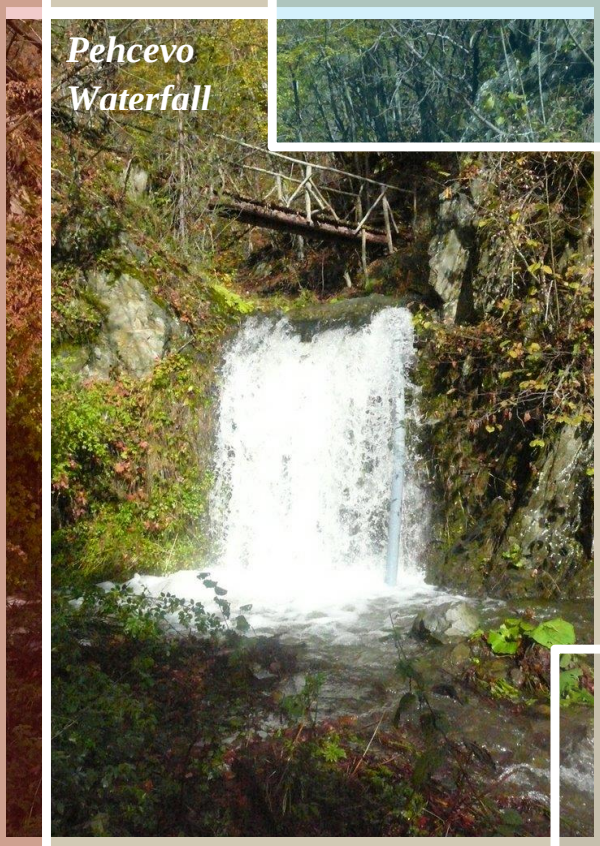
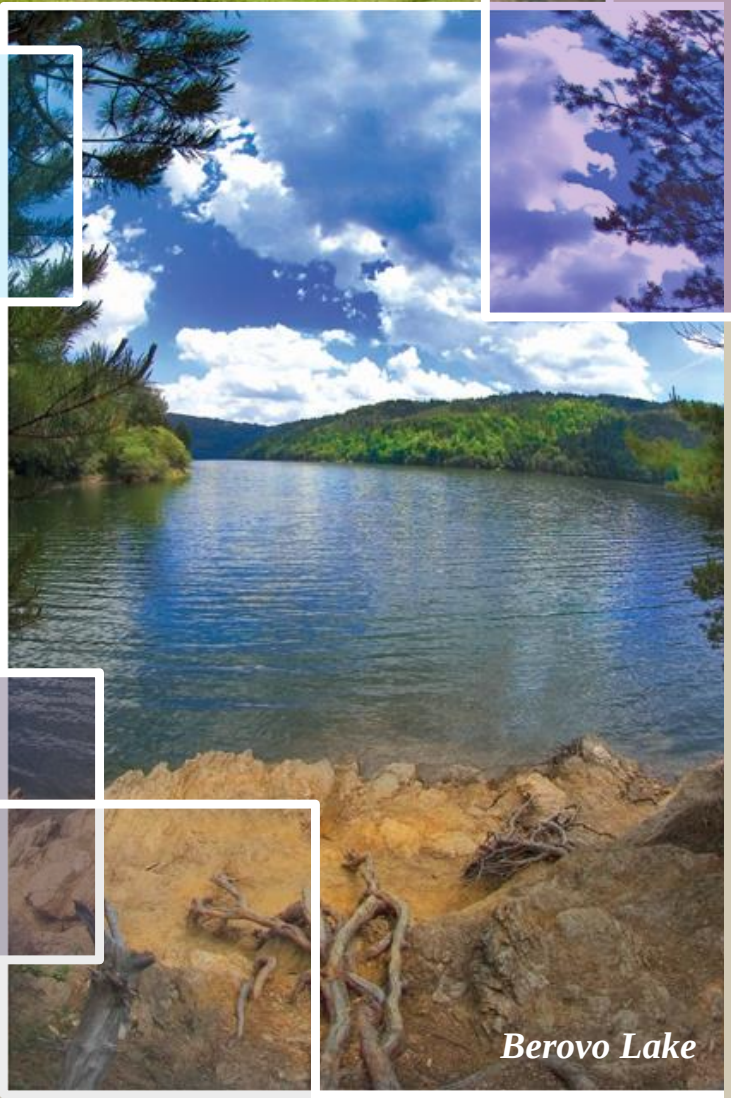
2017


Vinica vineyard


Pehcevo Waterfall


Berovo Lake


Delcevo

AIR QUALITY PLAN FOR FOUR TOWNS (BEROVO, PEHCEVO, VINICA AND DELCEVO)

JOINT INTEGRATED POLICY FOR LOW CARBON ECONOMY IN CROSS-BORDER REGION

РИ - ОПУСПРОЕКТ ДОО Скопје
Друштво за инженеринг,
истражување и услуги

Air Quality Plan for Berovo, Pehcevo, Vinica i Delcevo – made by the team of RI-OPUSPROEKT – Skopje

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CONTENT

Introduction

Air pollution is a clearly recognized global risk factor for the occurrence of diseases by the WHO (World Health Organization). Studies conducted in numerous cities around the world for decades have shown that the increasing of the pollution and the long-term exposure of people to polluted air increases the number of people who die as a consequence, and also reduces the life span of people. The polluted air, on the other hand, causes damage to the economy too. However, there is a reason for optimism, because there are documented evidences on a global level that show that air quality management at certain locations in the world has contributed for reducing the pollution and thus improving the health of the population.

The analysis of the available historical data on the quality of ambient air in Macedonia show that for certain pollutants the objectives stated in the legislation regarding the hours, the daily and annual limit values are not satisfying. Therefore, the East Planning Region, including the municipalities of Berovo, Pehcevo, Vinica and Delcevo, in achieving the vision for providing a healthy and clean environment for its inhabitants, which is set in the strategic documents of the municipalities - LEAP (Local Environmental Action Plans), envision preparation of Quality of Ambient Air Improvement Plan. The plan for improving the quality of ambient air is only an initial capsule towards achieving this vision. The elaboration of such a program arises from the legislation on quality of ambient air and is presented as one of the priority measures arising from the National Plan for Protection of Ambient Air of Republic of Macedonia for the period 2013-2018.

The Quality of Ambient Air Improvement Plan was developed by the project team of RI-OPUSPROEKT, Skopje, within the framework of the IPA project JOINT INTEGRATED POLICY FOR LOW CARBON ECONOMY IN CROSS-BORDER REGION, which was led by the Center for medicinal herbs and forest fruits “Ambrosia” from Pehcevo. During the implementation of the measurement campaigns, the executives of this project also had help and understanding from the environmental departments of the municipalities of Berovo, Pehcevo, Vinica and Delcevo.

With this project, parametric tests were conducted, for which there have not been made data for this region, thus obtaining initial data on the presence of certain harmful substances in the ambient air. The monitoring of quality of ambient air was carried out in two measuring campaings - in the summer (July 2017) and in the winter (October-November 2017),

The following measuring indicators were monitored:

- concentration of PM10 particles;
- concentration of SO2 (sulfur dioxide);
- concentration of CO (carbon monoxide);
- concentration of NOx (carbon monoxide);
- concentration of O3 (ozone);
- meteorological parameters (temperature, relative humidity, air pressure, speed and direction of the wind).

The project team of RI-OPUSPROEKT realized the monitoring of the measurement parameters in accordance with the reference methods for quality of ambient air, which are given in the European and Macedonian legislation and which were required in the technical specification.

On the basis of the conclusions drawn from this monitoring of quality of ambient air, measures are proposed that need to be taken in order to improve the situation with these parameters, using the European experience in managing the quality of ambient air. The measures outlined in the plan require the inclusion of a wide range of all decision-makers and stakeholders.

The Quality of Ambient Air Improvement Plan contains the chapters that were given in the technical specification of the “Monitoring of Air ” section of the "Joint Integrated Policy for Low Carbon Economy In Cross Border Region" project.

The main goals of the Quality of Ambient Air Plan for Berovo, Pehcevo, Vinica and Delcevo are:

- improving the quality of ambient air;

- fulfillment of legal obligations for managing the quality of ambient air in relation to the set limit values;
- to encourage and implement effective measures to reduce emissions of air pollutants;
- raise public awareness of air quality;
- to work in partnership with other institutions and organizations in order to implement national and regional air quality policies.

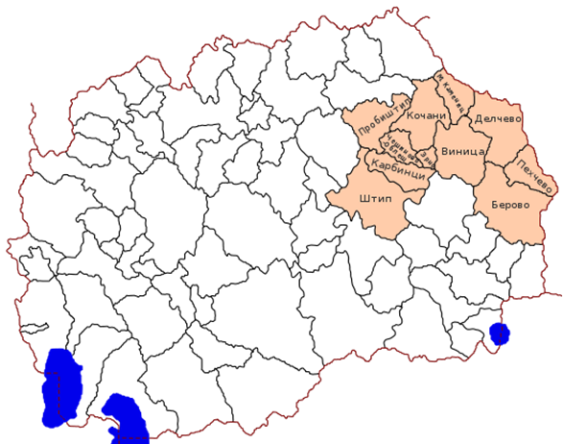
This document has gave a clearer picture of the state of the quality of ambient air in the East Planning Region (Berovo, Pehcevo, Vinica and Delcevo), in the seasons when the lowest and highest concentrations of harmful substances in the environment are expected. Processing the results of both seasons and historical data provides conclusions that include recommendations in direction of improving the environmental situation in the East Planning Region (Berovo, Pehcevo, Vinica and Delcevo) in the area of quality of ambient air.

I. General information about the East Planning Region

The East Planning Region is one of the eight statistical regions of Macedonia. This region is located in the eastern part of Macedonia and bordered by Vardar, Skopje, Northeast and Southwest region.

Table 1 presents the affected municipalities belonging to the East Planning Region, their area and the number of the population.

Table 1. Area and number of population in Berovo, Pehcevo, Vinica and Delcevo

No.	Municipalities	Area (km²)	Number of population (2002)	
1.	Berovo	595	7 002	
2.	Pehcevo	208.2	3 237	
3.	Vinica	432.67	19 939	
4.	Delcevo	423	11 500	

I.1 Municipality of Berovo

The municipality of Berovo is located in the eastern part of Macedonia and includes 9 settlements with 13,941 inhabitants and 4715 households with an average of 3.0 members per household. It covers an area of 595 km2, which is 4.3% of the territory of the Republic of Macedonia and is at an average altitude of 800 m. The town of Berovo, which is also the administrative center of the municipality, is located in the Malesevo valley and lies along the river Bregalnica. Borders with the state border of Bulgaria and the borders of the municipalities of Novo Selo, Bosilevo, Vasilevo, Radovish, Vinica, Delcevo and Pehcevo. The municipality is mostly mountainous. The most dominant mountain ranges are on the Maleshevo Mountains, which are located in the central part of the municipality, and the Ograzden Mountains in the south. The lowlands are mainly along the river Bregalnica. The highest peaks are Kadiica at 1932 m, Jami Tepe at 1801 m and Chengino Kale at 1748 m.

The Municipality of Berovo is a natural, geographical and economic whole, composed of 9 settlements, with 13,941 inhabitants. The seat of the municipality is located in Berovo (7,002 inhabitants) and the remaining eight settlements are: Budinarci (682 inhabitants), Vladimirovo (861 inhabitants), Dvoriste (757 inhabitants), Macevo (206 inhabitants), Mitrasinci (729 inhabitants), Ratevo 844 inhabitants), Rusinovo (2,095) and Smojmirovo (765) which fall into the category hilly-mountain villages.

The municipality of Berovo possesses rich natural resources, forest potential and a clean, unpolluted environment. The main economic branches are: agriculture, livestock, forestry, mining,

textile industry, artisanship, tourism and catering. In the area of the municipality of Berovo there are several major economic entities and several smaller business entities concerning the processing of agricultural products, production of lumber, parts of furniture and furniture manufacturing, chemical industry, textile industry, etc.

The economic structure of the municipality of Berovo, according to size and sectors of activity, is presented with 430 entities, from which 291 are micro, 138 are small and 1 is average. There is lack of presence of large entities.

According to the size, we can conclude that in the municipality of Berovo dominate micro entities with 67.67% of the total number of registered entities that employ up to 9 employees. Second in number are small entities with 32.09% employing up to 49 employees, then medium-sized entities that participate with 0.2% and employ up to 249 employees. The lack of presence of large entities in the municipality of Berovo and the small participation of medium-sized entities suggests that the economical development of the municipality of Berovo is mainly based on small and medium businesses. According to the data for the enterprises by sectors of activity, the municipality of Berovo is dominated by enterprises operating in the wholesale and retail trade sector, with 34.6% percent, followed by the processing industry with 14.8%, then accommodation and food service activities with 9.5%, transport and storage with 8.6%, other service activities with 7.2%, agriculture, forestry and fishing with 6.5% and the rest with less than 5%.

In the municipal environmental sector, some of these legal entities submitted, but they were also granted with one IPPC - A license, 2 IPPC - B license and 47 Environmental Policies.

I.1.1 Housing

There are about 5000 houses in the municipality of Berovo.

On the territory of the Municipality of Berovo there are two tourist settlements, one is "Ablanica", which is located two kilometers from the city of Berovo, which contains about 300 holiday homes, some of which are intended for renting to tourists. In the tourist resort there are 5 villas with total capacity of 26 beds.

The other tourist settlement is widespread around the Berovo Lake at an altitude of about 1 000 m and is located 6 km from the city, along the regional road leading to the Klepalo crossing border. There are about 150 weekend cottages there, and in the Tourist Information Point there are 22 visitor houses that are intended for accomodation for tourists, with a capacity of about 342 beds.

Public facilities are divided into educational, health, sports and administrative facilities.

I.1.2 Traffic in the municipality of Berovo

There are about 3 600 registered vehicles in the Berovo municipality.

There are 10 licensed taxi drivers in the municipality, a bus station with about 20 buses.

I.1.3 Energetics

Method of heating

Public facilities and institutions mostly have a central heating system that uses oil as a fuel.

Commercial buildings and firms use combined timber, oil and coal.

Households, about 95%, use firewood for heating, while the rest are heated with oil, coal and pellets.

Conducted energy efficiency

- Business incubator - Complete reconstruction and part new construction (central heating of pellets, hot facade, EE roof, insulation carpentry)
- Kindergarten “Rusinovo” - Complete reconstruction (roofing, carpentry, facade, central heating of pellets, solar collectors for hot water)
- O.U. “Nikola Petrov Rusinski” Partial reconstruction (roofing, carpentry, central heating, electric light bulbs)
- Secondary Municipal School – “Aco Ruskovski” (Replaced EE Roof and Energy Saving Lamps)
- Nursing home “D-r Ivan Vlashki” - Complete reconstruction of an existing building (hot facade, roof and carpentry)
- Kindergarten “23 August” Berovo - (Solar collectors for hot water, facade)

I.2 Municipality of Vinica

The municipality of Vinica is situated in the eastern part of Macedonia, between 41 ° 43` and 41 ° 59` SGS and 22 ° 26` and 22 ° 43` IGD, and with its area of 443 km2 is one of the smaller municipalities in Macedonia. To the north it borders the municipality of Kamenica, in the east it borders with the municipality of Delcevo, in the southeast with the municipality of Berovo, in the south with the municipality of Radovish, and in the west with the municipalities of Karbinci, Zrnovci and Kocani. It covers the southeastern part of the Vinica - Kocani basin. On the south side it is confined with the northern slopes of Mountain Plachkovica. To the east with the slopes of Mountain Golak. It belongs to the East Planning Region. The majority of the municipal area is a mountain-hilly area with an altitude of 301 m to 1,754 m above sea level.

The territory of the municipality is located in the central part of Eastern Macedonia between the Maleshevo - Pijanec valley from the east, Osogovo in the north, Kocani field to the west and the Strumica-Radovish valley in the south. These valleys in the eastern part of the Republic appear as the main communication corridors in the direction of Bulgaria.

The municipal center extends between Vinichka and Gradechka Reka, but it spreads in all directions. Besides the town of Vinica, there are 16 other settlements in the municipality: Blatec, Vinichka Krshla, Gradec, Grljani, Dragobrashte, Istibanja, Jakimovo, Kalimanci, Krushevo, Laki, Leski, Lipec, Pekljani, Trsino and Crn Kamen. The location of the Municipality provides good connection with the neighboring municipalities in the region.

According to the geographical position, the Municipality of Vinica is exposed to the influence of the continental-submediterranean climate. It is a typical area and combines the influences of the sub-mediterranean and eastern-continental climate.

The climate in the Vinica municipality is of great significance for its disposable position between the two massive masses - the Osogovo Mountains and Plachkovica, as well as the configuration of the Vinica-Kocani Valley itself, which is wide open towards west, and from all sides it is surrounded by high mountains. In this way, the valley, where the Vinica municipality belongs, is protected from the direct influence of the northern air masses with the mountain massif Osogovo, and it is also protected from the direct southern influences with the mountain massif Plachkovica.

The climate is characteristic of the fact that two different currents collide here. After the course of the river Bregalnica and Osojnica, the mediterranean climate occurs into the region, and the continental climate breaks away from Plachkovica and Golak. The effects of these two climatic currents can be seen through the cultivation of some agricultural crops, for example: poppy, rice, tobacco, etc., characteristic for the mediterranean climate and rye, oats, fruit plantations, characteristic of the continental climate.

Winds are also common in Vinica. There are winds from all eight directions with the dominance of the winds from the southwestern direction as well as the northeast direction. The southwestern wind is average 178%. The most frequent is the southwestern wind, with an average annual velocity of 2.5 m/sec. and a maximum speed of 16.0 m/sec. Secondly, the northeast wind with an average frequency of 104% and a speed of 24 m/sec. Western winds are hot because of the Mediterranean influence along Bregalnica, while those from the northwest are much colder.

In the municipality of Vinica, the population is mainly engaged in agriculture, while in the city dominate several industrial facilities from different sectors and service industries. Regarding the local economic potential and the available economic capacities, the Municipality of Vinica is included in the categories of developing municipalities.

The most developed important branches of the economy are: textile, wood industry, construction materials industry and furniture production, as well as food industry and floriculture.

The main industrial facilities in Vinica are: the factory for building materials "Tondah", the textile factories "Triko", "Vinka" and "Vinichanka", the wood processing facilities "Mebel - Vi" and "Furniture Trejd", the food industry "Vinchini", production of flowers and seeds "SBW Romero Vitro" and other smaller facilities.

According to the data of the State Statistical Office, the largest number of active business entities are in the sectors:

- Wholesale and retail trade; repair of motor vehicles and motorcycles, 193 entities,
- Manufacturing industry, 97 entities, and
- Transport and storage, 49 entities.

Of the other sectors of activity, active business entities in the municipality of Vinica are also registered in the sectors: agriculture, forestry and fisheries; mining and quarrying; water supply; waste water disposal, waste management; remediation of the environment; construction; accommodation facilities and food service activities; information and communications; professional, scientific and technical activities; education; health and social care activities; art, entertainment and recreation and other service activities.

I.2.1 Housing

According to the latest official census of the population and households in the Republic of Macedonia, 19,938 inhabitants live on the territory of the municipality of Vinica, ie 46.1 inh /km2, which points to the fact that the municipality is sparsely populated with much lower density than the population density in Macedonia, which in 2002 was 78.6 inh / km2.

The majority of the population lives in the municipal center Vinica, 10,860 inhabitants or 54.5%, while 27.2% live in the four largest settlements Blatec (1.594 inhabitants), Istibanja (1.476 inhabitants), Gradec (1.245 inhabitants) and Jakimovo (1.101 citizens). In the remaining eleven settlements, live 18.3% of the inhabitants: Vinica Krishla 99, Grljani 206, Dragobrashte 392, Kalimanci 239, Krushevo 131, Laki 314, Leski 579, Lipetz 430, Pekljani 432, Trsino 73, Crn Kamen 107.

I.2.2 Traffic in the municipality of Vinica

The municipality of Vinica, with its location in the central part of eastern Macedonia, objectively has a favorable geographical position. Through the municipality, in its northern part, crosses the main road M-5 (Kocani-Delcevo-Bulgaria), which connects the regional road P-527 (Prevalec-Vinica-Smojmirovo), which passes through the municipal center. These two road routes enable the municipality easy and quick communication with the rest of the country.

Vinica is 44 km away from Berovo, 44 km from Pehcevo, 10 km from Kocani, 40 km from Shtip, eastern Prevalec is 19 km away from Makedonska Kamenica, from Delcevo 42 km, and Vinica is 130 km away from Skopje. The international road to Bulgaria passes through Vinica and Delcevo, and through Kocani, Shtip and Veles exits on the highway Skopje - Gevgelija.

Due to the central location, the city of Vinica, as a municipal center, is practically directly connected with all the settlements in the municipality, with a network of local roads, which is well developed, but with poorer quality. From a total of 118 km local road network in the municipality, only 42 km are asphalted, while 51 km are earthy roads, and 25 km are impassable.

I.2.3 Waste management in the municipality of Vinica

Waste management in the municipality of Vinica is in the authority of JPKD Solidarnost from Vinica. The waste collected by JPKD Solidarnost is deposited at the municipal waste landfill with an area of 7.320 m2, near the settlement Leski, which is 2 km away from the city of Vinica. The landfill is managed by JPKD Solidarnost upon previously obtained consent from the Ministry of Environment and Physical Planning of the Republic of Macedonia.

For the industrial waste, there are no capacities that create hazardous waste in the municipality, ie there is no heavy industry. In the municipality, the small economy has been developed, so the waste

from the industry does not have hazardous waste characteristics and is stored in the same place with the municipal waste.

The municipality has a special landfill for extinct animals, so the disposal of extinct animals is carried out in a separate pit that is constantly covered with lime and soil.

In addition to the city of Vinica, the service is also performed in the rural parts of the municipality (village of Jakimovo, village Gradec, village Leski, village of Istibanje, settlement Gradec, village Dragobrashte and Blatec), which covers 68.7% of the population in Vinica. Within the municipality there is a registered weekend - settlement Gorna Osojnica where the municipality has organized a collection of communal waste.

In the municipality in the initial phase, waste is selected, ie a system for selecting specific types of waste is established in accordance with the legal provisions. In 2012, Vinica Municipality signed a contract with an authorized entity Eko Pak Hit from Kocani for selection and processing of five packaging and paper. The selection is carried out in special latticed containers placed in several locations in the city, which in the future is planned to be increased and placed in several locations in the city.

Although there is some progress, however, the fact remains that in the forthcoming period there will have to be seriously addressed the problem of the emergence of so-called illegal landfills, which have a major impact on human health, air quality, surface and groundwater, such as in the degradation of the land, and thus it has an impact on the overall quality of life in the municipality.

The Municipality of Vinica is part of the East Planning Region, and the future solution to the problem of waste management will be in accordance with the guidelines given in the National Waste Management Strategy.

From the aforementioned it follows that the waste situation on the territory of the Municipality of Vinica is as follows:

- 68.7% of the population is not covered by organized collection of waste;
- There is inappropriate landfilling of municipal waste - illegal landfills
- Low level of education among the local population for proper waste treatment, ie for its disposal and selection
- There is an organized system for selection, recycling/reuse and processing of collected waste, but is in the initial phase

I.3 Municipality of Delcevo

The municipality of Delcevo is located in the far north-eastern part of the Republic of Macedonia, at the footer of the mountain Golak (Chavka 1524 m), right to the Bulgarian border at a distance of only 10 km. In the east it is enclosed with the Vlaina Mountain, to the north with the Osogovo and to the south with the Maleshevo Mountains. It is located in the valley of Pijanec and spread along the upper course of the river Bregalnica. The municipality with its wider surroundings extends to the following coordinates: 41º 58 'northern latitude and 22º 46' east longitude, at an altitude of 630 meters.

The climate is moderate - continental. In the south, the municipality of Delcevo borders the municipalities of Pehcevo and Berovo, to the west with the municipality of Vinica, to the northwest with the municipality of Makedonska Kamenica, and to the east and northeast with the Republic of Bulgaria. The municipality is an important link on the East Macedonian highway, which connects all major settlements in this part of the country, and further with parts of the territory of neighboring Bulgaria. Practically, Delcevo lies on a very important crossroads through which in the intermediate direction leads the shortest connection between the valley of the river Vardar from one, and the valley of the river Struma on the other side. Administratively speaking, the town of Delcevo is the seat of the municipality of Delcevo, which has 22 more inhabited places.

The relief in the municipality of Delcevo is complex and created by tectonic movements and is represented with 4 relief forms that differ in age, altitude, geological composition, hydrological conditions, vegetation and various soils. It is mostly hilly - mountainous, and the lowland parts are mainly outspread along the river Bregalnica. The relief in the municipality is with the following structure: lowland (600 - 750m) - along the course of the river Bregalnica and the lower currents of its tributaries; hilly - mountainous (750 - 900m) - the eastern and northeastern part of the municipality; mountainous - (over 900m) - west of the river Bregalnica, the mountains of Obozna and Golak. According to the pedological map, 12 separate soil types are separated in the municipality of Delcevo.

The main water artery of the municipality of Delcevo is the river Bregalnica, which with a total length of 225 km and the total area of the confluence of 4315.5 km2 is the largest tributary of the river Vardar. In the drainage area of the river Bregalnica, the municipality of Delcevo participates with 100% of its territory, ie all 423 km2 belong to the basin of the river Bregalnica, directly through the immediate basin of the river or through the drainage areas of its tributaries.

Right tributaries of the river Bregalnica on the territory of the municipality of Delcevo with a drainage area greater than 10 km2 are: Zvegorska Reka (12.5 km2), Grashtica (23.3 km2), Ochipalska river (31.6 km2), Gabrovchica (34.0 km2), Zelevitsa 110.1 km2), while the left tributaries are: Loshana (15,9 km2) and Biglanska River (21,2 km2). Also, the hilly mountainous setting of the municipality allows formation of a large number of mountain watercourses, with small drainage areas and short lenghts which during the summer period dry up.

An important potential hydrographic object in the municipality is the Loshana dam, with volume of 1 400 000 m3 of water, at the village Razlovci, which is in the final phase and from this year will start its filling. This accumulation will mainly be used to completely solve the problem of water supply in the municipality of Delcevo, and part for irrigation of the Delcevo field (300 ha).

Another important built-up hydrographic object in the municipality is the accumulation Petrashevec with a volume of 180 000 m3 of water, which is used for irrigation of arable areas downstream of the dam.

Local self-government is the main carrier of the economic development of the municipality, pointing out the economic needs for faster economic development, attracting new and preserving permanent businesses.

Industry has the dominant place in the economic development of the municipality, followed by agriculture and construction, with the emphasis on the tertiary sector (trade, catering and small economy).

Types of business entities	total:	342
Enterprises		40
Trading Associations		28
DOO		35
Merchant individual		74
DOOEL		130
The rest		35

Sectors of activity	
Agriculture	18
Manufacturing factory	46
Construction	3
Wholesale and retail trade	211
Hotels and reastaurants	9
Financial intermediation	3
Education	4
Health and social work	14
Traffic and transport	9
Citizen associations	20
Public institutions	5

The economic activity is mostly realized in Delcevo, which causes incompatibility in the development of the entire territory of the municipality. In the existing industry, processing capacities from the light industry prevail, where the textile, leather and tobacco industry, as well as the wood processing industry, have a leading place.

I.3.1 Housing

According to the latest census of the population, households and apartments in the Republic of Macedonia (2004), there are a total of 17,505 inhabitants in the municipality of Delcevo, distributed in 5,568 households and 7,163 apartments.

On the territory of the municipality of Delcevo there are 17.713 inhabitants. In the municipality of Delcevo there are 22 settlements: the municipality center of Delcevo and the settlements: Bigla, Vetren, Virche, Vratislavci, Gabrovo, Grad, Dramche, Dzvegor, Iliovo, Kiselica, Kosovo Dabje, Nov Istevnik, Ochipala, Poleto, Razlovci, Selnik , Stamer, Star Istvnik, Trabotiviste, Turija and Liflik.

Table 3. The populated places and the number of inhabitants in them.

Table 3.

Populated place	Number of inhabitants
Delcevo	11536
Bigla	275
Vetren	114
Virche	494
Vratislavci	36
Gabrovo	799
Grad	529
Dramche	277
Dzvegor	882
Iliovo	127
Kiselica	35
Kosovo Dabje	21
Nov Istevnik	138
Ochipala	92
Poleto	194
Razlovci	831
Selnik	27
Star Istevnik	67
Trabotivishte	530
Turija	103
Liflik	53
Stamer	345
Total	17505

I.3.2 Traffic in the municipality of Delcevo

On the territory of the municipality crosses the A3/M5 National Road, which connects the municipality with the Republic of Bulgaria. With the traffic system of the state, the municipality is connected through several regional roads:

- The main road A3 (Crossroads Trebenishte (connection with A2) - crossroads Podmolje - Ohrid - Kosel - Resen - Bitola - Prilep - Veles - Shtip - Kocani - Delcevo - Bulgaria;
- P1302 Delcevo (connection with A3) - Pehcevo - Berovo - Dabile (connection with A4)
- P2341 Delcevo (connection with A3) - Gabrovo - border crossing with the Republic of Bulgaria;
- P2343 Delcevo (link to A3) - Golak
- P2345 connection with A3 - Bigla - Trsino - connection with P1304
- P2346 Trabotivishte (connection with P1302) - Razlovci - Mitrashinci (link to P1304)

- The main road A3 from the border crossing - Delcevo, M. Kamenica, Kocani and further Shtip
- R2345 connects Delcevo with Vinica, through village Bigla
- R2343 Delcevo - mountain Golak
- R1302 Delcevo - Berovo

In Delcevo, public transport of passengers and goods uses road transport. The bus station, which is privately owned, operates and performs its function.

The city transport in the municipality of Delcevo is carried out by 11 licensed carriers with minibuses and vans, which provide transport to the villages, as well as transport of students. There are four licensed taxi companies in the municipality and dozens of licensed individual taxi carriers.

City transport in the municipality of Delcevo is performed on the basis of 6 permits for certain lines, and it is carried out by 4 carriers with minibuses and vans. The transportation of students and employees in the larger legal entities in the municipality is done with permits for separate transport of passengers, which provide transport to the villages, as well as the transport of students.

I.4 Municipality of Pehcevo

In the Eastern part of the Republic of Macedonia, in the Malesevo valley, ie. in its north-eastern part, on the border with R. Bulgaria, is the municipality of Pehcevo. The municipality with its wider surroundings lies between 41˚ 41˚ and 41˚ 51˚ north latitude and 22˚ 47˚ and 23˚ 03˚ east longitude, with an average altitude of 1000 meters.

It is located in the far eastern part of the country, along the border with Bulgaria. In fact, the most eastern point of the municipality, at the peak Chengino Kale (1745 m) is the most eastern point of the Republic of Macedonia. Otherwise, the municipality of Pehcevo is situated on the elevation between Berovo and Delcevo Kotlina, at an altitude of about 700 to 1932 meters. To the west it is enclosed with the low mountain Bejaz Tepe (1348 m), and to the east with Vlaina (Kadića, 1932 m), which is the second highest in the eastern part of Macedonia (just behind the Osogovo Mountains, 2252 m). In the southeast it is enclosed with the highest part of the Maleshevski Mountains (Dzami Tepe, 1803 m). Administratively, the municipality of Pehcevo borders the municipality of Berovo in the south and the municipality of Delcevo in the north and in the east with the municipality of Simitli in Bulgaria.

On the area of 206,88 km2, there are 5,517 inhabitants, most of them in the municipality center Pehcevo (3,237 inhabitants), and the rest in the other six rural settlements: Negrevo (170 inhabitants), Chiflik (362 inhabitants), Umlena (391 inhabitants), Robovo (470 inhabitants), Crnik (752 inhabitants) and Pancharevo (467 inhabitants), which fall into the category hilly and mountainous villages.

Regarding the natural features, regardless of the small area, the municipality of Pehcevo is quite interesting and diverse. From geological point of view, this space is built of rocks of different ages, from the oldest pre-Cambium rocks (gneisses), through younger Paleozoic rocks (shales, granites), to the youngest pliocene, prouvial, deluvial, alluvial sediments and other modern sediments that occupy almost 70 % of the surface. On the territory of the municipality, under the top Kadiji, copper ore deposits are found (about 70 million tons and a concentration of 0.2%), which will soon be exploited. Near the villages Pancharevo and Crnik, there are certain reserves of coal.

The Municipality of Pehcevo has 6,775 ha of high quality forest wealth. Vegetation, most of the municipality of Pehcevo is covered with deciduous, coniferous and mixed forests. In the spring of Bregalnica, dense natural complexes of beech, pine and fir forests are represented, which is a rarity for the eastern part of Macedonia. In addition to forests, large area is covered by pastures, and more endemic plants occur.

On the territory of the municipality of Pehcevo there are dozens of weak, but cold, low-mineral springs. Some of them are for fountains and for water supply. The most important hydrographic object, beside the river Bregalnica, is the Pehchevska River which springs below the peak Kadiica at an altitude of 1,560 m. The river network consists of about 100 watercourses (with a total length of 540 km), mainly periodic or occasional and with a porous character. The longest watercourses (longer than 10 km) on the territory of the municipality are: Bregalnica, Zhelevica, Pehchevska Reka, Pancarevska Reka and others. In the course of heavy rainfall, torrential watercourses cause spillage from the river bed, floods, erosion and accumulations of the deposited material, and in this respect, Zelevica is especially characteristic. Pehchevska Reka, which was once problematic, in the second half of the last century is very well regulated especially through the town of Pehcevo. On the territory of the municipality there are no lakes, except larger puddles in the highest parts of the Maleshevo Mountains near Chengino Kale.

According to the data of the State Statistical Office, as of December 31, 2011, a total of 199 active business entities were registered in the Municipality of Pehcevo. The largest number of active business entities were in the sectors:

- Wholesale and retail trade; repair of motor vehicles and motorcycles, 54 entities,
- Manufacturing industry, 51 entities, and
- Agriculture, forestry and fishing, 36 entities.

Out of the other sectors of activity, active business entities are registered in the Municipality of Pehčevo and in the sectors: water supply; waste water disposal, waste management; environmental protection, Civil engineering, Transportation and storage, Accommodation and food service activities, Information and communication, Professional, scientific and technical activities, Education, Health and social activities, Art, entertainment and recreation, Other service activities.

Most of these active business entities, according to their size, fall into the category of micro entities, while only one subject belongs to the category of large business entities. On the other hand, the total number of active business entities is changing from year to year, with tendency of increasing the number of micro entities and reducing the number of small entities.

A) Production activities and firms covered by Elaborates and ISKZ:

- **Production activities and firms covered by elaborates:**

1. "JM Inzenering" DOOEL import-export Pehcevo - in 2010;
2. "Agro - Millenium", v. Negrevo - Pehcevo - in 2012;
3. DPTT "Natasha DOOEL Milk - Berovo - in 2012;
4. EMK DOOEL Small Hydro Power Plants - Skopje - 325, 327 - 2012;
5. DOOEL "Mivabo" - Pehcevo - 2013;
6. TDPRGP "Stella" DOOEL - Pehcevo - 2013;
7. TDVIL for PTU "Ceko - Fam", Nadica DOOEL import - export - Pehcevo - 2013;
8. "DRVOMAK" DOOEL - Pehcevo, 2013;
9. DPMDGT "Ino Slaj"
10. DPU "Progres" AD - Pehcevo - 2013;
11. "3 - ASA" - Pehcevo - 2013;
12. DIK "Fagus" DOOEL, Pehcevo - 2013;
13. SZD Auto Service Koce Kostadin Shumanski - Pehcevo - 2013;
14. TPDMD "Drvoprodukt" DOOEL - Pehcevo - 2013;
15. SZD "Mitko Dimitar" - Pehcevo - 2013;
16. TDUTU "Viktoria Peh" DOOEL - Pehcevo - 2015;
17. "Risto" DOOEL import-export - Pehcevo - 2015;
18. "Gavrilcho" DOOEL - Pehcevo - 2015;

- **Manufacturing and IPPC-covered businesses:**

1. B - integrated permit "Nova refraktori" DOO - Pehcevo;

I.4.1 Housing

In the municipality of Pehcevo there are 1004 households, while in the villages belonging to the municipality of Pehcevo the number of households is as follows: the village of Robovo -155; village Umlena - 139; village Chiflik - 118; village of Crnik - 229; village Negrevo - 86; village Pancharevo - 62 households.

The ratio and movement of the population, households and dwellings over the years is presented in the following table:

Table 4.

Settlement	Population				Households				Dwellings			
	1961	1971	1981	2002	1961	1971	1981	2002	1961	1971	1981	2002
Total	6000	5773	5859	5517	1390	1486	1637	2026	/	1315	1674	2877
Pehcevo	1827	1878	2440	3237	512	538	722	1126	/	500	806	1623
Negrevo	441	356	270	97	105	93	96	53	/	81	89	118
Pancharevo	973	877	707	375	164	194	179	143	/	167	182	184
Robovo	713	656	580	427	159	175	157	190	/	150	133	280
Umlena	643	593	520	354	132	152	140	155	/	123	128	190
Crnik	978	946	928	707	208	207	226	242	/	176	231	304
Chiflik	493	445	411	320	110	127	117	117	/	118	105	178
Urban population	1827	1878	2440	3237	512	538	722	1126	/	500	806	1623
Rural population	4173	3895	3419	2280	878	948	915	900	/	815	868	1254

I.4.2 Traffic in the municipality of Pehcevo

Within the Republic and the other administrative, economic and cultural centers, Pehcevo municipality communicates through two regional road routes:

- P-527- Berovo-Vinica-Kocani;
- P-523- Delcevo-Pehcevo-Berovo-Strumica.

In a way of communication it is well connected with the regional roads to Delcevo, Berovo and Vinica (Kocani), and the distance from Skopje is 170 km or 2.5 hours. Also, there are asphalt roads to each village in the municipality, then to the tourist site Ravna Reka and other localities. The total road network in the municipality of Pehcevo is over 150 km.

The local road network in the municipality, ie the connection of the administrative center (Pehcevo) with the rural settlements, is well developed and it extends over a total length of 104.1 km. Of that, 30.1 km are under asphalt, and 72 km are still with earthen substrate. Accordingly, the density of the local road network is 0.5 km1 / km2, which is 25% more than the average density of the local road network in Macedonia.

The secondary street network in the town of Pehcevo and in the rural settlements has a total length of 23.1 km, of which 14.6 km are asphalted streets, while 5.4 km are only composed surfaces. Additionally, 1,600 square meters of sidewalks have been built in the town of Pehcevo with a modern base (behaton tiles).

There is no bus station for organized public transport in the municipality of Pehcevo, but there are several regular lines from the Berovo - Trans - Berovo bus station that pass through the municipality of Pehcevo and there is also organized transport by Berovo - Trans - Berovo for all students and employees travel, twice every working day.

I.4.3 Energetics

a) Method of heating in households

All households on the territory of the municipality of Pehcevo are heated on wood and some families individually have installed heating in the same way on wood.

b) The mode of heating in the industry

The largest number of industrial buildings on the territory of the municipality of Pehcevo are heated on wood, while only a small part of them are using oil.

c) Method of heating in the state institutions

- Administrative building of the municipality of Pehcevo - installed system for central heating with boiler on wood;
- Public enterprise for service activities "Raven" - Pehcevo - with a stove on wood;
- Public utility company "Komunalec" - Pehcevo - with stoves on wood;
- Municipal elementary school "Vancho Kitanov" - Pehcevo - installed combined heating system with one boiler on wood and one boiler on oil;
- Sports hall "Jane Sandanski" - Pehcevo - installed system for heating on wood;
- Municipal High School "Aco Ruskovski" - Berovo, dispersed classes - Pehcevo - installed combined heating system with one boiler on wood and one boiler on oil (this building is connected to the same heating system from the Municipal Primary School "Vancho Kitanov" - Pehcevo);
- Municipal institution kindergarten "7 Septemvri" - Pehcevo - installed system for pellet heating (two boilers of pellets) and, if necessary, the old boiler on oil is used;
- Municipal Institution Primary Library "Kocho Racin" - Pehcevo - with a wood stove;
- Municipal institution Cultural Center "Jane Sandanski" - Pehcevo - installed system for central heating with one boiler on wood;
- Public enterprise Macedonian forests "Ravna Reka" - Pehcevo;
- Public health institution "Zdraven dom" - Pehcevov - installed system for central heating on wood connected to the heating system of the private factory DIK "Fagus" - Pehcevo;
- Border Police - Pehcevo - with a stove on wood;
- Administration for keeping registers - Pehcevo - with stove on wood;
- Office of the Regional Department of the Health Insurance Fund - installed system for central heating with boiler on wood (premises in the municipal building);
- Office of the Regional Department of the Ministry of Labor and Social Policy - installed system for central heating with boiler on wood (premises in the municipal building);
- Office of the Regional Department of the Ministry of Agriculture, Forestry and Water Supply - installed system for central heating with boiler on wood (premises in the municipal building);

- Office of the Regional Employment Agency - installed a system for central heating with boiler on wood (premises in the municipal building).

IMPLEMENTED AND PLANNED PROJECTS FOR ENERGY EFFICIENCY

a) Energy efficiency projects implemented

- Installation of thermostatic valves in the municipal building in Pehcevo;
- Installation of thermostatic valves in Primary School "Vancho Kitanov" - Pehcevo;
- Installation of thermostatic valves in the sports hall "Jane Sandanski" - Pehcevo;
- Installation of thermostatic valves in the "7 September" - Pehcevo;
- Installation of thermostatic valves in the primary school "Jane Sandanski" - Pehcevo and the primary school "Koco Racin" - Pehcevo;
- Installation of a central heating system in the primary school "Jane Sandanski" - Pehcevo and the primary school "Koco Racin" - Pehcevo;
- Construction of a boiler room at the Primary School "Jane Sandanski" - Pehcevo and supply of a boiler for central heating;
- Changing the unchanged windows in the Primary School "Jane Sandanski" - Pehcevo;
- Thermal insulation facade of the primary school "Jane Sandanski" - Pehcevo and the primary school "Koco Racin" - Pehcevo;
- Thermal insulation facade of the Municipal building of the municipality of Pehcevo;
- Changing windows in the Municipal building of the Municipality of Pehcevo;
- Installation of thermal insulation on the roof of the municipal building of the Municipality of Pehcevo;
- Replacement of Hg with Na light bulbs;
- Lofting of a boiler room and replacement of the boiler on oil with two boilers on pellets in OJUDG "7 September" - Pehcevo.

b) Energy efficiency projects planned

- Replacement of windows and doors in the POU "Vancho Kitanov" - v. Pancharevo - Pehcevo;
- Thermal insulation of the outer walls of the POU "VancHo Kitanov" - v. Robovo - Pehcevo;
- Thermal insulation of the outer walls of the POU "Vanco Kitanov" - v. Umlena - Pehcevo;
- Changing the outdoor lighting with LED in the OJUGD "7 September" - Pehcevo;
- Thermal insulation of roofs in the OJUGD "7 September" - v. Chiflik - Pehcevo;
- Reconstruction and isolation of the roof of the public utility "Komunalec" - Pehcevo;
- Thermal insulation of outer walls of PUC "Komunalec" - Pehcevo;

- Modernization of outdoor lighting in the sports hall "Jane Sandanski" - Pehcevo;
- Thermal insulation of the roof of the POU "Vancho Kitanov" - v. Pancharevo - Pehcevo;
- Installation of thermostatic valves in the POU "Vancho Kitanov" - v. Crnik - Pehcevo;
- Modernization of part of the interior lighting of the elementary school "Vancho Kitanov" - Pehcevo;
- Modernization of the interior lighting in the elementary school "Vancho Kitanov" - v. Robovo - Pehcevo;
- Thermal insulation of the outer walls of OJUDG "7 September" - Pehcevo;
- Partial replacement of windows and doors in the elementary school "Jane Sandanski" Cultural Center - Pehcevo;
- Replacement of windows and doors in JKP "Komunalec" - Pehcevo.

II Ambient air quality

Air pollution is a complex problem that poses multiple side challenges in managing and reducing pollution. An effective action to reduce air pollution requires a good study of the sources that cause the same, as well as all the knowledge about the status of air quality to this day and its impact on people and ecosystems.

