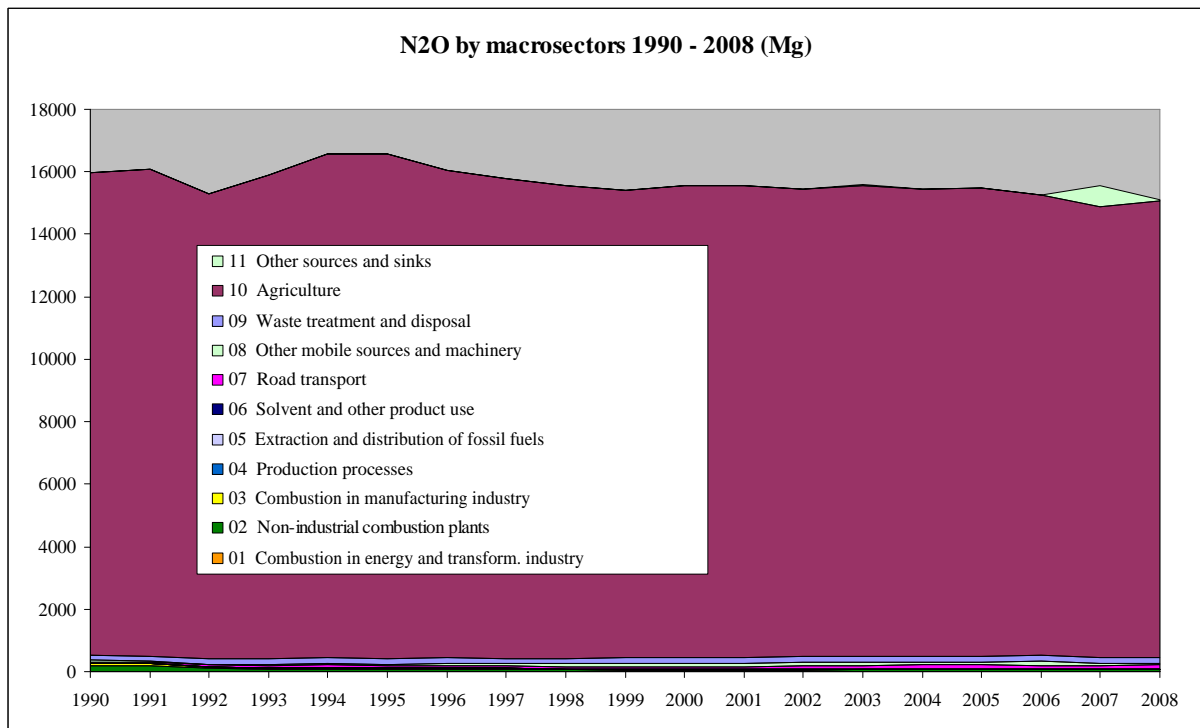


Figure 11 – Contributions of different sectors on N₂O emissions, years 1990 – 2008

3.4 Heavy metals and other aromatic hydrocarbons

Figure 12 and Figure 12 – Heavy metals emissions, years 1990 – 2008

show the total emission levels of heavy metals and aromatic compounds other than benzene for the period 1990 – 2008, respectively.

Combustion in energy and transformation industry, Non-industrial combustion plants, Combustion in manufacturing industry and Production processes are the main sources of heavy metals; *Road transport* is also a relevant source for Pb, Cd, Cr, Se and Zn.

Regarding aromatic compounds other than benzene, major contributions come from wood combustion in *Non industrial combustion plants*; only for PCBs, high shares are also associated to *Combustion in manufacturing industry and Production processes*. For all these pollutants, high levels have been also estimated in 2003, 2007 and 2008 for the already mentioned forest fires.

Emission levels of HCB and PCB are not represented in Figure 12 – Heavy metals emissions, years 1990 – 2008

because they are quite low during the whole period.

