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1. Mirceva, Georgina [уредник] 2. Ilievska, Natasha [уредник]

Preface

This volume contains the papers and abstracts presented at the 15th International Conference for Informatics and Information Technology (CIIT 2018) held on April 20-22, 2018 in Mavrovo, Macedonia. The conference was organized by the Faculty of Computer Science and Engineering, within the Ss. Cyril and Methodius University in Skopje, Republic of Macedonia.

In the fifteenth edition, the key CIIT conference mission remained to provide an opportunity for young researchers to present their work to a wider research community, but also facilitate multidisciplinary and regional collaboration. Despite the participation of scientists from the country, a remarkable number of participants from abroad attended the conference. Building on the success of the past fourteen conferences, this year the conference attracted a large number of submissions resulting in presentations of 44 full and short papers, 18 student papers and 5 abstracts, which were presented in eight regular sessions and three student sessions. Traditionally, the conference included student sessions presenting the work of the best undergraduate students, where they presented some of their ongoing work, or demonstrated practical implementations. Three best student papers and three best student presentations were awarded. The format of the conference allowed the participants to attend most of the talks that covered a diverse spectrum of research areas.

As a key note speaker we had the pleasure to have Prof. Ana Sokolova, associate professor at University of Salzburg, Salzburg, Austria, who gave a talk titled "Local Linearizability". We had three invited speakers covering different areas of the conference. Dimitar Nikolov, PhD, consultant at Altran AB, Malmö, Sweden, gave a talk on the topic "Ensuring correct operation in presence of faults". Mihaela Angelova, PhD, postdoctoral researcher at French Institute of Health and Medical Research, Paris, France, gave a talk on "Squamous lung carcinogenesis: immune evasion before tumor invasion". Tome Eftimov, PhD, researcher at Jožef Stefan Institute, Ljubljana, Slovenia, gave a talk titled "Are we aware of the importance of proper study analysis? Deep Statistical Comparison: a case study of meta-heuristic stochastic optimization algorithms".

Part of the conference success is owed to the support received from partners and sponsors: Ss. Cyril and Methodius University in Skopje, Sorsix, Software4Insurance, Macedonian Winemakers and S&T.

All in all, this year the CIIT conference has outgrown the role of being an excellent opportunity for young researchers to present their scientific growth, to a more premier role, that is to bring researchers together for establishing collaborative links between disciplines, for testing the ground for innovative ideas and for engaging the wider academic community.

January, 2019	Georgina Mirceva
Skopje	Natasha Ilievska

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EU Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe in Context of the Republic of Macedonia

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***Abstract*— The EU Directive 2008/50/EC on ambient air quality and cleaner air for Europe provides for rules in order to reduce pollution to levels which minimize harmful effects on human health, paying particular attention to sensitive populations and to improve the monitoring and assessment of air quality including the deposition of pollutants and to provide information to the public. This article provides for analysis of the ambient air quality and measurement systems in the Republic of Macedonia in context of this EU Directive and it offers for examination of the Directive requirements in respect of air quality management area delineation - zones and agglomerations. The evaluation is made on the basis of the regular measurements obtained from the existing measuring networks as well as via measurements of the emissions from stationary and mobile sources in several years period. Results from the analysis of air pollution parameters SO_2, NO_2, NOx, PM_{10} and ozone concentrations are presented both for specific regions and on the entire state territory.**

Keywords— ***EU directives, air pollution, zones, models***

I. Introduction

Air is fundamental natural resource for sustenance of life and for other activities in the biosphere. Its paramount importance proposes significant protection as a natural resource and as a right. As a right, protection is given on universal and on regional level although, the importance of environment was neglected in the past because of the lack international concern for the global protection of environment [1]. However such position has been changed in recent years with the rise of the conscience for the environmental problems with protection offered by European Convention of Human Rights (ECHR) and in the EU [2]. In 2008 the EU has adopted a new Directive 2008/50/EC (so called CAFÉ directive) on ambient air quality and cleaner air for Europe [3] which repealed the old Council Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management [4] and all of other Directives (1999/30/EC, 2000/69/EC, 2002/3/EC) and also the Council Decision 97/101/EC of 27 January 1997[5]. With that the EU has replaced all of these five instruments with one in the interests of clarity, simplification and administrative efficiency. For achieving the goals in the CAFÉ directive, Member States have the following responsibilities: a) assessment of ambient air quality; (b) approval of measurement systems (methods, equipment, networks and laboratories); (c) ensuring the accuracy of measurements; (d) analysis of assessment methods; (e) coordination on their territory if Community-wide quality assurance programs are being organized by the Commission; (f) cooperation with the other Member States and the Commission. Also another obligation form this Directive is that the Member States should establish zones and agglomerations throughout their territory, upon which air quality assessment and air quality management should be carried.