Air pollution takes the first place in the list of risk factors for human health today. It is not only an environmental problem, but a social problem that leads to adverse effects on human health, ecosystems, the environment and climate. Air pollutants are emitted from anthropogenic and natural sources, but can be transported, but also formed during long-distance transport. Some pollutants are retained in the air for an extended period of time and can accumulate in the environment and in the food chain, and thus have a negative impact on humans and animals, not only through air intake, but also through water and food intake.

The assessment of ambient air quality status is based on measurements of parameters in ambient air and linking data with anthropogenic emissions and their trends.

Cities in the East Planning Region monitor and apply the conclusions from the current analysis that indicate that ambient air quality policies in Europe have brought many improvements. In that direction, it is still working to reduce emissions and improve the ambient air quality in the region.

II.1 Law on ambient air quality

II.1.1 Review of EU air quality directives

European Union legislation on ambient air quality consists essentially of Directives 2008/50/EC and 2004/107/EC. The Ambient Air Quality and Cleaner Air Quality Directive in Europe (CAFE) (2008/50/EC) was published in May 2008. It replaced the Framework Directives and the first, second and third directive. The fourth directive (2004/107/EC) at a later stage will be included in the CAFE Directive.

Directive 2008/50/EC consolidates in one place most of the previous directives into a single Directive, setting new air quality targets for PM2.5 (fine particles), without changing existing indicators. This Directive is the main reference for the assessment of the ambient air quality in the EU Member States on the basis of common methods and criteria. In addition, various objectives for protection (human health, ecosystems, vegetation) are defined by the legislation. In accordance with the general goals of this document, more detailed information regarding the standards for protection of human health is given.

In accordance with Directive 2008/50/EC, Member States will establish zones and agglomerations in their territories. The assessment of air quality and air quality management will be carried out in each zone and agglomeration. The quality of air in each zone is assessed and classified in relation to the upper and lower assessment thresholds, defined for each pollutant. In all zones and agglomerations where the level of pollutants exceeds the lower assessment threshold for those pollutants, at least fixed measurements shall be used to assess ambient air quality.

The air quality limit values for the protection of human health are established for sulfur dioxide, nitrogen dioxide, lead, arsenic, nickel, cadmium, PM10, PM2.5 carbon monoxide, ozone and benzene.

II.1.2 National legislation on ambient air quality

The Ministry of Environment and Physical Planning (MEPP) has drafted the Ambient Air Quality Framework Law (Official Gazette 67/04, 92/07, 35/10, 47/11, 59/12, 100/12 and 163/13) in accordance with the old framework directive 96/62Ec for the assessment and management of ambient air quality, and adopted several amendments to the law in accordance with the 2008/50/EC Directive on ambient air quality and cleaner air in Europe (the so-called CAFE Directive). So far, several

bylaws have been developed and adopted in accordance with the EU regulations and this process is still ongoing.

The Regulation on limit values for the levels and type of pollutants in ambient air and alert thresholds, the conditions for achieving target values, tolerance margins, target values and long-term objectives was developed in accordance with the former framework directive and the first three directives. The limit values for sulfur dioxide, PM10, lead, carbon monoxide, nitrogen dioxide, benzene and PM2.5 are transposed into the existing Decree. Amendments to the Regulation are made with the PM2.5 limit values specified in Directive 2008/50/EC and the heavy metal limit values specified in the Heavy Metal Directive 2004/107/EC.

In Table 5 a list of all legal regulations in Macedonia related to this area is given.

Table 5. Legal regulations in the field of environment and air quality

No.	Legal regulations	Official Gazette of RM No./year
Laws		
1	Law on environment	53/2005; 81/2005; 24/2007; 159/2008; 83/2009; 48/2010; 124/2010; 51/2011; 123/2012; 93/2013; 44/2015
2	Law on Ambient Air Quality	67/2004; 92/2007; 35/2010; 47/2011; 100/2012; 163/2013
Rules and regulations on air emissions		
1	Rulebook for methods, manner and METHODOLOGY FOR AIR EMISSIONS MEASUREMENTS from stationary sources	11/2012
2	Decree for determination of the combustion INSTALLATIONS which should TAKE MEASURES FOR PROTECTION OF AMBIENT AIR from the pollution, THROUGH REDUCING EMISSIONS of some pollutants into the air	112/2011
3	Rulebook on the form and the content of the forms for submitting data for emissions in the ambient air from stationary sources, the manner and time period of data delivering, according to the capacity of the installation, the content and manner of keeping DIARY FOR EMISSIONS in the ambient air	79/2011
4	Rulebook on the amounts of EMISSION CEILINGS of polluting substances for the purpose of setting projections for a certain period concerning the polluting substances emission reduction at annual level	2/2010
5	Rulebook on the LIMIT VALUES OF PERMISSIBLE LEVELS OF EMISSIONS and types of polluting substances in waste gases and vapors released FROM STATIONARY SOURCES into the air	141/2010
6	Rulebook on INVENTORY and DETERMINATION OF THE LEVELS OF THE POLLUTANT EMISSIONS in the ambient air in tones per year, for all types of duties, as well as other data needed for submission of the Program for monitoring the air in Europe (EMEP)	142/07

Regulations, decrees and instructions regarding ambient air quality		
1	Rulebook on the equipment, devices, instruments and appropriate facilities requirements for ENTITIES PERFORMING professional matters for ambient AIR QUALITY MONITORING	69/2011
2	Rulebook on the contents and the manner of TRANSMISSION OF DATA AND INFORMATION on the status of the ambient air quality management	138/2009
3	Rulebook of METHODOLOGY FOR MONITORING OF AMBIENT AIR QUALITY	138/2009
4	Rulebook on CRITERIA, METHODS AND PROCEDURES FOR ASSESSMENT OF THE AMBIENT AIR QUALITY	82/06, 169/13
5	Decree on LIMIT AND TARGET VALUES for levels and type of pollutants in the ambient air, ALERT AND INFORMATION THRESHOLDS; deadlines for achieving limit and target values for specific substances; MARGINS OF TOLERANCE for limit value and target value and long term objectives for specific pollutants	50/05, 4/13
6	Guidance on the application of the Regulation on limit values of levels and types of pollutants in ambient air and alert thresholds, deadlines for achieving limit values, margins of tolerance for the limit values, target values and long-term goals	4/13
Regulations regarding the drafting of plans and programs		
1	Rulebook on content and manner for preparation of PROGRAMS FOR AIR IMPROVEMENT AND PROTECTION	108/2009
2	Rulebook on content and manner for preparation of ACTION PLANS FOR AIR PROTECTION	108/2009
3	Rulebook on content and manner for preparation of NATIONAL PLAN ON AIR PROTECTION	108/2009

The limit values given in the Macedonian legislation for measuring parameters in the ambient air are listed in Table 6.

Table 6. Limit values given in the Macedonian legislation for measuring parameters in the ambient air

Limit values for health protection			
POLLUTANTS	**Period of:**	**Limit Values**	**Allowed number of exceedances per year**
Sulfur dioxide SO_2	1 hour 24 hours	350 μg/m^3 125 μg/m^3	24 3
Nitrogen dioxide NO_2	1 hour 1 year	200 μg/m^3 40 μg/m^3	18 -
Suspended particles PM10	24 hours 1 year	50 μg/m^3 40 μg/m^3	35 -
Suspended particles PM2.5	1 year*	25 μg/m^3 20 μg/m^3	-
Carbon monoxide CO	Maximum daily value 8 x average value	10 mg/m^3	-

Critical levels for the protection of vegetation			
Sulfur dioxide SO_2	1 year - winter	20 µg/m^3	-
Nitrogen oxides NOx	1 year	40 µg/m^3	-
NOTE - The critical levels for vegetation protection is valid for rural agricultural and forest areas and are specified for protection from the effects of pollution on the trees, other plants and ecosystems.			
Thresholds of informing and alerting			
Ozone O_3	1 year	180 µg/m^3 - informing	-
Ozone O_3	3 consecutive hours	240 µg/m^3 alarming	-
Sulfur dioxide SO_2	3 consecutive hours	500 µg/m^3 alarming	-
Nitrogen dioxide NO_2	3 consecutive hours	400 µg/m^3 alarming	-
Suspended particles PM10	5 consecutive days[2]	>50 µg/m^3 informing	-
	10 consecutive days[1]	>100 µg/m^3 alarming	-

* - the closing date to the limit value for particulate matter $PM_{2.5}$ is 2020/2025

Index of air quality

The index of air quality is used to simply describe air quality trought a colour scheme that is easily understandable. It is based on hourly values of the concentrations of pollutants, and provides characterization of air quality.

Index takes into consideration the concentration of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter (PM_{10}), fine particles ($PM_{2,5}$), ozone (O_3) and carbon monoxide (CO). The measured concentrations are compared with existing guidelines for air quality.

This index for air quality is developed through joint information on air quality in Europe (CITEAIR), projects funded by the European Union (http://www.airqualitynow.eu/index.php). The colour scheme correspondents with levels of concentration.

Color codes corresponding to the concentration levels.

	SO_2	NO_2	PM_{10}	$PM_{2.5}$	O_3	CO*
Very high	500-	400-	100-	60-	240-	20-
High	350-500	200-400	50-100	30-60	180-240	10-20
Medium	100-350	100-200	30-50	20-30	120-180	7.5-10
Low	50-100	50-100	15-30	10-20	60-120	5-7.5
Very low	0-50	0-50	0-15	0-10	0-60	0-5

*- the concentrations are given in µg/m^3 except for CO where are given as mg/m^3

II.2 Sources of harmful effects and their impact on the environment

Air pollution occurs in many forms, but generally refers to pollutants in gas and solid state that are present in the earth's atmosphere. Gas pollutants include sulfur dioxide, nitrogen oxides, ozone, carbon monoxide, volatile organic compounds, hydrogen sulphide, fluoride and various gas forms of metals. Polluters are corrosive to different materials and can cause damage to the cultural heritage, can negatively affect ecosystems and organisms, aggravate respiratory diseases and cause new and also reduce visibility. These pollutants can be emitted from 4 different sources:

1. Mobile sources (vehicles, buses, airplanes, trucks and trains)
2. Stationary sources (energy generating plants, oil refineries, industrial plants and factories)
3. Surface sources (agricultural areas, cities and fires)
4. Natural springs (dust carried by wind, forest fires and volcanoes)

The contribution of each of the sources of pollution to the local population depends on the type and number of local industrial processes, the density and age of road transport and local climatic conditions.

Mobile sources can make up to half of the total air pollution. Stationary sources emit large amounts of pollution from one location and therefore are still known as point sources of pollution. Large areas as sources of pollution consist of several smaller sources of pollution that summarily emit large quantities of air pollutants. Natural sources can sometimes be significant, but they usually do not cause problems continuously with air pollution like other sources.

II.2.1 Classification of sources of ambient air pollution

Data on emission sources can be extracted from:

a) Emissions inventory according to the CORINAIR (CoR Inventory for Air Emission) methodology by sector and activity; and

b) Database of the Cadastre polluters (by individual business entity).

By applying the CORINAIR methodology and using the Selected Nomenclature of Air Pollution (SNAP), the nomenclature of air pollution is classified according to sectors and activities.

The data taken from the Cadastre are presented according to the national methodology for identification of pollutants and the polluting substances and can not be guaranteed to be compatible with the EU methodology.

a) Emissions inventory according to CORINAIR

In the framework of the Convention on Long-Range Transboundary Air Pollution, the inventory of pollutants in the air has been established under the CORINAIR Program, which has been applied in the Republic of Macedonia since 2005.

This program has developed a unique nomenclature and methodology (SNAP) for displaying the quantities of the basic pollutants: sulfur dioxide, nitrogen oxides, carbon monoxide and total suspended particles within eleven sectors, which are listed in Table 7.

Table 7. SNAP nomenclature

SNAP sector	Name
1	Combustion and transformation of energy in electro energetic objects
2	Non-industrial combustion plants
3	Combustion in the manufacturing industry
4	Production processes
5	Extraction and distribution of fossil fuels and geothermal energy
6	Use of solvents and other products
7	Road traffic
8	Other mobile sources and machines
9	Treatment of waste
10	Agriculture
11	Other sources and absorbents

b) Emission inventory according to the Cadastre of Pollutants

The first Cadastre for Air was established in 2005 and contains emissions of pollutants in the air since 2004. This cadastre has been updated and upgraded in 2009. This report also presents data on the 2009 emissions of large stationary sources from the Cadastre database.

The presented data in the Cadastre refer to 84 municipalities in the Republic of Macedonia, organized in 8 statistical regions, and cover the following measured pollutants according to the characteristics of the source: CO_2, NO_X, CO, VOC and TSP.

The Cadastre shows the total emissions of pollutants in the air from the following sources:

- Stationary sources

The Cadastre database contains data on 1660 registered business entities that release pollutants in the air, out of which 1042 perform non-manufacturing activities (for example, schools, hospitals, etc.), and 618 perform production activities (production of heat and electricity, mining, etc.). 2758 registered discharges from all recorded stationary sources emit emissions of pollutants in the air.

- Mobile sources (traffic)

Road traffic is one of the largest mobile sources of air pollution. The remaining mobile sources (railway traffic, air traffic and waterways) are negligible compared to the total air pollution from mobile sources.

- Diffuse sources

Sources of diffusive emissions are transport, handling, loading, unloading into open warehouses, gas stations where a leakage of pollutants into solid, liquid or gaseous state or evaporation from certain parts of equipment (ventilation pumps, valves, etc.) can occur.

III The impacts of the quality of the ambient air on the human health and the environment

III.1 PM_{10} particles

Suspended particles are a complex heterogeneous mixture of solid and liquid particles that differ in size, shape, color, chemical composition, physical characteristics and origin. Suspended particles in the ambient air are categorized according to their size, further more they represent one of the main sources for the reducing of the visibility.

The bigger particles with diameter bigger than 10 micrometers are classified as Total Suspended Particles (TSP). PM_{10} are rough particles with size of 10 μm, while $PM_{2.5}$ are so called fine particles with size smaller or equal to 2.5 μm.

The suspended particles, more widely known as aerosols, can be also categorized as primary and secondary suspended particles. The primary particles are emitted directly in the atmosphere (ex. from chimneys), while the secondary particles are formed in the atmosphere by oxidation and transformation of the emissions of the primary gaseous substances. The emissions of the gaseous substances which take part in the formation of the particles are known as precursors.

The suspended particles are a significant factor that has a major impact on human health. Prolonged exposure of humans to suspended particles can affect their health, because they can be inhaled and by doing so they can penetrate into the thoracic region of the respiratory tract and cause irritation of the nose and throat, lung damage, bronchitis, cardiovascular disease, and even death.

From a number of in vivi and in vitro case studies done on animals it can be concluded that individuals exposed to increased concentrations of PM particles have a bigger chance for developing chronic diseases of the respiratory tract, heart and lung damage.

Particles with an aerodynamic diameter of less than 2.5 μm ($PM_{2,5}$) are a dust fraction that enters the alveolar region of the lungs, that is, in the part where gas is exchanged.

According to epidemiological studies associated with PM_{10}, and especially with $PM_{2.5}$ that cause significant health problems, the exposure of these pollutants leads to: premature death, lung cancer, chronic obstructive respiratory disease, development of chronic lung disease, cardiac arrest, increased heart disease and lung disease, aggravation of the asthma, acute respiratory symptoms, decreased lung function, decreased immunity, premature births, and reduced weight in newborns. Particularly significant is the impact on the vulnerable categories of the population.

Mortality in cities with high levels of pollutants is also increasing in the relatively cleaner observed cities by 15-20%. Even in the EU, the average life expectancy is reduced by 8.6 months as a result of exposure to $PM_{2.5}$ produced by human activity.

III.2 Sulfur dioxide (SO_2)

Sulfur dioxide under standard conditions is a colorless, poisonous gas with sharp irritating odor, with pronounced acidic properties. Sources of sulfur dioxide emission, SO_2, can generally be divided into:

- Natural sources: volcanoes (immediate), biological sources (biological decomposition) from the oceans and the mainland (indirectly), etc.
- Anthropogenic sources: combustion of fossil fuels and biofuels containing sulfur, melting of sulphide ores of Cu, Zn and Pb, production of H_2SO_4, production of cellulose and paper, etc.

Studies have shown that the toxic effects of SO_2 on humans occur when its mass concentration in the air is of about 6 mg / m^3, resulting in bronchial problems, and at higher concentrations than 6 mg / m^3 more serious health problems occur. The effects of SO_2 on human health are manifested by an increased number of humans suffering from bronchitis, asthma, decreased lung function, aggravation of the respiratory tract and even lung cancer, it can also cause headaches, general discomfort and anxiety. SO_2 is also known as being highly toxic to the flora. In plants it can cause two kinds of damage, both acute and chronic. Sulfuric acid from the air can be transferred to the water systems by rain and lead to a change in the acidity of the waters.

Sulfur dioxide is one of the important precursors for acid rain that accelerates the corrosion of objects and monuments as well as the acidification of soil, lakes and streams. It also leads to reduced visibility.

III.3 Nitrogen oxides (NO_x)

Nitrogen dioxide is an orange gas, with a smell similar to the smell of the gas chlorine. When dissolved in water, by hydrolysis formation of nitrite and nitric acid occurs, i.e. an environment with highly acidic properties is obtained. NO_2 is a reactive gas that is mainly formed by the oxidation of nitrogen monoxide (NO).

As an air pollutant, NO_2 is the main source of nitrous aerosols, which form a significant fraction of $PM_{2.5}$ and in the presence of ultraviolet light, they form ozone. The main source of anthropogenic NO_2 emissions are the combustion processes (heating, energy generation, engines in vehicles and ships). Nitric oxide in the air can later be converted into nitric acid in acid rain. Also, NO and NO_2 are involved in reducing the ozone layer.

The content of nitrogen oxides in the air changes during the day, the season and the meteorological conditions. In the morning, with the intensification of traffic, the NO concentration increases. With the conversion of NO into NO_2, under the action of solar radiation, there is an increase in the concentration of NO_2 and a decrease in the NO concentration. At night, the concentration of the two oxides decreases. The relationship between NO and NO_2 changes with the time of year. Thus, in late autumn and winter the NO content is greater due to the reduced intensity of solar radiation. The amount of NOx increases during the winter period due to more intensive use of fossil fuels.

As for toxicity, NO_2 is four times more toxic than NO, with toxicity more pronounced at higher concentrations of nitrogen oxides, but over a longer period of time. Toxicity increases with the rise in temperature. By inhalation of polluted air, nitrogen oxides (NO and NO_2) easily enter the human lungs because they are characterized by low solubility.

Epidemiological studies show that the symptoms of bronchitis in asthmatic children grow along with long-term exposure to NO_2. The decrease of the pulmonary function is increasing and is associated with NO_2 concentrations in the air.

Nitrogen oxides also adversely affect vegetation. Young leaves are particularly sensitive, the growth of which may be impeded. Plants exposed to NO_2 have a reduction in their yields. Nitrogen oxides also adversely affect materials such as metals, textiles, colors and various additives.

III.4 Ozone (O_3)

The ozone is a gas with a specific odor and a higher reactive ability. It is present in the troposphere and the stratosphere. A small proportion of the amount of the tropospheric ozone occurs naturally, and the rest occurs as a result of anthropogenic factors.

Ozone is naturally occurring in the higher layers of the atmosphere, where it forms an ozone layer that is 20 km thick and located at a height of 25-30 km. In this part, the concentration of ozone is very high in contrast to the lower layers of the atmosphere (troposphere).

Higher concentrations of ground-level ozone O_3, formed by photochemical reactions involving NO_X, VOCs and other ozone precursors in the presence of sunlight can cause harmful effects in humans and the environment. These photochemical reactions usually occur during the hot summer months, as ultraviolet radiation from the sun initiates subsequent photochemical reactions. Ozone is also a key constituent of urban smog.

Higher concentrations of O_3 can be seen in places at high altitudes. Namely, in the ground layer and near NO_X emission sources (such as traffic in urban areas), O_3 concentrations are lower due to the conversion of NO into NO_2. Therefore, unlike other pollutants whose concentrations are higher in urban areas, higher O_3 concentrations are observed in rural areas**.**

Ozone in the air we breathe can be detrimental to our health, usually on warm, sunny days when ozone can reach levels that are not suitable for the human well-being. Even relatively low levels of

ozone can have an impact on the well-being. Children, people with lung diseases, elderly people and people who are active in open areas, including outdoor workers, may be particularly vulnerable to ozone. Children are at greatest risk of exposure to ozone because their lungs are still under development and are likely to be active in the open, when ozone levels are high, thus increasing their exposure. Breathing in of ozone can trigger various health problems including chest pain, coughing, throat irritation, and hemorrhage in the brain. May cause aggravation of bronchitis, emphysema, and asthma.

Ozone damages the leaves of the trees and other plants (photooxidation), destroying the appearance of cities, parks and areas for recreation. In some sensitive plants, O_3 can cause damages to the leaves that resemble burns. With the reduction of plant growth and reproduction, high levels of O_3 can lead to lower yields, reduced growth of forests and reduced bio-diversity.

III.5 Carbon monoxide (CO)

Carbon monoxide (CO) is a colorless highly toxic and flammable gas, odorless and tasteless which is somewhat lighter (less dense) than air and soluble in water. Carbon monoxide (CO) is one of the most abundant pollutants in the atmosphere.

Carbon monoxide acts directly on the cardiovascular system, as well as the central nervous system. Those who for a long amount of time are exposed to CO, or are exposed for a short amount of time but at a higher dose in addition to a headache they feel dizzy, fatigued and have reduced mental ability.

Carbon monoxide can lead to a greenhouse effect and global warming.

IV Hitorical data

The monitoring of the ambient air quality has been carried out so far by several institutions: the Ministry of Environment and Physical Planning (MEPP), the Institute for Public Health-Skopje (IPH), the National Hydrometeorological Service of the Republic of Macedonia. Macedonia (HMS).

The Ministry of Environment and Physical Planning through the National Air Quality Monitoring Network performs 24-hour monitoring at 5 locations in the Eastern Zone of Macedonia (Veles 1, Veles 2, Kavadarci, Kocani and Kumanovo). The city Kocani is the closest to the cities where monitoring in this project was carried out from all of these monitoring stations.

This monitoring station of the Ministry of Environment and Physical Planning monitors the following parameters: O_3, NO_2, SO_2, CO and PM10. The data on the ambient air measurement parameters (daily, monthly and annual reports) are publicly available on the MEPP website (http://airquality.moepp.gov.mk/) and they were used for data processing.

IV.1 Historical data for PM10 particles for the period 2013 - 2017

The values obtained for the PM10 particles are compared with the daily and annual average values as well as with the threshold of the limit values. The average daily limit value is 50 μg / m³ and it should not be exceeded more than 35 days in one calendar year. Table 8 shows the number of exceedances of the prescribed daily limit value for PM10 particles. The measuring station in Kocani showed more than 35 times annual exceedances in 2014, 2015 and 2016. By the first half of November 2017 there are already 54 exceedances.

Table 8.

Monitoring station	Year					Comments on LV
	2013	2014	2015	2016	2017	
Kocani	18[1)]	52	133	90	48[2)]	Not to be exceeded more than 35 days per year

Note:
1) in 2013, the exceedance refers to the first two months of the year. For the rest, there are no data. In order to give a realistic picture of the ambient air quality for one year, at least 70% of the data coverage (265 days) should be obrtained
2) in 2017 the exceedances are calculated by the end of November.

From the analyzes made by the MOEPP, usually the daily values for PM10 particles during the one calendar year are the highest in the winter period and are shown in Figure 1. The high concentrations of PM10 particles in the winter are due to the cold cold winter days and the occurrence of temperature inversion that causes episodes of high concentrations of this air pollutant.

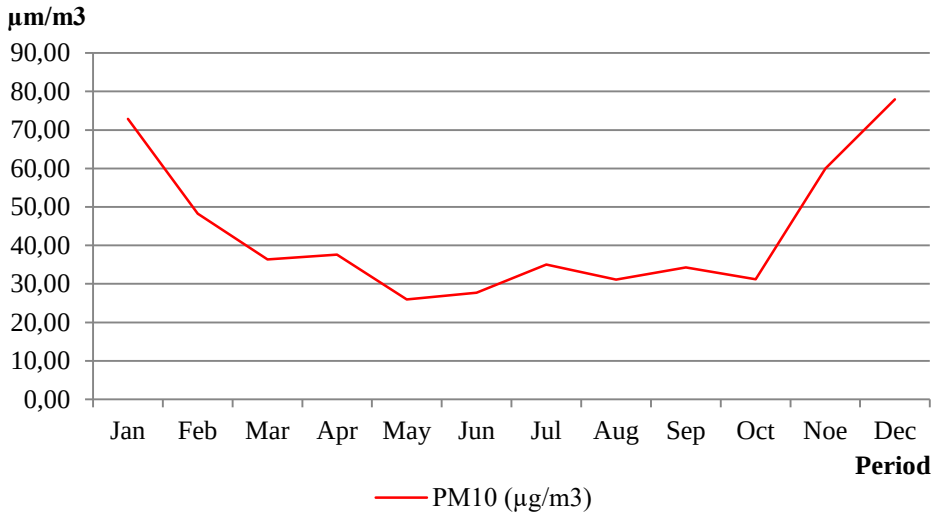


Figure 1. Trend of annual distribution of concentrations of PM10 (µg / m^3) for the measuring station in Kocani for 2016

The annual limit value for PM10 particles is 40 µg/m³. The results for the average annual concentrations of PM10 for the monitoring station in Kocani for the period 2013-2017 (November) are shown in Figure 2. It can be concluded that the annual limit value for the PM10 particles is exceeded for each year.

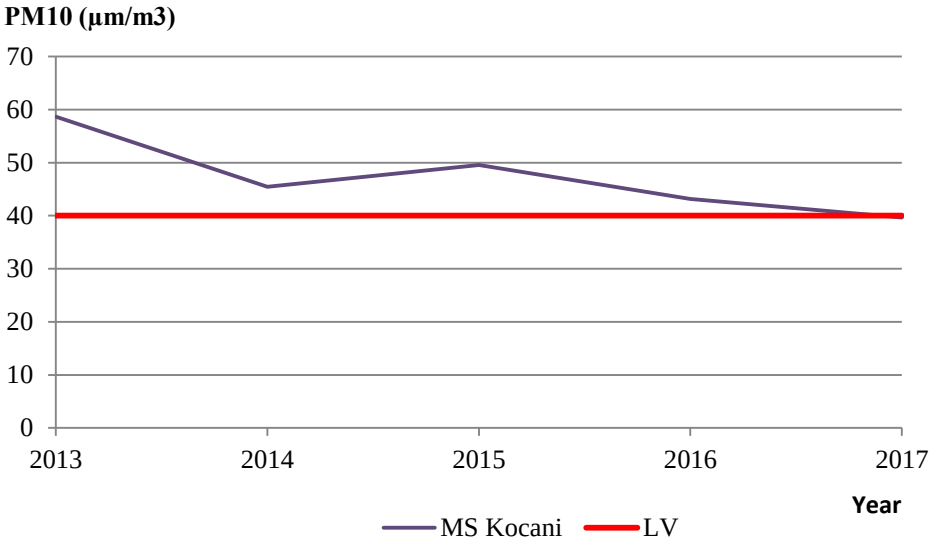


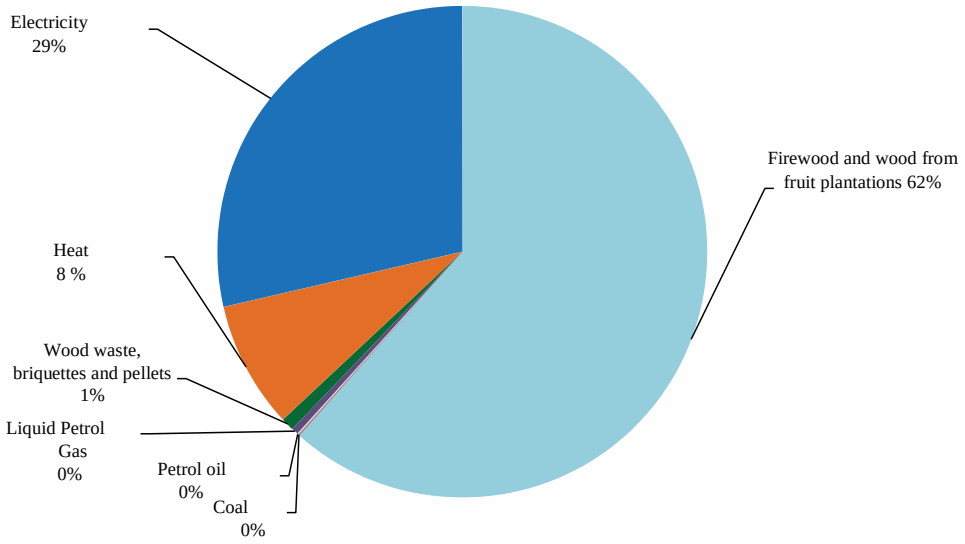
Figure 2. Annual average concentrations of PM10 particles for the measuring station Kocani (2013-2017)

In accordance with the inventory of suspended particles (TSP, PM2.5 and PM10) in 2015 (last annual report of the MOEPP), the most important part of the emissions of particles is the heating of homes and administrative capacities, especially due to incomplete combustion of trees in old stoves. The calculation of emissions resulting from the heating of homes has been made according to the data

stated in the publication "Household Energy Consumption, 2014" published by the State Statistical Office of Republic of Macedonia, published in 2015.

According to the latest official census in the country there are 559 187 dwellings. According to a survey done in 2015 (State Statistical Office, 2015) of the total number of households, 62% use wood as the primary source of heat, 29% use electricity, 8% are connected to central heating, while the remaining 1% use another type of heat sources.

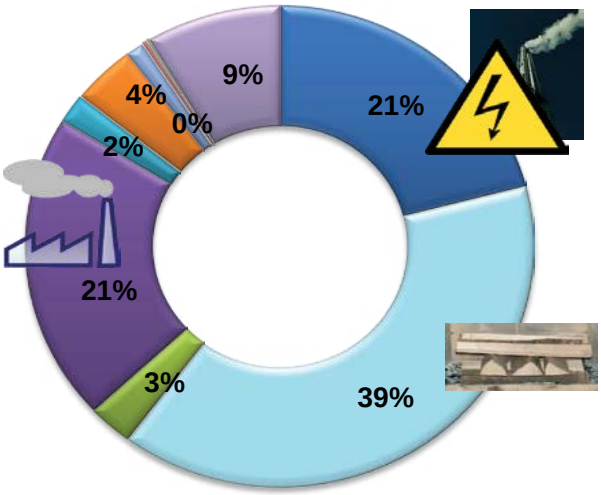
Graph 1. Participation in the number of households in the total number of households according to the energy consumed as the basic type of heating



Source: State Statistical Office of Republic of Macedonia

The contribution of emissions from combustion of fuels used in households, in particular in total emissions of total solid particles (TSP), is 39%, in emissions of particles up to 10 micrometers (PM10) is 33% and 57% in emissions of solid particles up to 2.5 micrometres (PM2.5). It has been established that other key sources in the suspended particulate emissions are the processes for production of heat and electricity (25%, 21%, 13%) and the production processes especially in the field of metallurgy (20%, 21%, 22%). For the region in concern, it can be excluded as a contribution to concentrations production processes from the metallurgical area.

Graph 2 shows the distribution of suspended particulate emissions for PM10 expressed in kilotons.



Regarding emissions from the traffic sector, it should be emphasized that this contribution in the total emissions of solid particles and with this year's calculations, is with a very low share of about 1-2%, even though a higher level 2 was used in the calculation of the emissions (Tier 2). In accordance with the signed memorandum of cooperation between the MOEPP and the Ministry of Interior in 2016, the calculations were used from the the obtained data on the structure of vehicles from the base of the Ministry of Interior for 2015. It is expected that the contribuition of traffic in particulate маттер emissions would increase with the application of national emission factors to calculate emissions from braking and wearing the tires of cars, but it is not expected that traffic would become a key source in the emissions of these pollutants. However, the fact remains that the failure to use the best available techniques for emission reduction in large thermal power plants and part of the metallurgical sector, as well as the dominant application of domestic heating, contributes to the most dominant emission of dust at the national level.

At the same time, it should be pointed out that the contribution od distribution of emission of these substances from different sources at the local level, differs from the shown distribution at the national level, taking into account that at the local level (in different cities) there are different dominant sources of emission of the individual pollutants.

IV.2 Historical data SO_2 (sulfur dioxide) for the period 2013 - 2017

The average hourly limit value for SO_2 of 350 μg/m³ must not be exceeded more than 24 times per year. The second limit value for the protection of human health is the daily limit value for SO_2, which is 125 μg/m³. This value must not be exceeded more than three days a year. Data from the monitoring network of the MOEPP were used in the processing of ambient air quality data for sulfur dioxide.

According to the data presented in the Monthly Reports of the processed environmental quality data for 2013, 2014, 2015, 2016 and 2017 (until October) referring to sulfur dioxide in the city of Kocani, the following can be concluded:

- in the period 2013-2017. the measurements show that the average hourly limit value for SO2 of 350 μg / m³, which must not be exceeded more than 24 times per year, has not been exceeded even once during this period.
- The limit value for the protection of human health for SO_2 (daily concentration) is 125 μg/m³ (it must not exceed more than three days a year). Measurements show that in the period 2013-2017, there were no exceedances of this value. So, the permitted number of exceedances of the daily limit value from the aspect of health care is not exceeded even once in this period.

The average annual concentrations of SO_2 for the period 2013 to 2017 are presented in Figure 3.

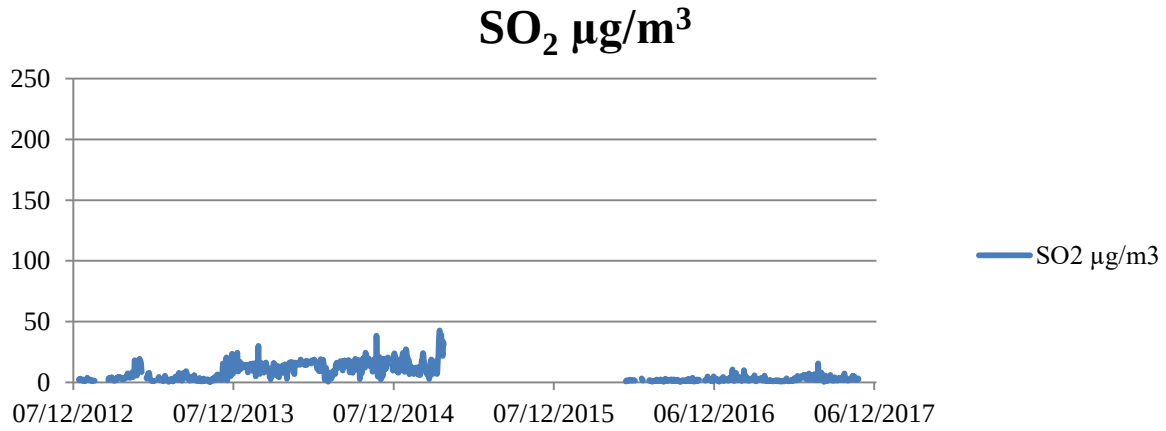
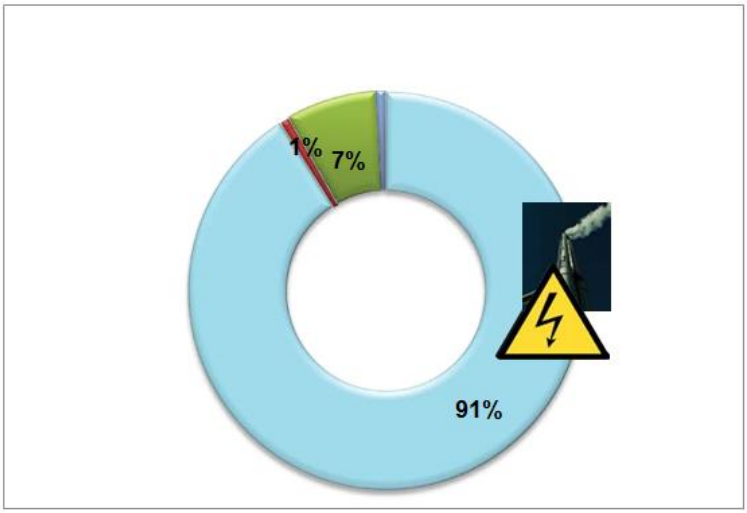


Figure 3. The average annual concentrations of SO_2 for the period 2013 to 2017 in Kocani

In 2015, the calculated national emissions of SO_2 were 76.40 kilotons. As can be seen from the next graph in the Republic of Macedonia, the key and dominant source of sulfur oxides in the air are the combustion processes of fuels (coal and fuel oil) in the production of electricity with 91%. The remaining emissions of this pollutant are emitted from combustion plants in the manufacturing industry (7%), and the combustion of fuels in households accounts for a share of 1%.



Graph 3. Contributions of emissions of SO_2 in 2015

In terms of emissions in 2014, emissions of sulfur dioxide are reduced only for -8.59%, as a result of lower consumption of coal and fuel oil in the thermal power plants, as well as reduced emissions from the household sector, where from year to year the consumption of wood for heating of households is reduced slightly due to the increased consumption of pellets and natural gas.

IV.3 Historical data NO2 (nitrogen dioxide) for the period 2013 - 2017

The average annual limit value for nitrogen dioxide is 40 μg/m3. The average hourly limit value of 200 μg/m³ NO_2 for the protection of human health must not exceed 18 times a year.

The data from the monitoring network of the MOEPP were used in the processing of ambient air quality data regarding nitrogen dioxide

The data presented in the Monthly Reports of the processed environmental quality data for 2013, 2014, 2015, 2016, and 2017 concerning nitrogen dioxide in Kocani can be summarized as follows:

- in 2013, 2014 I 2015. no data are available for NO_2 from the monitoring station in Kocani. Annual reports of the MOEPP for ambient air quality, states that due to problems with the regular maintenance of the monitoring stations, i.e. irregular supply of spare parts, there is lower coverage of NO_2 data from all measuring stations in Macedonia.
- average annual limit value for nitrogen dioxide for 2016 has not been exceeded, nor has the average hourly limit value been exceeded, and therefore the number of allowed exceedances of the average hourly value for protection of human health.
- until the first half of 2017, the measuring station in Kocani has more than 30% coverage of data. Although, to provide an assessment of ambient air quality, it is necessary to have at least 70% coverage of data in the year, to include this data in the annual reports of the MOEPP. From the data processing it can be concluded that in 2017, the average annual limit value for nitrogen dioxide, the average hourly value, and therefore the number of allowed exceedances of the average hourly value for protection of human health are not exceeded.

Average annual concentrations of NO_2 for the period 2016-2017 are shown on Figure 4.

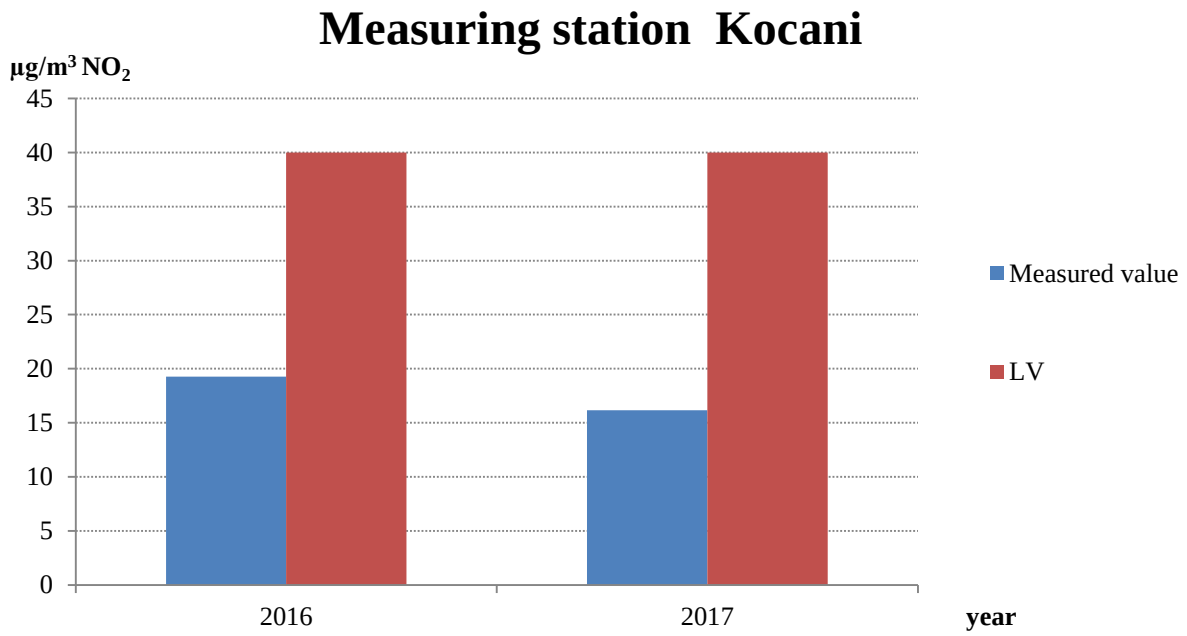
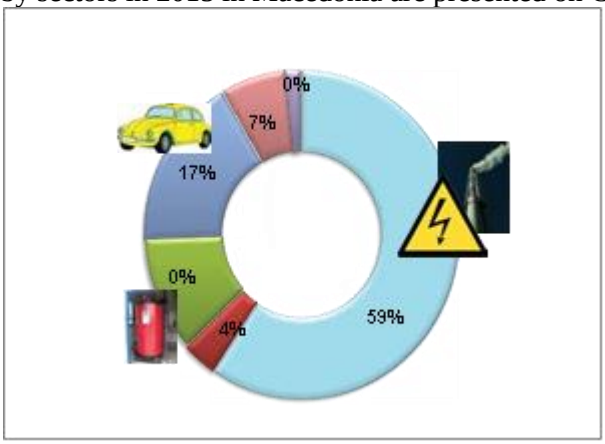


Figure 4. Average annual concentrations of NO_2 for the period 2016-2017

In our country, the largest quantities of nitrogen oxide emissions are emitted during the production of electricity and heat (59%) due to the existing capacities for coal-fired power generation. However, it should be noted that the quantities of emitted emissions in recent years have been reduced as a result of the modernization of the boilers in REK Bitola and the reduced number of hours of operation of REK Oslomej (an installation that operates only 5 months a year in the winter period due to the reduced quantities of available domestic coal. Also, the emissions from road traffic (17%) have a large share in the total emissions of this pollutant. The smaller share of traffic in the total emissions of nitrogen oxides arises from the applied of the calculation methodology according to the EMEP / EEA guidelines at a higher second level (Tier 2), taking into account that for the preparation of this year's inventory there were available the detailed data for the vehicle fleet obtained from the data base of MOI. In terms of the emissions in the previous year 2014, national NOx emissions have been reduced by only 6% for this pollutant because there is no significant reduction in emissions from key sectors.

The NOx emissions by sectors in 2015 in Macedonia are presented on Graph 4.



Graph 4. The NOx emissions by sectors in 2015 in Macedonia

IV.4 Historical data O_3 (ozone) for period 2013 - 2017

Measured concentrations are compared with target values and long-term goals. The long-term targets for ozone concentrations in ambient air are determined in order to protect human health and vegetation. The maximum daily 8-hour average ozone value over a calendar year for the protection of human health is 120 μg/m^3. The value of AOT40 for vegetation protection calculated from the hourly values for the period May-June is 6000 μg / m^{3}h. The data from the MOEPP monitoring network were used in processing of ambient air quality data against ozone. According to the data presented in the Monthly Reports of processed environmental quality data for 2013, 2014, 2015, 2016 and 2017, referring to Kocani, the following can be concluded:

- The long-term goal for protection of human health has been exceeded at the measuring point in Kocani in 2013 and 2014.
- The value of AOT40 for the protection of vegetation during the analyzed period was exceeded in 2013 and 2014.

Exceedances of long-term ozone targets during this period in our country are due to the geographical location in the southern part of Europe, which is characterized by a large number of sunny days during the summer period. The highest concentrations of this pollutant are also observed in spring and summer, while the lowest concentrations are observed during the winter period.