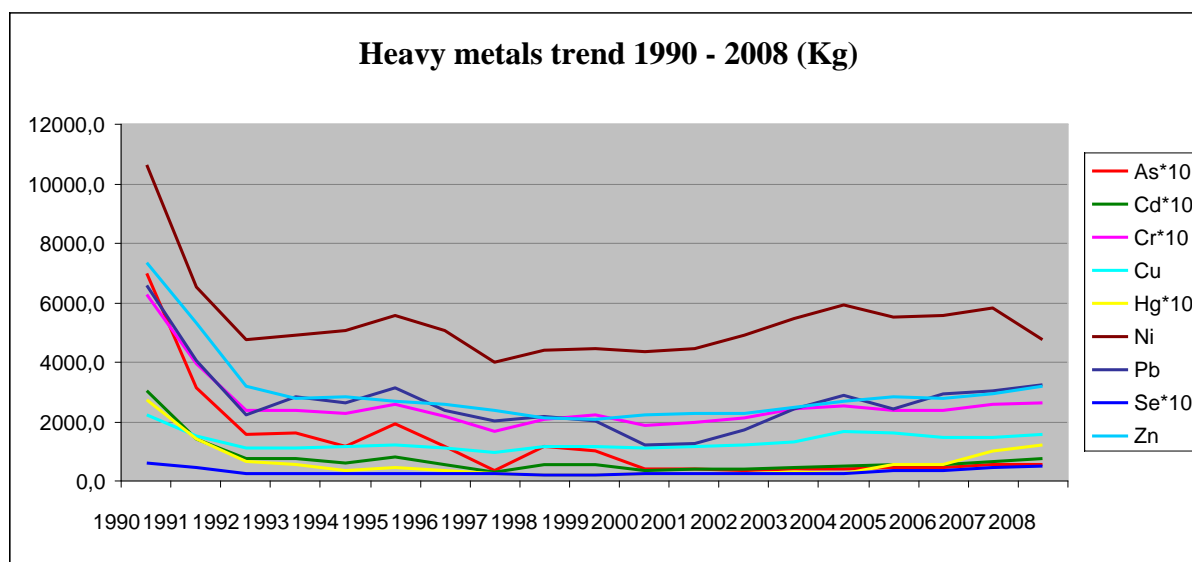


Figure 12 – Heavy metals emissions, years 1990 – 2008

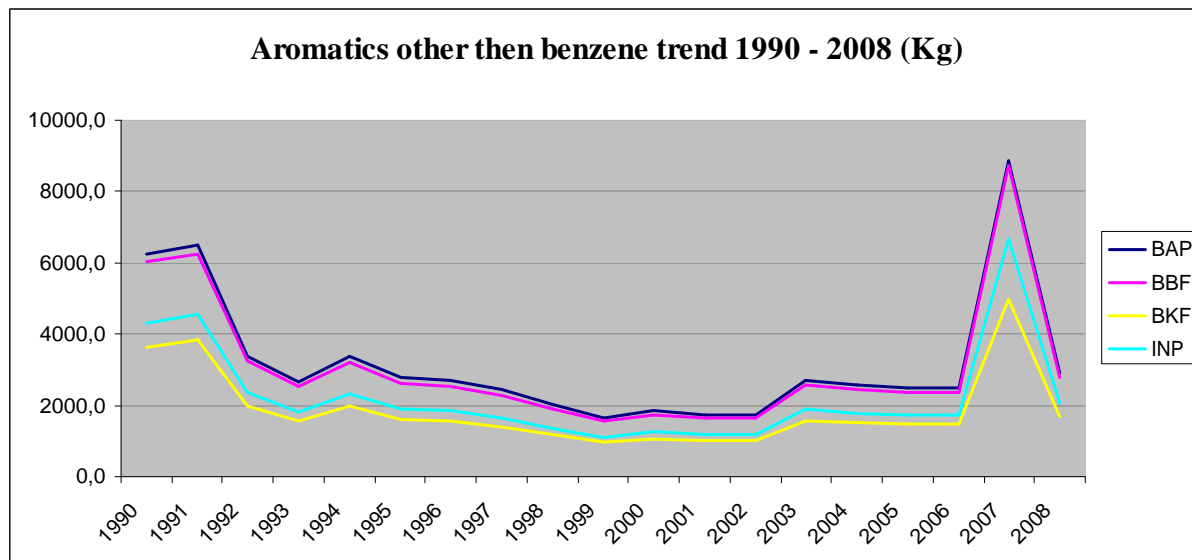


Figure 13 – Aromatic compounds emissions, years 1990 – 2008

3.5 Point sources

The following table shows the point sources mainly responsible of the levels of the main pollutants emissions in the Country.