The detailed limits for each substance of interest are set out in the Directive and specify the requirements for air quality assessment in each of the zones.

In this aspect, the monitoring of the situation in the Member States of the EU has shown for example, that total of 19 % of the EU-28 urban population was exposed to PM10 (Particular matter 10) levels above the daily limit value and approximately 53 % was exposed to concentrations exceeding the stricter WHO AQG (World Health Organization – Air quality guidelines) value for PM10 in 2015. This represents an increase compared with 2014, but the magnitude of the change may be considered as being within the expected year-to-year variability [6].

Republic of Macedonia faces tremendous problems in correlation to the health of the population arising out of the ambient air quality. Every year, the concentration of the pollutants exceeds the thresholds for the protection of the human health. The problem is evident in every part of the country, but it is mostly present in the urban environments such as Skopje and Tetovo [7]. Most problematic pollutants are the PM10 and NOx which seriously endanger the health of the population. The most relevant legal sources are the Ambient Air Quality Act [8] and the Decree on the thresholds and types of pollutants of the ambient air and thresholds for alarming, deadlines for achieving the thresholds, margins of tolerance of the thresholds, goals and long term goals [9].

This paper is part of the continuous work performed by the Laboratory for Eco-informatics at the Faculty of Computer Science and engineering at the University "Ss. Cyril and Methodius" Skopje, Republic of Macedonia and represents follow up on the new developments in the EU based on the adoption of the new EU directive[10]. The rest of the paper is organized as follows. In section 2 methods that are used for air quality methods are presented, while in Section 3 the results from the conducted measurements with analysis on the key components that affect this quality issue pointed by the expert group.

II. METHODS

The requirements laid down in the Directive for air quality assessment methods in each of the zones depend on how deep pollution levels in the zones fall below the limit values [14].

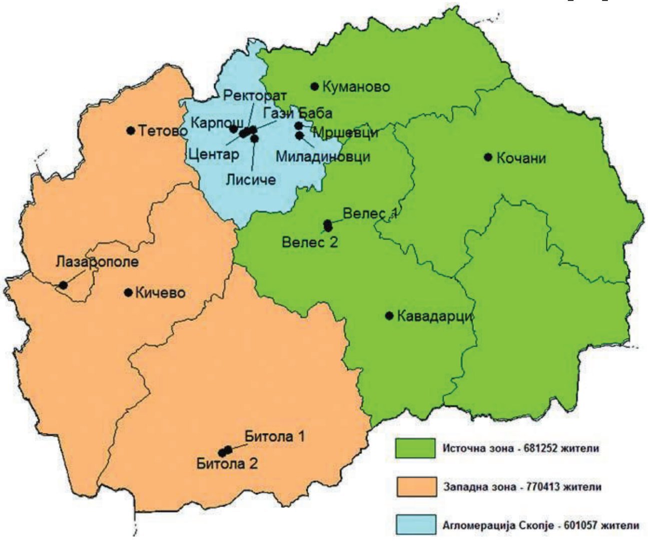

Fig.1. Zones and agglomeration in the Republic of Macedonia

The borders of administrative units may serve for delineating zones or combining administrative areas with similar air quality characteristics (Fig.1).

The ambient air quality directive does not stipulate measurements any longer as the only tool for determining levels in a zone, and envisages – depending on pollution levels – the use of modeling techniques and expert estimates and their combinations.

It is important to notice that in this context the distinction between measurement and other assessment methods (interpretation, spatial interpolation of measurements, modelling) is not as clear-cut as is often thought. The Guidance on Preliminary Assessment [11], suggests that three components be used as part of the assessment process;

- preliminary measurements(monitoring system),
- modeling, and
- air emission inventories.