Unlike other pollutants, ozone levels are generally higher in rural areas. This is because, in urban stations and stations that monitor traffic pollution, in the immediate vicinity of which there are sources of nitrogen oxides, the ozone is depleted by a titration reaction with freshly emitted nitrogen monoxide. In general, the highest concentrations of ozone are observed at rural measuring points, lower in urban locations, and lowest at the measuring points where traffic is the dominant source. But the occurrence of high concentrations in large urban environments is because the formation of ozone occurs at a time when there is high solar radiation and high temperature. The appearance of high concentrations in large urban environments is because the formation of ozone occurs at a time when there is high solar radiation and high temperature. Also, ozone concentrations increase with increasing altitude.

The variations of the O_3 concentration during 2014 (selected due to the largest number of available data) is shown in the graph in Figure 5.

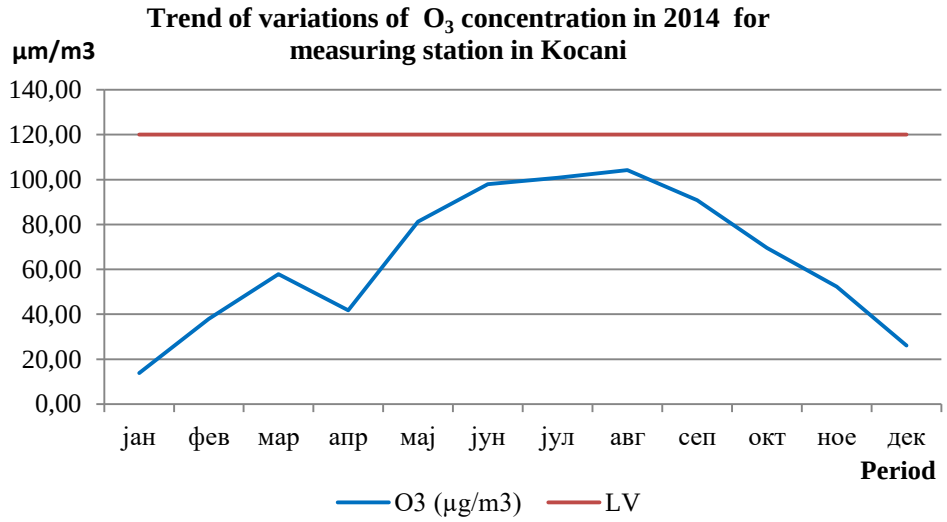


Figure 5. Trend of variations of O_3 concentration in 2014 for measuring station in Kocani

Figure 6 graphically presents the ozone results for the period 2013-2017 of the measuring station in Kocani.

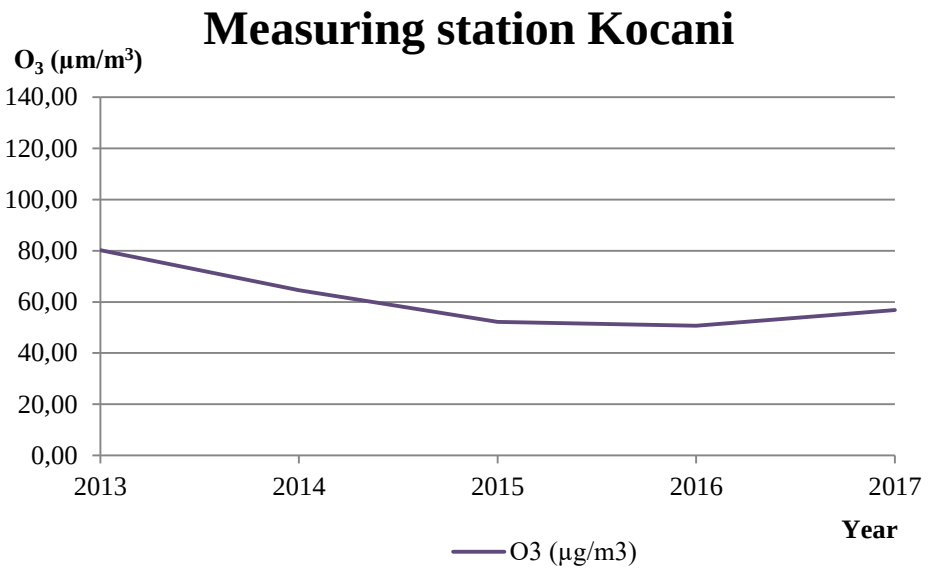


Figure 6. Average annual concentration for O_3 for the period 2013-2017 in Kocani

IV.5 Historical data CO (carbon monoxide) for period 2013 - 2017

The maximum 8-hour daily limit value for human health protection for CO is 10 mg/m3. The data from the monitoring network of the MOEPP were used in the processing of data on ambient air quality in relation to carbon monoxide.

According to the data presented in the Monthly reports on processed environmental quality data for 2013, 2014, 2015, 2016 and 2017, referring to Kocani, the following can be concluded:

- in the analyzed period there are no exceedances of this pollutant.

The variations of CO concentration during 2016 (selected due to the largest number of measurement data) is shown in Figure 7 with a graph showing the change in CO concentration during that year.

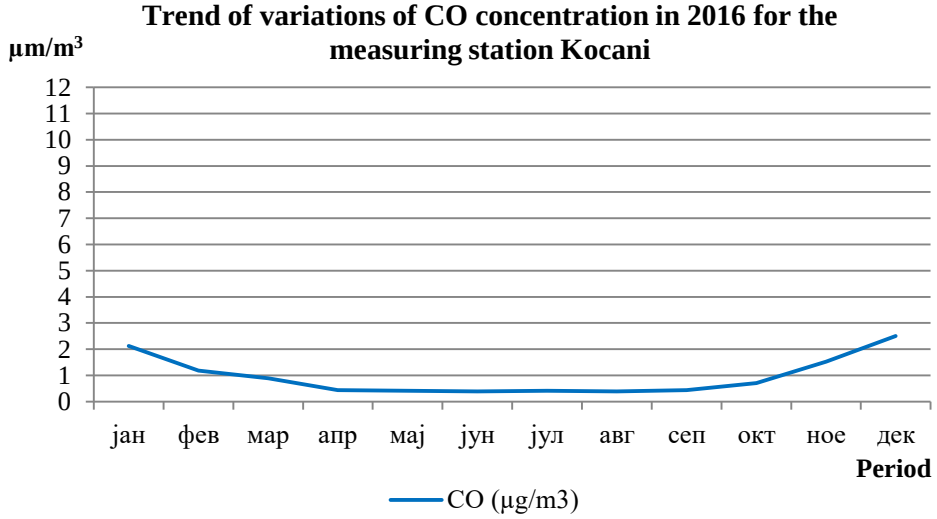


Figure 7. Trend of variations of CO concentration in 2016 for the measuring station Kocani

The maximum 8-hour daily concentrations of CO from the MOEPP monitoring network for the period 2013 - 2017 in Kocani are shown in Figure 8.

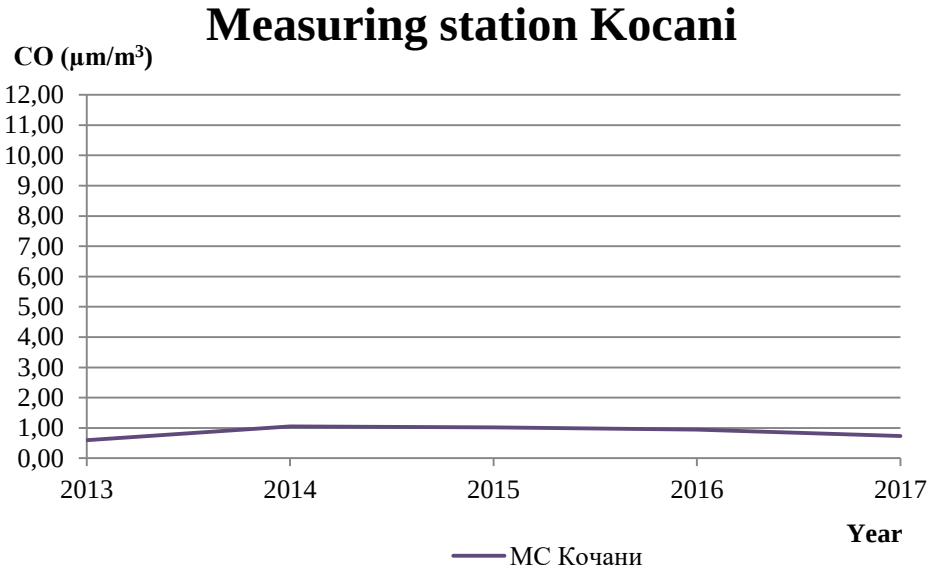
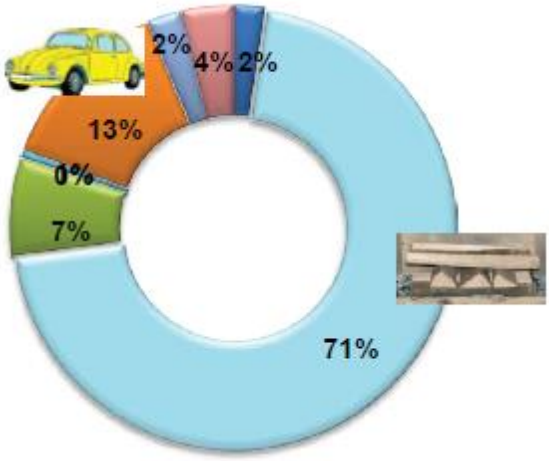


Figure 8. Maximum daily eight-hour average values in the calendar year for CO for the period 2013-2017 in Kocani

During the preparation of the inventory in 2016, data from the publication "Household Energy Consumption, 2014" was published by the State Statistical Office of Republic of Macedonia. Higher quantities of CO at the national level, calculated for 2014 differ in relation to the published data from the past years, due to the data for consumption of wood in households which is much higher than the published data from the statistical anniversaries that were used in previous years. The total amount of emissions of carbon monoxide at the national level for 2014 is 101 260 kilotons. Key sources in carbon monoxide emissions are the household heating and administrative capacity sectors with 61%, followed by the traffic sector, which participates in the total emissions with 27%. In terms of CO emissions from household heating, emissions in 2014 are lower than in 2013, mainly due to warmer winter, i.e. lower consumption of firewood.

Road transport was once a significant source of CO emissions, but with the introduction of catalytic converters there was a significant reduction in its emissions. Concentrations of CO vary depending on traffic during the day. Important sources of carbon monoxide are combustion of fuels in power plants, public institutions and households. The total amount of discharged carbon monoxide emissions at the national level for 2015 is 82,02 kilotons. Key sources in carbon monoxide emissions are the household heating and administrative capacity sectors with 61%, followed by the traffic sector, which participates in the total emissions with 27%. This is probably due to incomplete combustion of solid and liquid fuels used in these two sectors. CO emissions for 2014 are recalculated due to the application of a higher level of methodology for calculation of emissions from the transport sector (road transport). Regarding CO emissions from household heating in 2015, emissions are lower compared to 2014 mainly due to warmer winter, that is, the lower consumption of firewood.

CO emissions by sectors in Macedonia for 2015 are given in Graph 5.



Graph 5. The CO emissions by sectors in 2015 in Macedonia

V Temporary conditions for development and transport of pollution

V.1 Impact of climate factors

In order to get a clearer picture of the climate characteristics in the region, this section will consider the climatic characteristics of the Kocani valley, the Delcevo field and the Berovo valley.

Kochanska valley

The Kochanska valley with the high mountain massifs of Osogovo is somewhat protected from direct south-eastward penetration, so in the climate of this area the influence of the orographic characteristics of the site is greatly expressed.

The average annual air temperature is 12.9 ° C. It is 2.2 ° C higher than the one in Delcevo. The average winter temperature is 3.0 ° C, and the average summer temperature here is 22.5 ° C. Monthly temperature difference in the spring and autumn months is quite pronounced, so the transition from winter to summer and summer to winter is not slow, which is characteristic of areas that are to a certain extent under continental climate influence. The influence of the continent here is also expressed through the appearance of low temperatures in the winter months. The average annual minimum temperature is 6.3 ° C, while the average annual maximum temperature is 18.6 ° C (a value lower than -10 ° C is from November to March and sometimes even below -15 ° C, this spring and autumn up to 25 ° C, and 35 ° C and sometimes over 40 ° C in summer).

From the foregoing it can be concluded that the temperature regime in the Kochanska Valley is conditioned by the moderate continental climate influence and the orographic local characteristics of the valley. This is manifested through the increased values of average and absolute annual fluctuations, through increased intermolecular temperature differences in the spring and autumn months and through the pronounced transition from winter to summer and vice versa.

The average annual amount of precipitation is 538 mm. Therefore, this valley belongs to the drier areas in Macedonia. The main monthly maximum of precipitation occurs in May and the second in November. The main minimum of precipitation is in August and the second in February. Oscillation of precipitation per month is high. Thus, the main monthly minimum for years occurs in all months except August, while June and July are wetter. And the difference in monthly amounts of precipitation in the same month by year is quite high. Rainfall in the Kochanska Valley is mostly rain, and only 8% is from the snow. During the year precipitation is quite unevenly distributed.

From the foregoing for the precipitation regime, it can be concluded that it is conditioned by the combined mediterranean and moderate continental climate influence, which is strongly marked by the local orographic characteristics of the valley.

Fog is a less common occurrence in Kocani valley. In some years it appears in the cold part of the year. They usually appear 7 days with fog, and in some years this number ranges from 0 to 18 days.

The Kocani valley is quite windy, and from the total number of measured cases 69.2% is with winds from different directions, and 30.8% is windless.

The southwest wind is the most frequent, with an average annual of 16.9% (average speed 2.5 m / s), followed by the northeast with 10.4% (average speed 2.4 m / s and maximum in March, and minimum in August), followed by the southeast, north, south, west, east and northwest winds.

Delcevo Pole

This area is at significantly higher altitude than the Kocani valley and therefore here the air temperature is lower. The average annual temperature is 10.4 ° C. The warmest month is July, an average of 20.6 ° C, and the coldest month is January with an average of 0.0 ° C. February is warmer than December, but only 0.1 ° C. The autumn is by 0.8 ° C warmer than spring, while the inter-month difference in air temperature in the spring and autumn months is quite expressed. Thus the transition from winter to summer and vice versa is not slow, but the access is noticeable, which is a result of moderate continental climate impact. This also manifests itself on the occurrence of the minimum and maximum air temperatures and, therefore, there is an extremely temperature fluctuation of 63 ° C.

Relatively high air temperatures in the hot part of the year are observed for the altitude of this area.

The average annual amount of precipitation is 570 mm. The main maximum of precipitation falls in May with 66.2 mm, the secondary in November with 65.5 mm. The main minimum precipitation is in September, with an average of 36.4 mm, the secondary in February with 39.4 mm.

Rainfall in the area of Delcevo is mainly from the rain, but less than snow. The average amount of precipitation is only 10% snow, while the rest is rain. Drying periods are most frequent with a duration of 10-15 days.

The precipitation regime is the result of the disturbed continental climate impact, and the specifics of the site contributed. Here, most of the annual rainfall is in the warm part of the year, the maximum in May, the secondary in November, and the minimum in September.

The area of Delcevo is quite windy. Of the total number of measured cases, 65.0% are with frequency of winds from different directions, and 35.0% without winds.

The most frequent is the northern wind, an average annual of 14.0% (average velocity 3.5 m / s), followed by the southern wind with an average annual frequency of 10.9% (average speed of 3.3 m / s), and followed by the west, southeast, southwest and northwest with approximately the same representation as the eastern and northeastern winds.

Berovo valley

The site of Berovo has significantly lower average annual air temperature from the areas at the same altitude in the wider part of this valley. Thus with an altitude of 800 m, the mean annual value is 11.1 ° C, while in Berovo at the same altitude it has a value of 8.7 ° C. This is due to the specificities of this high valley, in which the so-called lakes of cold air often occur, and the frequencies of temperature inversions are frequent.

During the day, inversion is disturbed and normal stratification is established, and overnight and in the morning, inversion temperature stratification is re-established. Temperature inversions in the Berovo valley are common in the cold part of the year, as well as in the night hours of the summer part of the year. Throughout the year, an inverse temperature situation occurs in the morning.

The coldest month in this valley is January, with an average value of -1.2 ° C, and the warmest July with an average value of 18.2 ° C. The average annual temperature fluctuation has a value of 19.5 ° C and 1.2 ° C lower than in Delcevo. This is due to the high influence of the annual temperature of the Berovo valley.

Autumn is a bit warmer than spring, and the average monthly temperature in October is higher than in April. Monthly temperature difference in the autumn and spring months is quite expressed, therefore the transition from winter to summer and vice versa is accelerated.

Because of the batten character with a potentiated night-time decay, there are quite low values of the minimum temperature here. The average annual minimum temperature is 2.8 ° C.

The orographic specificities of the Berovo valley are conditioned by relatively high summer air temperatures. The average annual maximum temperature here is 15.3 ° C.

Most of the precipitation in the Berovo Valley is in the warm part, but the cool part of the year is also significant. The average annual amount of precipitation is 672.2 mm. The main maximum falls in May, an average of 76.8 mm, and the secondary in November, an average of 64.3 mm. The main minimum is in August, an average of 37.6 mm, and the secondary one is in February.

In the average annual amount, the snow participates with 15% and it occurs from October to May. Dry periods are at frequent occurrence in the Berovo valley. These are usually short-lived.

Precipitation regime in Berovo Basin is affected by continental climatic influence, conditioned by the geographical specificities of the valley. The maximum precipitation is in May and June, and the minimum in August and September. Most of the rainfall is falling in the warm part of the year. This change in the rainfall regime is also reflected in the fact that the secondary maximum of precipitation is in November, the main minima are in August and there is a very small difference in the hot and cold part of the year.

In Berovo valley there is a rare occurrence of fog. An average of 8.4 days with fog occur every year, with a maximum of 2.5 days in December.

There are winds from all 8 world directions in this valley, but the north and northwest winds prevail. The North is with an average frequency of 14.7% (average annual velocity of 2.4 m / s). This wind occurs all year round, with a maximum in January, February and March.

The Northwest wind is with an average frequency of 10.3% (average annual speed of 2.0 m / s), and occurs in all months of the year. Nearly the same frequency is for the southeast and southwestern winds, followed by the south, northeast, western and eastern winds. The average annual frequency of the winds is 49.4%, with peaks in September, October and December. The smallest frequency of the winds is in March and April, ie. these months are the most venerable in the Berovo valley.

V.2 Transport of pollution

Transport and dispersion of pollution is very complex and depends on many factors, including meteorological (wind, atmospheric stability) and topographic factors (local terrain).

The study of transport and the dispersion of air pollution is a good indicator of where to install air quality monitoring stations.

Meteorological parameters have a major impact on the development and transport of pollution. Climate factors can directly or indirectly affect the quality of ambient air.

Direct climate impacts include:

- **Sunlight** - under the influence of sunlight some pollutants enter into chemical reactions producing photochemical smog. The photochemical smog represents a complex mixture of chemical compounds-products generated by the interaction of sunlight and two basic groups of compounds nitrogen oxides and hydrocarbons. Also, other pollutants such as sulfur dioxide and particles can participate in the reactions, but they are not crucial for the making of photochemical smog. The phenomena of photochemical smog is aided by stable meteorological conditions that are present in a period of several days, when the emitted pollutants are retained without dispersion in an urban environment, whereby their maximum contact is ensured. A visible effect of photochemical smog is the reduction in visibility.
- **Rain** - the rain washes away water-soluble pollutants and PM particles. Humidity and precipitation can affect air pollutants both positively and negatively. On one hand, conditions can be created for transformation of the pollutants to even more dangerous secondary pollutants which will cause the so-called. acid rain. On the other hand, the rain can wash away the pollutants from the air and bring them to the surface (moist deposition).
- **Temperature** - higher temperatures accelerate chemical reactions in the air. The air usually cools as the height of the layer increases. But sometimes the upper air layer is warmer than the lower one. This phenomenon is called temperature inversion. Temperature inversions are usually formed in clear and quiet nights when the earth cools rapidly. Inversions are important because the upper warmer layer forms a layer that captures the polluted air below it.

  Inversion layers are usually transported from the wind or by the hot air that rises as the earth heats up. If the inverse layer remains in one place for a long time, pollutants can reach very high concentrations that may have health effects, but also cause other harmful effects.
- **Wind speed** - Wind is one of the key parameters for the development of pollution. A higher pressure air mass is made up of "heavy" cold air, while an air mass of lower pressure is made up of warmer and lighter air. The air moves from places with lower pressure to places with higher pressure. Wind velocity can drastically affect the

concentration of pollution. The wind can dilute the pollution and quickly disperse it in the air, but on the other hand it can bring the pollution in clean environments.

- **Atmospheric stability / turbulence** - atmospheric turbulence refers to the vertical movement of the air. As the earth is heated during the day, so the air that is closer to the surface is usually warmer and lighter, and as such it moves towards the upper layers and vice versa, the cold air from the upper layers is heavier and moves towards the lower layers. Air turbulence contributes to dispersing polluted air as it moves from the source.

Conversely, stable conditions commonly occur at night when the air is cooler. The pollutants released in urban environments at night time (such as households) do not disperse easily, causing localized air pollution.

The meteorological conditions may indirectly affect the ambient air quality. Under favourable meteorological conditions, human activities are reduced in terms of air pollution, while in unfavourable meteorological conditions human activities increase which contribute to deterioration of ambient air quality. Weather conditions indirectly affect pollution in a way that, for example, when the weather is cold people burn more fire for heating and travel to work more often with motor vehicles.

VI Monitoring campaign 2017

VI.1 Applied methodology

The methodology according to which the various pollutants were determined is described for each pollutant separately. The methods under which the monitoring is carried out are in accordance with the Macedonian legislation, ie. according to the Rulebook on the content and manner of transmission of data and information on the conditions in the management of ambient air quality (Official Gazette of the Republic of Macedonia No. 138 of 17.11.2009).

- Nitrogen Oxides $NO/NO_2/NOx$ - Chemiluminescence (EN14211)
- Ozone O_3 - UV photometry (EN14625)
- Sulfur Dioxide SO_2 - UV Fluorescence (EN14212)
- Carbon Monoxide CO - NDIR gas filter correlation (EN14626)
- Particulate Matter PM10 – Particulate gravimetry (EN12341)

Two methods for parallel determination of particulate matter were used to determine the PM10: gravimetric and nephelometric method. The gravimetric method according to EN12341 is a reference method for determining PM10. The nephelometric method provides real-time tracking results. The gravimetric determination of particulate matter was used to determine a comparable and reliable result.

The following equipment was used to determine ambient air quality: Airpointer®recordum and Comde Derenda LVS3.1 - low-volume sampling pump**.**

- Airpointer® recordum Messtechnik GmbH approved according to TUEV certificate and European air quality monitoring standards. It enables the measurement of a wide range of pollutants, including the determination of sulfur dioxide, ozone, carbon monoxide, nitrogen oxides and dust PM10 (nephelometric), as well as monitoring of meteorological parameters (speed and direction of wind, pressure, temperature and relative humidity) is shown in Figure 9.

Figure 9. **Airpointer® recordum Messtechnik GmbH**

- Comde Derenda LVS 3.1 was used for sampling of PM10 samples in ambient air (Figure 10). The gravimetric determination of PM10 was carried out with an analytical scale Mettler Toledo XP26PC (1μg) in laboratory conditions.

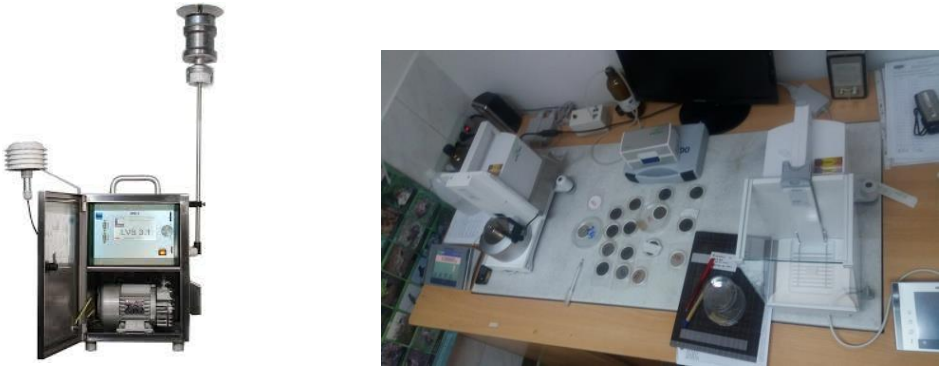


Figure 10. Comde Derenda LVS3.1 and Mettler Toledo XP26PC (1μg)

VI.2 Selection and description of locations

In determining the micro and macro locations, the guidelines prescribed in the Rulebook on the locations of the measuring stations and measuring points (Official Gazette of the Republic of Macedonia No. 120/2008), as well as the Rulebook on the content and manner of data transmission and information for the conditions in the management of the ambient air quality (Official Gazette of the Republic of Macedonia no.138 / 2009) were followed.

VI.3 Selection of macrolocation

In determining the macrolocation of sampling points for the determination of sulfur dioxide, ozone, carbon monoxide, nitrogen oxides and PM10, were selected zones in the four cities where the highest and lowest concentrations to which the population is exposed are expected, directly or indirectly, in a certain period which is significant in relation to the period of calculating the average of the limit values.

VI.4 Selection of microlocation

When selecting the microlocation, interferential sources, reliability, access to the site, availability of electricity, public safety, equipment and operators were taken into account, as well as recommendation for joint placement of sampling points for different pollutants. The flow around the entrance of the sampling probes was unlimited (free 270 degrees) without any interference that could affect the flow of air near the sampling device, that is, at a certain distance from buildings, trees and other obstacles. Probe inputs were placed away from sources of pollution to avoid direct suction of emissions mixed with ambient air.

VI.5 Description of measuring locations

VI.5.1 Description of the measuring location - Berovo

Measuring location B – GPS coordinates N: 41° 42′ 30,3" и E: 22° 51′20,0" located in the center of Berovo, on the street "Marshal Tito", in the school yard of the elementary school "Dedo Ilo Maleshevski". Figure 11 gives a satellite image of the city of Berovo with a location on the measuring point B, while in Figure 12 is given a picture from the location where the measuring equipment is installed. The measuring equipment for PM10 was set at a height of 1.8 m (breathing zone).

Figure11. Satellite image from the measuring point in the Municipality of Berovo


Figure 12. Measuring location in the Municipality of Berovo

VI.5.2 Description of the measuring location - Vinica

Measuring location V – GPS coordinates N: 41° 53′ 04,2" and E: 22° 53′ 17,3", located in the center of Vinica, on the street "Bel Kamen" No.13. The measuring point is located at a distance of 30 m from the building of the municipality of Vinica and the Cultural Center "Toso Arsov" and 80 m from the road. The satellite image of the city of Vinica with a marked measuring location is shown in Figure 13, while Figure 14 shows the location of the measuring equipment. The measuring equipment for PM10 was set at a height of 1.8 m (breathing zone).

Figure 13. Satellite image from the measuring point in the Municipality of Vinica


Figure 14. Measuring location in the Municipality of Vinica

VI.5.3 Description of the measuring location - Делчево

Measuring location D – GPS coordinates N: 41° 58′ 05,84" and E: 22° 46′ 28,94" is located in the center of Delcevo, on the street ,,Nikola Nikolov Vapcarov" bb, in the yard of the Primary School "Vanco Prke"". The measuring point D is at a distance of 80 m from the edge of the Blvd. "Makedonija" and 350 m from the industrial area. The traffic on the Blvd."Makedonija"" takes place in two directions and two traffic lanes. Figure 15 shows a satellite image of the town of Delcevo marked with a measuring point, and Figure 16 shows the location of the installed measuring equipment. The measuring equipment for PM10 was set at a height of 1.8 m (breathing zone).

Figure 15. Satellite image from the measuring point in the Municipality of Delcevo


Figure 16. Measuring location in the Municipality of Delcevo

VI.5.4 Description of the measuring location - Pehcevo

Measuring location P – GPS coordinates N: 41° 45′ 42,8" and E: 22° 53′ 04,98" located in the center of Pehcevo, on the Blvd.,,Raven" No.8, in the yard of the administrative building of the Municipality of Delcevo. The measuring point P is located at a distance of 8 m from the edge of the thoroughfare. The traffic in this section is in two directions, in a traffic lane. Figure 17. shows a satellite image of the town of Pehcevo with a marked measuring point, and Figure 18 shows the location of the installed measuring equipment. The equipment for measuring the PM10 dust was set at a height of 1.8 m (breathing zone).

Figure 17. Satellite image from the measuring point in the Municipality of Pehcevo


Figure 18. Measuring location in the Municipality of Pehcevo

VI.5.5 Description of the monitoring station of the MOEPP in Kocani

Kocani is located 120 km away from Skopje, in the eastern part of the Republic of Macedonia, it is more precisely occupying the north side of the Kocanska Valley and covers the area on both sides of the valley, where it leaves Osogovo and extends its valley.

The city has a southern location to the foothills of the Osogovo Mountains (2252 m). At 8 km to the south the fertile Kocanska valley is closed with the mountain Plackovica (1754 m), and the altitude of the city's land is up to 450 m.

The Municipality of Kocani covers an area of 382 km^2 with 38 092 inhabitants and 28 settlements (according to the 2002 census), and it grows into a third regional center in the eastern part of the Republic of Macedonia.

No.	Place	Type of Data-Census 2002			
		Population	Households	Flats	Territory (ha)
1	Kocani	28330	8858	10541	1978
2	Beli	466	141	150	1519
3	Gorni Podlog	704	191	207	270
4	Gorno Gratce	13	9	36	541
5	Grdovci	1288	420	446	662
6	Dolni Podlog	476	151	161	367
7	Dolno Gratce				143
8	Jastrebnik	48	23	34	2004
9	Leski	29	17	35	808
10	Mojanci	556	166	184	341
11	Nivicani	343	96	120	1888
12	Pantelej	64	29	55	1390
13	Pasagikovo			27	1036
14	Polaki	113	59	180	7454
15	Pripor	1	1	10	414
16	Rajcani	33	17	17	803
17	Trkanje	1225	389	440	1110
18	Crvena Niva			11	293
19	Orizari	3776	1176	1429	1928
20	Bezikovo	8	4	13	1778
21	Vraninci	10	5	24	696
22	Glavovica	59	23	48	871
23	Kostin Dol	20	10	26	593
24	Nebojani	46	20	28	2512
25	Novo Selo	15	4	26	610
26	Preseka	131	33	49	2541
27	Pribacevo	388	131	150	303
28	Recani	13	8	17	873
	Total:	38155	11981	14464	35729

There are 11 981 households and 14 464 flats in Kocani.

Through the municipality of Kocani, a main road runs through which connects the city with Stip (30 km) and Veles (70 km), and then exits on the Skopje-Gevgelija highway, that is, with this road Kocani is connected to the whole of Macedonia.

Kocani is a crossroads of several regional roads, connected with the nearest towns. To the east it is connected with Vinica (10 km), Makedonska Kamenica (30 km), Delcevo (55 km), Berovo (60 km), Bulgarian border km), and in the west it is connected with Probishtip (36 km), and Kratovo (48 km).

The existing railway, which was built in 1926, has a traffic meaning. Through this railway line Kocani is connected with Stip-Veles-Skopje.

The traffic infrastructure is as follows: 26 villages or 60,5% are connected with the national road through regional and local asphalt roads. The remaining 17 villages or 39,5% are connected with earth or forest roads. In the plain and flatland-hill villages there is a modern network of streets, while in the others it is not present.

The climate in the region of the municipality of Kocani is moderate-continental under the influence of the altered Mediterranean climate, which penetrates the valley of the river Bregalnica. The average annual air temperature is 12,9˚C with an average amount of precipitation of 538mm.

With an average annual air temperature of 13,0 ˚C Kocani Valley is ranked among the warm valleys in Macedonia. The average monthly temperatures in any month of the year are not below zero, which is a feature of the Mediterranean climate. The minimum average monthly air temperature is January, 1,6˚C, while the maximum in July, 23,5˚C. Accordingly, the annual temperature fluctuation is 21,9 ° C.

All summer months of the year have a temperature above 20˚C, and the mean summer temperature is 22,6˚C. The mean winter temperature is also high and it is 3,0˚C. The mean temperature in the spring is 12,8˚C, and in autumn it is 13,5˚C. Monthly temperature difference in the spring and autumn months is very pronounced, so the transition from winter to summer and summer to winter is not slow, which is characteristic of areas that are to a certain extent under continental climate influence. This influence is also expressed here through the appearance of low temperatures in the winter months. Thus, the average annual minimum temperature is 6,3 ˚C. The absolute minimum temperature for months is below 0 from September to April.

The average annual maximum temperature is 18,6˚C. The number of summer days, that is days in which the temperature is higher than 25˚C and they are 120 days, is also big. There are also numerous tropical days (at a temperature higher than 30˚C) which average 49 days a year. The vegetation period is 200 days and lasts from April to October 20.

The winds in Kocansko blow almost all directions and at any time of the year. Of the total number of measured cases 69.2% are with winds from different directions, and 30.8% is without wind or with silences. However, the southwest wind is of the highest frequency, average a year with 16.9% o and average annual velocity of 2.5 m/s.

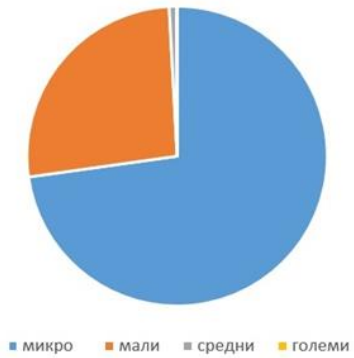
In Kocani, a traditional economic branch is agriculture, for which there are excellent natural and agrotechnical conditions. Rice is the most important agricultural crop with centuries-old tradition, good yields and excellent quality. Annually sow 4,000 hectares under rice, with a yield of about 6,000 kg/ha. Also cultivated early garden crops produced in greenhouses, which are warmed with geothermal water.

In the light industry, the textile processing (ready-made production) prevails, the woodworking industry, construction and the largest number of small and medium enterprises are involved in the trade activity.

In the Municipality of Kocani there are active 1.403 business entities (as of 31.12.2013), of which 1021 are micro, 370 small, 11 medium and 1 large enterprises.

The business entities are mainly divided into the following sectors: trade (40%), processing industry (17%), transport (6%), agriculture (5%), construction (3%) and service activities (7%), while the remaining percentages refer to education, health, social protection, financial activities, administrative matters, arts, information and communications, and more.

		Active business subjects by size			
Kocani	Total	Micro	Small	Medium Sized	Large
	1 403	1 021	370	11	1



Measuring station Kocani (Figure 19.) – Kocani is a acity of 30 000 inhabitans in the Eastern Part of Macedonia. The maeasuring station in Kocani is located in the yard of the primary school "Ljupco Santov", at 6-7 m distance from a frequent road in the city center. Its GPS coordinates are N 41 ° 54'50" and E 22 ° 24'57", at an altitude of 349 m. The highway is 1,2 km away. There are no significant sources of emission from the heavy industry in Kocani.
Pair pollutant that are measured are O_3, NO_2, SO_2, CO and PM10.

Figure 19. Measuring station of MOEPP in Kocani

In Figure 20, a satellite image is given bearing the marks for the measuring station in Kocani and the measuring points where the ambient air quality is monitored.

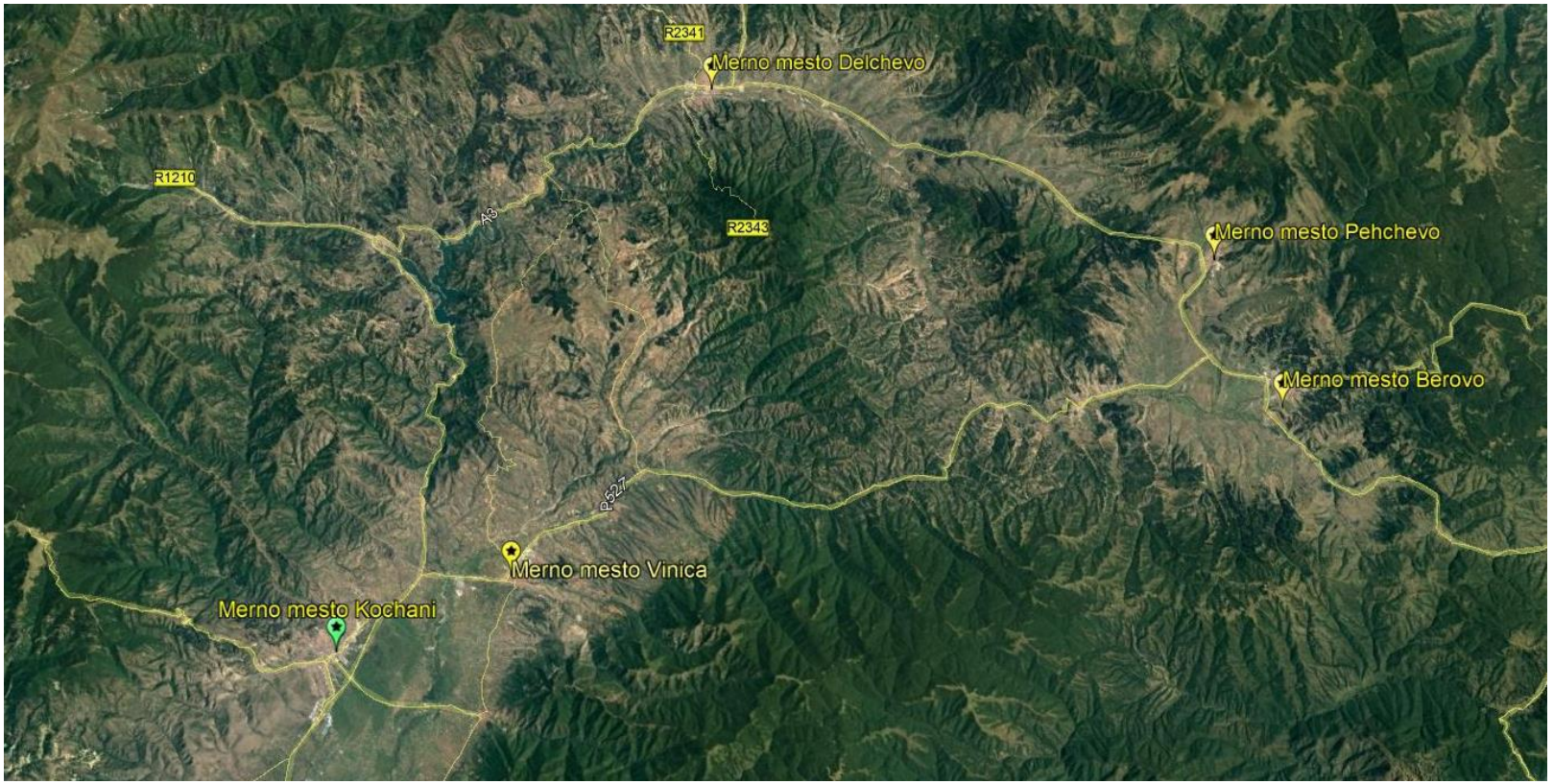


Figure 20. Measuring station in Kocani and measuring locations in the region for air quality determination

VII Results, processing and discussion

The results of the performed measurements of the ambient air quality in the four cities of the East Planning Region (Berovo, Vinica, Delcevo and Pehcevo) were processed for each parameter separately, and for the monitored period, concentrations of pollutants from the measuring network of the MOEPP in Kocani. The assessment was made on the basis of comparison with the limit values given for each parameter separately in the Decree on limit values for levels and types of pollutants in ambient air and alert thresholds, deadlines for achieving limit values, margins and tolerance for limit value, target values and long-term goals (Official Gazette of the Republic of Macedonia No. 50/05), hereinafter referred to as Regulation(s).

VII.1 Particulate Matter PM_{10}

VII.1.1 PM_{10} in summer season 2017

The summary of data for PM10 (24h averaged value) in the monitored period (08.07-20.07.2017), obtained from the measurements of the Ri-opusroject and the data from the State Automatic Monitoring Network for ambient air quality of the MOEPP are presented in Table 11. In the table, The results of the measurements of the PM10 are marked according to the air quality index markings in the table.

Table 11. Comparison of data Ri-opusproject - MOEPP for the monitored period

Measuring location	**Berovo**	**Vinica**	**Delcevo**	**Pehcevo**	**MOEPP Kočani**
Date	**PM10 (µg/m^3)**	**PM10 (µg/m^3)**	**PM10 (µg/m^3)**	**PM10 (µg/m^3)**	**PM10 (µg/m^3)**
08.07.2017	25,84				32,5
09.07.2017	21,7				43,2
11.07.2017				35,02	45,9
12.07.2017				33,8	43,8
16.07.2017			14,8		27,8
17.07.2017			13,06		29,1
19.07.2017		18,11			28,7
20.07.2017		28,78			33,9

Pollution	**Air Quality Index**	**Unit**	**Average period**
Very low	0-15	µg/m^3	24 hours
Low	15-30	µg/m3	
Medium	30-50	µg/m3	
High	50-100	µg/m3	
Very high	>100	µg/m3	

The graphic display of the campaign for monitoring the measuring parameter PM10 in the summer season 2017 is given in Figure 21.

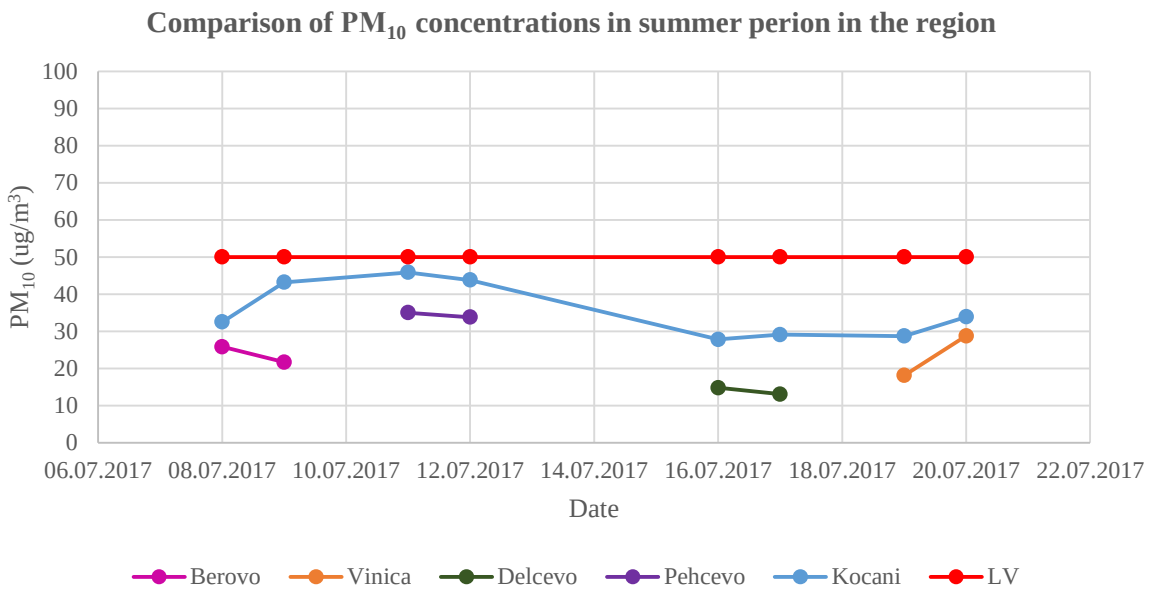
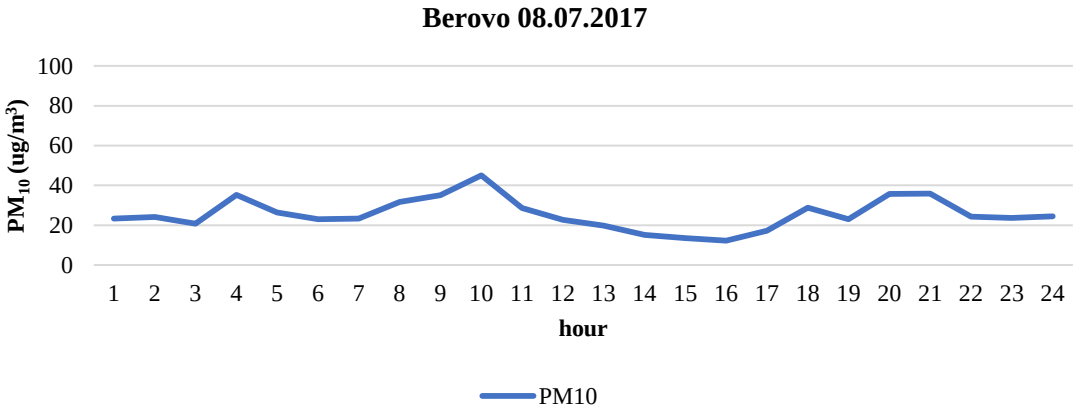


Figure 21. Results of the summer monitoring campaign 2017 for PM10 in the region

The results of the performed measurements of the concentration of PM10 at the four locations in the East Planning Region are presented and processed for each location separately. The presented results present average daily concentrations of suspended particles with a size <10 μm, values obtained from measurements in the period 08.07-20.07.2017.

