

# **ENVIRONMENTAL PROTECTION**



## METHODS OF REDUCING AIR POLLUTION IN R. OF NORTH MACEDONIA

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**Abstract:** *A high quality and healthy living environment is one of the main prerequisites for high quality life of all citizens of the Republic of North Macedonia. Clean air is one of the main components that, unfortunately, has been highly polluted for the last decades. The air in urban and industrial environment is characterized by a large number of polluting substances:*

- *Primary (emitted directly from sources of pollution);*
- *Secondary (formed by interaction of two or a number of polluting substances or during interaction of primary polluting substances with components that are present in unpolluted air).*

*The emission of polluting substances in the air originates from almost all economic and social human activities: traffic, industry, combustion plants and power plants, households, construction activities, landfills (particularly the unregulated ones) and agricultural activities. The combustion of biomass from households, i.e., the combustion of solid fuels as are wood and coal is an important source of directly emitted solid particles and polycyclic aromatic hydrocarbon (PAHs) that belong to the class of cancerogenic substances. Agriculture is the activity that is mainly responsible for the emission of ammonia (NH<sub>3</sub>) that affects the health of the people and the ecosystems. The Republic of N. Macedonia regularly monitors (although with a lot of challenges and space for improvement) the quality of air in Skopje and other larger cities in the Republic of N. Macedonia and elaborates inventories of emissions of polluting substances in accordance with the EMEP/EEA instructions (common instructions within the European Monitoring and Evaluation Program and the European Environment Agency) transposed into the Rulebook on Methodology for Inventory and Definition of Level of Emissions of Polluting Substances in the Atmosphere in Tons per Annum for All Kinds of Activities adopted in November 2007 (Official Gazette of RM no. 147/2007).*

**Key words:** *pollution, air quality, harmful concentrations, suspended particles, emissions*

## 1. INTRODUCTION

Air pollution is the greatest cause of premature death and increased number of diseases among people. It is the biggest risk in the environment pertaining to the health of the citizens in Europe where, according to the EEA and WHO data, it is the cause of about 400,000 premature deaths.

Unfortunately, according to the latest report of the European Environment Agency regarding air pollution, the Republic of N. Macedonia has been ranked the worst among all European countries. The cities of Skopje, Bitola and Tetovo were among the most polluted 10 cities in Europe in 2017. According to the latest analyses made by the World Health Organization, air pollution has been the main cause of 1300 deaths per annum and increased number of persons suffering respiratory diseases. According to the analyses made by the World Bank, air pollution costs the country about 2.5% of its GDP, i.e., additional resources for health care services or 3000 million euro per annum.

## 2. SPECIAL METHOD FOR DEFINITION OF AIR POLLUTION

Due to a greater number of socio-economic factors, air pollution is increasing from year to year and the conditions are becoming worse and alarming. Certain analyses and modeling of the emissions of polluting substances done for the household heating sector in the Skopje valley point to the fact that pollution will have been increased for 30% by the year of 2025 if urgent system measures for reduction of the emissions are not effectuated. These numbers will be even higher if one adds the emissions from other sectors as is, for example, the transport sector whose participation in the pollution is rapidly increasing at annual level.

The quality of air in larger cities has considerably been reduced. According to the annual report on the quality of the environment drawn up by the Ministry of Environment and Physical Planning for the year 2017, the average annual concentrations of PM<sub>2,5</sub> in 2015, for example, in Centar municipality, amounted to 40,14 mg/m<sup>3</sup>, while in Karposh municipality, these amounted to 50,51 mg/m<sup>3</sup>, while the concentration of PM<sub>10</sub> amounted to 72,82mg/m<sup>3</sup> and 57,06 mg/m<sup>3</sup>, respectively. The problem of air pollution in the cities in Macedonia is an old one. Accordingly, the citizens in the cities located in valleys are permanently exposed to higher concentrations than the allowed ones. All reports point out that there is an abrupt increase of the concentrations during the heating season, namely thrice to four times. For example, Skopje and Tetovo are

characterized by many days in the year when the maximum defined average daily values for PM<sub>2.5</sub> and PM<sub>10</sub> particles are exceeded.