A. Monitoring systems and methodologies applied in Macedonia

Assessment is done with all the data available from the automatic monitoring systems in the MoEPP measurement programs.

a) Automatic Air Monitoring System (MoEPP)

State automatic network for air quality monitoring consists of 18 stations that consistently measure air quality in different parts of the country. This number of stations meets the minimum number of monitoring stations on national level and is in consent with the requirements stated in the national legislation and European directives. In order to obtain credible results, equipment for monitoring must regularly be maintains and calibrate. Unfortunately, the poor regular maintenance of the instruments and deficiency of spare parts results with lower coverage with data especially in past a few years [7]. Laboratory for Eco-informatics used one mobile monitoring station (Air pointer-MLU-Austria) for this purposes. Our database system used all the data available for acquisition from the MoEPP and from our station for Air pollution assessment and modeling purposes.

b) Air pollution modeling

Air pollution dispersion models can be used for impact assessment of certain sources of emissions and categories the sources on the quality of air. They can be used to support the process decisions by providing information on the impact of measures to improve air quality and emission reductions, also to support traffic and urban planning. In order to achieve quality results, quality data from the meteorological observations and detailed emission information are needed. The weakness availability of quality input data limits usage of the dispersion models in the country. MoEPP used Local (UDM-FMI) and (CAR-FMI) and regional (SILAM) models developed by the Finnish Meteorological Institute for assessment of air quality. On the other hand Laboratory for Eco-informatics used Street canyon Operational Street Pollution Model (OSPM) and HYSPLIT (HYbrid Single-particle Lagrangian integrated trajectory) model. The idea in this article is to compare output results from different models and also to predict and improve air quality in R.Macedonia.

c) Air emission inventories

There are natural and anthropogenic sources of suspended particles in the atmosphere. Anthropogenic sources are combustion of fuels for production energy, incineration, heating in households and combustion of fuels from vehicles. Especially in cities, important local sources represent road traffic (vehicles and dust from the roads), as well and burning wood or coal for heating in households. Production energy and industrial emissions generates different sizes of suspended particles, depending on manufacturing process. The size of the suspended particles is very significant from a health aspect, since the finest particles get deeper in the human body and cause it more serious health impact.

III. RESULTS

The biggest individual sources of pollution are REK Bitola (located at Pelagonija Valley), FENI Industry (located at the most famous vinery area), Jugohrom ALZAR (Polog Valley) and MakSteel, ArcelorMittal and USJE (Skopje Valley).

Only REK BITOLA and TEC-Oslomej Thermal Power Stations would likely affect SO_2 levels in air significantly when judged against the directive. Simple calculation [12] shows that annual average values would probably be about 30 μg/m^3 or less. This seems to correspond with the slight elevation in SO_2 levels noted in measurements in Bitola when compared to other towns (Fig.2).

Similar simple calculation shows that TEC Oslomej, near Kichevo, would give rise to an annual average of about 25 μg/m^3 or less from a 180 m stack.

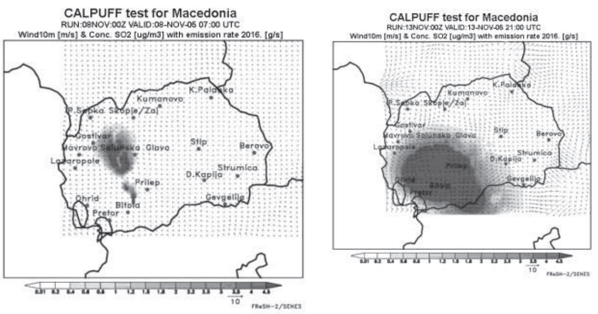

Fig 2. Emission of SO_2 according to CALPUFF model [13] and corresponding puffs before 10 years.

A. *Exceedance of air quality limit values in regions of Macedonia (PM10 and PM2.5)*

According to Fig.3, annual average PM_{10} values exceeded the EU annual limit values in all stations except Lazaropole, an EMEP station located at 1100 m a.s.l. in the west region.