1) Measuring location B – Municipality of Berovo

The results of the performed measurements of the concentration of PM10 with the measuring equipment installed in the yard of the Primary School "Dedo Iljo Malesevski" in Berovo for the examined period from 08.07 to 09.07 are shown, for each day separately and on a summary chart for the monitored period, compared with the limit value in regulation for 24 hours (Figure 22)



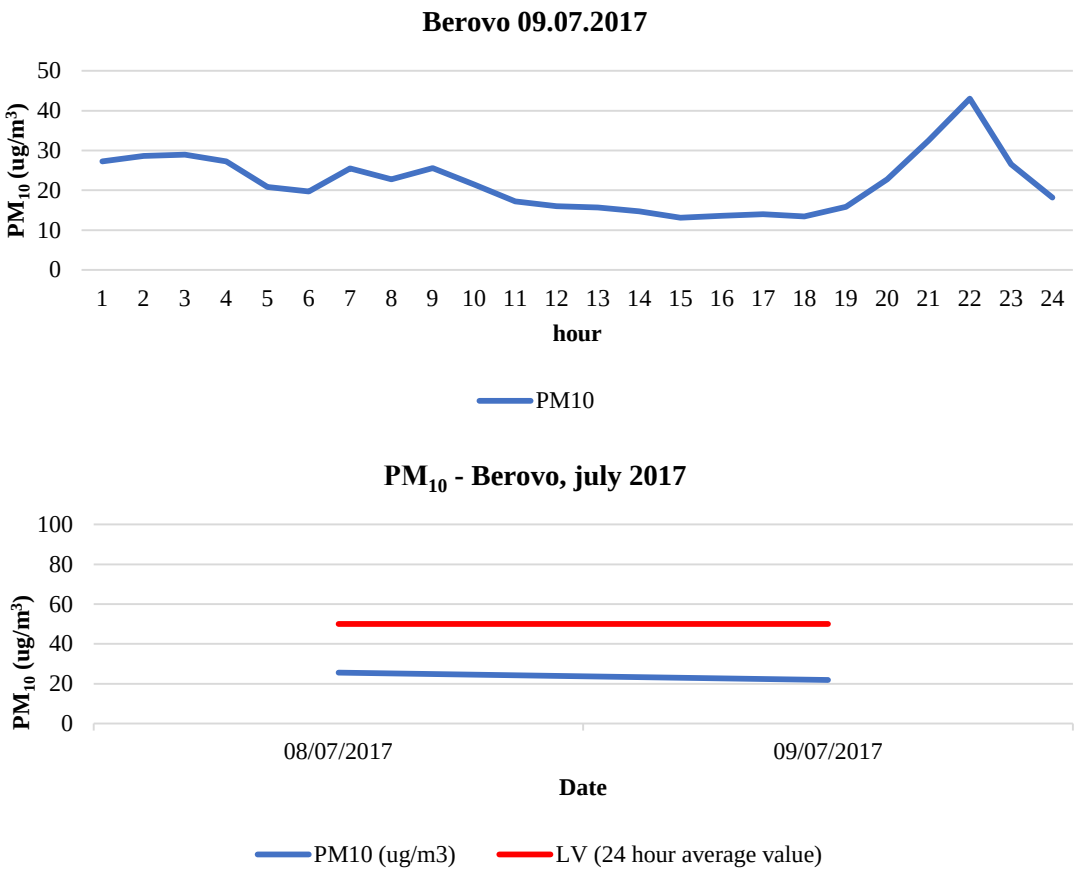
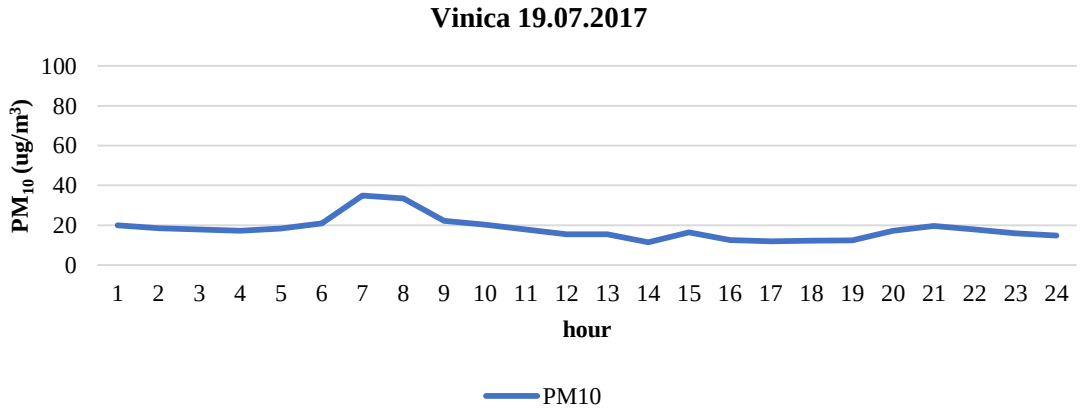


Figure 22. PM10 summer monitoring campaign in Berovo

2) Measuring location V – Municipality of Vinica

The results of the performed measurements of the concentration of PM10 with the measuring equipment installed in front of the administrative building of the municipality of Vinica for the examined period from 19.07 to 20.07 are shown, for each day separately and on a summary chart for the monitored period, compared with the limit value in regulation for 24 hours (Figure 23)



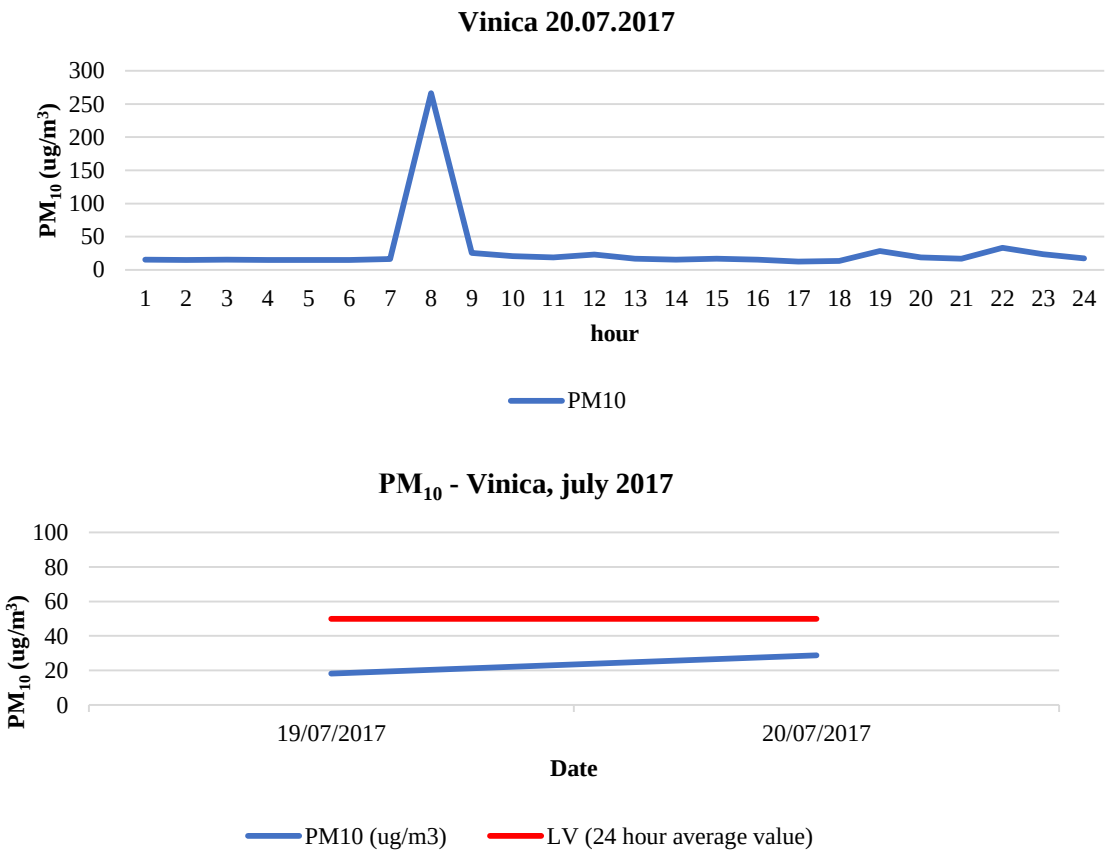
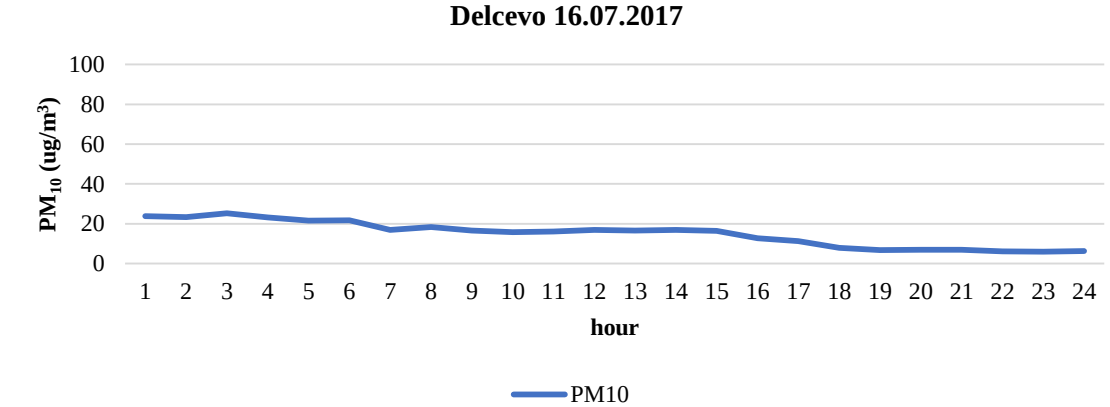


Figure 23. PM10 summer monitoring campaign in Vinica

3) Measuring location D – Municipality of Delcevo

The results of the performed measurements of the concentration of PM10 with the measuring equipment installed in center of Delcevo on Blvd „Nikola Jonkov Vapcarov" for the examined period from 16.07 to 17.07 are shown, for each day separately and on a summary chart for the monitored period, compared with the limit value in regulation for 24 hours (Figure 24)



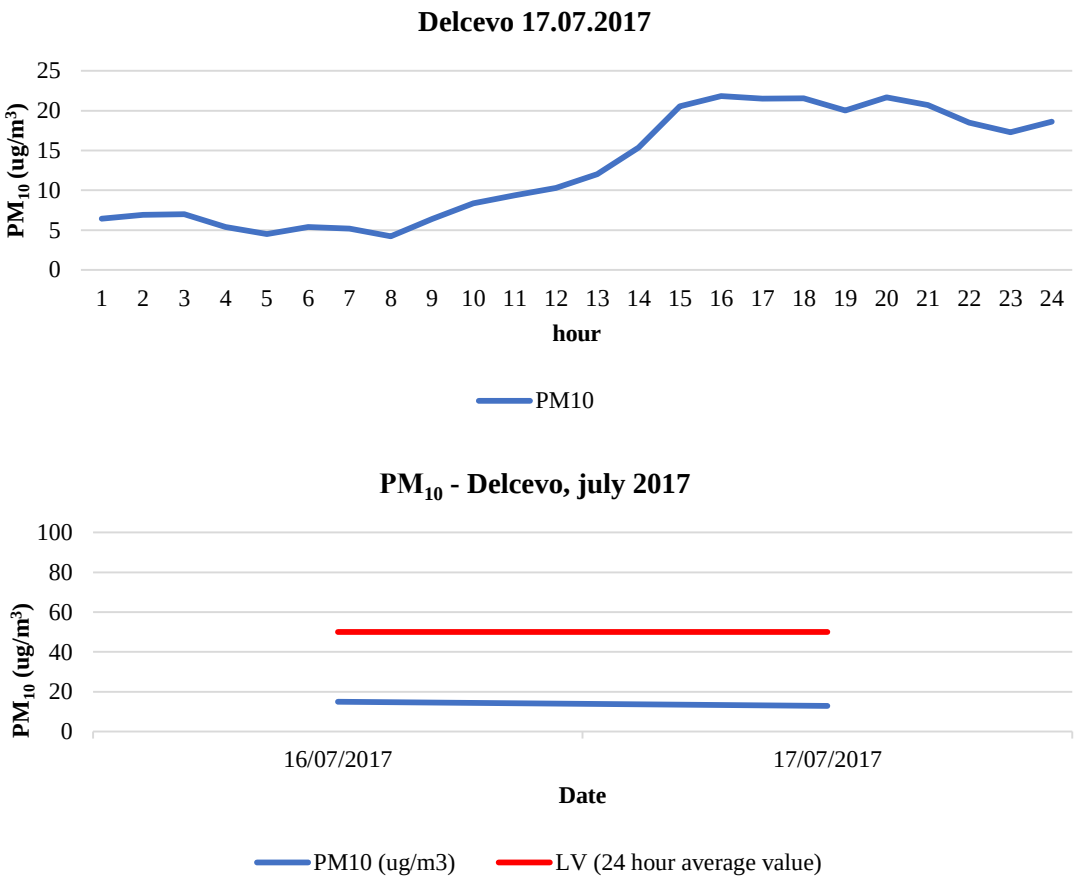


Figure 24. PM10 summer monitoring campaign in Delcevo

4) Measuring location P – Municipality of Pehcevo

The results of the performed measurements of the concentration of PM10 with the measuring equipment installed in front of the administrative building of the municipality of Pehcevo for the examined period from 11.07 to 12.07.2017 are shown, for each day separately and on a summary chart for the monitored period, compared with the limit value in regulation for 24 hours (Figure 25)

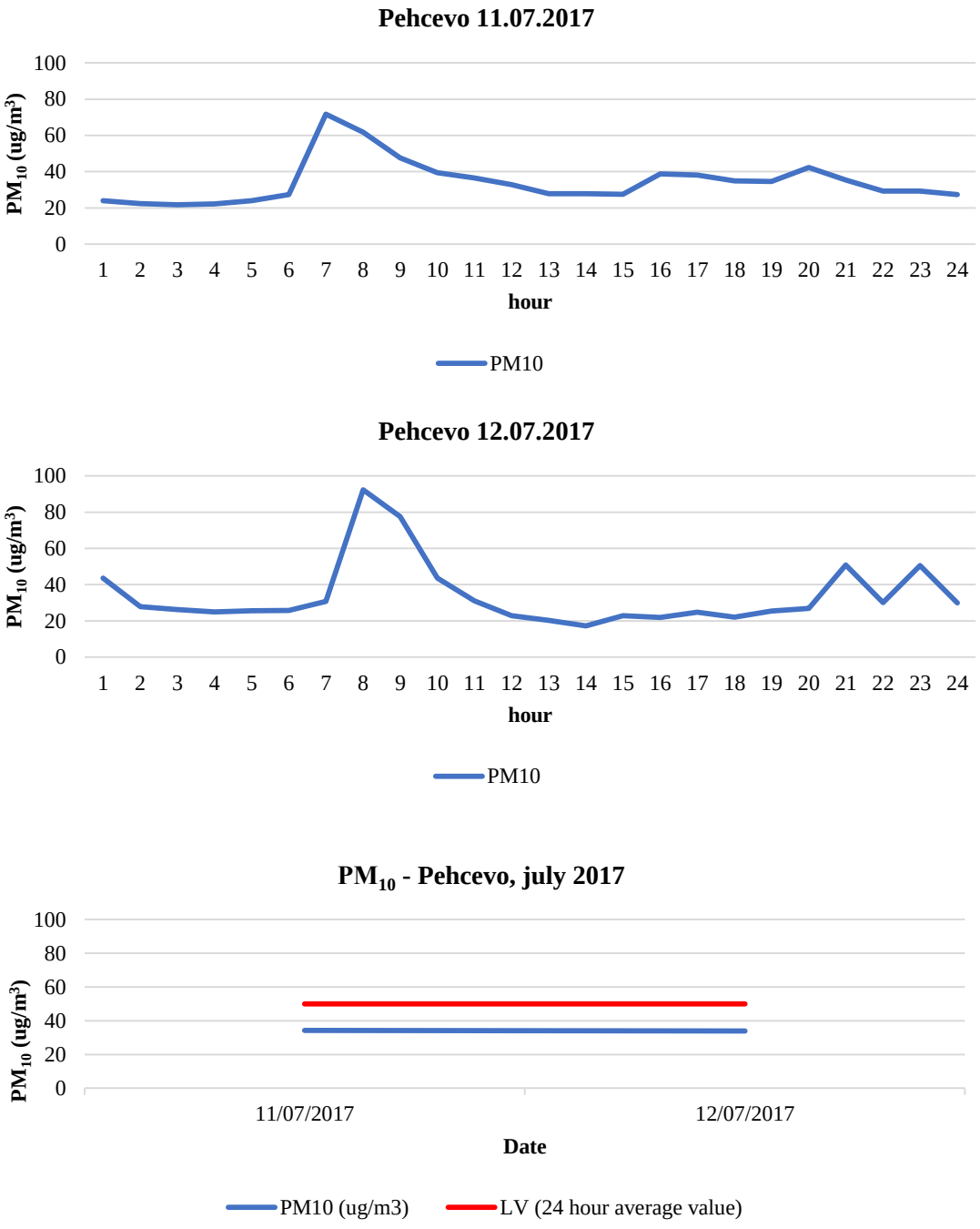


Figure 25. PM 10 summer monitoring campaign in Pehcevo

VII.1.2 PM_{10} in winter monitoring campaign 2017

The summary data for PM10 dust (24h averaging period) in the monitored period (23.10.19.11.2017), obtained from the measurements of the RI-opusproject and the data from the State Automatic Monitoring Network for ambient air quality of the MOEPP are presented in Table 12. The results of the measurement of the PM10 are marked according to the air quality index markings in the table.

Table 12. Comparison of data Ri-opusproject - MOEPP for the monitored period

Measuring location	**Berovo**	**Vinica**	**Delcevo**	**Pehcevo**	**MOEPP - Kocani**
Date	PM10 ($\mu g/m^3$)	PM10 ($\mu g/m^3$)	PM10 ($\mu g/m^3$)	PM10 ($\mu g/m^3$)	PM10 ($\mu g/m^3$)
20.10.2017		45,05			53,8
21.10.2017		36,21			50
22.10.2017		42,7			48,3
23.10.2017		42,37			45
24.10.2017					28,6
25.10.2017			13,12		31,8
26.10.2017			33,47		34,8
27.10.2017			41,61		46
28.10.2017			18,4		38,7
29.10.2017			26,2		34,6
30.10.2017			28,69		19,8
01.11.2017					37,9
02.11.2017				38,35	55,3
03.11.2017				47	87,9
04.11.2017				31,42	68,7
05.11.2017				40,35	63,8
06.11.2017					54,9
07.11.2017	34,85				43,4
08.11.2017	42,36				54,3
09.11.2017	59,73				52,5
10.11.2017	64,97				73,5
11.11.2017	60,99				72,9
12.11.2017	66,38				39
13.11.2017					40
14.11.2017		50,05			48,5
15.11.2017		43,08			46
16.11.2017		39,14			48,3
17.11.2017		30,91			34,8
18.11.2017		34,79			40,6
19.11.2017		36,68			41

Pollution	Air Quality Index	Unit	Average period
Very low	0-15	µg/m^3	24 hours
Low	15-30	µg/m3	
Medium	30-50	µg/m3	
High	50-100	µg/m3	
Very high	>100	µg/m3	

The graphic display of the campaign for monitoring the measuring parameter PM10 in the winter season 2017 is given in Figure 26.

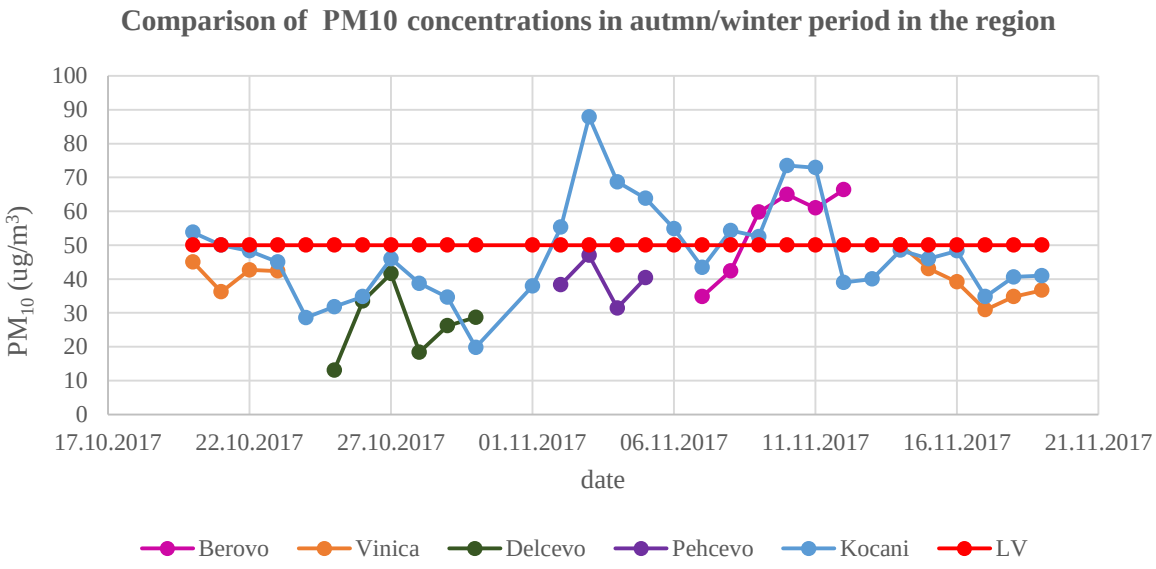


Figure 26. Results of the winter monitoring campaign 2017 for PM10 in the region

The results of the performed measurements of the concentration of PM10 at the four locations in the East Planning Region are presented and processed for each location separately. The presented results represent average daily concentrations of suspended particles with a size <10 µm, values obtained from measurements in the period 20.10.-19.11.2017.

5) Measuring location B – Municipality of Berovo

The results of the performed measurements of the concentration of PM10 with the measuring equipment installed in the yard of the Primary School "Dedo Iljo Malesevski" in Berovo for the examined period from 07.11.2017 to 12.11.2017 are shown as an hourly averaging values and also on a summary chart for the monitored period, compared with the limit value in regulation for 24 hours (Figure 27)

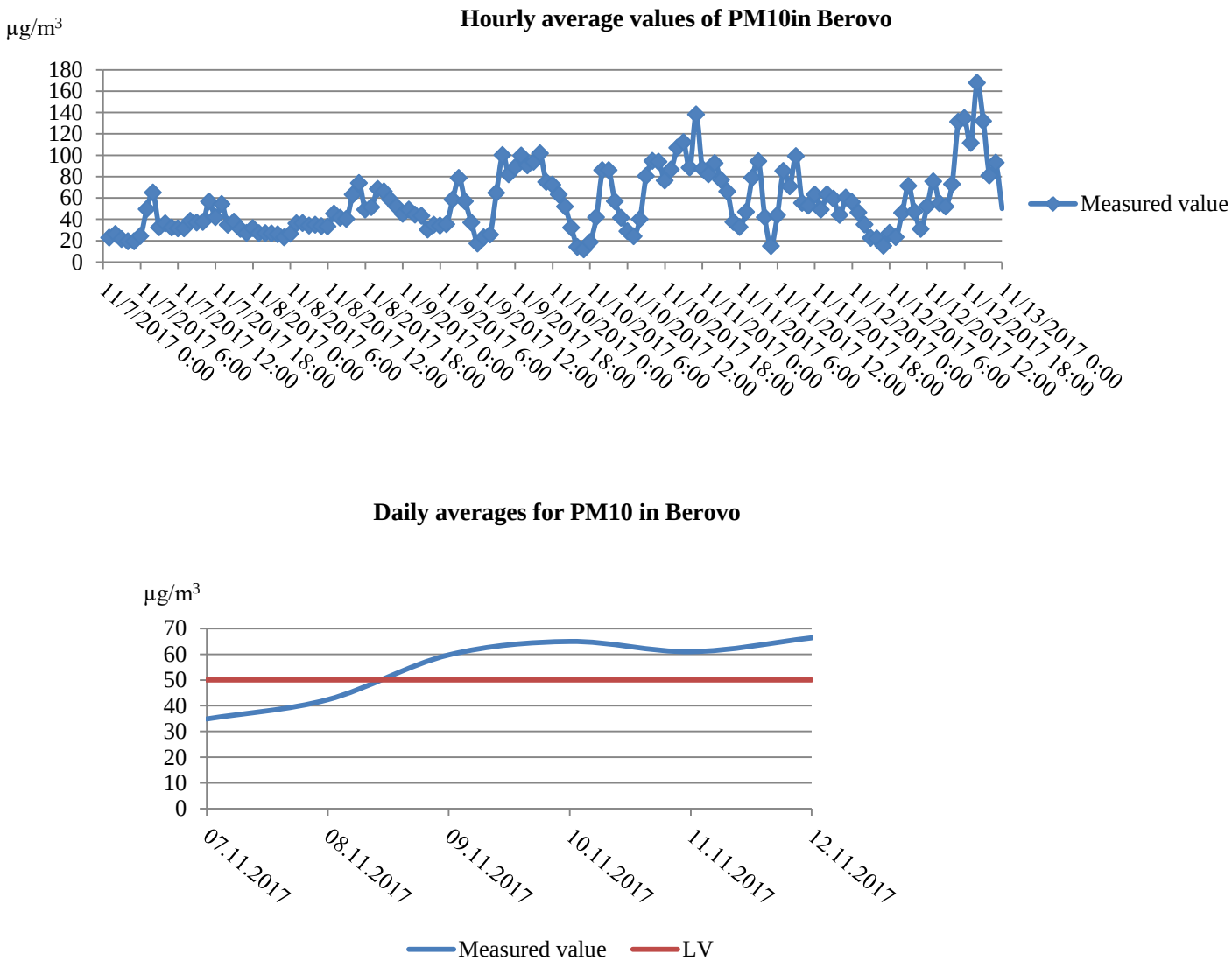
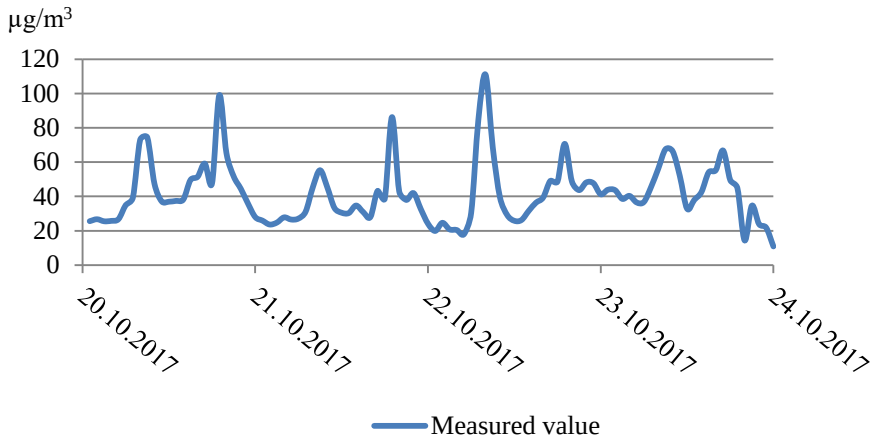


Figure 27. PM 10 in winter monitoring campaign in Berovo

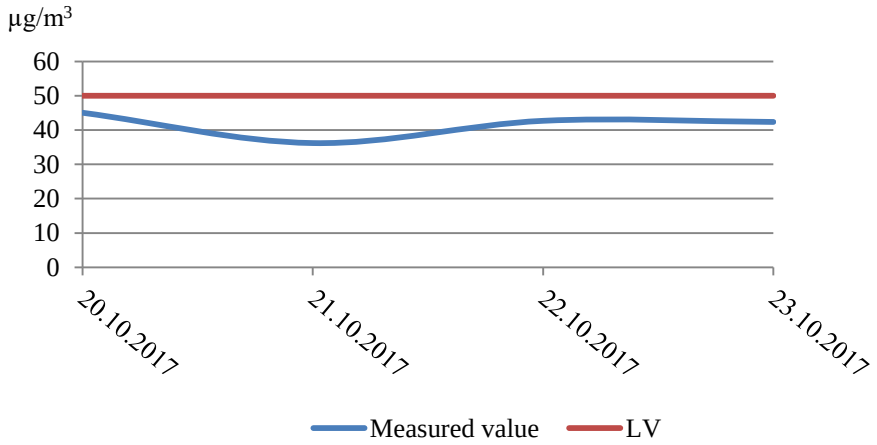
6) Measuring location V – Municipality of Vinica

The results of the performed measurements of the concentration of PM10 with the measuring equipment installed in the administrative building of Municipality of Vinica for the examined period from 20.10.2017 to 24.10.2017 and 14.11.2017 to 20.11.2017 are shown as an hourly averaging values and also on a summary chart for the monitored period, compared with the limit value in regulation for 24 hours (Figure 28)

Hourly average values of PM10 in Vinica



Daily averages of PM10 in Vinica



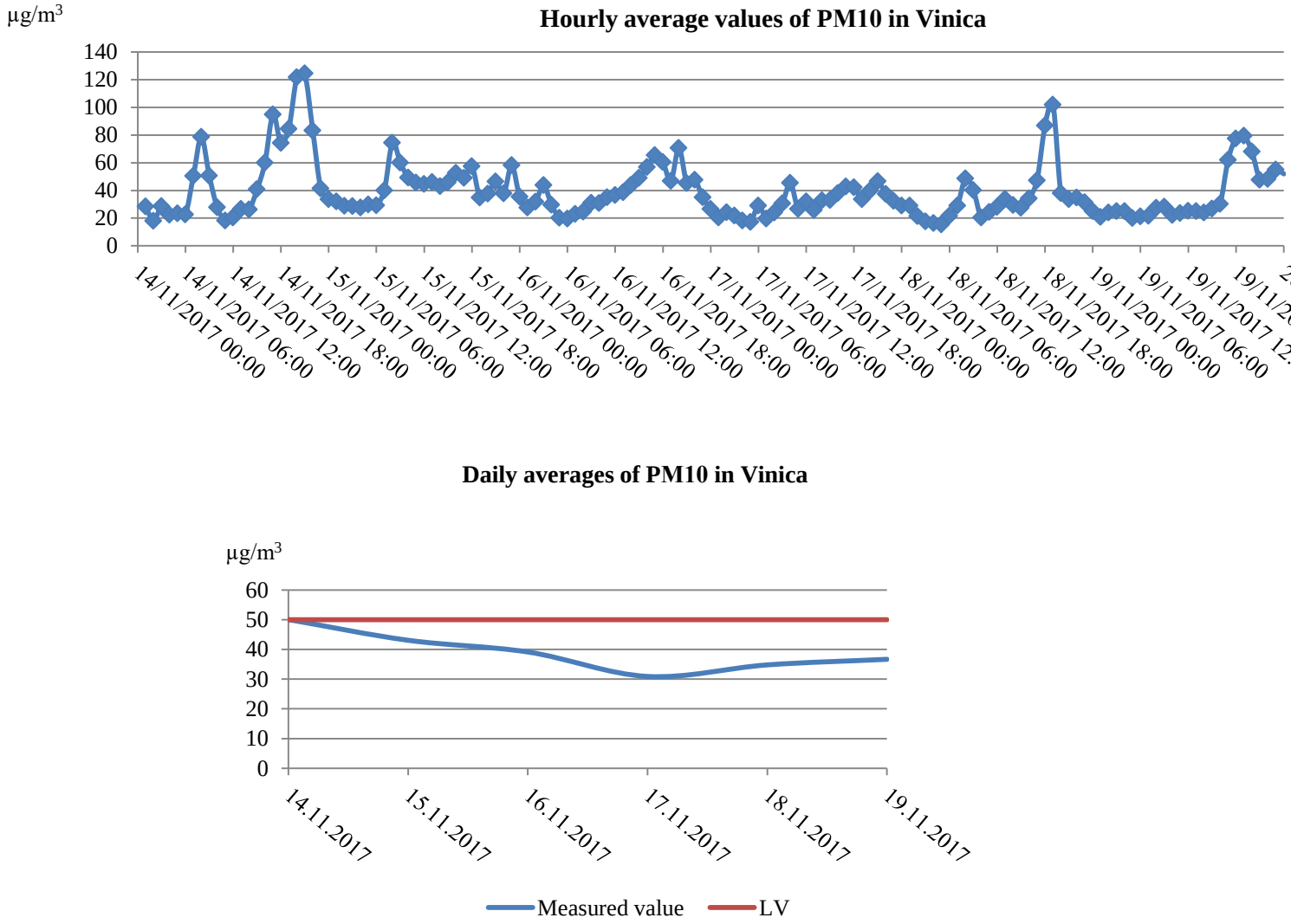


Figure 28. PM 10 in winter monitoring campaign in Vinica

7) Measuring location D – Municipality of Delcevo

The results of the performed measurements of the concentration of PM10 with the measuring equipment installed in the center of Delcevo on Blvd.„Nikola Jonkov Vapcarov" for the examined period from 25.10.2017 to 31.10.2017 are shown as an hourly averaging values and also on a summary chart for the monitored period, compared with the limit value in regulation for 24 hours (Figure 29)

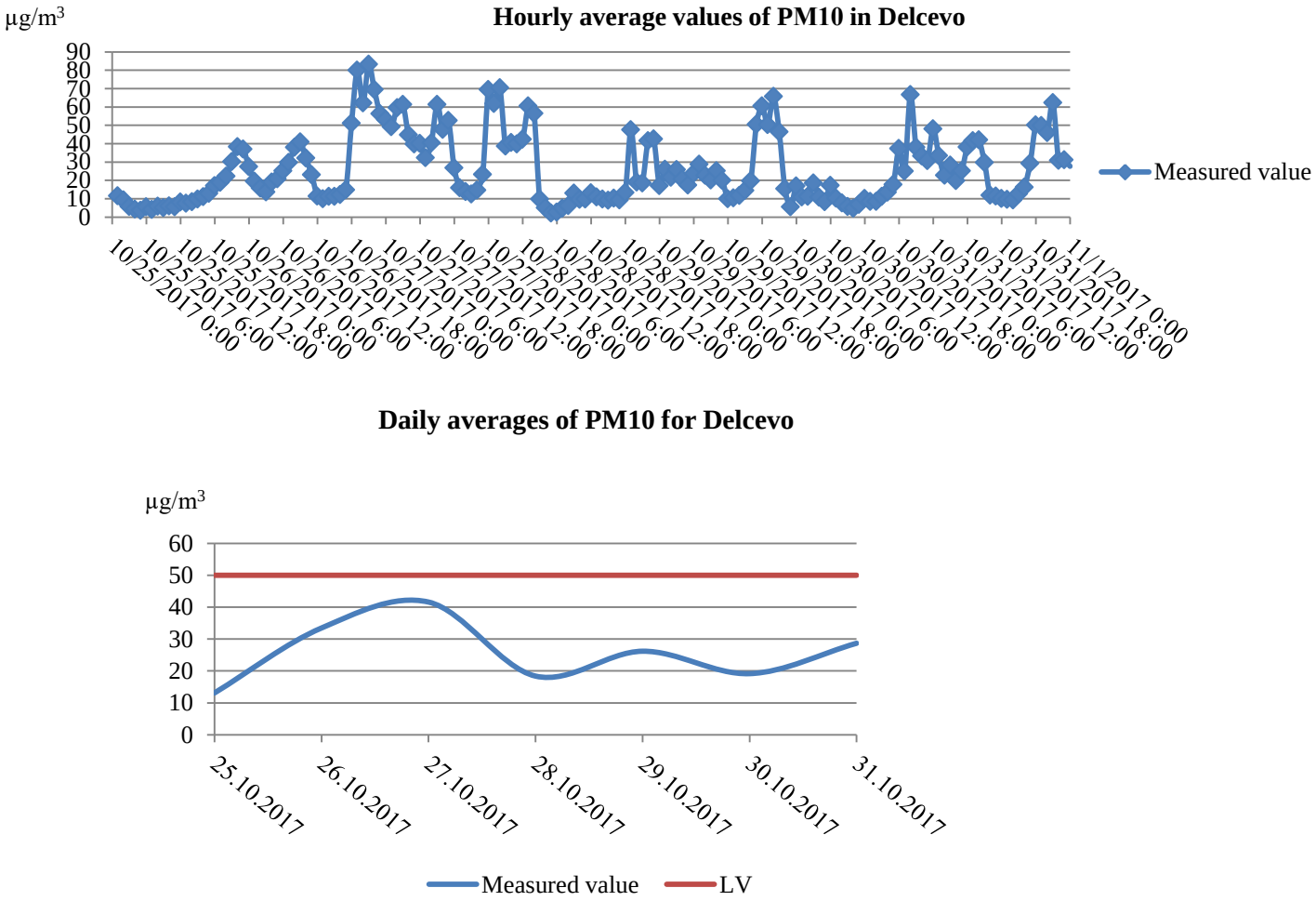
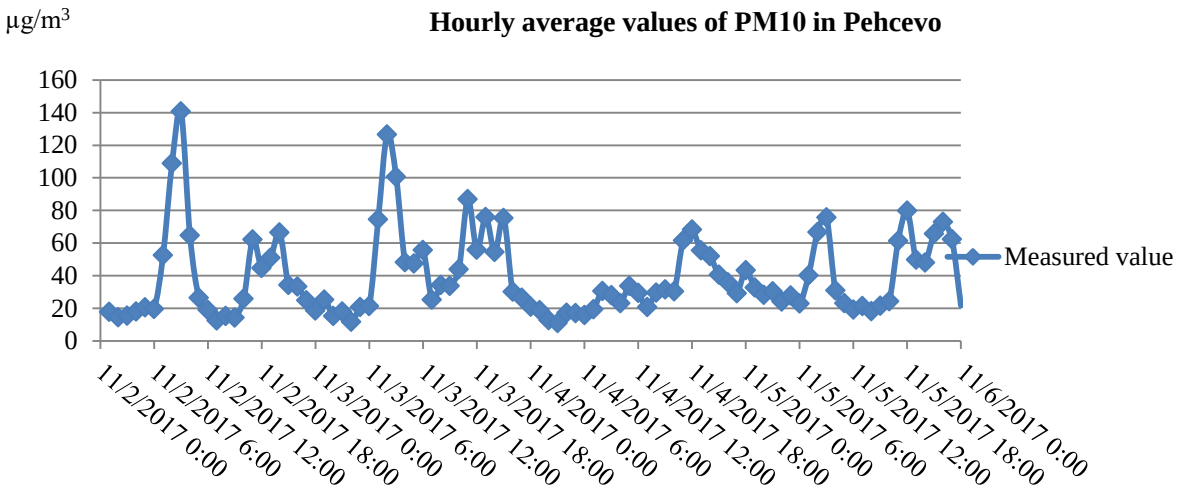


Figure 29. PM 10 in winter season in Delcevo

8) Measuring location P – Municipality of Pehcevo

The results of the performed measurements of the concentration of PM10 with the measuring equipment installed in front of the administrative building of municipality of Pehcevo for the examined period from 02.11.2017 to 06.11.2017 are shown as an hourly averaging values and also on a summary chart for the monitored period, compared with the limit value in regulation for 24 hours (Figure 30)



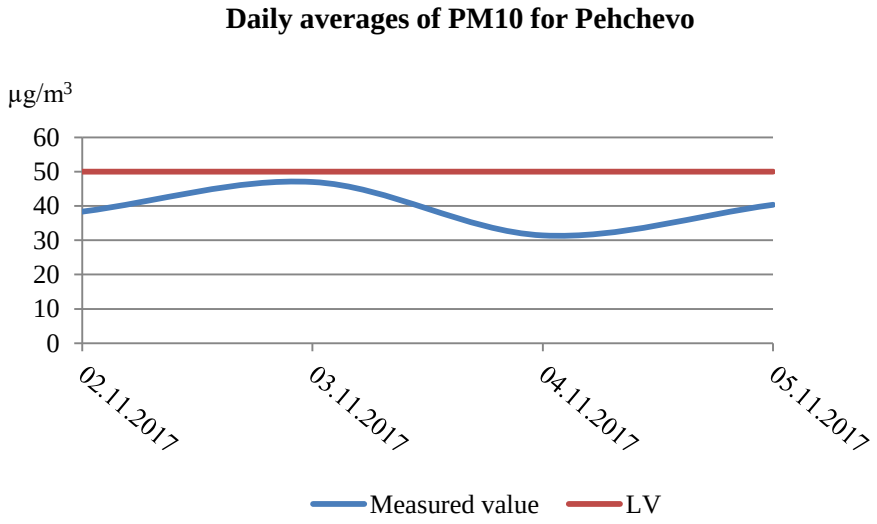


Figure 30. PM 10 in winter season in Pehcevo

The results of PM10 in the city of Kocani compared to the other cities in the Republic of Macedonia.

The annual averages for PM10 at the monitoring stations for the cities in the Republic of Macedonia are presented on the following figure.

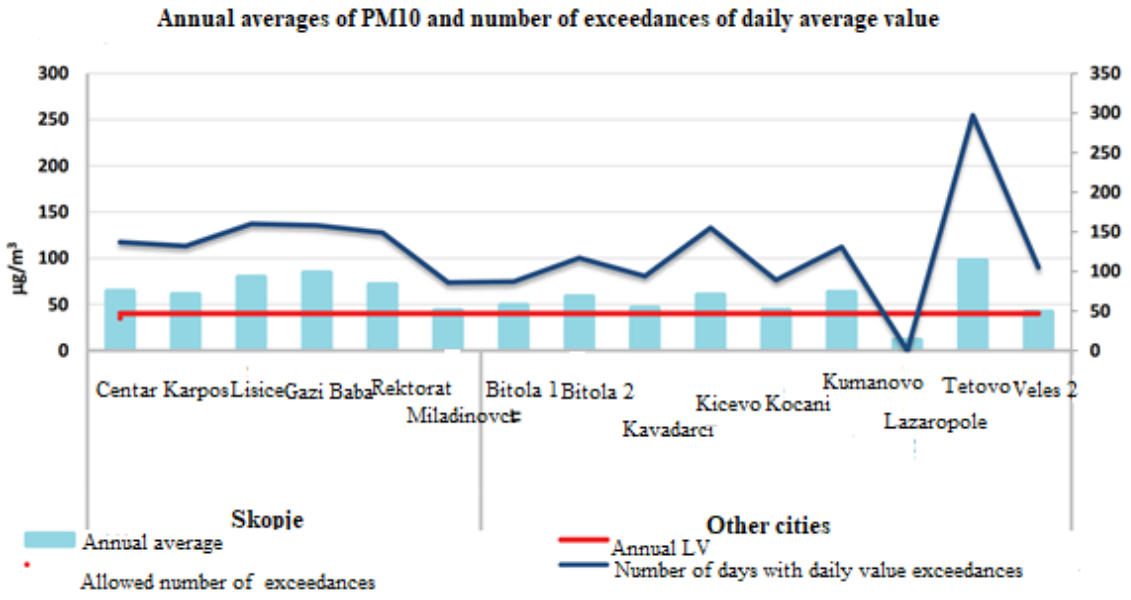


Figure 31.