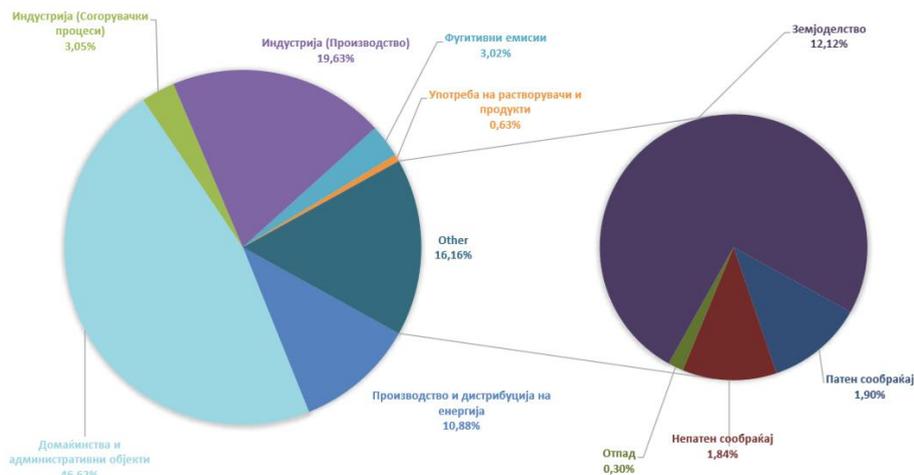
The situation with the other larger cities is similar, but for these, unfortunately, there haven't been any comprehensive and detailed studies although there have been indicative investigations pointing out that the biggest polluters in these valleys are the heating, the waste and the industry.

Air pollution is the consequence of many factors, wherefore its reduction necessitates reduction of emissions of polluting substances from all mentioned sources.

The first step to solving the problem of pollution is definition of the sources of pollution. For that purpose, the Ministry of Environment and Physical Planning, the city of Skopje and other relevant institutions have carried out a series of analyses and studies for the last years in order to define the period of the year when the largest concentrations of polluting substances occur. In accordance with these studies, if the average monthly or daily concentrations are analyzed, the biggest peaks (the highest concentrations) occur in the course of the winter period, during the heating season. This is illustrated in the subsequent graph showing the PM<sub>2.5</sub> particles.

All analyses and findings have so far pointed to heating as the biggest polluter of air in the Skopje valley. Such findings have been confirmed also in the study elaborated by the Meteorological Institute of Finland within the frames of the twinning project with the Ministry of Environment and Physical Planning when it was computed that even 90% of the total emissions of PM particles come from heating (wood used as a fuel).

According to foreign scientific studies, in regions of intensive use of wood for heating, investigations have shown high concentrations of PM<sub>2.5</sub>, PM<sub>10</sub> and volatile organic compounds (VOC). In many cities worldwide, heating by use of wood is the dominant source of pollution and contributes to even 95% of the measured concentrations of PM in the winter period (Jordan et al. 2006). According to WHO, even 28 components in the emissions coming from combustion of wood are defined as toxic, out of which 14 are considered cancerogenic (Smith et al. 2014). Non-specific solid particles (PM) originating from combustion of wood and coal have also recently been classified by IARC as cancerogenic (Loomis et al., 2013).



Emissions of PM10 in 2016 per sectors  
(Source: Quality of environment in RM – Annual report for 2017)

Although these studies show the concentrations of polluting substances and point to the sources of pollution, they are still not sufficient enough for corresponding planning and realization of successful activities at a micro level since they do not contain data on the reasons of pollution. For this reason, in January 2017, the Ministry of Environment and Physical Planning in cooperation with the city of Skopje and UNDP, carried out an investigation of the modes of heating of the households on a representative example of 5044 households from the entire Skopje region (all 17 municipalities). The findings have been analyzed and the results have been presented in the report entitled: “Scientific – research Study: What do the households in Skopje use for heating?”

In addition to heating, the sources of pollution from other sectors are not at all to be neglected or underestimated. The waste and the illegal landfills as well as their combustion, then industrial capacities, the construction expansion and the non-observation of the rules of construction, the numerous neglected areas giving rise to a lot of dust as well as the traffic add to the complexity of the challenge and the diversity of the reasons of pollution, aggravating the process of their solution.

### 3. OBJECTIVES OF THE PROGRAM

Hence, a conclusion can be drawn that only the combination of measures directed to change of modes of heating of households and other sectors like construction, heating of small firms, transport, arrangement of

public areas, along with strengthening of the capacities of inspection and supervision and more frequent controls of industrial capacities and other legal entities will give the best results in solving the problem.

Therefore, adoption of a program for reduction of air pollution is proposed. To realize this program, a systematic approach to reduction of emissions from all identified sectors will be applied through strategically planned and distributed measures whose purpose is:

Reduction of air pollution by 2020 in:

- Skopje, up to 50%
- Other towns, from 30 to 50%

The program will be implanted in 2019 and 2020 in all segments:

- Monitoring
- Inspection
- Public campaign
- Modification of corresponding laws
- Sectors that are the most critical sources of pollution:
  - Household heating
  - Transport
  - Industry
  - Construction
  - Urban green areas
  - Waste

#### **4. PRIORITY ACTIVITIES**

With this program for reduction of pollution, in the period 2019 – 2020, priority activities will be financed in the following fields:

1. Monitoring of air quality – the activities will be aimed at improvement of the system for monitoring of air quality through:
  - Complete replacement of all instruments at monitoring stations;
  - Application of the most recent mathematical models for modeling and corresponding prediction of air pollution.
  