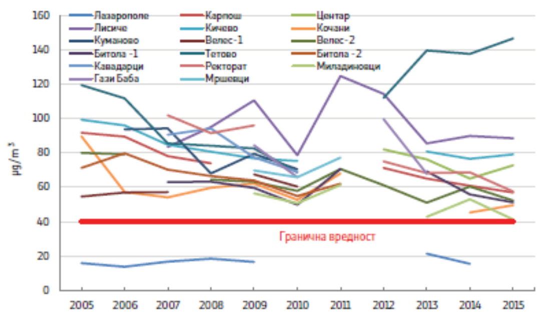

Fig.3 Average annual values for PM10 for the period 2005-2015 [7]

TABLE I. ILUSTRATE EU STANDARDS FOR PM10 AND PM2.5

Parameter	Average period	Value	Comments
PM10	Average daily value	50 μg/m^3	Not to exceed more than 35 days a year
PM10	Average annual value	40 μg/m^3	

The highest annual average concentrations of PM10 were measured in Tetovo and Skopje (Lisice) and exceeded 120 μg / m3. Levels of concentrations remain stable for the entire period between 2005 and 2015 year. It is estimated that the average value of PM10 in urban locations is approximately 80 μg / m3. Concentrations of PM10 in urban areas have pronounced and equal seasonal variations [7]. PM10 concentrations are high in the period December – January (Fig.4).

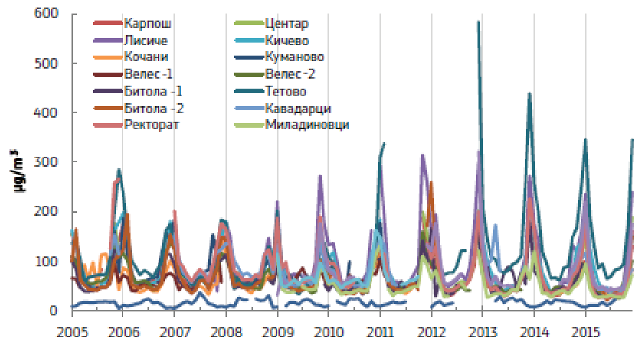

Fig.4 Average annual values for PM10 for the period 2005-2015.

Concentrations of fine suspended particles (PM2.5) are measured in two monitoring stations in Skopje since 2012.The average annual value of the concentrations is about 40-50 μg / m3, which is two times higher than the limit value.

B. *Exceedance of air quality limit values in regions of Macedonia (NOx)*

The main share of national emissions of NO2 originates from the energy sector (41% in 2014) and traffic (40% in 2014) (Fig.5). The total amount of NOx emissions in 2014 is approximately 32000 tons (MoEPP, 2016).

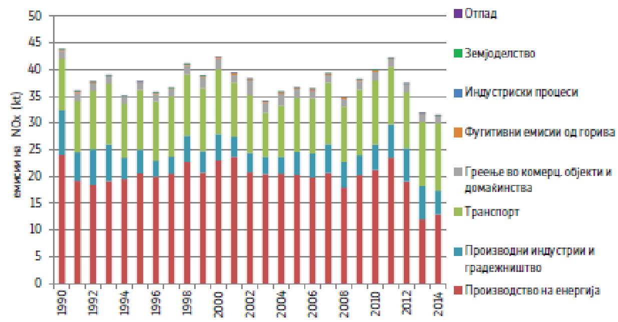

Fig.5 National emissions of NOx in the period 1990-2014, by sectors(MoEPP, 2016).

NOx emissions have seen a downward trend since 2011, which is the result of the reduced operation of the thermal power plant REK Oslomej, that is, the reduced consumption of coal and gasification on a heating plant.

TABLE II. ILLUSTRATE EU STANDARDS FOR NO2

Parameter	Average period	Value	Comments
NO_2 (for Human health)	One hour	200 μg/m3	Not to exceed more than 18 hours a year
NO_2 (for Human health)	Average annual value	40 μg/m^3	

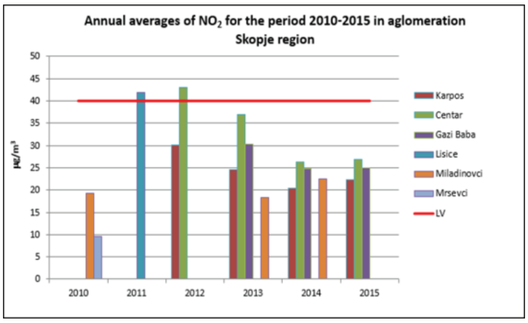

Fig. 6. Annual average concentrations of NO2 for the period 2010-2015 measured in Agglomeration Skopje region

Annual limit of NOx set for the protection of Human health in Macedonia is not exceeded only at measurement stations in Lisice(2011) and Center(2012) (Skopje region) (Fig.6)