From Figure 31 it can be concluded that the city of Kocani, located near the cities where an indicative monitoring of ambient air is performed in the East Planning Region (Delcevo, Pehcevo, Berovo and Vinica) in relation to the quality of ambient air with PM10 belongs to the environments with lower pollution compared to cities like Skopje, Bitola, Kumanovo and Kichevo. The quality of ambient air in the city of Kocani corresponds more to urban areas in Kavadarci and Veles.

VII.1.3 Conclusion for PM10

Hourly average values

For the parameter PM10 there are no hourly average limit values, but CITEAIR, the European Union, has established an ambient air quality index, which is also applied by the MOEPP.

If we compare the hourly averaged values for PM10 with respect to the index of ambient air quality for the summer period for Berovo, Delcevo, Pehcevo and Vinica, the following conclusion can be drawn:

- Very low pollution during the whole period of examination in the town of Delcevo, i.e. no peaks were observed.
- The index of air pollution for the city of Vinica in the morning (07-09 h) indicates low to very high pollution, while low-pollution indexes are remarked at evening and night (19-22 hours)
- The index of air pollution for the city of Pehcevo indicates from medium to high pollution were in the morning (07-09 h), while low-pollution is indicated in night and night (20-23 hours)
- For the city of Berovo, in the morning (07-09 hours), as well as in the evening and night (20-23 hours), there are low indexes of air pollution

If we compare the hourly values for PM10 with respect to the ambient air quality index for the autumn and winter period for Berovo, Delcevo, Pehcevo and Vinica, the following conclusion can be drawn:

- Medium pollution during the morning (07-09 h) and during the night of night (19 -23 h) during the examination in the city of Delcevo was registered.
- During the morning (07-09h) and during the evening and night (19-23h), from medium to high air quqliaty index was registered in Vinica and Pehcevo
- Medium air quality index was recorded in Berovo in the morning (07-09 h), while in the period from 16 to 23 h an index of high pollution was registered.

Daily averages of PM10

The limit value for the 24 hour and average annual concentration of PM10 is prescribed in the Decree on limit values for levels and types of polluting substances in ambient air and alert thresholds, deadlines for achieving limit values, margins and tolerance for limit values, target values and long-term goals.

The city of Kocani is a urban environment where it can be concluded that ambient air quality regarding PM10 is one of the lowest in the country. If a retrospective of the average annual values of PM10 for the city of Kocani is made, it can be concluded that in the last 3 years the average value has been exceeded and shows a slight downward trend.

From a retrospective of the average monthly values of PM10 for the city of Kocani in 2016 can be concluded that from November to February, where the average monthly value of PM10 is from 50 $\mu g/m^3$ in February to 77 $\mu g/m^3$ in December, can be characterized as critical months.

The comparison of the average concentrations of PM10 in the city of Kocani with the rest of the cities given in Table 11 (summer period) and Table 12 (autumn winter period) is shown in Table 13.

Table 13

City	**Berovo**	**Kocani - MOEPP**	**Vinica**	**Kocani - MOEPP**	**Delcevo**	**Kocani - MOEPP**	**Pehcevo**	**Kocani - MOEPP**
Parameter	**PM10 ($\mu g/m^3$)**	**PM10 ($\mu g/m^3$)**	**PM10 ($\mu g/m^3$)**	**PM10 ($\mu g/m^3$)**	**PM10 ($\mu g/m^3$)**	**PM10 ($\mu g/m^3$)**	**PM10 ($\mu g/m^3$)**	**PM 10($\mu g/m^3$)**
Average value for the monitored period (July-October-November)	47,1	51,4	37,3	43,2	23,7	32,8	37,7	60,9
Average value for the monitored period July	23,8	37,9	23,4	31,3	13,9	28,5	34,4	44,9
Average value for the monitored period October-November	54,9	55,9	40,1	45,6	26,9	34,3	39,3	68,9

From the comparison for the entire period of examination (summer and autumn/winter measuring campaign) given Table 13 can be concluded as follows:

- Concentration of PM10 in the city of Kocani is higher than the same in Berovo by 8%.
- Concentration of PM10 in the city of Kocani is higher than the same in Vinica by 14%.
- Concentration of PM10 in the city of Kocani is higher than the same in Delcevo for 28%.
- Concentration of PM10 in the city of Kocani is higher than the same in Pehcevo by 40%.

From the comparison for the period of the summer monitoring campaign given in Table 13 it can be concluded that the concentration of PM10 in the city of Kocani is significantly higher than the other cities, i.e. it is higher by 23% from the city of Pehcevo, 25% from the city of Vinica, 37% from the city of Berovo and 51% from the city of Delcevo.

From the comparison of the average results for PM10 for each city separately in the autumn/ winter monitoring campaign given in Table 13 can be concluded as follows:

- The concentration of PM10 in the city of Kocani is almost identical to that in the city of Berovo.
- The concentration of PM10 in the city of Kocani is higher than Vinica by 12%.
- The concentration of PM10 in Kocani is higher than Delcevo by 21%.
- The concentration of PM10 in the city of Kocani is higher than the same in Pehcevo by 43%.

From the locations covered by indicative monitoring in Berovo, Delcevo, Pehcevo and Vinica as well as the stationary mobile station in Kocani given in Table 11 of the summer period and Table 12 from the autumn/winter period a sublimate was made showing the number of exceedances of the daily limit value.

Table 14.

PM_{10}	Berovo	Vinica	Delcevo	Pehcevo	Kocani - MOEPP
Number of exceedances of daily limit values during a summer campaign (July 2017)	0/2	0/2	0/2	0/2	0/8
Number of exceedances of daily limit values during a autmn/winter campaign (October – November 2017)	4/6	1/10	0/6	0/4	11/30

From Table 14 it can be concluded that in the summer period there were no exceedances of the prescribed limit values, whereas in the autumn/winter period there are exceedances in Vinica, Berovo and Kocani.

In the city of Pehcevo and Delcevo, the limit value was not exceeded, with a note that during periods of examination in the town of Delcevo, there was no exceeding of limit value neighter in the city of Kocani, while in the period of examination in the town of Pehcevo, the monitoring station in Kocani showed values above лимит валуес in the entier period.

VII.2 Results for sulfur dioxide (SO2)

The ambient air quality index for SO_2 has been established by CITEAIR, European Union, which is also applied by the Ministry of Environment and Physical Planning of the Republic of Macedonia. Macedonia is shown in picture 21.

Pollution	Air Quality Index	Unit	Averaging period
Very low	0-50	µg/m^3	24 h
Low	50-100	µg/m3	
Medium	100-350	µg/m3	
High	350-500	µg/m3	
Very high	>500	µg/m3	

Figure 32.

VII.2.1 SO2 in the summer monitoring camapaign 2017

The summary data for SO2 (24h value) in the monitoring period (08.07-20.07.2017), obtained from the measurements of the RI project and the data from the State Automatic Monitoring System for ambient air quality of the MOEPP are presented in Table 15.

Table 15. Comparison of data Ri-posproekt - MOEPP for the monitoring period

Measuring location mesto	Berovo	Vinica	Delcevo	Pehcevo	MOEPP in Kočani
Date	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3
08.7.2017	2,7				0,8
09.7.2017	2,5				1
11.7.2017				1,6	1,16

12.7.2017				3,4	1,02
16.7.2017			1,7		0,86
17.7.2017			6,2		0,95
19.7.2017		2,2			1,04
20.7.2017		1,6			2,16

Pollution	Air Quality Index	Unit	Average period
Very low	0-50	µg/m^3	24 hours
Low	50-100	µg/m3	
Medium	100-350	µg/m3	
High	350-500	µg/m3	
Very High	>500	µg/m3	

The graphic representation of the measurement campaign for monitoring the measurement parameter SO2 in the summer season 2017 is given in Figure 33.

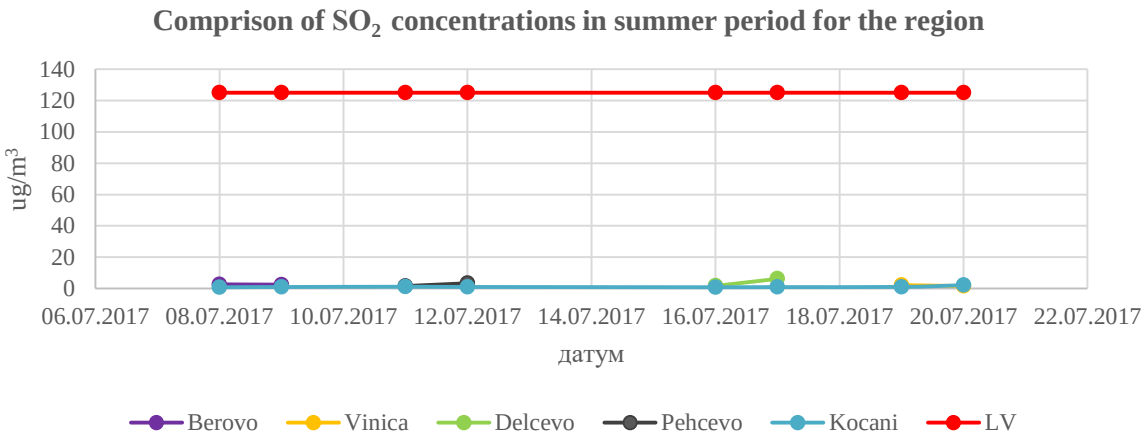


Figure 33. Overview of the entire monitoring campaign for tracking the SO_2 in the summer monitoring campaign

1) Measuring location in Berovo

In Figure 34 graphical measurements of the measurement of sulfur dioxide in ambient air in real time for the period of the measurement campaign 08-09.07.2017 where the results of the measurement are compared with 1 hour limit values.

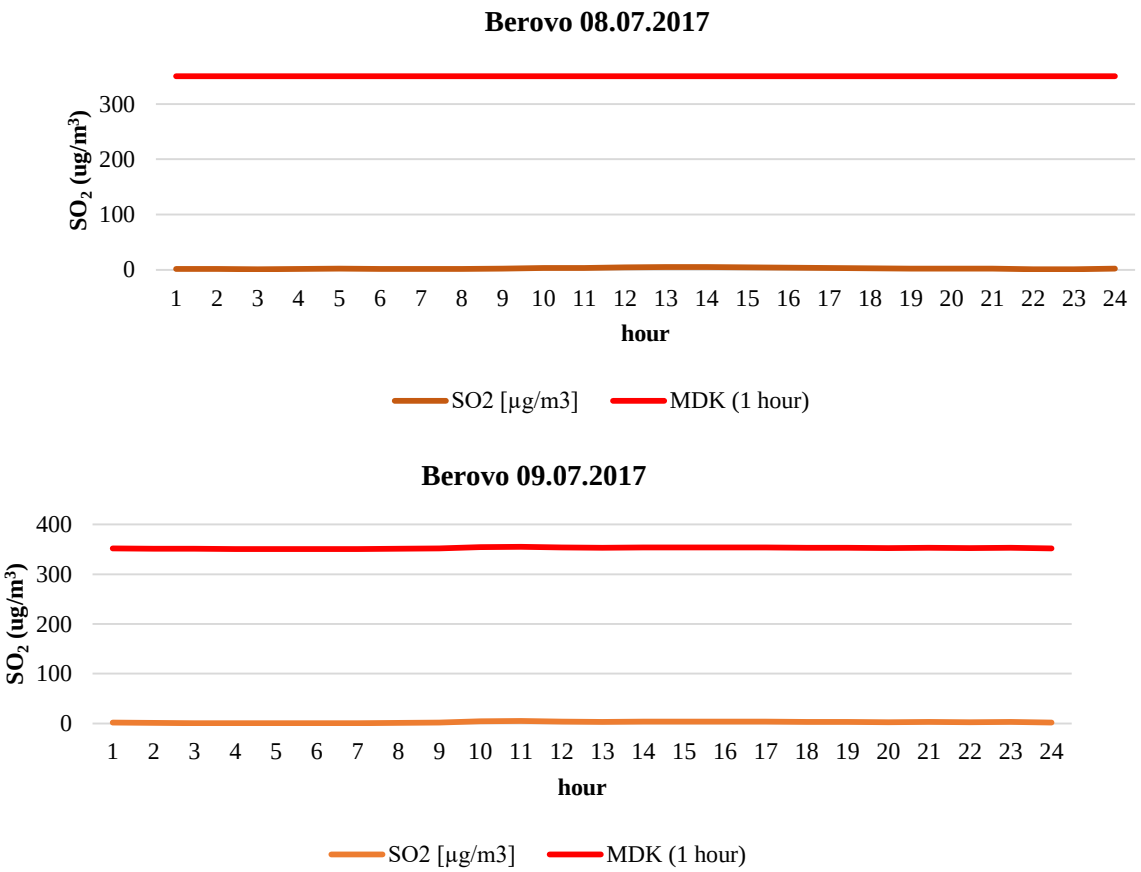


Figure 34.

Figure 35 shows a graph of the comparison of daily values with the daily limit values for sulfur dioxide in ambient air.

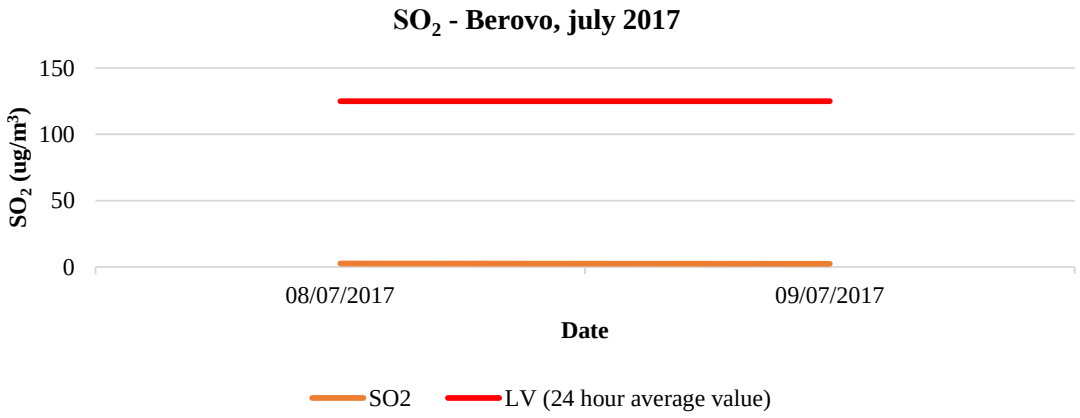


Figure 35.

2) Measuring location in Vinica

Figure 36 shows a graphical representation of the measurement of sulfur dioxide in ambient air in real time for the period of the measurement campaign 19-20.07.2017 where the results of the measurement are compared with 1 hour limit values.

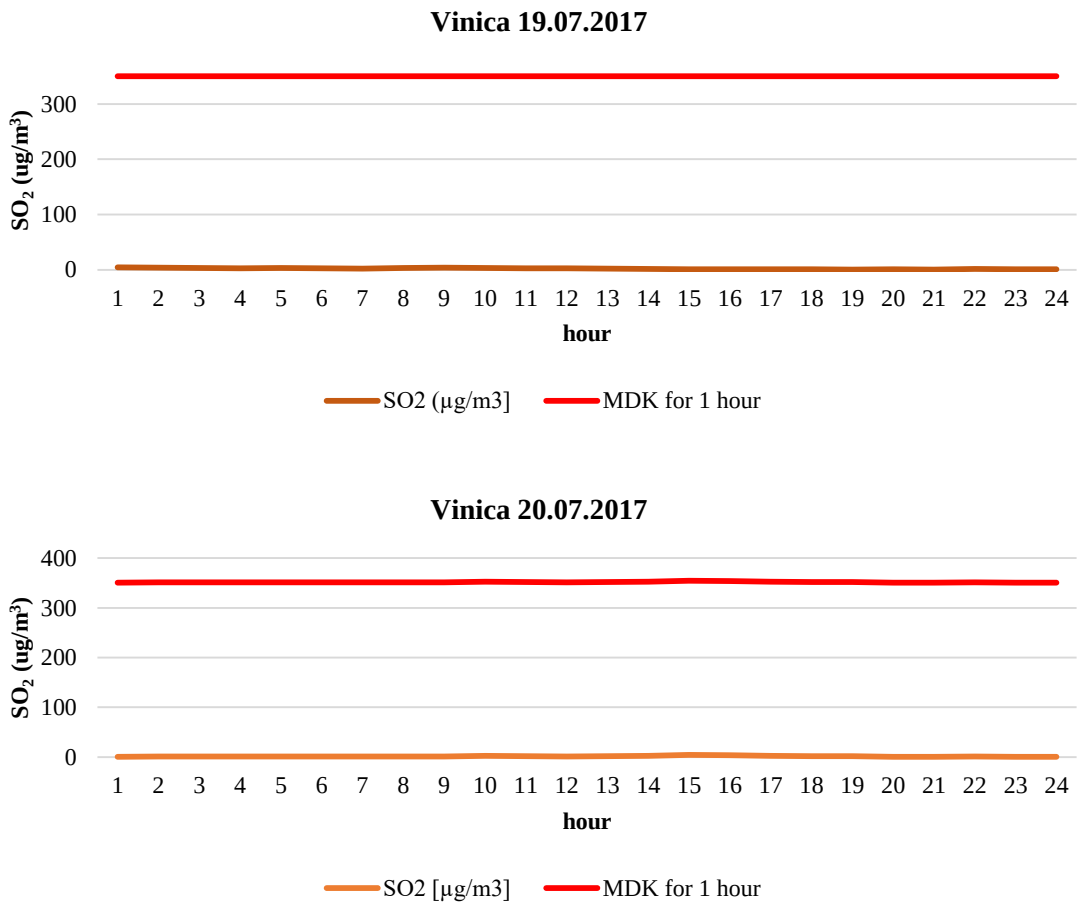


Figure 36.

Figure 37 shows a graphic representation of the comparison of daily values with the limit values for sulfur dioxide in ambient air.

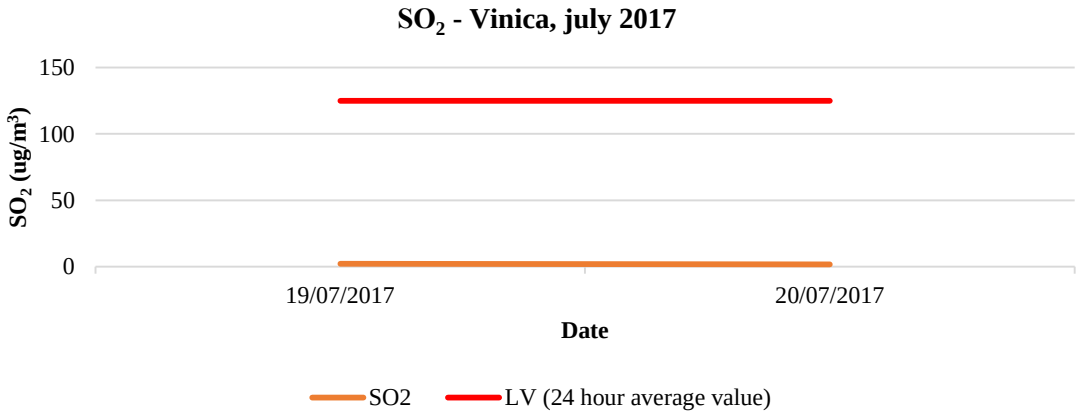


Figure 37.

3)Measuring place in Delcevo

In Figure 38 is a graphical representation of the measurement of sulfur dioxide in ambient air in real time for the period of the measurement campaign from 16 to 17.07.2017, where the results of the measurement are compared with 1 hour limit values.

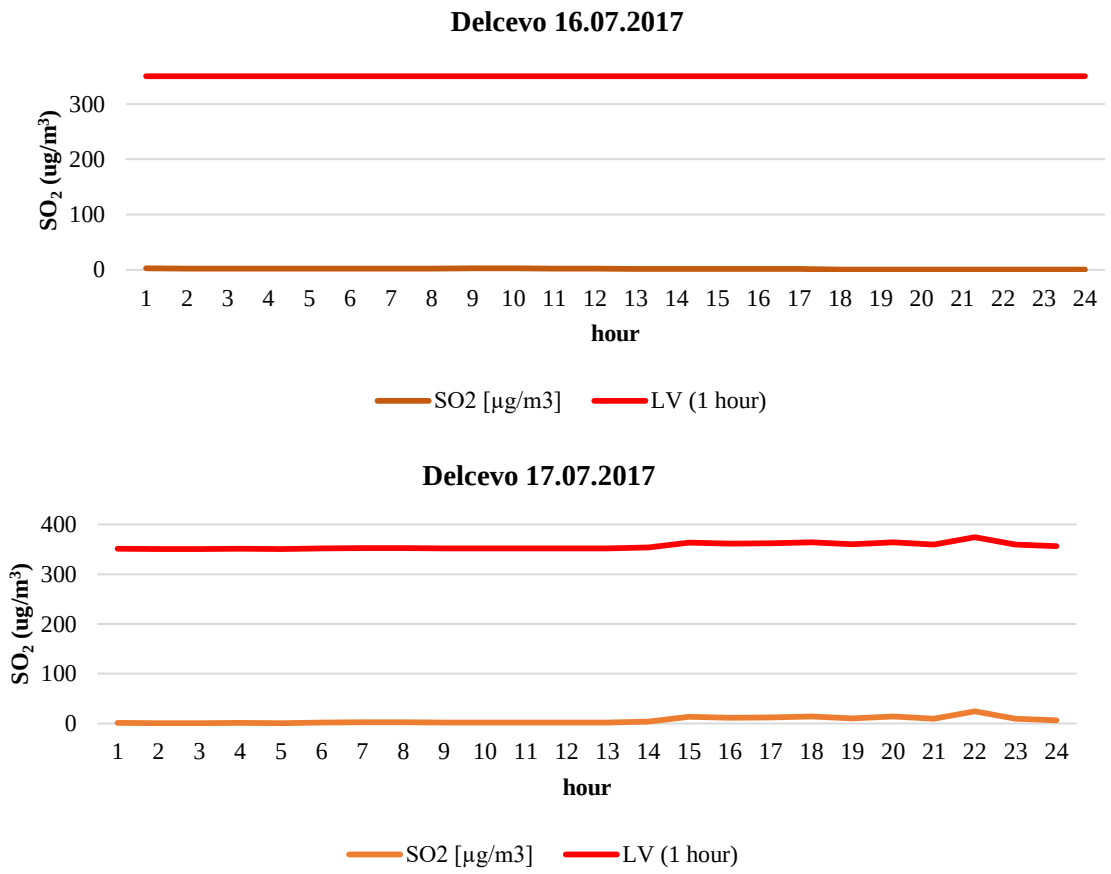


Figure 38.

In Figure 39 is given graphic representation of the comparison of daily values with the limit values for sulfur dioxide in ambient air.

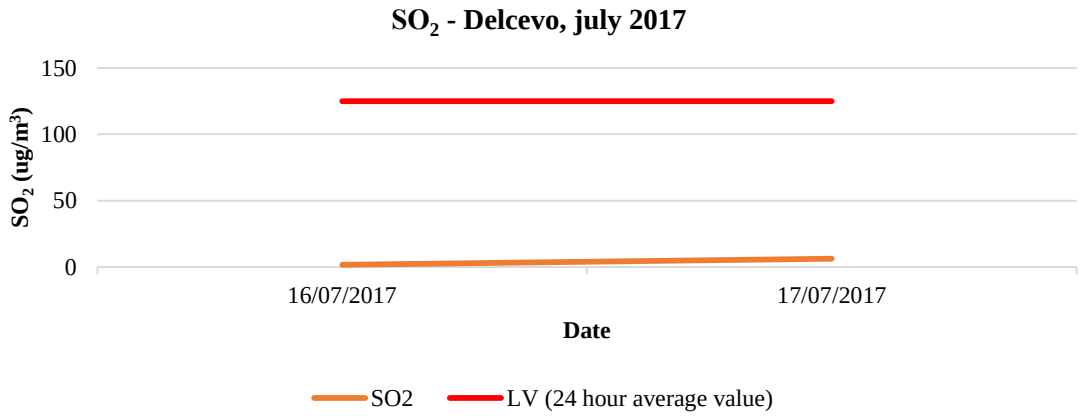


Figure 39.

4) Measurement location in Pehcevo

In Figure 40 is a graphic representation of the measurement of sulfur dioxide in ambient air in real time for the period of the measurement campaign 11 to 12.07.2017, where the results of the measurement are compared with 1 hour limit values.

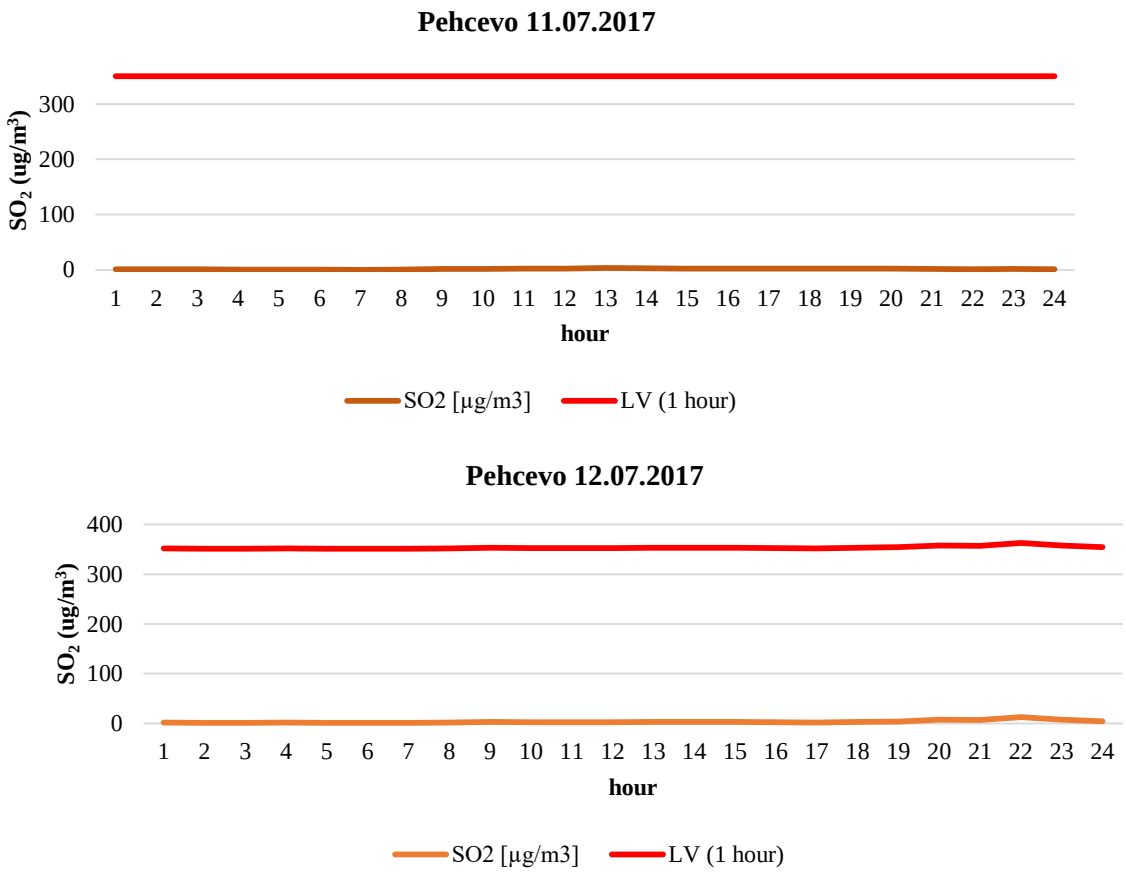


Figure 40.

In Figure 41 is given a graphic representation of the comparison of daily values with the limit values for sulfur dioxide in ambient air.

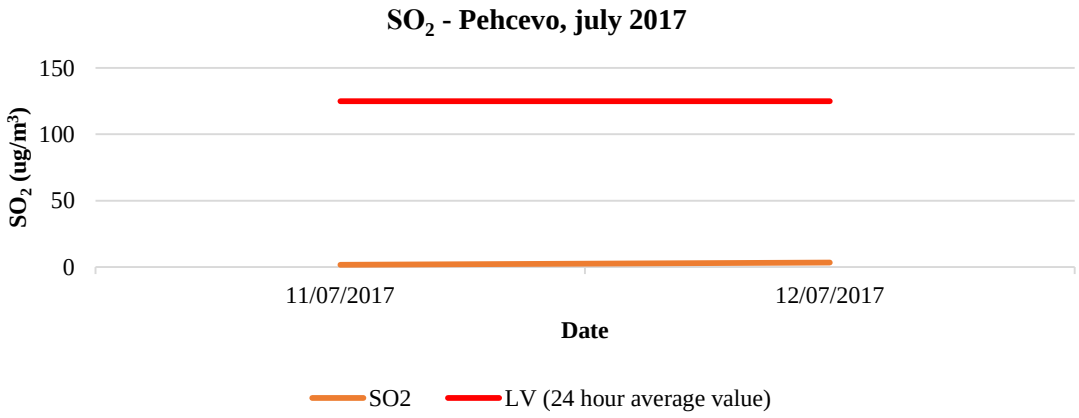


Figure 41.

VII.2.2 Autumn winter measuring campaign

The summary data for SO2 (24h value) in the monitored period (23.10-19.11.2017), obtained from the measurements of the Ri-opusproject and the data from the State Automatic Monitoring System for ambient air quality of the MOEPP are presented in Table 16.

Table 16. Comparison of data Ri-posproekt - MOEPP for the monitoring period

Measuring location / Date	Berovo	Vinica	Delcevo	Pehcevo	MOEPP Kocani
20.10.2017		5,0			1,51
21.10.2017		3,4			1,12
22.10.2017		3,3			1,55
23.10.2017		1,2			0,68
24.10.2017					0,56
25.10.2017			2,6		0,63
26.10.2017			5,5		0,63
27.10.2017			5,2		0,77
28.10.2017			4,3		0,64
29.10.2017			6,9		0,72
30.10.2017			4,2		1,02
31.10.2017			8,7		0,80
02.11.2017				5,7	1,04
03.11.2017				5,9	0,65
04.11.2017				1,6	0,67
05.11.2017				1,3	1,03
06.11.2017					0,66
07.11.2017	2,3				0,71
08.11.2017	1,6				0,57
09.11.2017	2,3				0,50
10.11.2017	4,4				0,48
11.11.2017	4,9				0,51
12.11.2017	3,1				0,42
13.11.2017					0,40
14.11.2017		1,7			0,42
15.11.2017		3,0			0,45
16.11.2017		6,1			0,77
17.11.2017		17,1			1,09
18.11.2017		8,1			0,87
19.11.2017		3,5			0,48

Pollution	Air Quality Index	Unit	Average period
Very low	0-50	µg/m^3	24 hours
Low	50-100	µg/m3	
Medium	100-350	µg/m3	
High	350-500	µg/m3	
Very High	>500	µg/m3	

The graphic representation of the measurement campaign for monitoring the measurement parameter SO2 in the winter season 2017 is given in Figure 42.

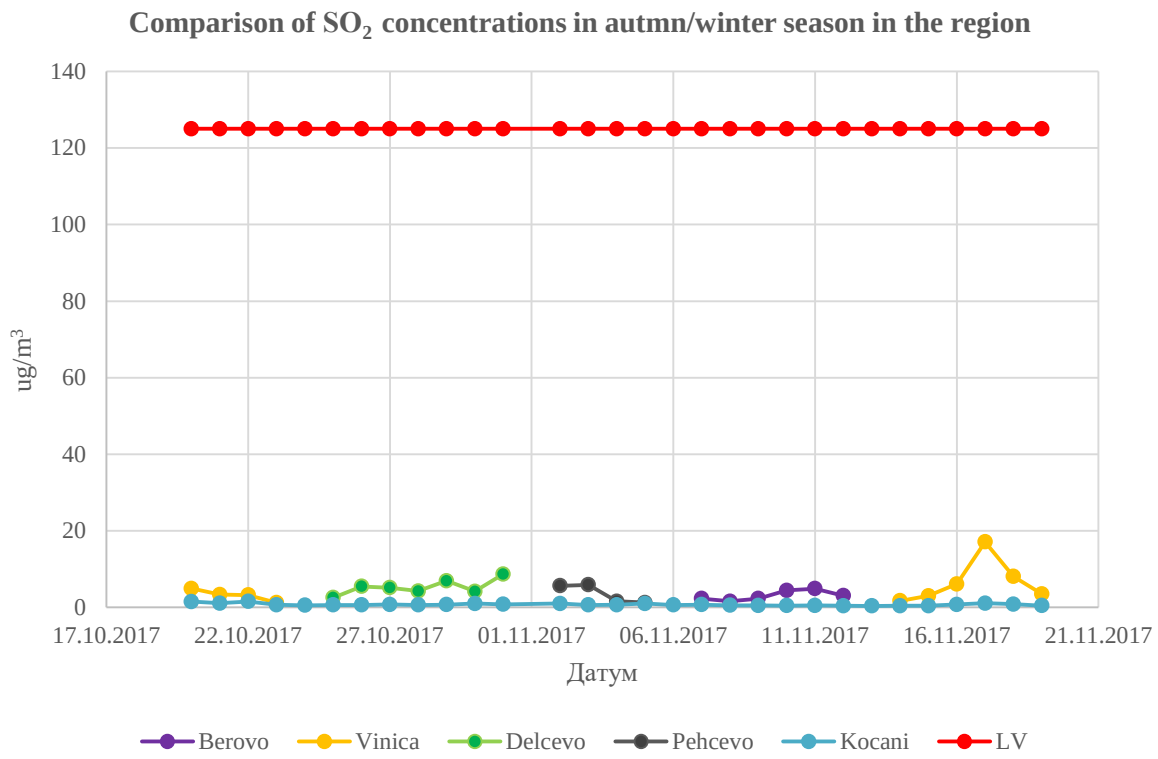


Figure 42. Overview of the measurement of the SO2 measurement parameter in the winter season 2017

1)Measuring location in Berovo

In Figure 43 there are graphical measurements of the measurement of sulfur dioxide in ambient air in real time for the period of the measurement campaign 07-13.11.2017, where the results of the measurement are compared with 1 hour limit values.

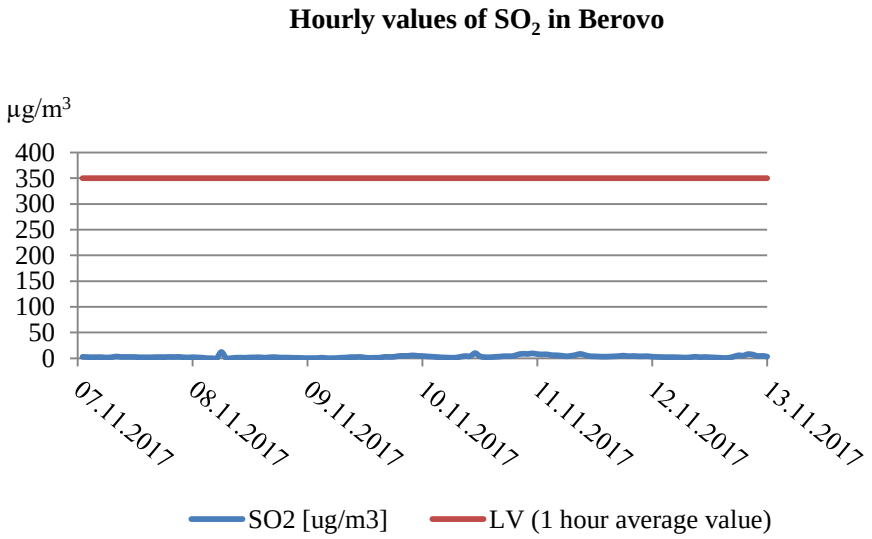


Figure 43.

In Figure 44 is a graphic representation of the comparison of daily values with the limit values for sulfur dioxide in ambient air.

Daily average values of SO_2 in Berovo

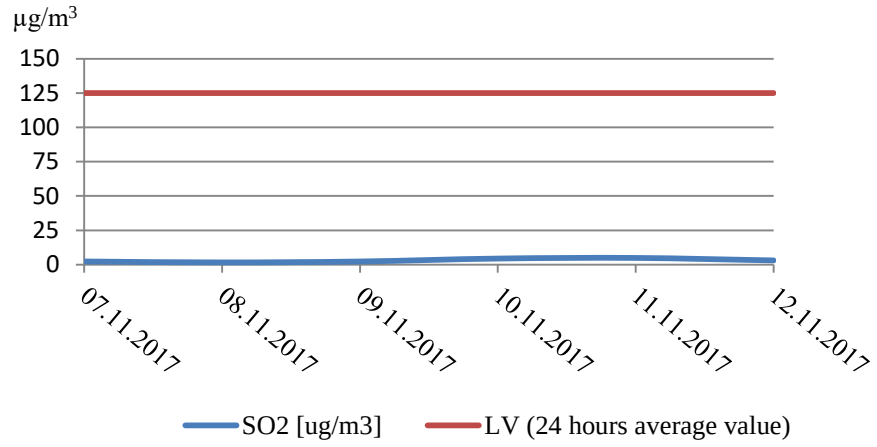
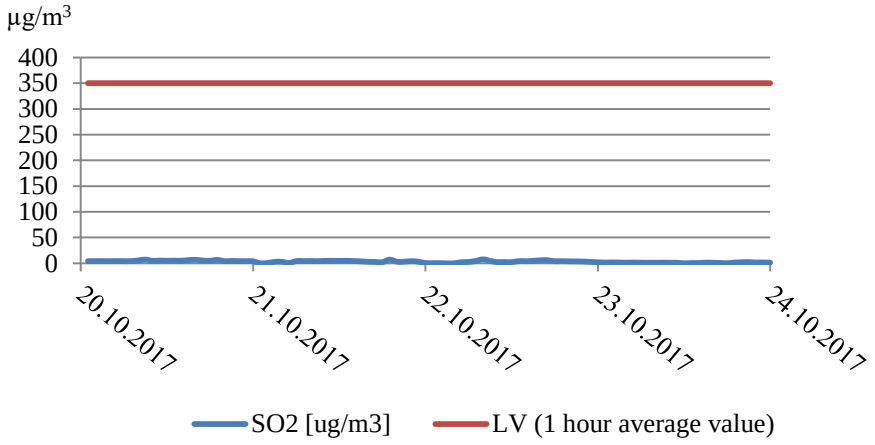


Figure 44.

2) Measuring location in Vinica

In Figure 45 there are graphical measurements of the measurement of sulfur dioxide in ambient air in real time for the period of the measurement campaign from 20-23.10 and from 14.11 to 19.11.2017 where the results of the measurement are compared with 1 hour limit values.

Hourly average values of SO_2 in Vinica



Hourly average values of SO_2 in Vinica

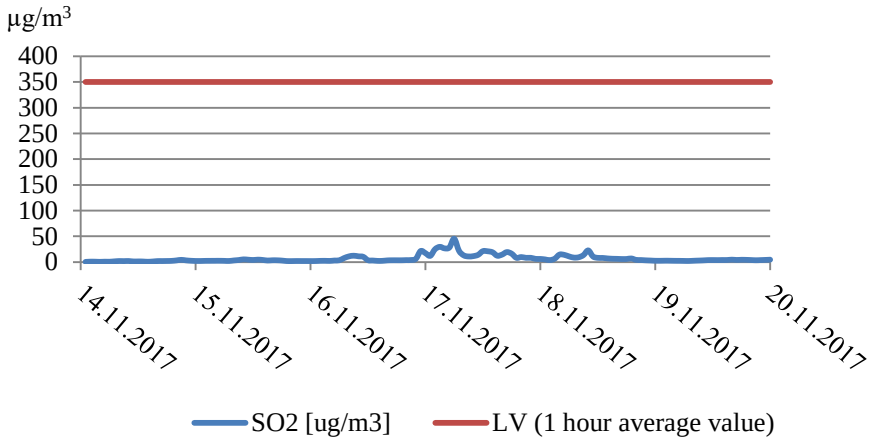
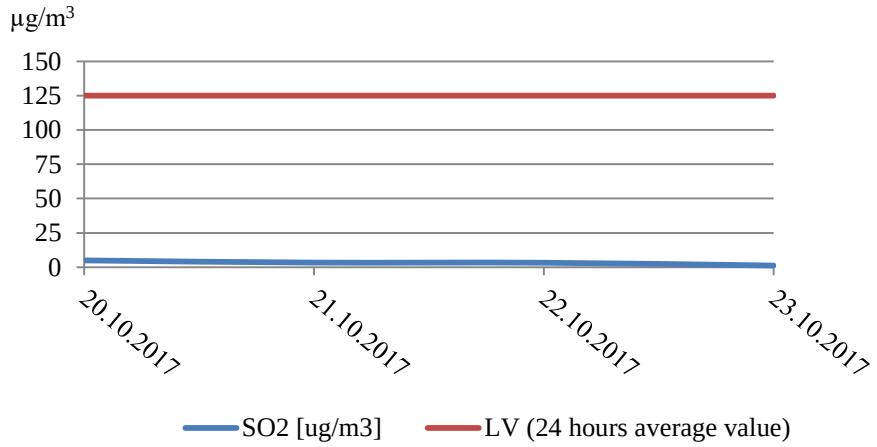


Figure 45.

In Figure 46 is a graphic representation of the comparison of daily values with the limit values for sulfur dioxide in ambient air.

Daily average values of SO_2 in Vinica



Daily average values of SO_2 in Vinica

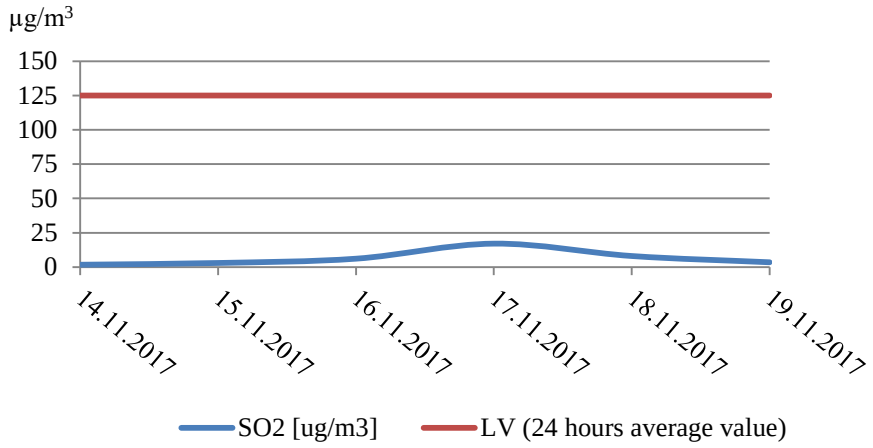


Figure 46.

3) Measuring location in Delcevo

In Figure 47 is a graphical representation of the measurement of sulfur dioxide in ambient air in real time for the period of the measurement campaign from 25 to 31.10.2017, where the results of the measurement are compared with 1 hour limit values.

Hourly average values of SO_2 in Delcevo

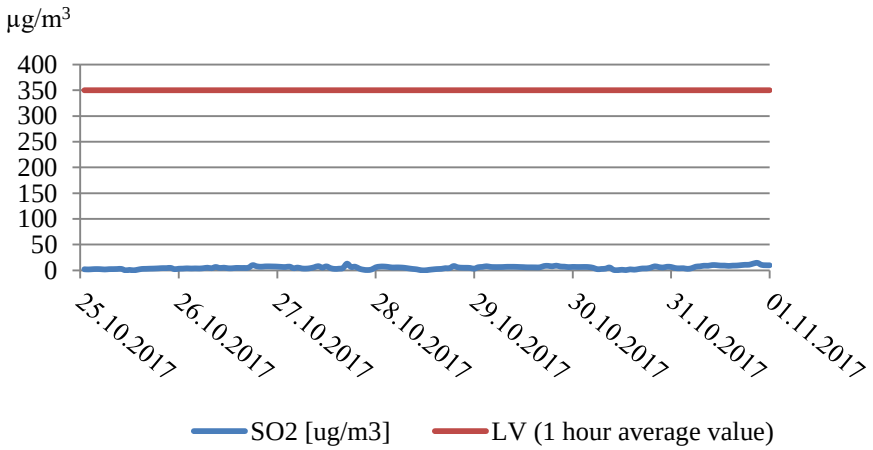


Figure 47.