2. Improvement of the capacities of the inspectorates for environment in performing inspections for the purpose of enabling complete application of the relevant legal regulations for protection of the environment. The activities will include:

- Legal modifications (Inspection Council, Inspectorate for Environment);
  - Increased number of employees;
  - Increased scope of regular controls;
  - Introduction of a more efficient system for performance of inspections.
3. Raising of public awareness through educational campaigns will be one of the priority activities in this program aimed at informing the citizens about the harmfulness of using non-ecological sources of heating and also educating them regarding alternative, more efficient, more ecological and economically feasible possibilities for heating, transport, waste disposal, etc.
4. Reduction of emissions of polluting substances from heating of households. As the biggest source of pollution, most of the activities will be focused on this sector. Taking into account that subvention is not the most appropriate and efficient way of stimulation for changes and, at the same time, may negatively affect the market activities in this sector (offer and demand of new technologies and fuels), the activities will be directed toward finding models of stimulating private companies to offer more appropriate packages in order that the households could easily decide on changing their heating technologies. The activities in this sector will enable the achievement of the following goals:
- 10,000 households will be connected to the existing heating operator (BEG). The hot water network will be expanded;
  - VAT to delivered heating energy from the heating operator will be reduced to 5%. The measure will contribute to increase of the consumption for 11%;
  - 20,000 households will change the old, non-ecological wood stoves by more efficient wood stoves;
  - 20,000 households will procure inverter air conditioners for heating;
  - Private firms that sell ecological devices will receive assistance in building their capacities and preparation of marketing strategies as well as establishment of partnerships with banks in order to offer more favorable packages for all categories of citizens;

- 10,000 households will improve the energy efficiency of their homes;
  - 3,000 households will be connected to the gas pipeline;
  - 2,000 households of socially vulnerable categories will receive subventions to change their mode of heating through a specially designed support mechanism;
  - Coal will be forbidden for use – legal modifications passed in 2019.
5. Urban green areas–neglected areas and dust are also a big source of pollution in urban centers. The deposited debris and waste on these areas additionally aggravate the conditions, while their frequent combustion is too dangerous for all surrounding settlements. Therefore, these activities should also have priority for realization:
- Urgent realization of the plan for grassing by use of the resources from the compensation for the construction of the gas line on Vodno mountain;
  - Skopje will be without the neglected muddy areas – the entire quay of Vardar and Lepenec rivers, other areas in the urban part of the city (continuation of the initiative of the city of Skopje for redesign of neglected public areas);
  - URGENT dislocation of all illegally populated “settlements” on both sides of Vardar river and their grassing.
6. Waste management - some of the activities in this sector are mentioned in the previous item. With over 3000 small and big illegal landfills throughout the country, most of them being located immediately next to large cities and many around the capital city, this sector considerably contributes to the emissions of polluting substances. The activities within this sector will be directed to:
- Cleaning of landfills;
  - Educational activities toward reduction of waste creation and its reuse and composting of organic waste;
  - Placement of nets in rivers to collect waste plastic;
  - Stimulation to collection, selection and recycling of plastic and other activities.
7. Transport -As to air pollution originating from this sector, the citizens are the most direct participants since emissions are due to their daily motion. Therefore, the activities in this sector will be

directed not only toward reduction of emissions but also reduction of exposure of the citizens that move from one place to another. For that purpose, the activities will be focused on:

- Modifications of the Law on Vehicles (introduction of ecological labels, subventions for procurement of electrical and hybrid vehicles, subvention for building-in devices that use oil or earth gas);
  - Restructuring of the public transport;
  - Introduction of winter traffic regime;
  - Introduction of Park& Ride system.
8. Industry – Large industrial capacities with A and B integrated permits that are relatively in a small number mainly fulfill the legal regulations regarding placement of filters and reporting on air quality. Still, regular inspections will continue in order to assure that all these fulfill the strict regulations. Legal entities that are obligated to prepare reports and those that combust waste within the circle of their capacities are a big challenge. Therefore, the following activities will be carried out:
- Frequent regular controls;
  - Modifications of the Law on Industrial Emissions;
  - Transparent announcement of all companies with valid A and B permits.
9. Construction. The expansion of construction activities and the non-observation of legal regulations on construction and safety of engineering structures under construction as well as the improper disposal of construction debris have considerably contributed to pollution, among which air pollution, for the last years. Therefore, in this sector, the following activities will be carried out:
- Stricter controls of construction activities;
  - Introduction of a system for construction waste disposal through preparation of a waste disposal plan at the beginning of construction.

## 5. CONCLUSIONS

The progress of the implementation and the results from the used program and method will be monitored through the system for monitoring of the program that will be established during the first months of the implementation. To monitor the results, a monitoring plan with

measurable and real indicators will be prepared. A tool for collection and analysis of data will also be developed. Reports on the progress and the results of the implementation of the program will be submitted to the Government of the Republic of Macedonia twice a year.

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