C. Exceedance of air quality limit values in regions of Macedonia (SO_2)

Concentrations of SO2 in the air are visibly reduced in the past years, because the consumption of lignite and fuel oil is reduced. However, total national SO2 emissions are still high. Because of that it is necessary to introduce technologies to reduce emissions of SO2 especially in the main thermal power plants. The main share (over 90% in 2014) of national SO2 emissions comes from the energy sector that includes the production of electricity energy and heat

TABLE 3 ILLUSTRATE EU STANDARDS FOR SO_2

Parameter	Average period	Value	Comments
SO_2 (for Human health)	Maximum one-hour average value	350µg/m^3	24 hours a year
SO_2 (for Human health)	Maximum daily eight-hour average value	125µg/m^3	3 days a year

In the past ten years, the reduction in SO2 concentrations is a relatively systematic trend in all monitoring stations. Since 2007 there have been no registered exceeding of limit values of SO2. (Fig.7)

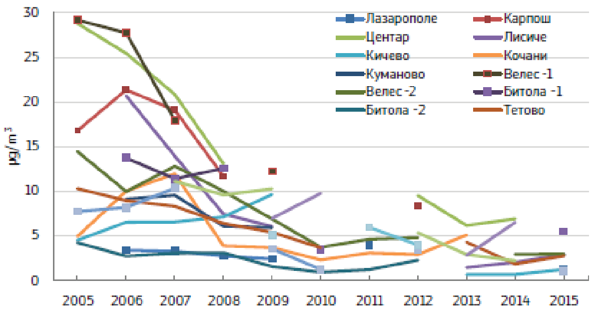

Fig.7 Average annual concentrations of SO2

D. Exceedance of air quality limit values in regions of Macedonia (CO)

The limit value of carbon monoxide in R. Macedonia still goes beyond a few days in a year in some cities. This is probably related to the old vehicles and widespread use of wood for heating in households. In cities throughout Europe, CO concentrations have dropped significantly since catalysts have become mandatory for new ones vehicles with petrol engines in 1992 year.

The main share in the national emissions of CO consists of heating in households (over 60% in 2014) and transport (27% in 2014) (MoEPP, 2016).(Fig.8).

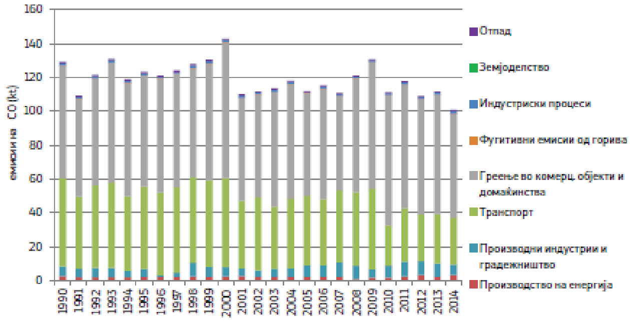

Fig.8 National emissions of CO in the period 1990-2014, by sectors

The limit value for CO (Table 4) is defined in national legislation transposing the air quality directive 2008/50 / EC (EU, 2008).

TABLE 4 ILUSTRATE EU STANDARDS FOR CO

Parameter	Average period	Value	Comments
CO (for Human health)	Maximum daily eight-hour average value	10mg/m3	

In Skopje and other urban areas of the country carbon concentrations monoxide occasionally exceeds the daily limit value.(Fig.9)

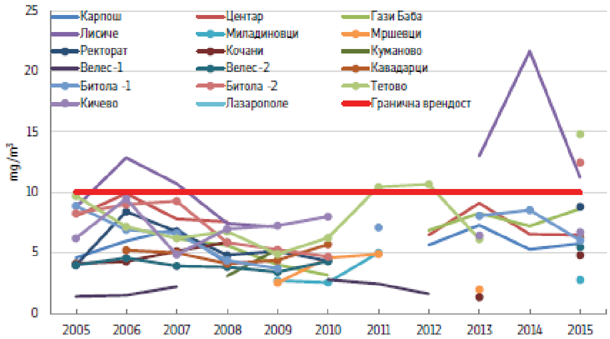

Fig.9 Average daily limit value of CO

Over the past few years, the limit value of CO has been exceeded in Skopje, Tetovo and Bitola, as major cities in the country that have more traffic density.