In Figure 48 is given a graphic representation of the comparison of daily values with the limit values for sulfur dioxide in ambient air.

Daily average values of SO_2 in Delcevo

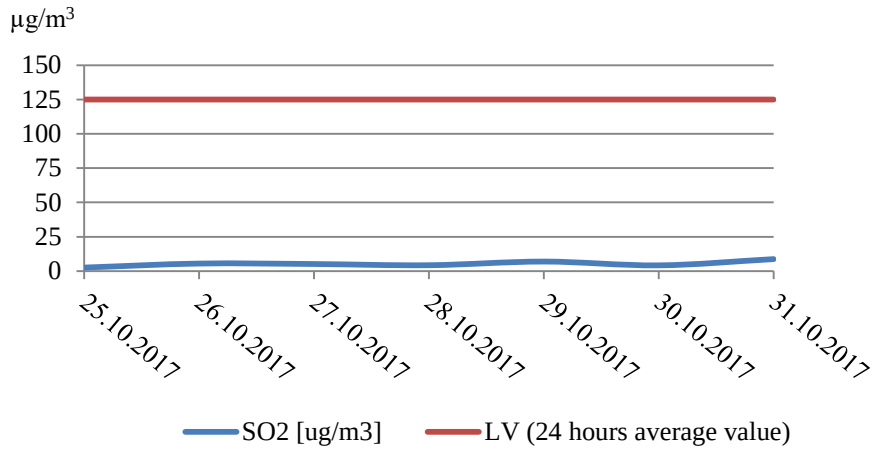


Figure 48.

4) Measuring location in Pehcevo

In Figure 49 there are graphical measurements of the measurement of sulfur dioxide in ambient air in real time for the period of the measurement campaign 02 to 05.11.2017, where the results of the measurement are compared with 1 hour limit values.

Hourly average values of SO_2 in Pehcevo

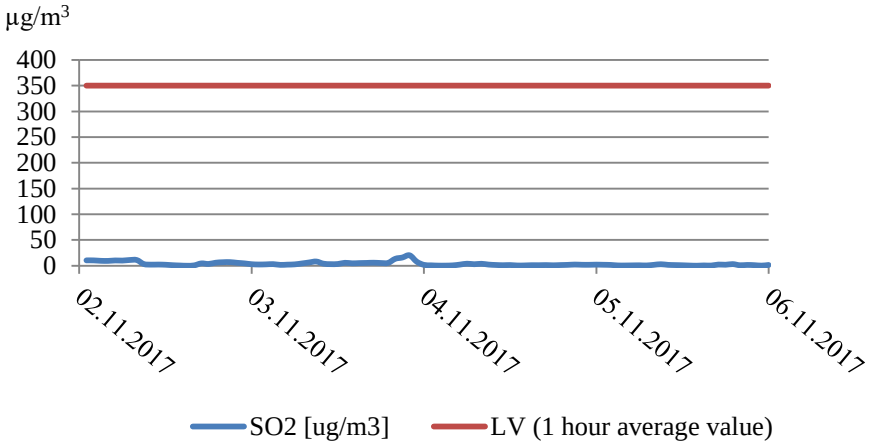


Figure 49.

In Figure 50 is given a graphic representation of the comparison of daily values with the limit values for sulfur dioxide in ambient air.

Daily average values of SO_2 in Pehcevo

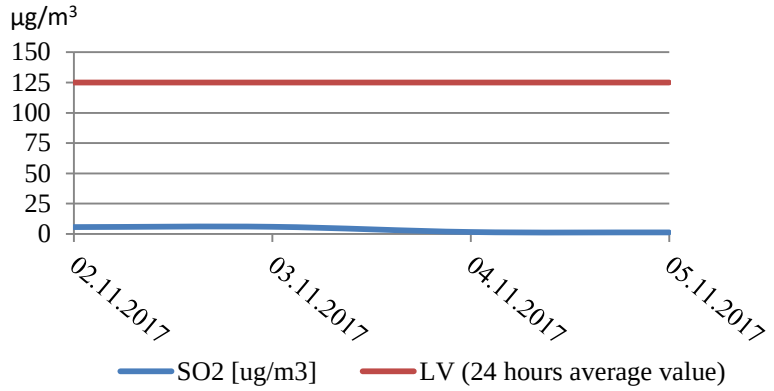


Figure 50.

VII.2.3 Conclusion for SO2

Hourly values

For the measuring parameter SO2 the limit values at the level of 1 hour, both in the summer period and in the autumn-winter period, are not exceeded in Kocani and in the monitoring areas Berovo, Delcevo, Pehcevo and Vinica:

Comparing the measured hourly values for sulfur dioxide with ambient air quality indexes for SO2 established CITEAIR, European Union, which is also applied by the Ministry of Environment and Physical Planning of the Republic of Macedonia. Macedonia can conclude that the pollution index for all measuring points is very low.

24 Hour Values

At all measuring points, ie in the cities of Berovo, Delcevo, Pehcevo and Vinica, higher concentrations of sulfur dioxide were observed in the autumn-winter period compared to the summer. The limit value for the 24-hour concentration of SO2 prescribed in the Regulation on limit values for levels and types of pollutants in ambient air and alert thresholds, deadlines for achieving limit values, margins and tolerance for limit values, target values and long-term objectives is not exceeded for any location in the summer and autumn-winter period. Historical data on the city of Kocani show that the average 24 hour concentration of SO2 is not exceeded even once.

VII.3 Results for nitrogen oxides (NO_2)

Ambient air quality indices for NO_2 established by CITEAIR, European Union, which is also applied by the Ministry of Environment and Physical Planning of the Republic of Macedonia is shown in Figure 51.

Pollution	Air quality index	Unit	Averaging period
Very low	0-50	µg/m³	NO_2 for a period of 1 hour
Low	50-100	µg/m3	
средно	100-200	µg/m3	
High	200-400	µg/m3	
Very high	>400	µg/m3	

Figure 51.

VII.3.1 NO_2 in the summer monitoring campaign 2017

The summary data for NO2 (24h value) in the monitoring period (08.07-20.07.2017), obtained from the measurements of the Ri-opus project, are presented in Table 17.

Table 17. Summary data of the Ri-pusproject

Measuring location	Berovo	Vinica	Delcevo	Pehcevo
Date	NO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
08.7.2017	2,9			
09.7.2017	2,3			
11.7.2017				1,8
12.7.2017				2,2
16.7.2017			1,1	
17.7.2017			1	
19.7.2017		1,6		
20.7.2017		1,6		

The graphic representation of the measurement campaign for monitoring the NO2 measurement parameter in the summer season 2017 is given in Figure 52. The graph gives a comparison of the daily average value for NO2 observed during the test period compared to the annual limit value.

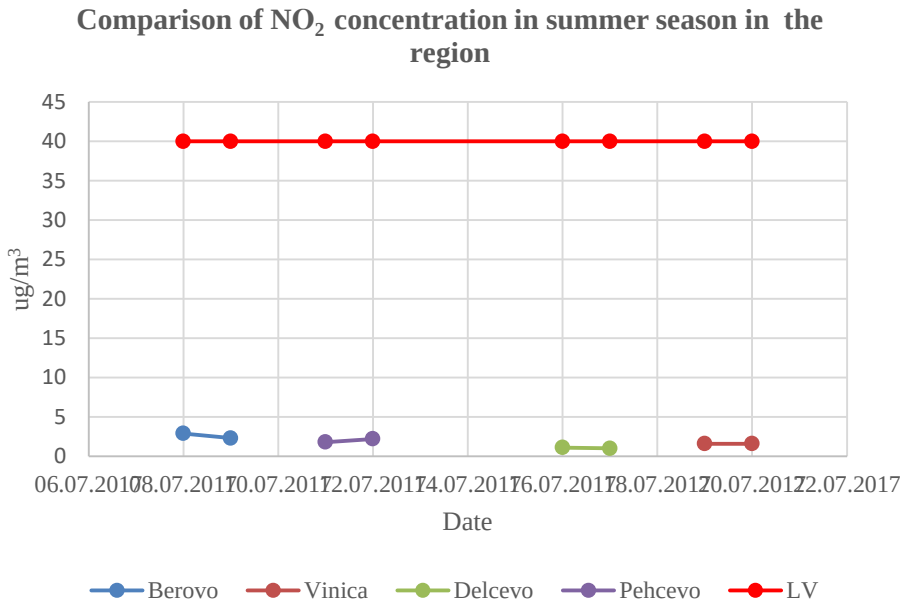


Figure 52. View from the monitoring of the NO2 measurement parameter in the summer season 2017

1) Measuring location in Berovo

In Figure 53 is a graphic representation of the measurement of nitrogen dioxide in ambient air in real time for the period of the measurement campaign 08-09.07.2017 with the hourly values being compared with hourly limit values for nitrogen dioxide.

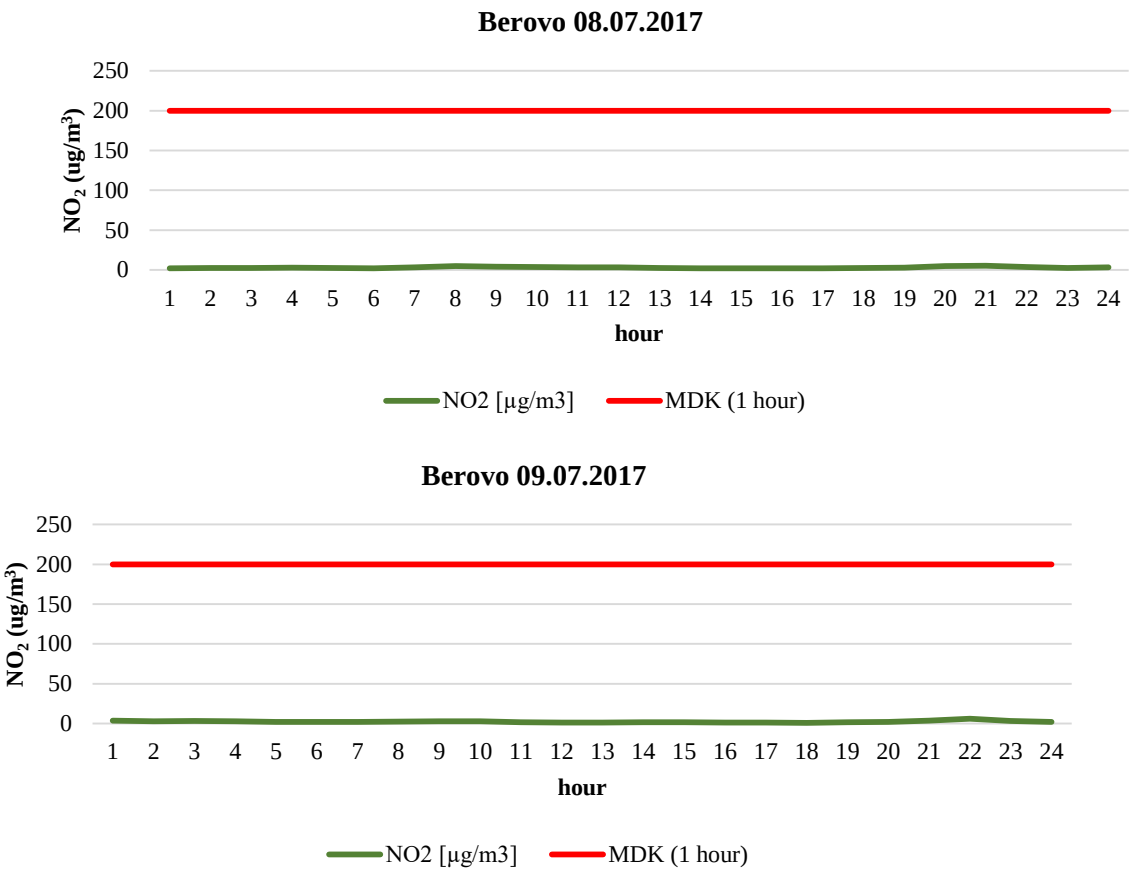


Figure 53.

In Figure 54 is given a graphic representation of the comparison of daily values with the annual limit value for nitrogen dioxide in ambient air.

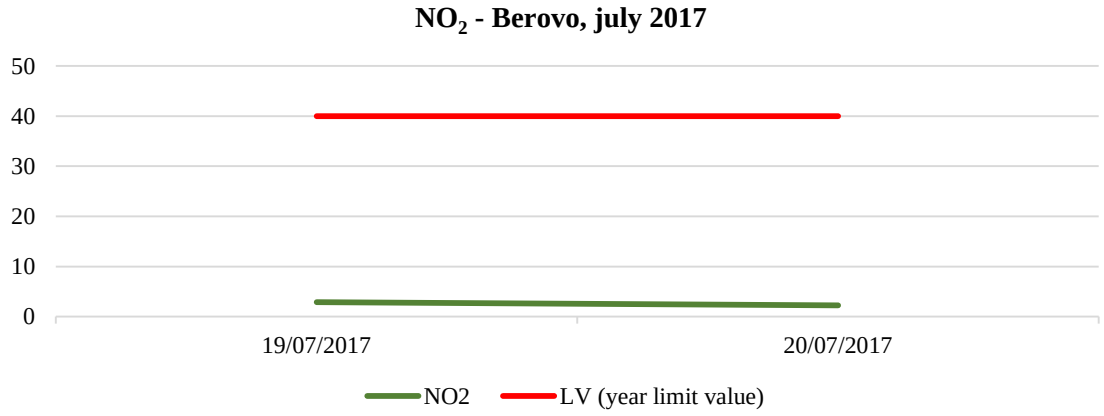


Figure 54.

2) Measuring location in Vinica

In Figure 55 is a graphic display of the measurement of nitrogen dioxide in ambient air in real time for the period of the measurement campaign 19-20.07.2017 with the hourly values being compared with hourly limit values for nitrogen dioxide.

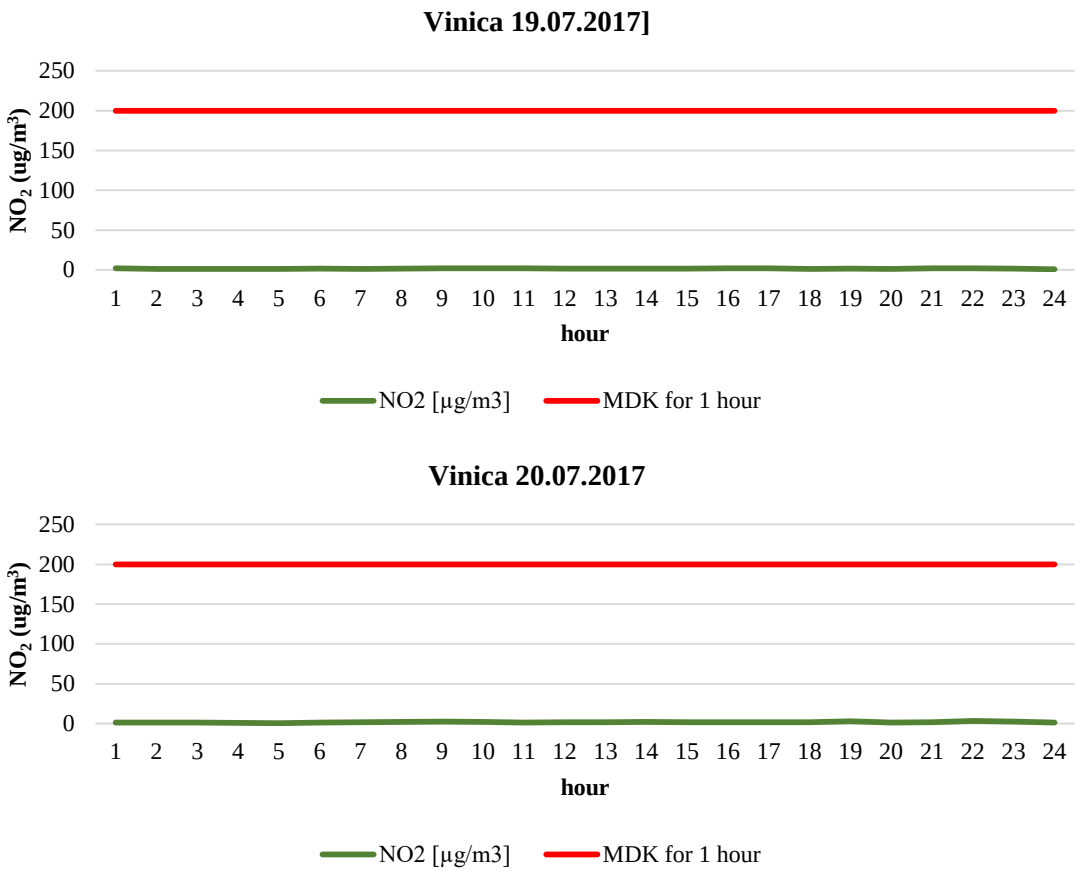


Figure 55.

In Figure 56 is given a graphic representation of the comparison of daily values with the annual limit value for nitrogen dioxide in ambient air.

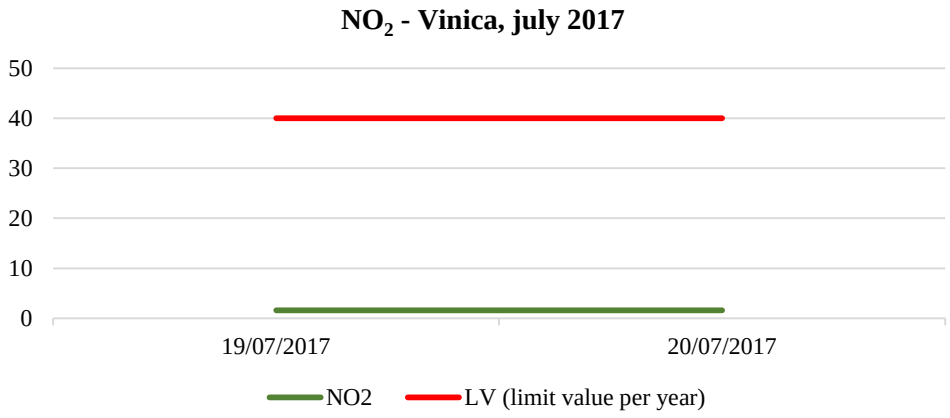


Figure 56.

3***) Measuring location in Delcevo***

In Figure 57 is a graphical representation of the measurement of nitrogen dioxide in ambient air in real time during the summer measurement campaign from 16th to 17th of July, 2017, with the hourly values being compared with hourly limit values for nitrogen dioxide.

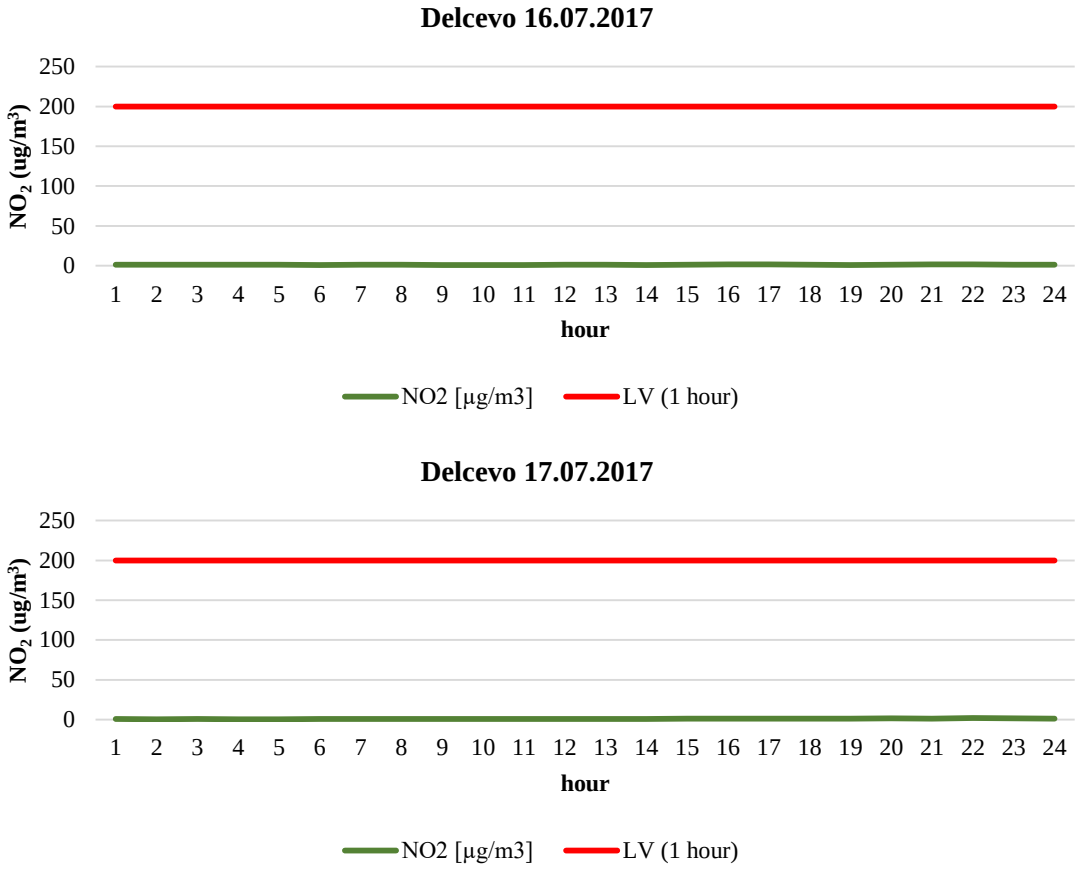


Figure 57.

In Figure 58 is given a graphic representation of the comparison of daily values with the annual limit value for nitrogen dioxide in ambient air.

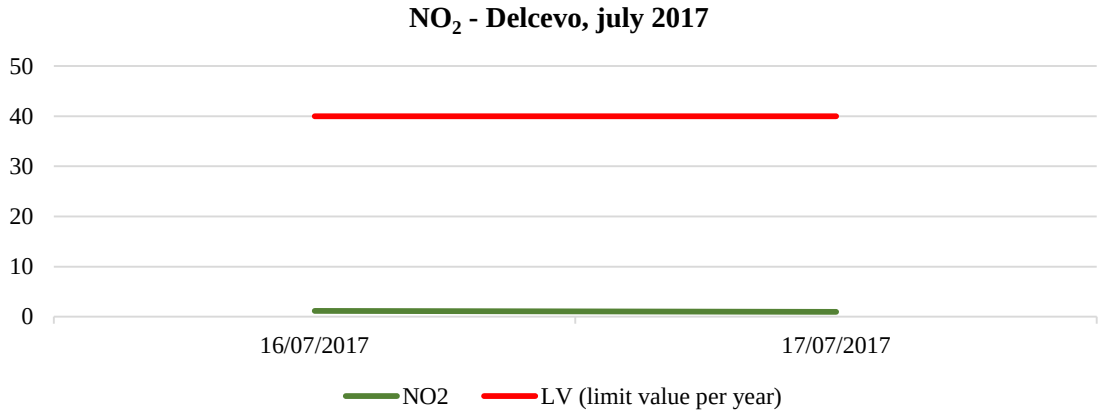


Figure 58.

\

4) Measurement location in Pehcevo

In Figure 59 is a graphical representation of the measurement of nitrogen dioxide in ambient air in real time for the period of the measurement campaign 11 to 12.07.2017, with the hourly values being compared with hourly limit values for nitrogen dioxide.

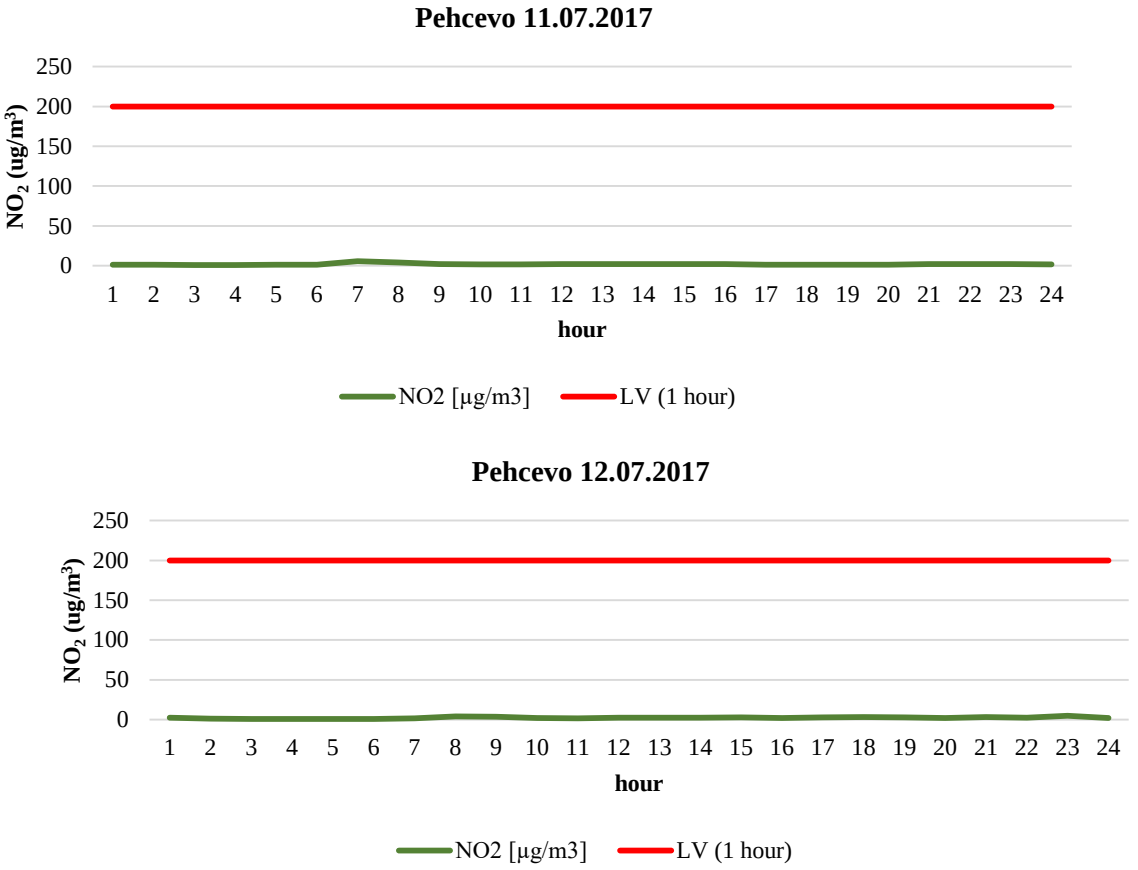


Figure 59.

In Figure 60 is given a graphic representation of the comparison of the daily values with the annual limit value for nitrogen dioxide in the ambient air.

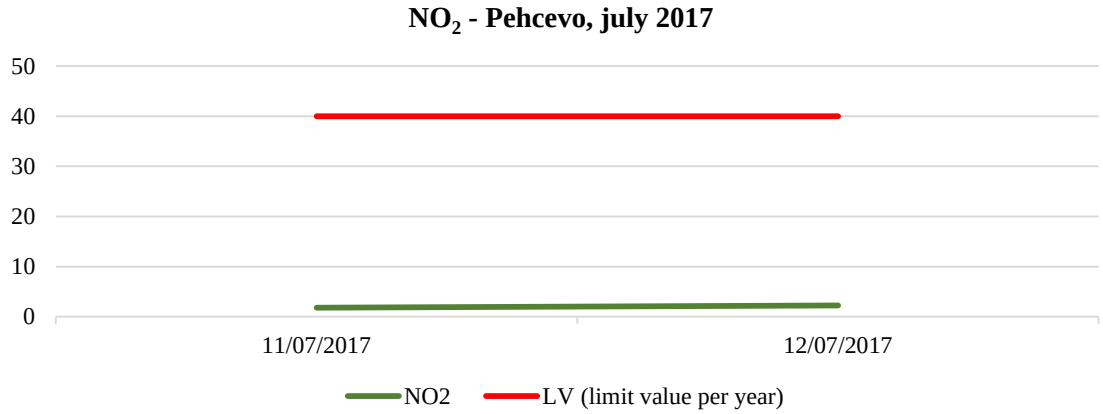


Figure 60.

VII.3.2 Autumn winter measuring campaign

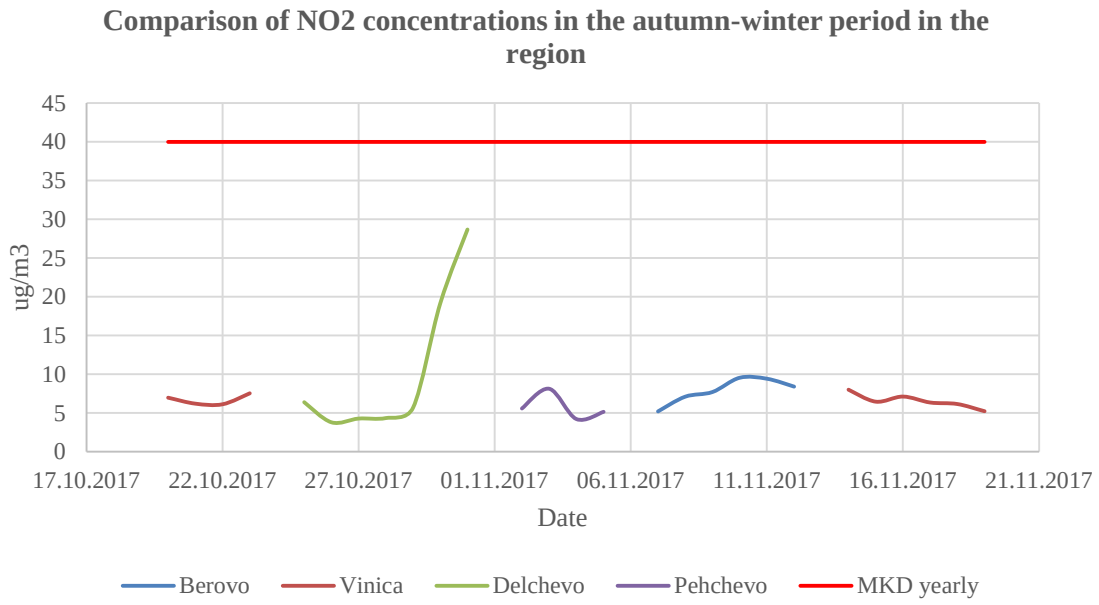
The summary data for NO2 (24h value) in the monitored period (October 23, 19, 2017), obtained from the measurements of the Ri-opus project, are presented in Table 18.

Table 18. Comparison of data from Ri-opus project for the ensuing period

Measuring location	**Berovo**	**Vinica**	**Delcevo**	**Pehcevo**
Date				
20.10.2017		7,0		
21.10.2017		6,2		
22.10.2017		6,1		
23.10.2017		7,6		
24.10.2017				
25.10.2017			6,4	
26.10.2017			3,8	
27.10.2017			4,3	
28.10.2017			4,4	
29.10.2017			5,7	
30.10.2017			19,2	
31.10.2017			28,7	
02.11.2017				5,6
03.11.2017				8,1
04.11.2017				4,2
05.11.2017				5,2
06.11.2017				
07.11.2017	5,2			
08.11.2017	7,1			
09.11.2017	7,7			
10.11.2017	9,6			
11.11.2017	9,4			
12.11.2017	8,4			
13.11.2017				
14.11.2017		8,0		
15.11.2017		6,5		
16.11.2017		7,1		
17.11.2017		6,4		
18.11.2017		6,2		
19.11.2017		5,2		

The graphic display of the measurement campaign for monitoring the NO2 measurement parameter in the winter season 2017 is given in Figure 61.

Figure 61. Display of the monitoring parameter NO2 in the winter season 2017



1) Measuring locaton in Berovo

In Figure 62 is a graphical representation of the measurement of nitrogen dioxide in ambient air in real time for the period of the measurement campaign 07-13.11.2017 where the results of the measurement are compared with 1 hour limit values and annual limit values.

Hourly average values of NO_2 in Berovo

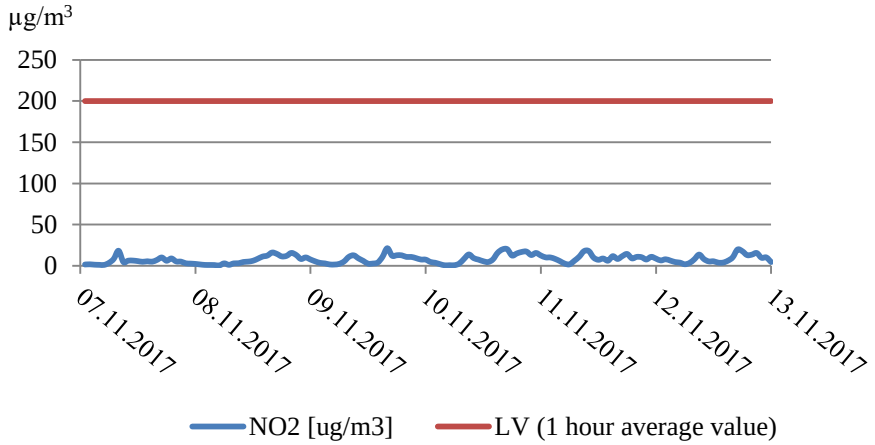
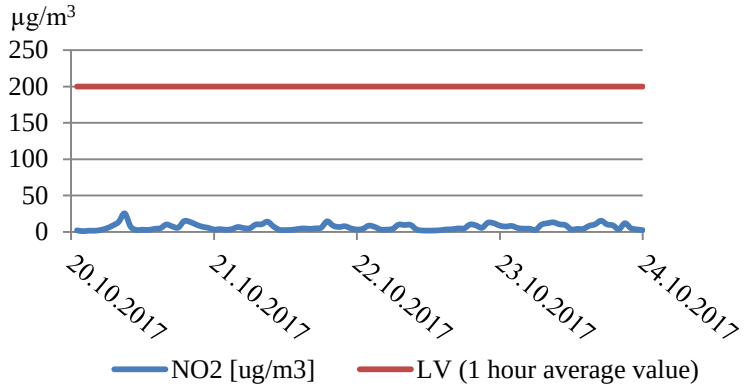


Figure 62.

2) Measuring location in Vinica

In Figure 63 is a graphic representation of the measurement of nitrogen dioxide in the ambient air in real time for the period of the measurement campaign from 20-23.10 and from 14.11 to 19.11.2017, where the results of the measurement are compared with 1 hour limit values and annual limit values.

Houry average values of NO_2 in Vinica



Houly averager values of NO_2 in Vinica

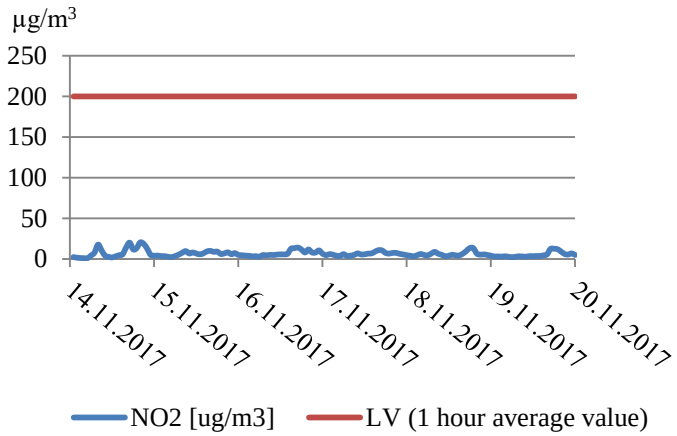


Figure 63.

3) Measuring location in Delcevo

In Figure 64 is a graphical representation of the measurement of nitrogen dioxide in the ambient air in real time for the period of the measurement campaign from 25 to 31.10.2017, where the results of the measurement are compared with 1 hour limit values and annual limit values.

Hourly average values of NO_2 in Delchevo

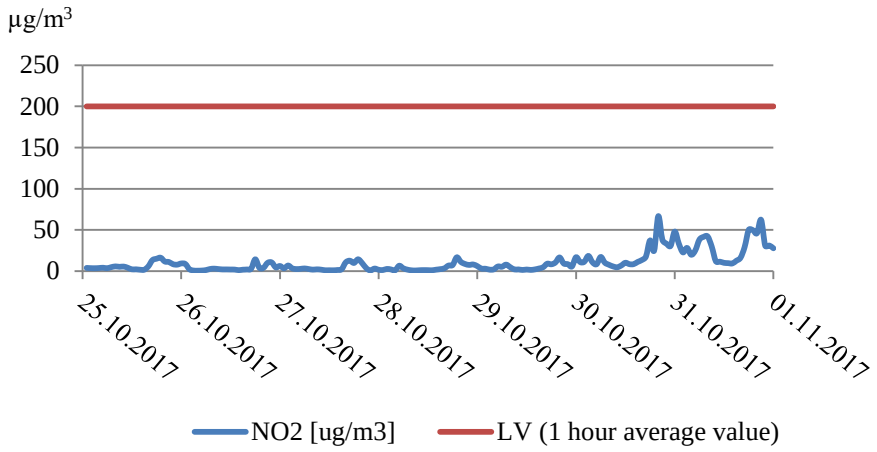


Figure 64.

4) Measuring location in Pehcevo

In Figure 65 is a graphical representation of the measurement of nitrogen dioxide in the ambient air in real time for the period of the measurement campaign from 02 to 05.11.2017, where the results of the measurement are compared with 1 hour limit values and annual limit values.

Hourly average values of NO_2 in Pehcevo

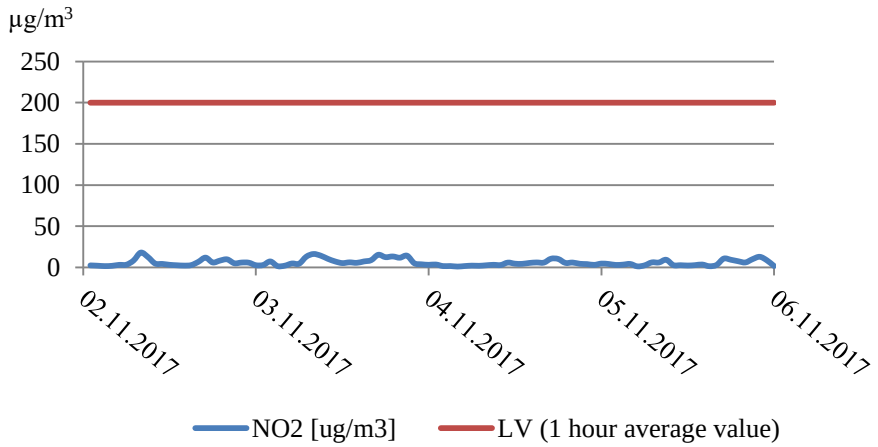


Figure 65.

VII.3.3 Conclusion on NO2

Hourly values

Limit values at the level of 1 hour for the measured parameter NO2, during the summer period, but also during the autumn-winter period, the monitoring areas Berovo, Delcevo, Pehcevo and Vinica are not exceeded. For NO2 there is no data from the monitoring station of the MOEPP for the city of Kocani.

Comparing measured hourly values for nitrogen dioxide with ambient air quality indices for NO2 established CITEAIR, European Union, which is also applied by the Ministry of Environment and Physical Planning of the Republic of Macedonia, Macedonia can conclude that for all measuring

points the pollution index is very low, with the exception of the city of Delcevo in the autumn winter where values with a low pollution index are observed.

24 Hour Values

From the comparison of the obtained average 24 hour values for nitrogen dioxide between the summer measurement campaign and the autumn / winter it can be concluded that for all environments (Berovo, Delcevo, Pehcevo and Vinica) in the autumn / winter period the concentrations of nitrogen dioxide are greater than those in summer period. Limit value for the 24 hour concentration of nitrogen dioxide prescribed in the Decree on limit values for levels and types of polluting substances in ambient air and alert thresholds, deadlines for achieving limit values, margins and tolerance for limit values, target values and long term objectives has been exceeded for no location, both in the summer and autumn-winter period.

VII.4 Results for carbon monoxide (CO)

Indices of ambient air quality for CO established CITEAIR, European Union, which is also applied by the Ministry of Environment and Physical Planning of the Republic of Macedonia is shown in Figure 66.

Pollution	Air quality index	Unit	Averaging period
Very low	0-5	mg/m^3	CO - maximum daily average 8 hour value
Low	5-7,5	mg/m^3	
Medium	7,5-10	mg/m^3	
High	окт.20	mg/m^3	
Very high	> 20	mg/m^3	

Figure 66.

VII.4.1 CO in the summer monitoring campaign 2017

The total data for carbon monoxide (maximum daily average 8h value) in the monitoring period (08.07-20.07.2017), obtained from the measurements of the Ri-opusproject and from the monitoring station in the city of Kocani (MOEPP) are presented in Table 19.

Table 19. Comparison of data of Ri-opusproject and MOEPP for the monitoring period

Measuring location / Date	Berovo	Vinica	Delcevo	Pehcevo	Kocani
08.7.2017	1,25				0,3
09.7.2017	1,25				0,4
11.7.2017				0,81	0,4
12.7.2017				0,44	0,3

16.7.2017			1		0,3
17.7.2017			0,95		0,4
19.7.2017		0,635			0,3
20.7.2017		0,63			0,2

The graphic representation of the measurement campaign for monitoring the measurement parameter CO in the summer season 2017 is given in Figure 67. The graph gives a comparison of the maximum daily average 8 hour value for the CO observed during the test with the prescribed limit value.

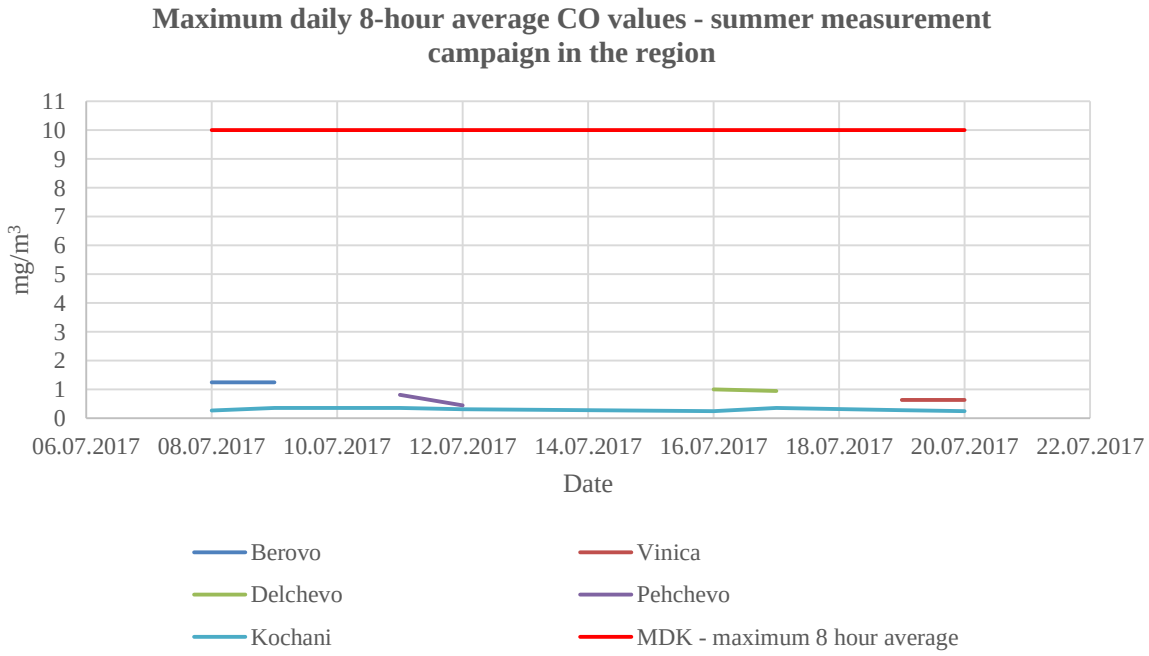
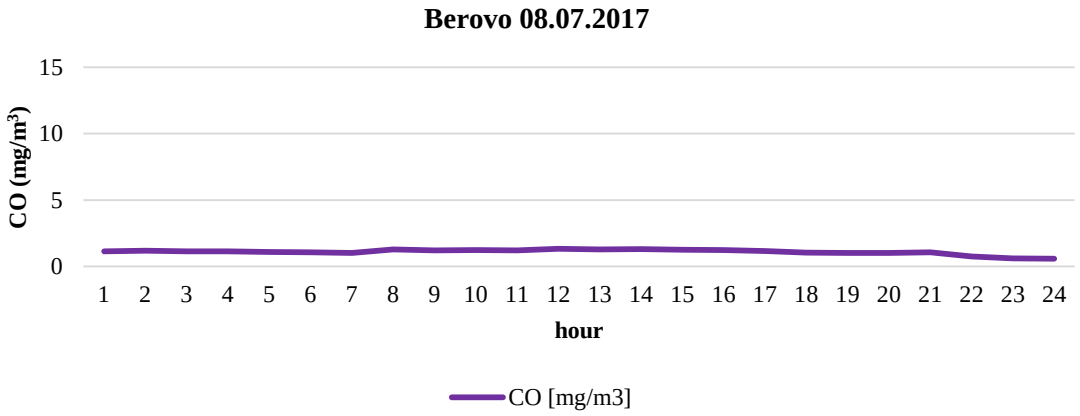


Figure 67. Overview of monitoring of CO in the summer monitoring season 2017

1) Measuring location Berovo

In Figure 68 graphical measurements of the measurement of carbon monoxide in ambient air in real time for the period of the measurement campaign 08-09.07.2017.