Table 4 – Point sources contribution to the main pollutants emission levels

| Pollutant | Main contribution | Additional relevant contributions |
|-----------------|---|--|
| SO _x | Ballsh Deep Oil Refinery; T.E.C - Fier Njesia e Prodhimit | UPN-Fier Oil Refinery; Thermal Power Plant of Ballsh (TEC) |
| NO _x | Ballsh Deep Oil Refinery; T.E.C - Fier Njesia e Prodhimit | Elbasan Cement Factory (ECF); Albanian Chrome |
| PM | Albanian Chrome; Ballsh Deep Oil Refinery | T.E.C - Fier Njesia e Prodhimit |
| CO | Albanian Chrome | |
| VOC | Ballsh Deep Oil Refinery; UPN-Fier Oil Refinery | Elbasan Cement Factory (ECF) |

4 FINAL COMMENTS

Making a general overview on the described data it seems to be important to underline a few aspects.

The compiled air emission inventory is the first complete inventory prepared for Albania on all pollutants which are relevant to implement obligations coming from the International Conventions ratified by the Country. Since private companies and public institutions are not obliged to cooperate to such an activity and they are not used to register data in the necessary formats and detail, some lack of data, as described in the chapter on data collection, somehow may affect the estimated levels of pollution. Anyway, all results are coherent with the general knowledge on atmospheric pollution, there is a good relation between the final emission levels and the known activity indicators and therefore the above described results seem to be a good description of the emission situation in the Country.

Taking into account the comments on contribution of different sources to the level of atmospheric pollutants, it can be summarized that:

- high levels of pollution come from Energy and Industry sectors for all pollutants;
- high levels of particulate matter and carbon monoxide come from wood combustion;
- there is a gradual increase of pollution coming from road transport over the years;
- higher levels of emissions are estimated for the first years, 1990 – 1993, as explained by the economic decline observed in the early nineties;
- there is a high influence of forest fires on the emissions of some pollutants in 2000, 2003, 2007 and 2008;
- it is observed a sensible increase of emissions coming from Waste during the years; this sector is affected by an underestimation since no data were available on uncontrolled incineration of waste over the territory.

The following graph (Figure 14) describes the trend of the main pollutants over the whole investigated period, 1990 – 2008. Emissions are reported in Gg.

The diagram confirms the summarized conclusions. While VOC emissions are more or less constant during the whole period (since major contribution is that related to vegetation), it appears a decrease of the levels of pollution in the period 1990 – 1993, related to SO_x, NO_x, PM₁₀ and CO. It is clear the hotspot in 2007 due to fires. A gradual increase of emissions is shown for NO_x, especially in the last years.

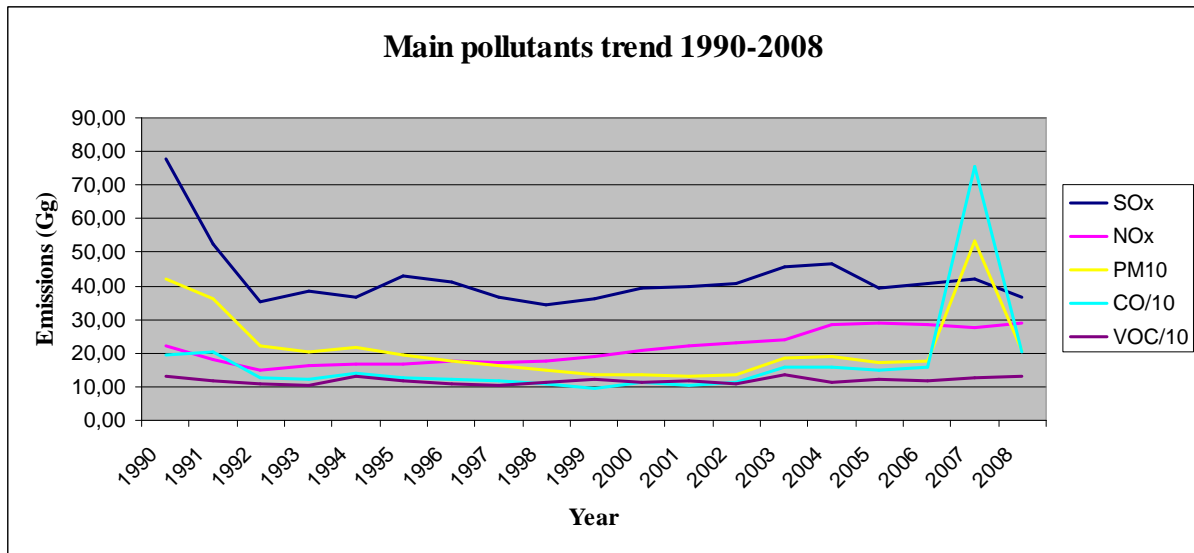


Figure 14 – Main pollutants trend (1990 – 2008)