E. Exceedance of air quality limit values in regions of Macedonia (O_3)

The average ozone concentrations in cities are relatively low due to the presence of other polluting substances that break down ozone from the air. Concentrations of O3 usually increase with an increase in altitude, so the O3 concentrations in monitoring stations at a higher altitude may be higher than with stations stationed at a lower altitude.

Sometimes, in episodes of high solar radiation and temperature, high concentrations of O3 may occur in urban environments [15]. In the national legislation, air quality standards related to O3 are defined in order to protect human health and vegetation

TABLE 5 ILLUSTRATE EU STANDARDS FOR O3

Parameter	**Average period**	**Value**	**Comments**
O3 (for Human health)	Maximum daily eight-hour average value	120 µg/m^3	Not to exceed more than 25 days a year
O3(Long - term goal of protecting human health)	Maximum daily eight-hour average value	120 µg/m^3	

The maximum daily eight-hour mean value is 120 µg / m3 and is defined in order to protect human health.

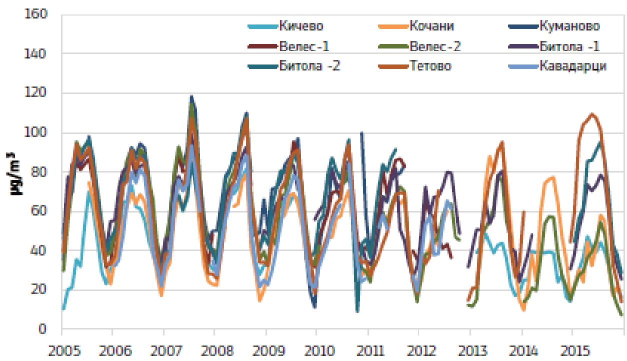

Fig.10. 8-th hour exceedance values for ozone (O_3) in Macedonia.

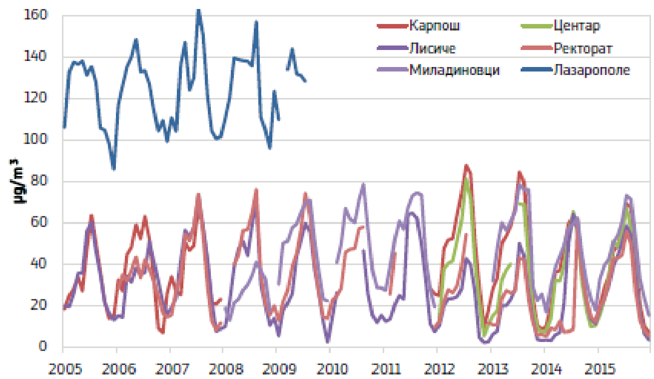

Fig.11. 8-th hours exceedance values for ozone (O_3) in Skopje and Lazaropole.

IV. DISCUSSION AND RECCOMMENDATIONS

Discussion and recommendations given in this section are founded on the results given by the previous maps and measured data obtained from the measuring station.

According to the legislation, it is necessary to implement measures for improvement of the air quality in order not to go beyond the limit values defined for the protection of humans.

The analysis shows a significant downward trend in the concentrations of sulfur dioxide in the ten-year period which was observed. High concentrations of suspended particles represent serious risk to the health of the population.

From the results above, the borders values for suspended particles are exceeded in the whole territory of R. Macedonia. In order to successfully decrease emissions in the air, efforts need to be taken by the central and local authorities, government, the business sector, but also the citizens need to raise their awareness regarding the environment.

IV. CONCLUSIONS

This paper is part of the continuous work performed by the Laboratory for Eco-informatics at the Faculty of Computer Science and engineering at the University "Ss. Cyril and Methodius" Skopje, Republic of Macedonia and represents follow up on the new developments in the EU based on the adoption of the new EU directive.

The ambient air quality in the Republic of Macedonia shows that national plan will be needed for PM_{10} as the limit values are exceeded in most zones.

Based on these research results, not only a review of the locations of all monitoring stations (MoEPP) as part of the overall action plan is needed but also an elaboration of the reasoning behind the selection of each site is more than welcomed solution. In this context a more comprehensive project is needed which might consider modeling the effect of the existing large sources of pollution across the country as a whole and to see what improvement of the ambient air quality this might produce when compared to other sources. This will be an important issue when considering what constitutes the Best Available Technique for each of the major plant and, importantly, the time allowed for the plant to reach new legislative standards.

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