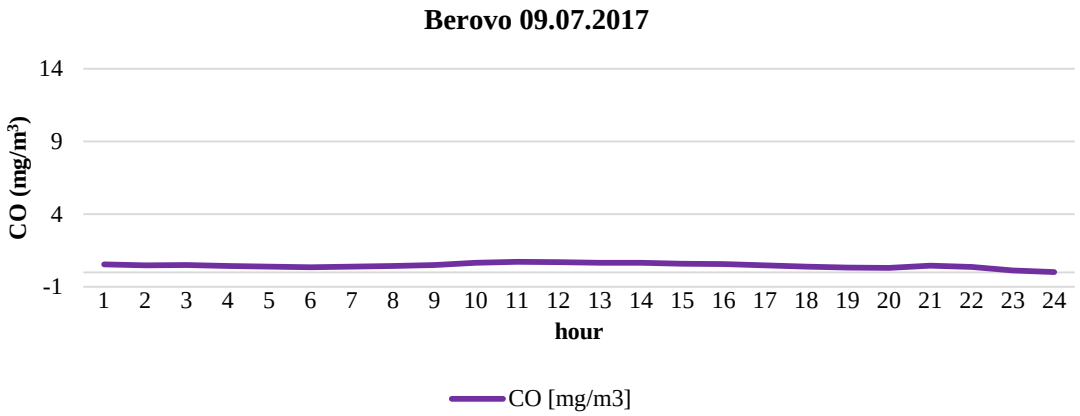


Figure 68.

In Figure 69 is given a graphic representation from the comparison of maximum 8 hour average values with carbon monoxide limit values in ambient air.

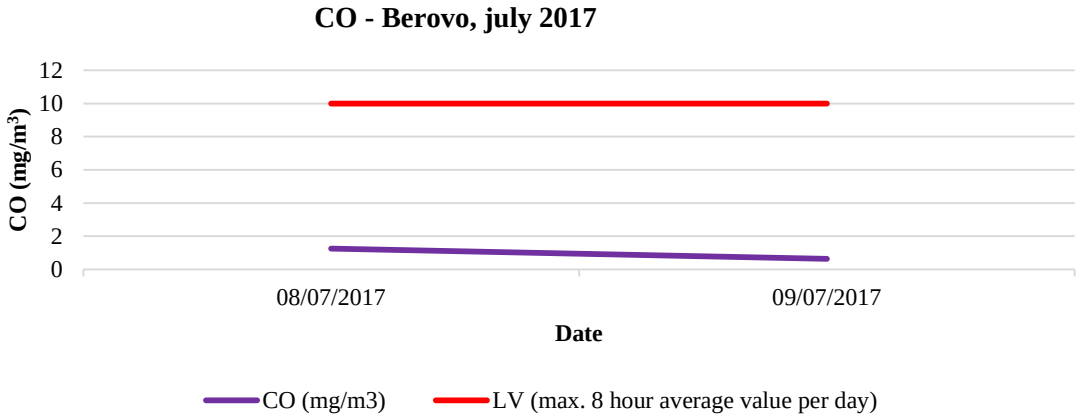
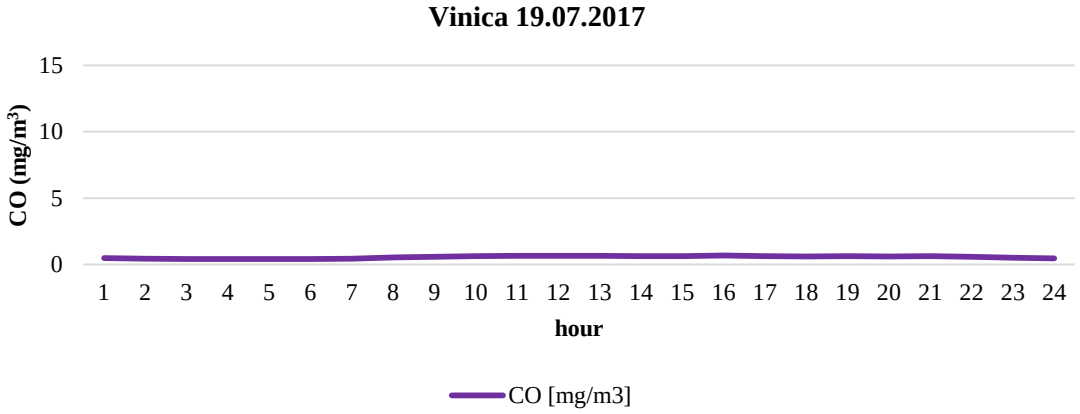


Figure 69.

2) Measuring location in Vinica

In Figure 70 shows a graphic display of the measurement of carbon monoxide in ambient air in real time for the period of the measurement campaign 19-20.07.2017.



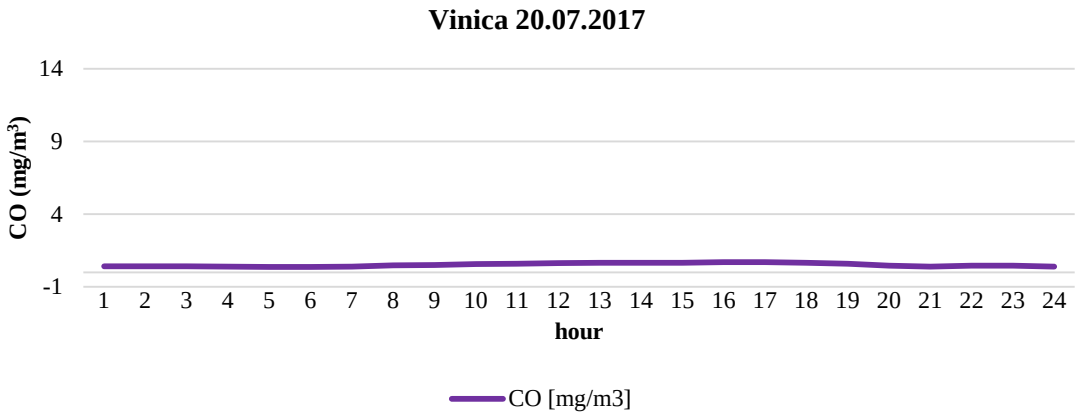


Figure 70.

In Figure 71 a graphic representation of the comparison of maximum 8 hour average values with the carbon monoxide limit values in ambient air is given.

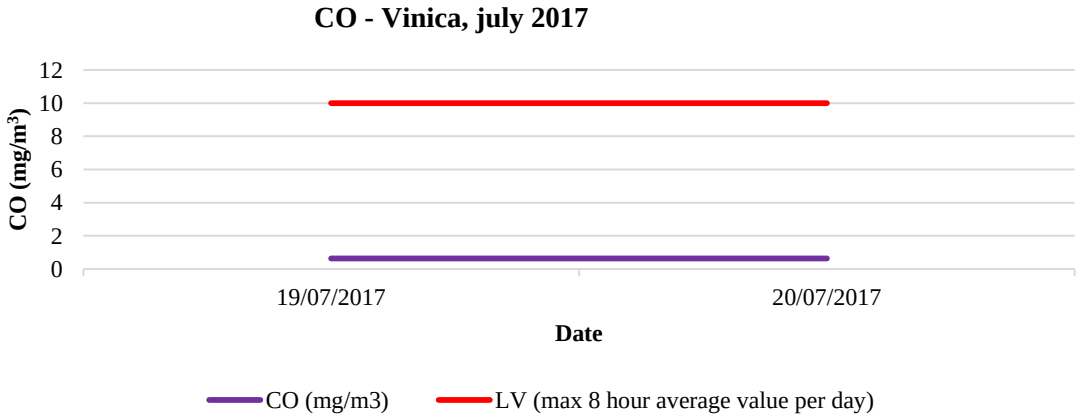
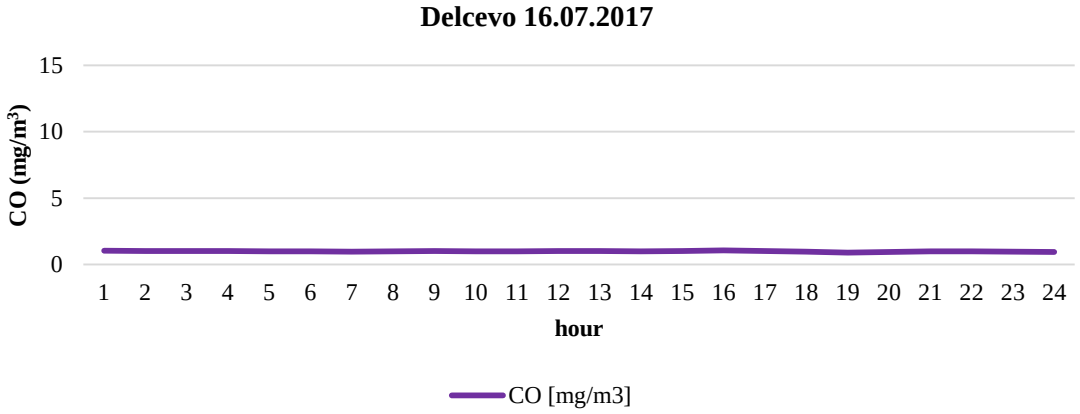


Figure 71.

3) Measuring location in Delcevo

Figure 72 shows a graphic display of the measurement of carbon monoxide in ambient air in real time for the period of the measurement campaign from 16 to 17.07.2017.



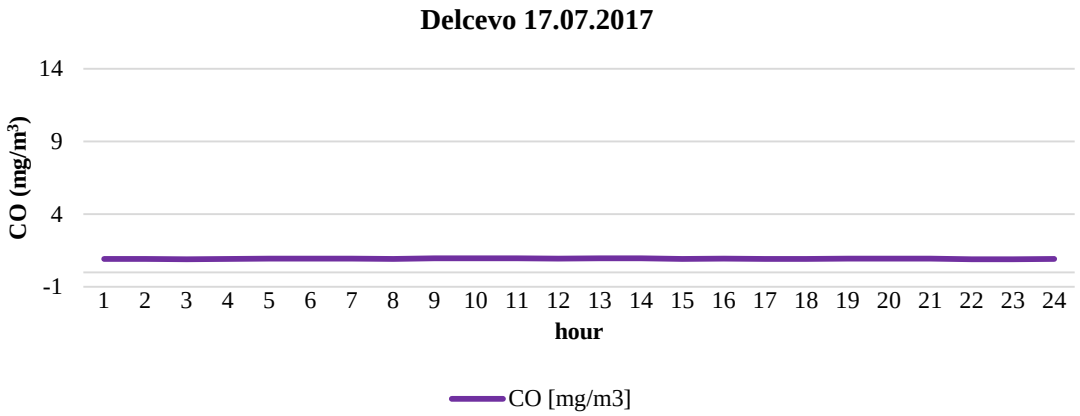


Figure 72.

In Figure 73 is given a graphic representation from the comparison of the maximum 8 hour average values with the limit values for carbon monoxide in ambient air.

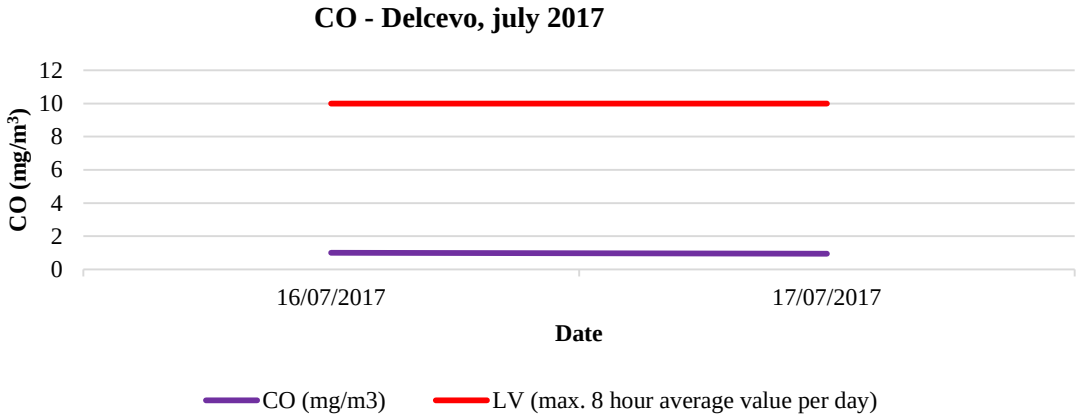
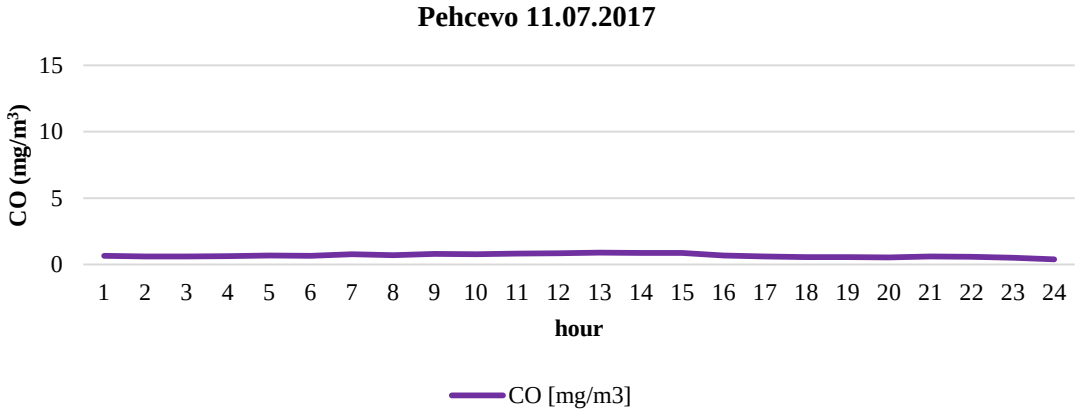


Figure 73.

4) Measuring location in Pehcevo

In Figure 74 is a graphic display of the measurement of carbon monoxide in the ambient air in real time for the period of the measurement campaign 11 to 12.07.2017



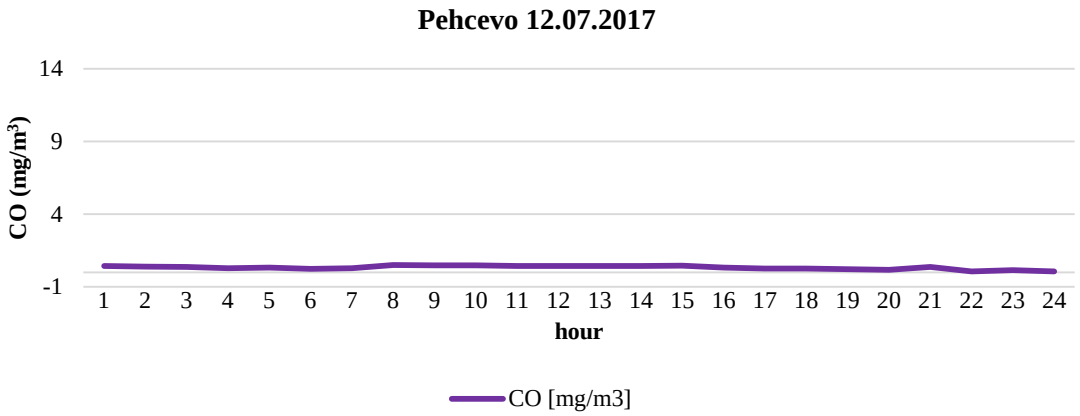


Figure 74.

In Figure 75 is given a graphic representation from the comparison of maximum 8 hour average values with carbon monoxide limit values in ambient air.

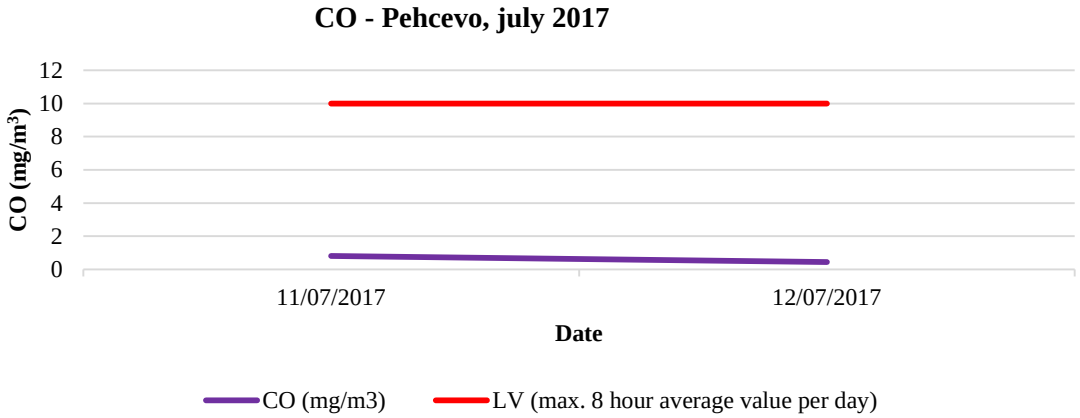


Figure 75.

VII.4.2 Autumn winter measuring campaign

The summary data for the CO (maximum daily average 8 hour value) in the monitoring period (23.10.-19.11.2017), obtained from the measurements of the RI-opusproject and from the monitoring station of the MOEPP in the city of Kocani are presented in Table 20.

Table 20. Comparison of data of Ri-opusproject and MOEPP for the monitoring period

Measuring location	**Berovo**	**Vinica**	**Delcevo**	**Pehcevo**	**Kocani**
Date	**CO (mg/m^3)**	**CO (mg/m^3)**	**CO (mg/m^3)**	**CO (mg/m^3)**	**CO (mg/m^3)**
20.10.2017		3,1			0,4
21.10.2017		2,2			0,4
22.10.2017		1,5			0,5
23.10.2017		0,9			0,6
25.10.2017			1,9		0,6
26.10.2017			2,1		0,5
27.10.2017			1,7		0,7

28.10.2017			1,0		0,7
29.10.2017			1,3		0,8
30.10.2017			0,8		0,6
31.10.2017			1,0		0,9
02.11.2017				1,5	0,8
03.11.2017				1,7	1,5
04.11.2017				1,3	1,4
05.11.2017				1,9	1,2
07.11.2017	1,7				0,7
08.11.2017	2,2				1,3
09.11.2017	3,6				1,0
10.11.2017	3,9				1,2
11.11.2017	2,2				1,4
12.11.2017	3,9				0,8
14.11.2017		2,6			0,9
15.11.2017		1,3			1,1
16.11.2017		2,1			1,5
17.11.2017		1,2			1,0
18.11.2017		2,1			0,8
19.11.2017		2,4			0,8

The graphic display of the measurement campaign for monitoring the measurement parameter CO in the winter season 2017 is given in Figure 76.

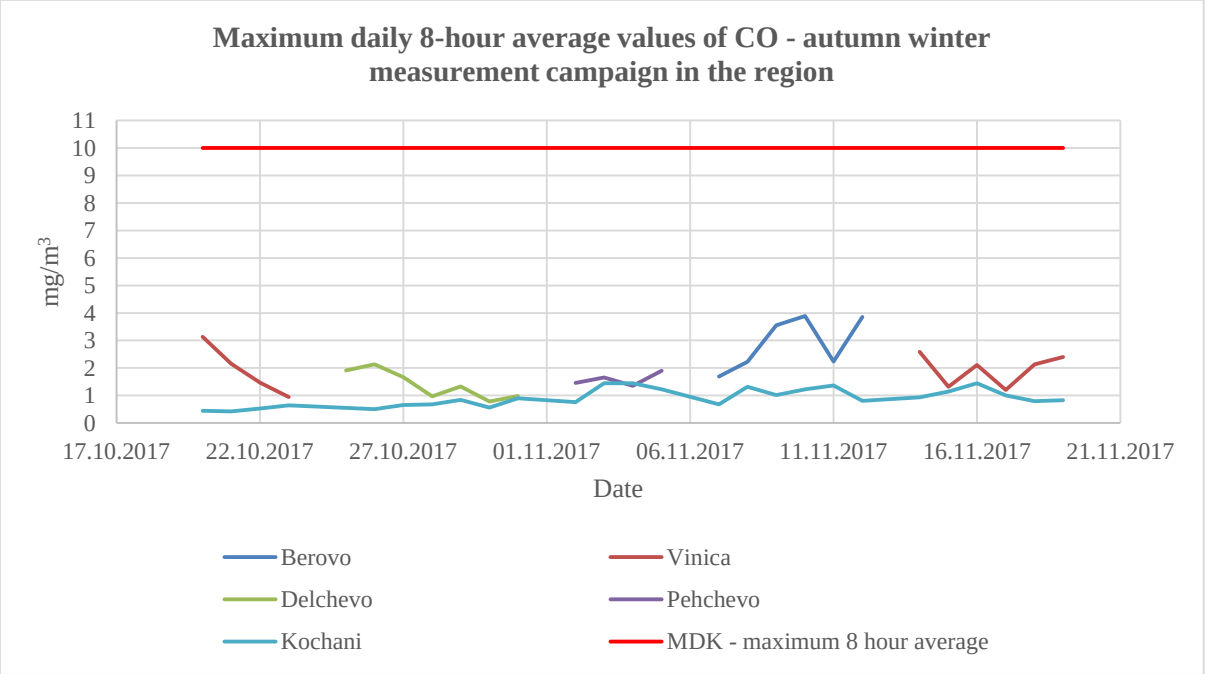


Figure 76. Overview of the measurement parameter CO in winter season 2017

1) Measuring location in Berovo

In Figure 77 is a graphical measurements of the measurement of carbon monoxide in ambient air in real time for the period of the measuring campaign 07-13.11.2017, where the results of the measurement are compared with a maximum of 8 hours of daily average value.

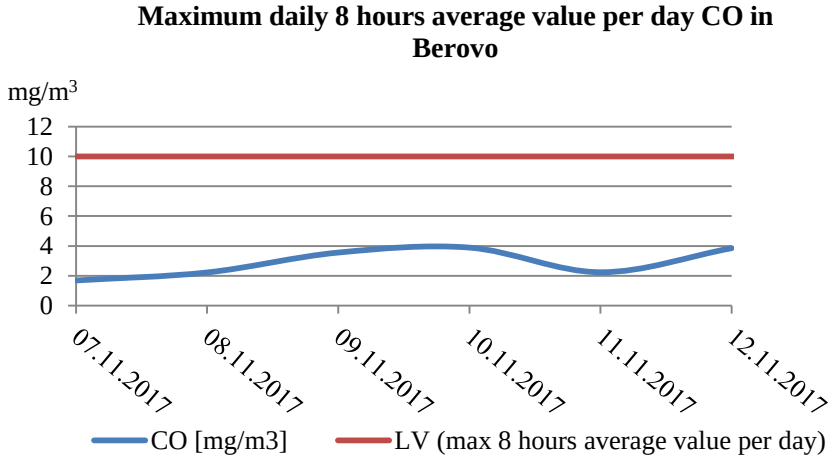
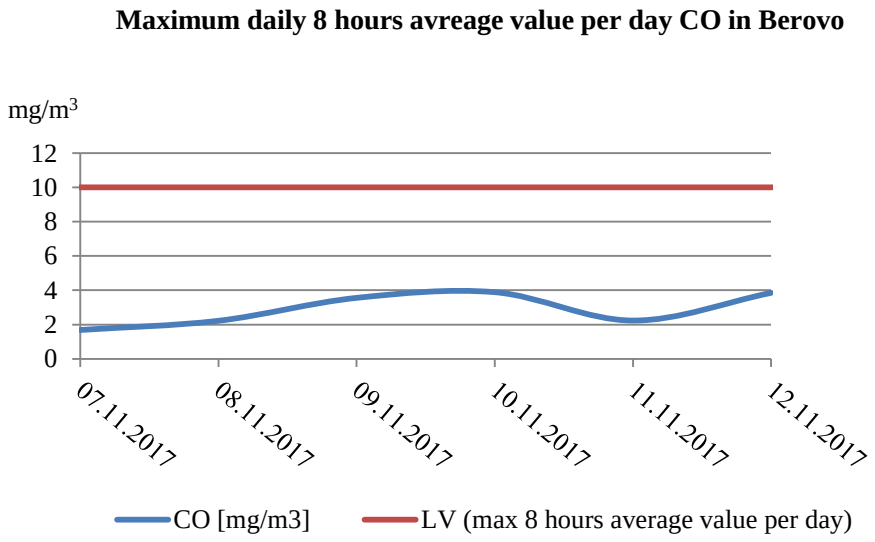


Figure 77.

2) Measuring location in Vinica

In Figure 78 is a graphical measurements of the measurement of carbon monoxide in ambient air in real time for the duration of the measurement campaign from 20-23.10 and from 14.11 to 19.11.2017, where the results of the measurement are compared with a maximum of 8 hours daily average value.



Maximum daily 8 hours average value per day CO in Vinica

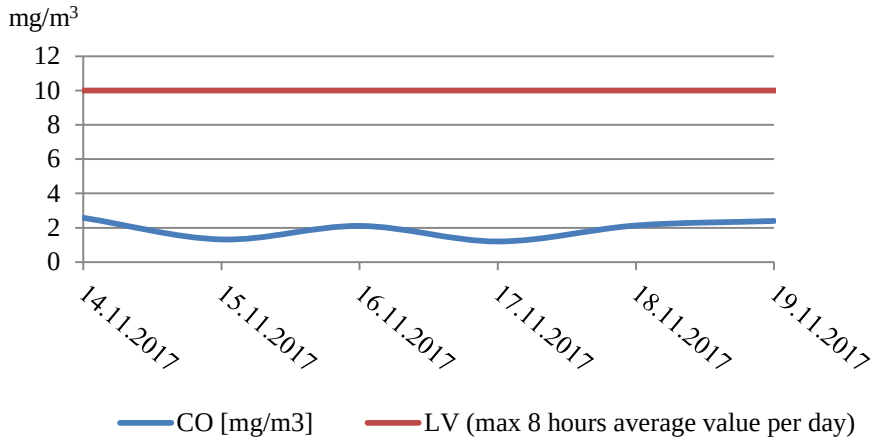


Figure 78.

3) Measuring location in Delcevo

In Figure 79 is a graphical display of the measurement of carbon monoxide in ambient air in real time for the period of the measurement campaign from 25 to 31.10.2017 where the results of the measurement are compared with a maximum of 8 hours of daily average value.

Maximum daily 8 hours average value per day CO in Delcevo

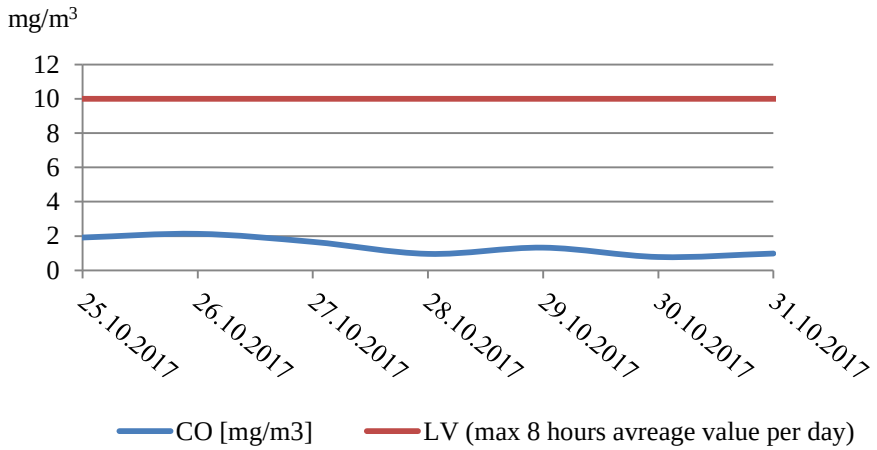


Figure 79.

4) Measurement location in Pehcevo

In Figure 80 is a graphical measurements of the measurement of carbon monoxide in ambient air in real time for the period of the measurement campaign 02 to 05.11.2017, where the results of the measurement are compared with a maximum of 8 hours of daily average value.

Maximum daily 8 hours average value per day CO in Pehcevo

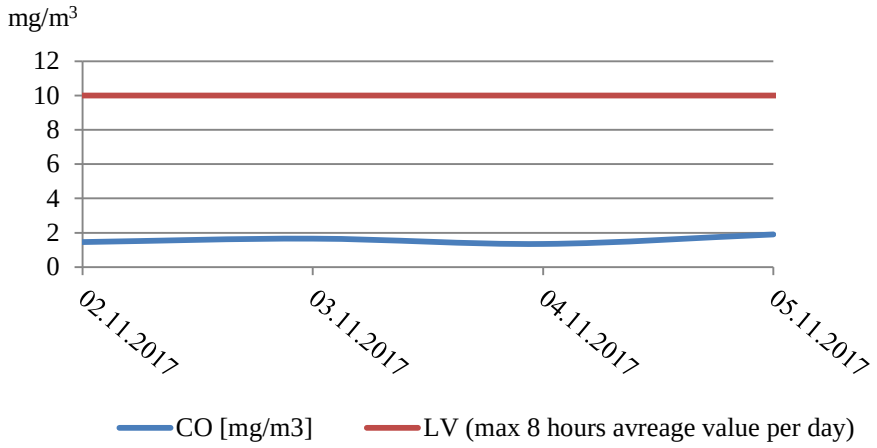


Figure 80.

VII.4.3 Conclusion on CO

Maximum 8 hour daily average concentration

For the measured parameter carbon monoxide CO, the limit value is given as the maximum 8 hour average daily. In the summer period, as well as in the autumn-winter period, the limit value is not exceeded in the monitoring areas Berovo, Delcevo, Pehcevo, Vinica and the city of Kocani (departments of the monitoring station at the MOEPP).

Comparing measured hourly values for nitrogen dioxide with ambient air quality indices for NO2 established CITEAIR, European Union, which is also applied by the Ministry of Environment and Physical Planning of the Republic of Macedonia, it can be conclude that the pollution index for all measuring points is very low.

When comparing the obtained 8 hour average daily carbon monoxide values between the summer measurement campaign and autumn winter, it can be concluded that for all environments in the autumn winter period the concentrations of carbon monoxide are higher than in the summer period. The maximal 8 hours average carbon monoxide daily values in the summer measurement campaign occur during the day (8 pm to 6 pm), while during the autumn / winter measurement campaign, the maximum occurs most frequently between 16 and 23 hours.

VII.5 Ozone Results (O_3)

Indices of ambient air quality for O3 established CITEAIR, European Union, which is also applied by the Ministry of Environment and Physical Planning of the Republic of Macedonia is shown in Figure 81.

Pollution	Air quality index	Unit	Averaging period
Very low	0-60	µg/m^3	O3 for a period of 1h
Low	60 - 120	µg/m3	
Medium	120 - 180	µg/m3	
High	180 - 240	µg/m3	
Very high	> 240	µg/m3	

VII.5.1 O3 in the summer monitoring campaign 2017

The summed data for ozone O_3 (maximum daily average 8 hour value) in the monitoring period (08-20 July 2017), obtained from the measurements of the Ri-opusproject are presented in Table 11.

Table 21. Comparison of Ri-posproject data - for the monitored period

Measuring location	**Berovo**	**Vinica**	**Delcevo**	**Pehcevo**
Date	**O_3 (µg/m^3)**	**O_3 (µg/m^3)**	**O_3 (µg/m^3)**	**O_3 (µg/m^3)**
08.07.2017	100,1			
09.07.2017	112,9			
11.07.2017				116
12.07.2017				112,6
16.07.2017			98,7	
17.07.2017			86,5	
19.07.2017		99,4		
20.07.2017		108,7		

The graphic display of the measurement campaign tracking parameter measuring O_3 in the summer season 2017 is given in Figure 82.

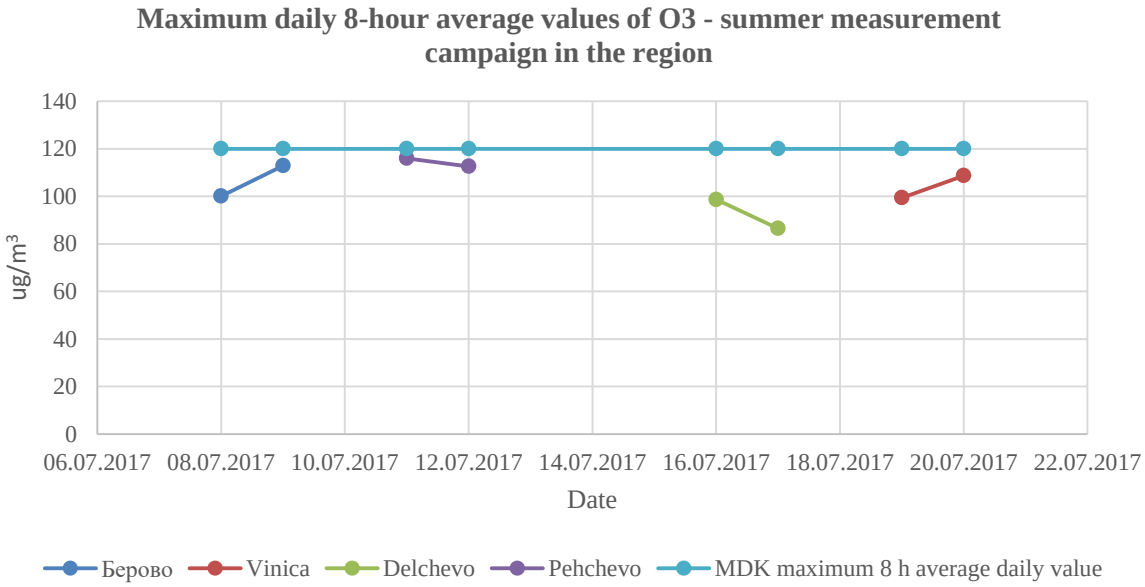


Figure 82.

1) Measuring location - Berovo

In Figure 83 is a graphic representation of the measurement of ozone in ambient air in real time for the period of the measurement campaign 08-09.07.2017.

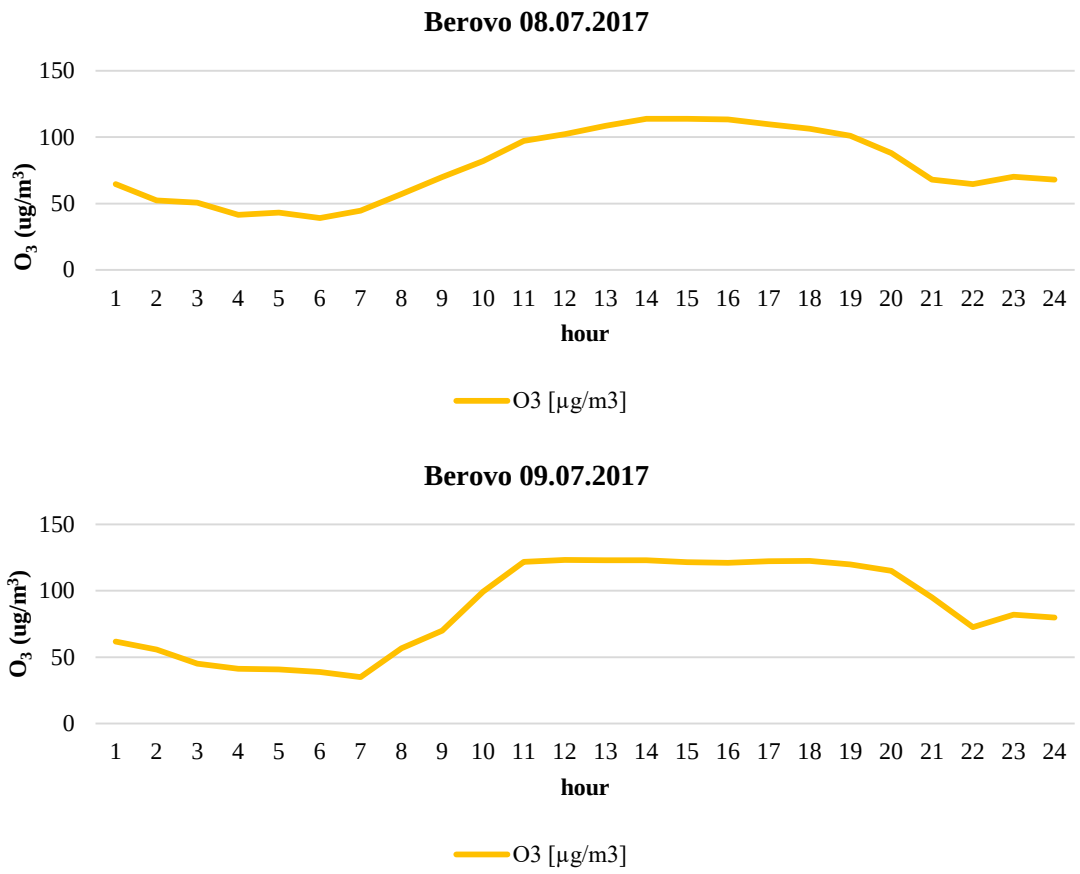


Figure 83.

In Figure 84 is given a graphic representation from the comparison of maximum 8 hour average daily values with ozone limit values in ambient air.

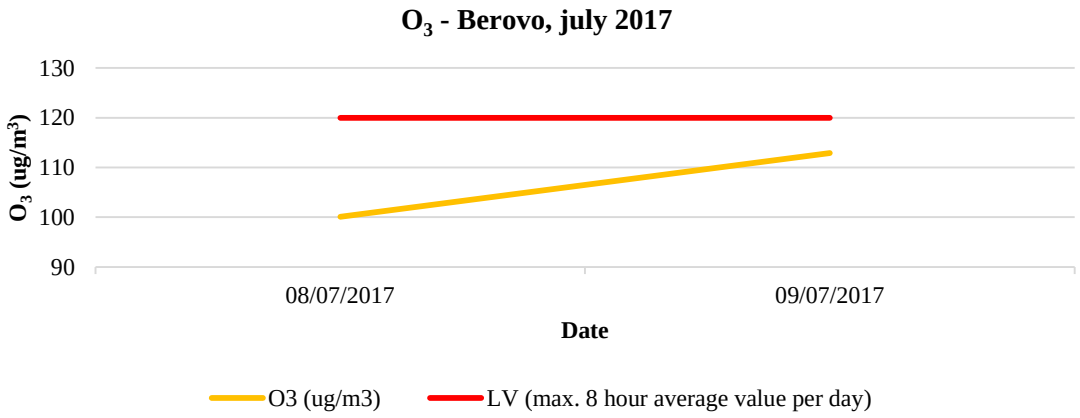


Figure 84.

In Figure 85 is given a graphic representation of the comparison of hourly values with the threshold of informing the public about ozone in ambient air.

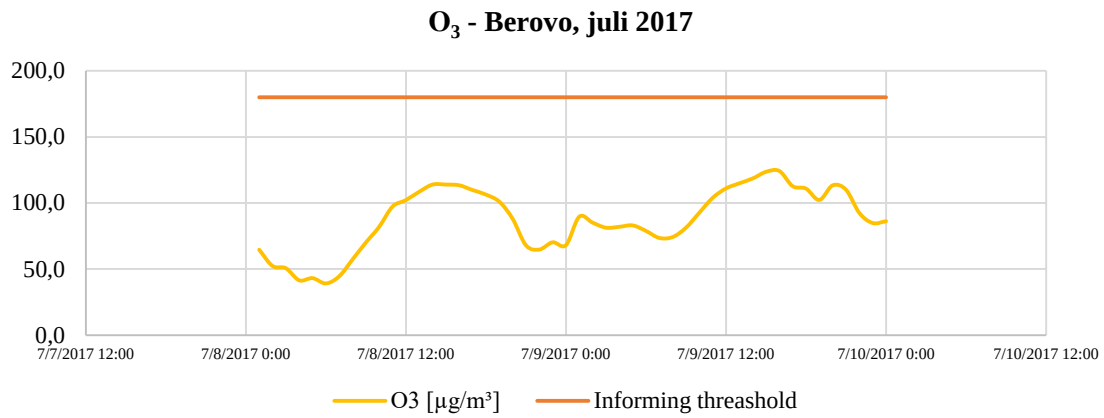


Figure 85.

2) Measuring location - Vinica

In Figure 86 is graphical representation of the measurement of ozone in ambient air in real time for the period of the measurement campaign 19-20.07.2017.

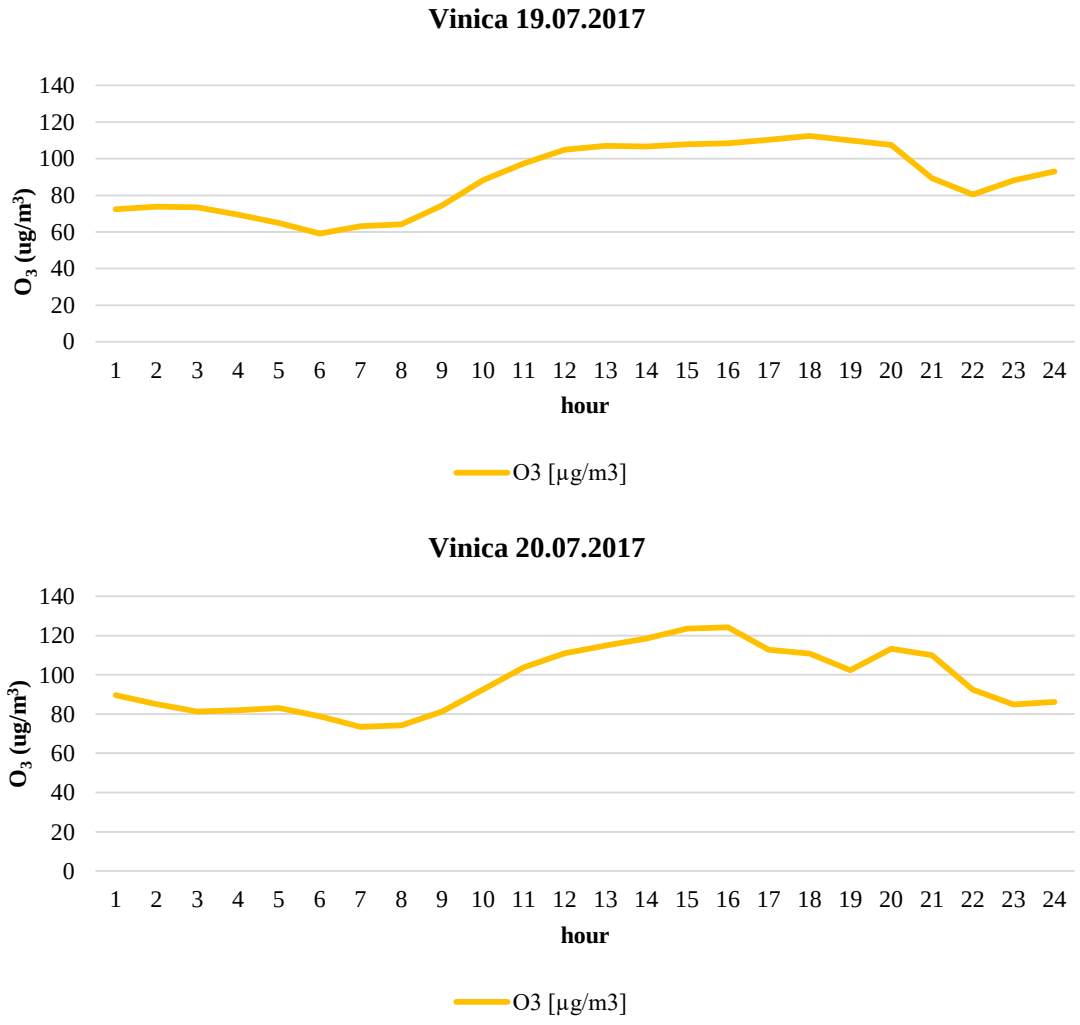


Figure 86.

In Figure 87 is given a graphic representation from the comparison of maximum 8 hour average daily values with ozone limit values in ambient air.

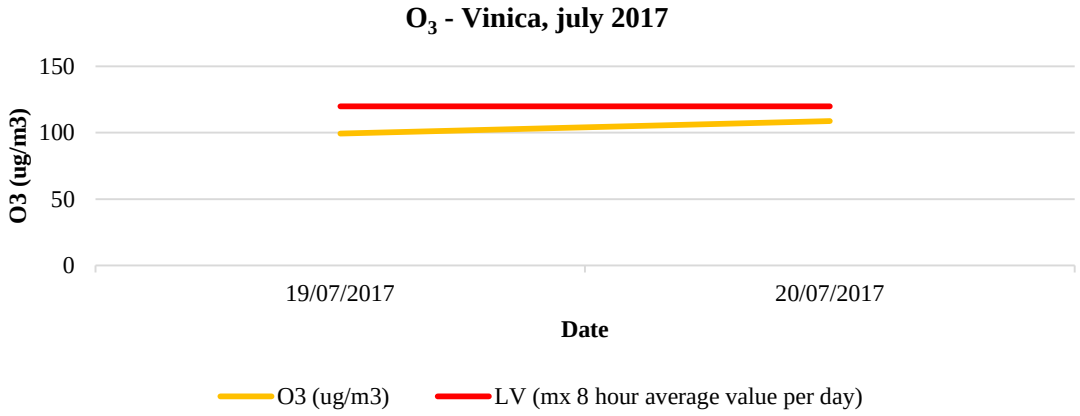


Figure 87.

In Figure 88 is given a graphic representation of the comparison of hourly values with the ozone information threshold for ozone in the ambient air.

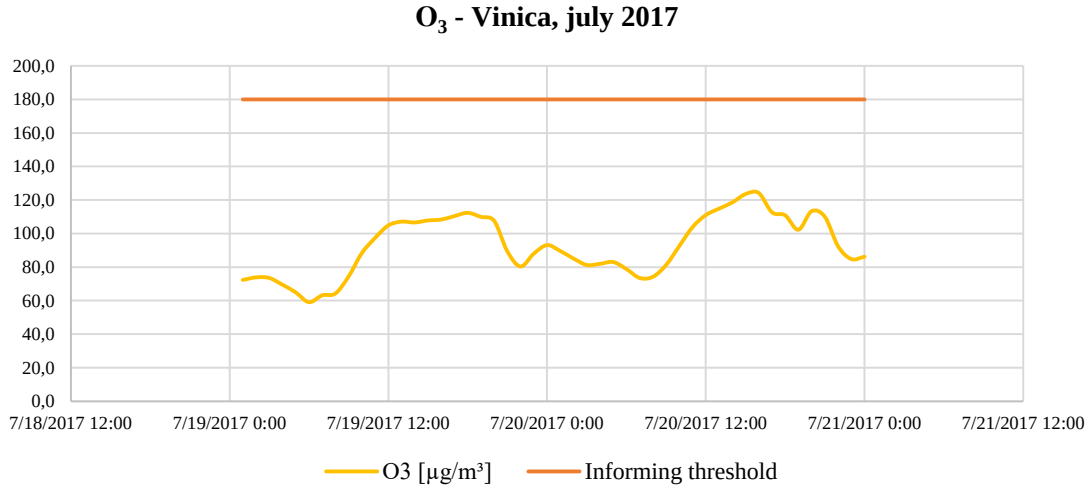


Figure 88.

3) Measuring location - Delcevo

In Figure 89 are given graphical measurements of ozone in ambient air in real time for the period of the measurement campaign from 16.07. to 17.07.2017.

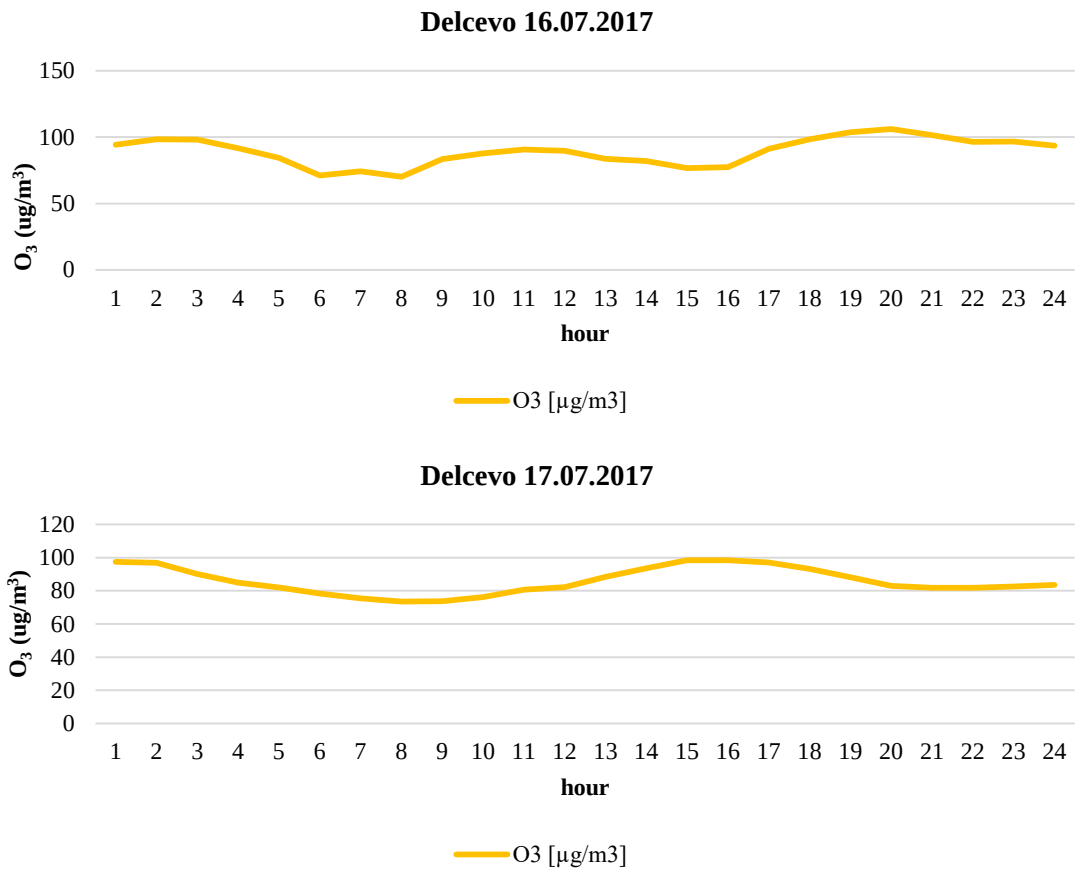


Figure 89.

In Figure 90 is given a graphic representation from the comparison of the maximum 8 hour average daily values with the ozone limit values in ambient air.

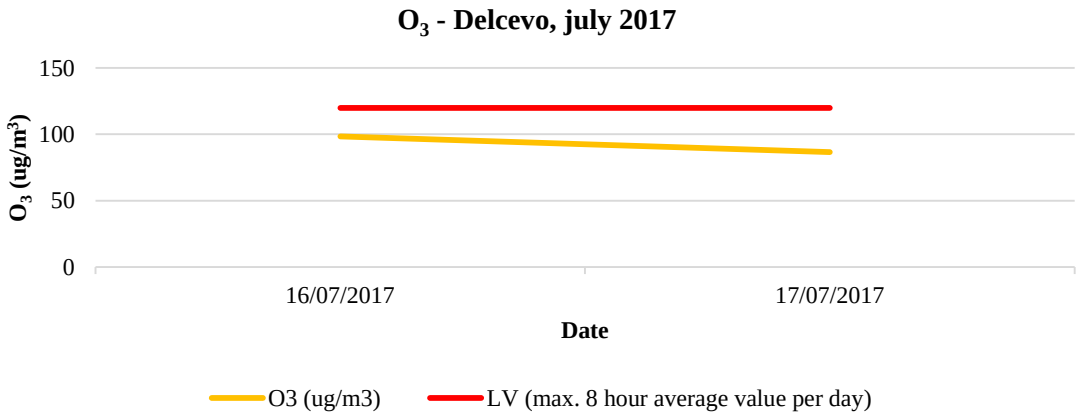


Figure 90.

In Figure 91 is a graphic representation of the comparison of hourly values with the threshold of informing the public about ozone in ambient air.

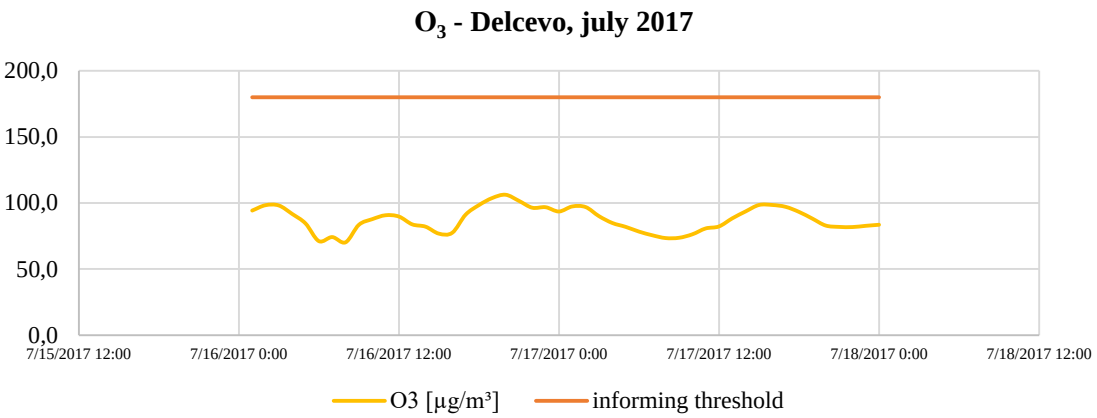


Figure 91.

4) Measuring location in Pehcevo

In Figure 92 is a graphical representation of the measurement of ozone in ambient air in real time for the period of the measurement campaign 11 to 12.07.2017.

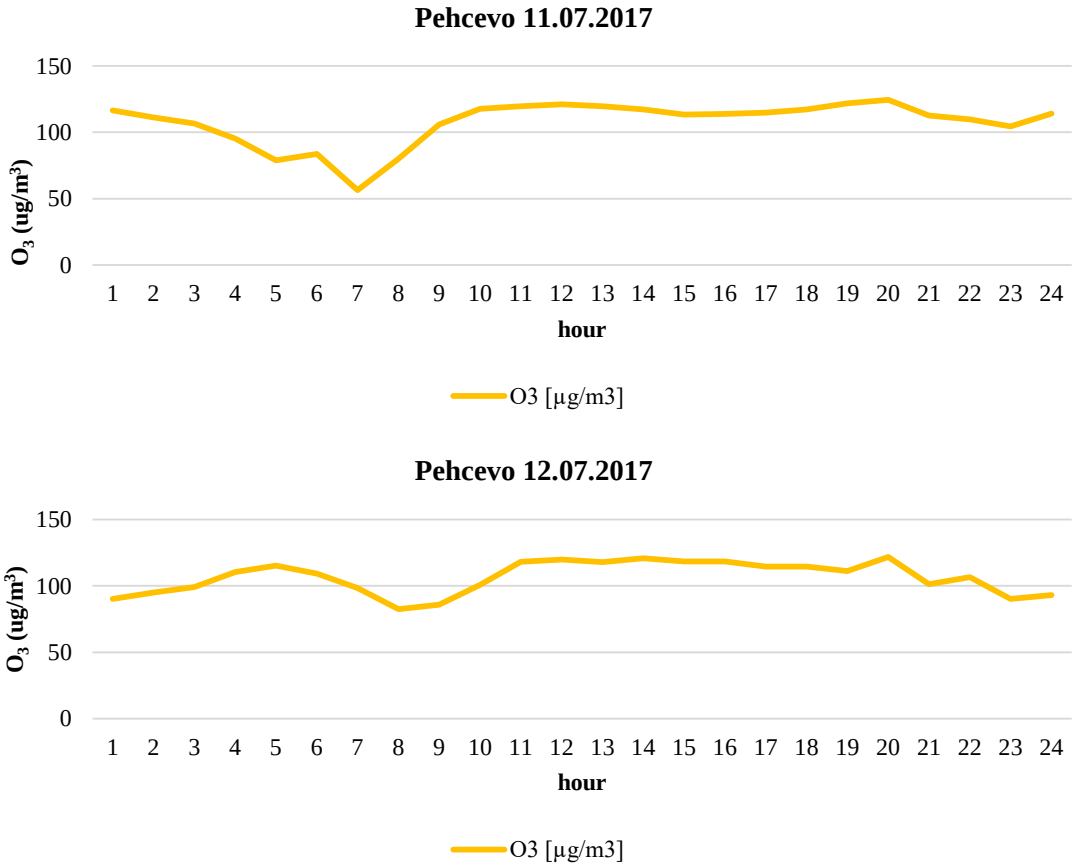


Figure 92.

In Figure 93 is given a graphic representation of the comparison of maximum 8 hour average daily values with ozone limit values in ambient air.

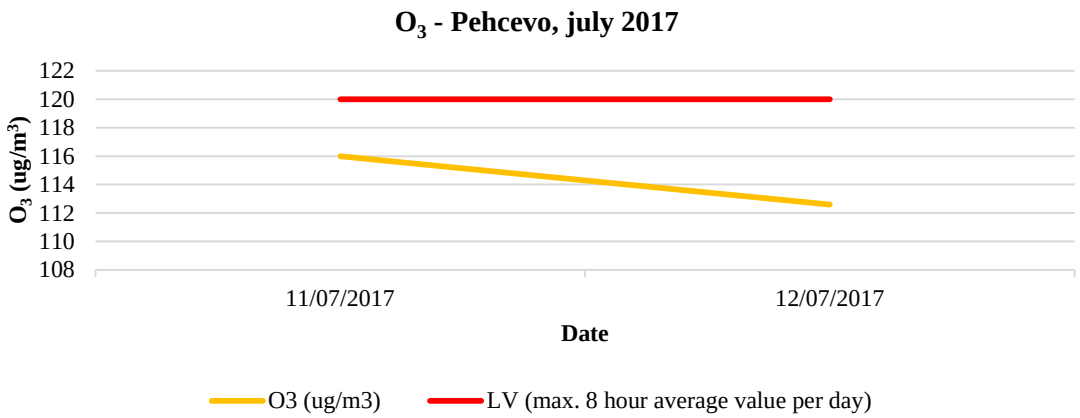


Figure 93.

In Figure 94 is given a graphic representation of the comparison of hourly values with the threshold of informing the public about ozone in ambient air.

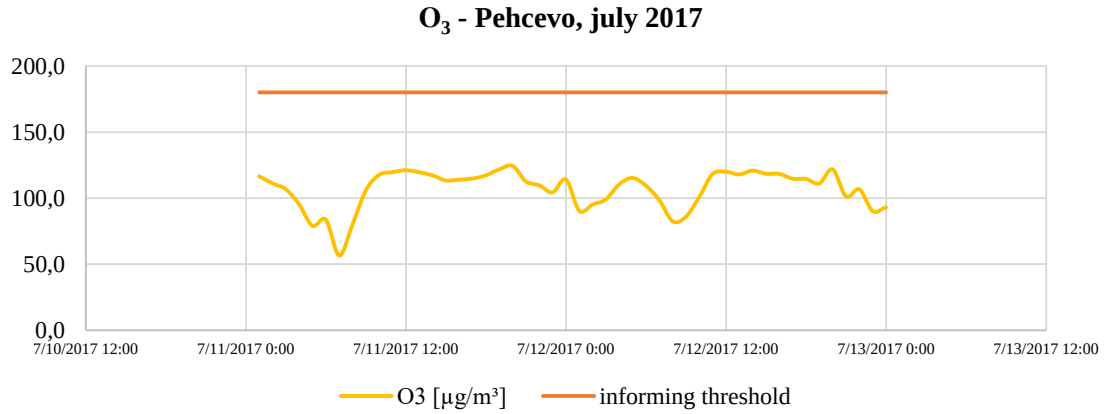


Figure 94.

VII.5.2 Autmn/Winter measuring campaign

The summed data on Ozone O3 (maximum daily average 8 hour value) in the monitored period (23.10-19.11.2017), obtained from measurements of the Ri-opusproject are presented in Table 22.

Table 22. Comparison of Ri-opusproject data - for the monitored period

Measuring location	**Berovo**	**Vinica**	**Delcevo**	**Pehcevo**
Date	**O_3 ($\mu g/m^3$)**	**O_3 ($\mu g/m^3$)**	**O_3 ($\mu g/m^3$)**	**O_3 ($\mu g/m^3$)**
20.10.2017		85,4		
21.10.2017		85,5		
22.10.2017		82,2		
23.10.2017		68,8		
25.10.2017			66,0	
26.10.2017			65,5	
27.10.2017			60,9	
28.10.2017			68,2	

29.10.2017			75,1	
30.10.2017			83,4	
31.10.2017			79,3	
02.11.2017				78,0
03.11.2017				70,8
04.11.2017				67,4
05.11.2017				81,5
07.11.2017	78,0			
08.11.2017	83,5			
09.11.2017	63,9			
10.11.2017	65,1			
11.11.2017	60,8			
12.11.2017	54,6			
14.11.2017		60,2		
15.11.2017		35,2		
16.11.2017		27,2		
17.11.2017		40,3		
18.11.2017		33,2		
19.11.2017		31,4		

The graphic display of the measurement campaign for monitoring the measurement parameter O3 in the winter season 2017 is given in Figure 95.

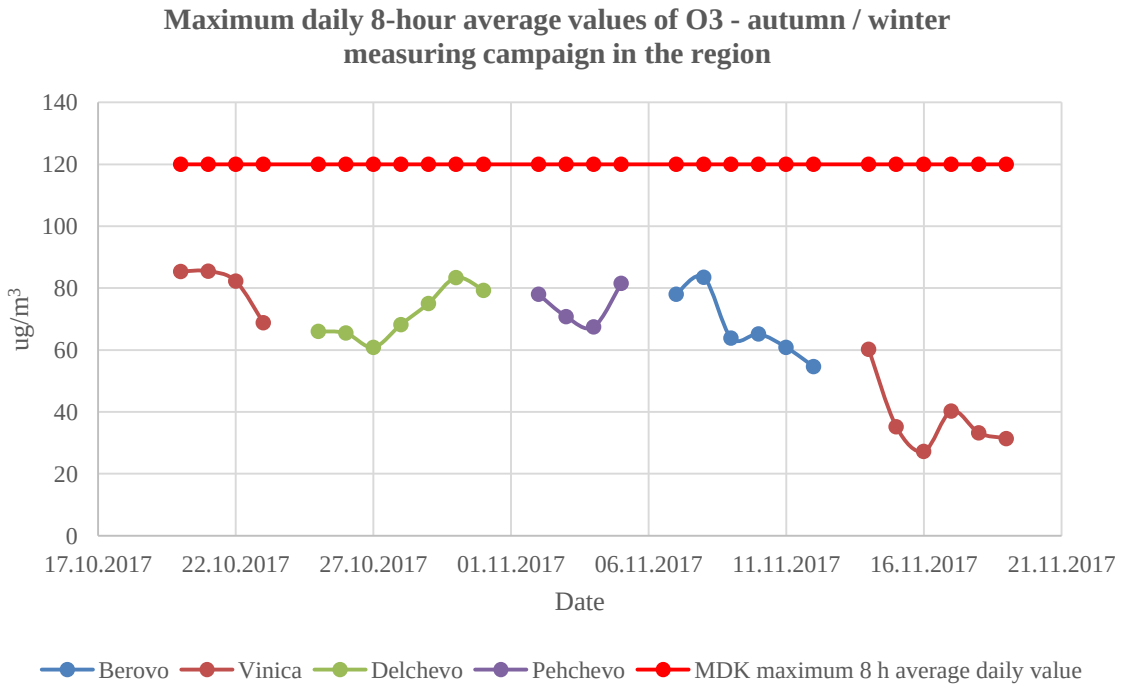


Figure 95.

1) Measuring location - Berovo

In Figure 96 is given a graphic representation from the comparison of the maximum 8 hour average ozone values with the ozone limit values in ambient air.

Maximum daily 8 hours average values per day O_3 in Berovo

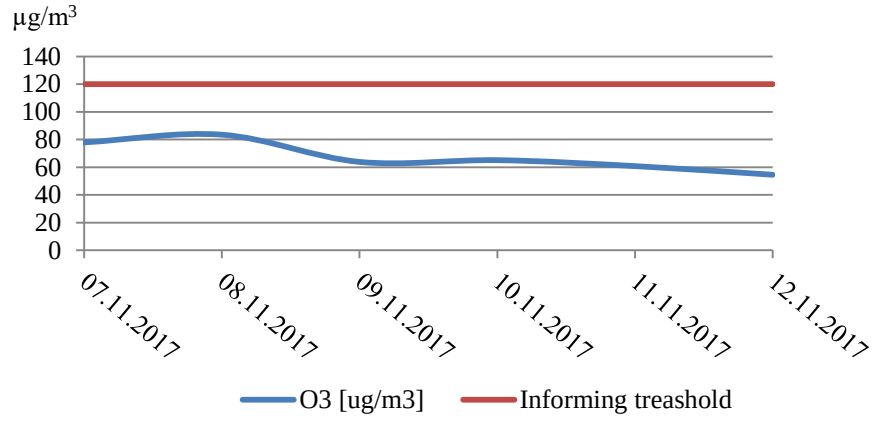
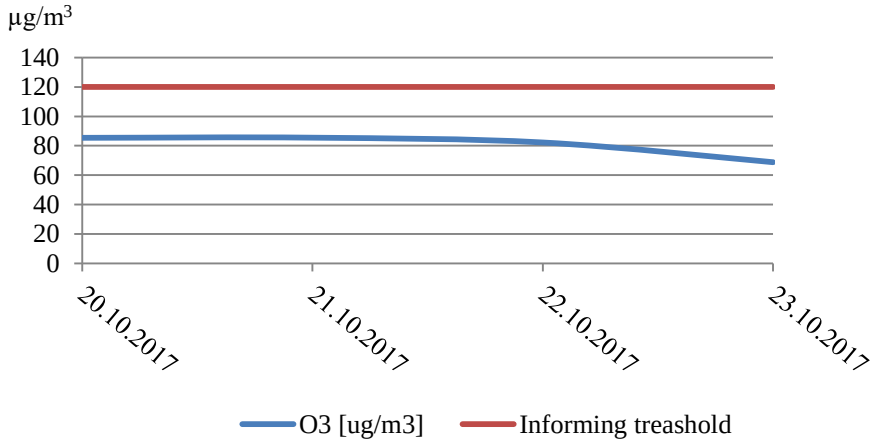


Figure 96.

2) Measuring location - Vinica

In Figure 97 is given a graphic representation of the comparison of the maximum 8 hour average ozone values with the ozone limit values in ambient air.

Maximum daily 8 hours average values per day O_3 in Vinica



Maximum daily 8 hours average values per day O_3 in Vinica

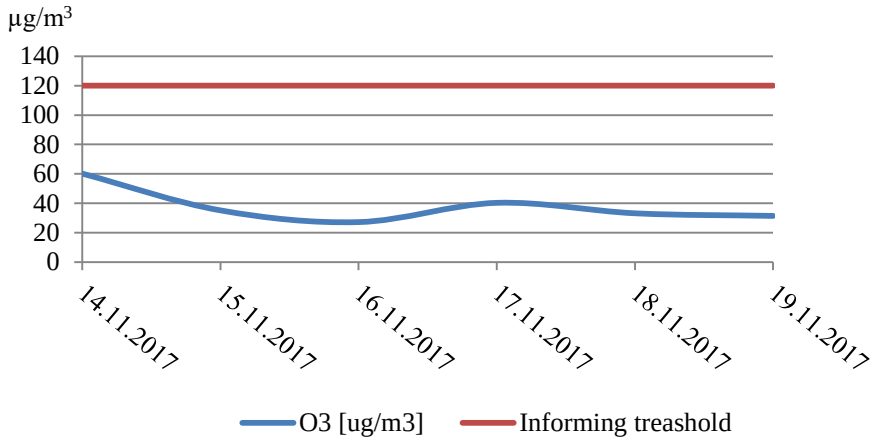


Figure 97.

3) Measiring location - Delcevo

In Figure 98 is given a graphic representation of the comparison of the maximum 8 hour average daily ozone values with ozone limit values in ambient air.

Maximum daily 8 hours average values per day O_3 in Delcevo

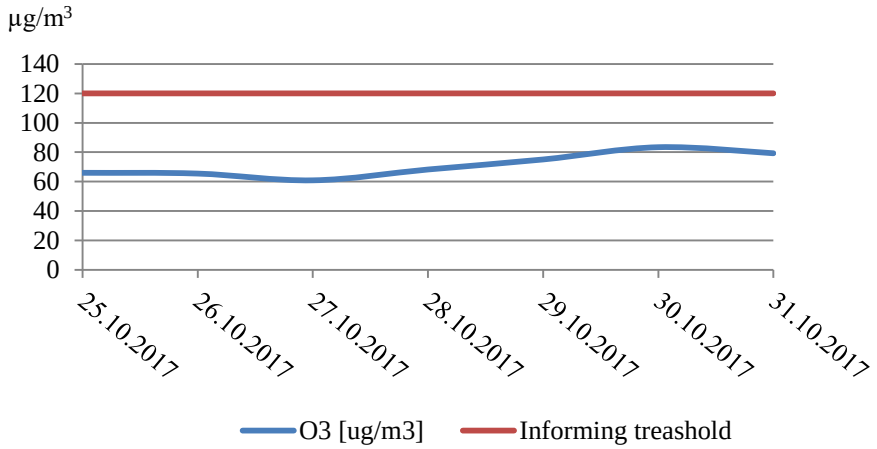


Figure 98.

4) Measuring location - Pehcevo

In Figure 99 given graphic representation of the comparison of the maximum 8 hour average ozone values with the ozone limit values in ambient air.

Maximum daily 8 hours average value per day O_3 in Pehcevo

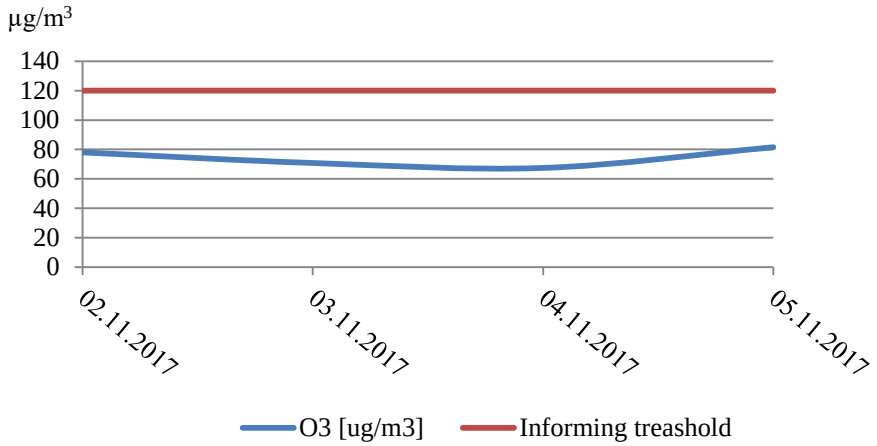


Figure 99.

VII.5.3 Conclusion for O_3

Maximum 8 hour average daily concentration

For the measurement parameter ozone O3 the limit value is given as the maximum 8 hour average daily. In the observed summer and autumn-winter period it is not exceeded for all monitoring areas Berovo, Delcevo, Pehcevo and Vinica. There are no exceedances in the city of Kocani in the monitoring station at the MOEPP.

Comparing the measured hourly values for ozone with ambient air quality indices for O3 established CITEAIR, European Union, which is also applied by the Ministry of Environment and Physical Planning of the Republic of Macedonia it can be conclude that for all measuring points the pollution index is from very low to low in the autumn / winter period, while in the summer the index is from very low to medium.

When comparing the obtained 8 hour average daily ozone values between the summer measuring camapaign and autumn / winter, it can be concluded that for all environments in the autumn winter period ozone concentrations are lower than in the summer period.

VII.6 Meteorological parameters

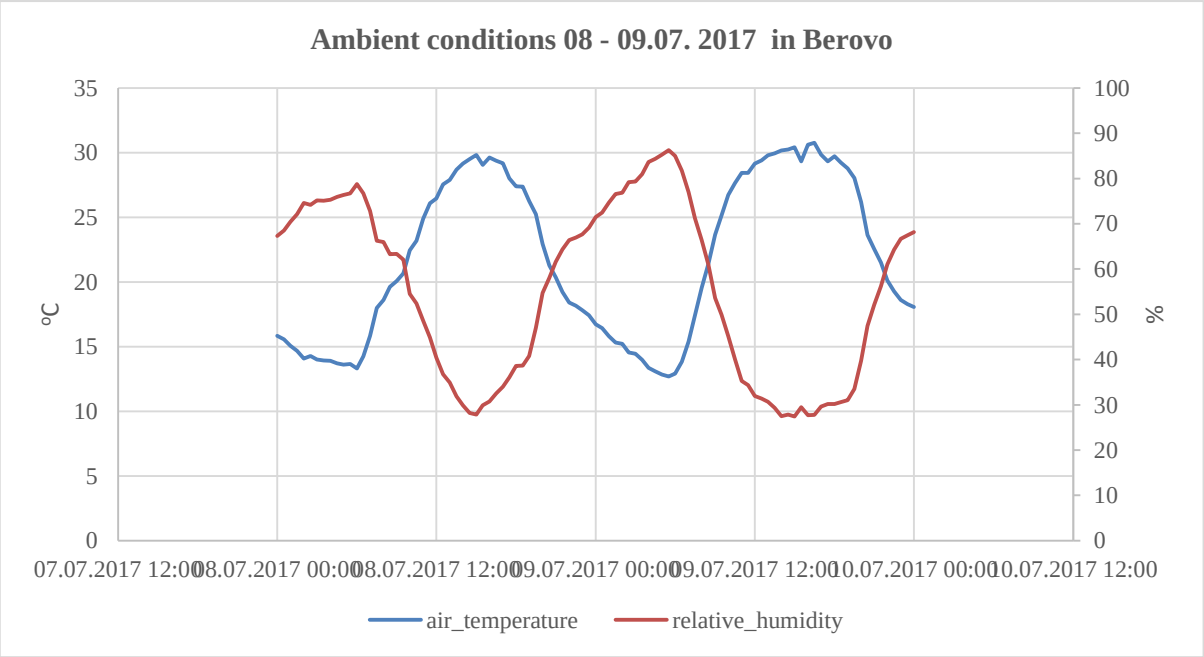
VII.6.1 Summer measuring campaign

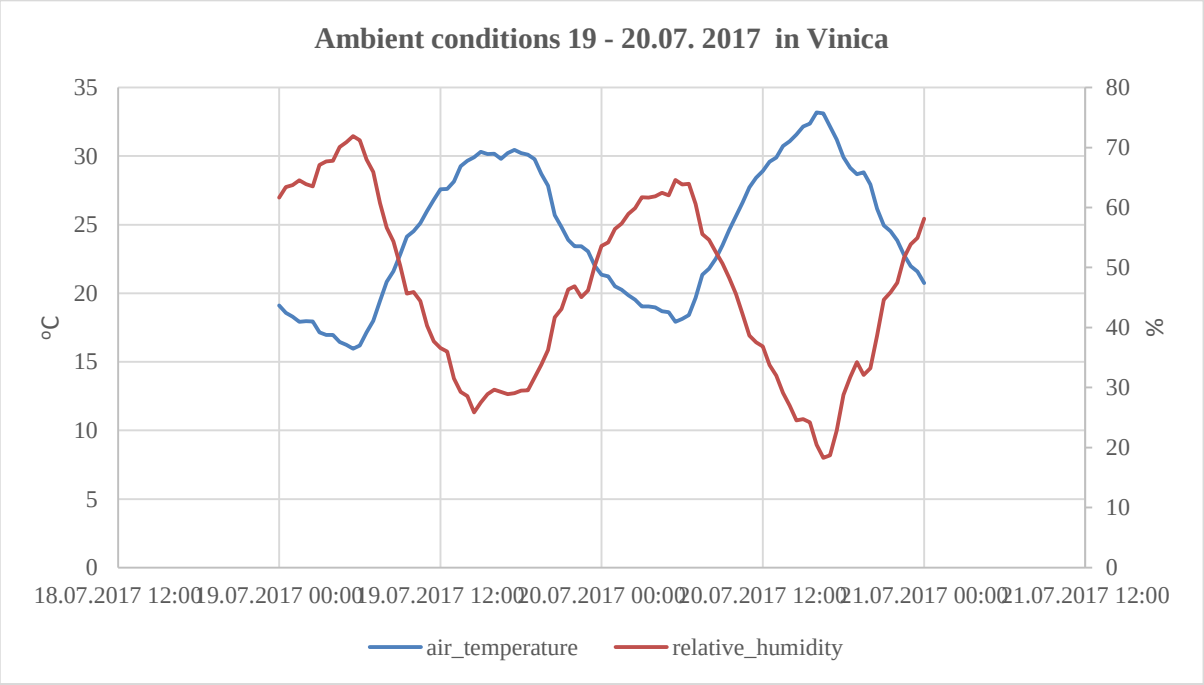
The ambient air parameters in the summer monitoring campaign are given in Table 23.

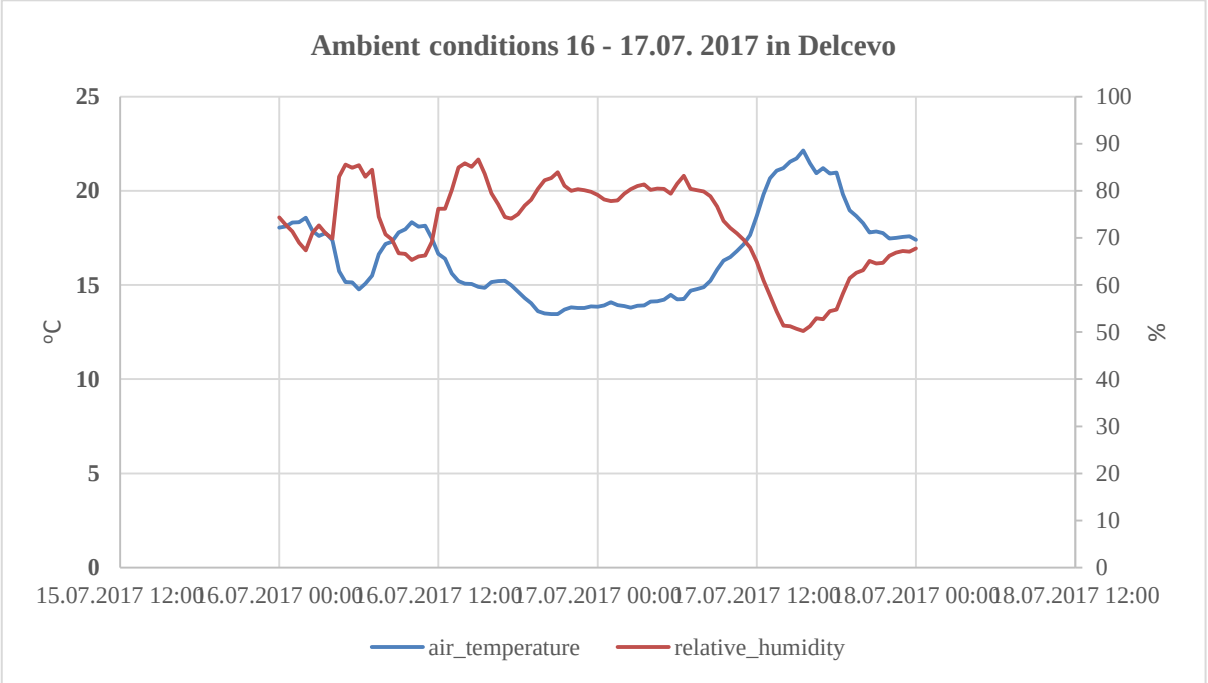
Table 23.

Measuring location	Parameter	Temperature	Air pressure	Relative humidity	Average wind speed
	Date	°C	hPa	%	m/s
Berovo	08.07.17	21,2	56,2	922,0	0,4
	09.07.17	22,5	53,8	921,8	0,3
Pehcevo	11.07.17	19,5	70,7	910,9	0,3
	12.07.17	25,0	55,1	907,9	0,4
Delcevo	16.07.17	25,1	42,3	908,7	0,3
	17.07.17	15,5	77,3	947,7	0,7
Vinica	19.07.17	17,6	67,3	949,6	1,4
	20.07.17	23,8	47,1	972,7	1,1

The results given in Table 23 are presented for each city in Figure 100.







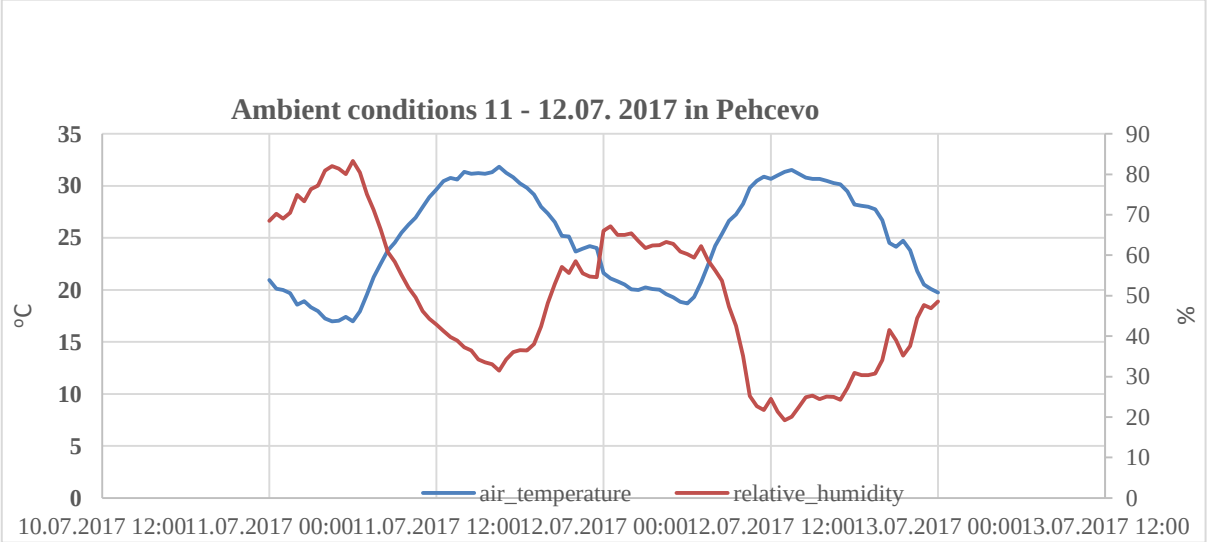
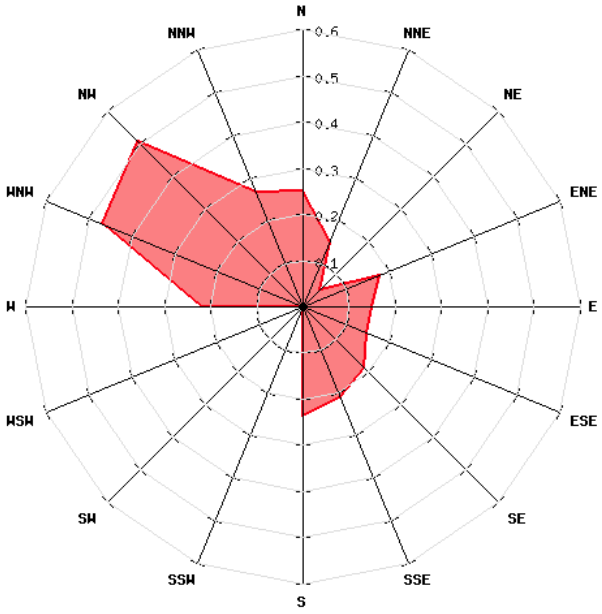


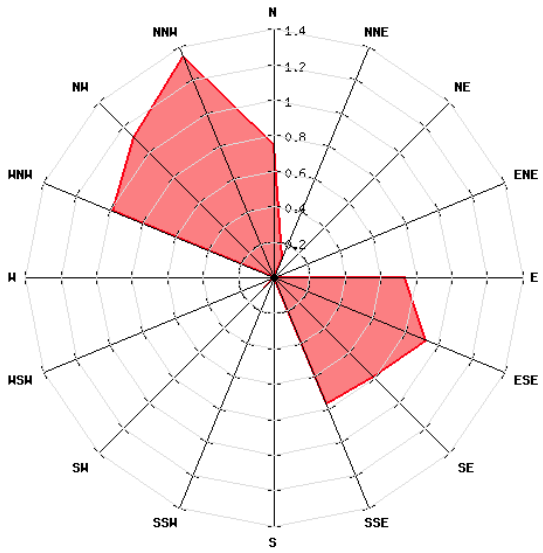
Figure 100.

Rose wind for cities in summer monitoring campaign are given in Figure 101.

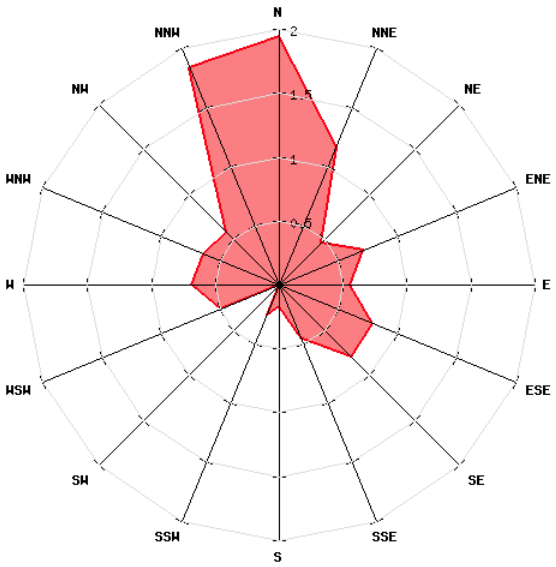
Berovo, measuring period 8 - 9.7.2017 (dominant wind from northwest direction)



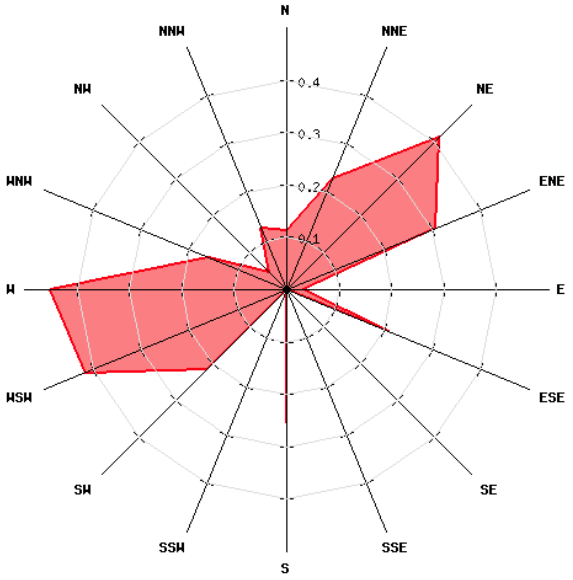
Vinica, measuring period 19 - 20.7.2017 (dominant wind from the northwest direction)



Delcevo, measuring period 16 - 17.07.2017 (dominant wind from north direction)



Pehcevo, measuring period 11 - 12.7.2017 (dominant wind from the northeastern and western directions)



VII.6.2 Autmn / winter measuring campaign

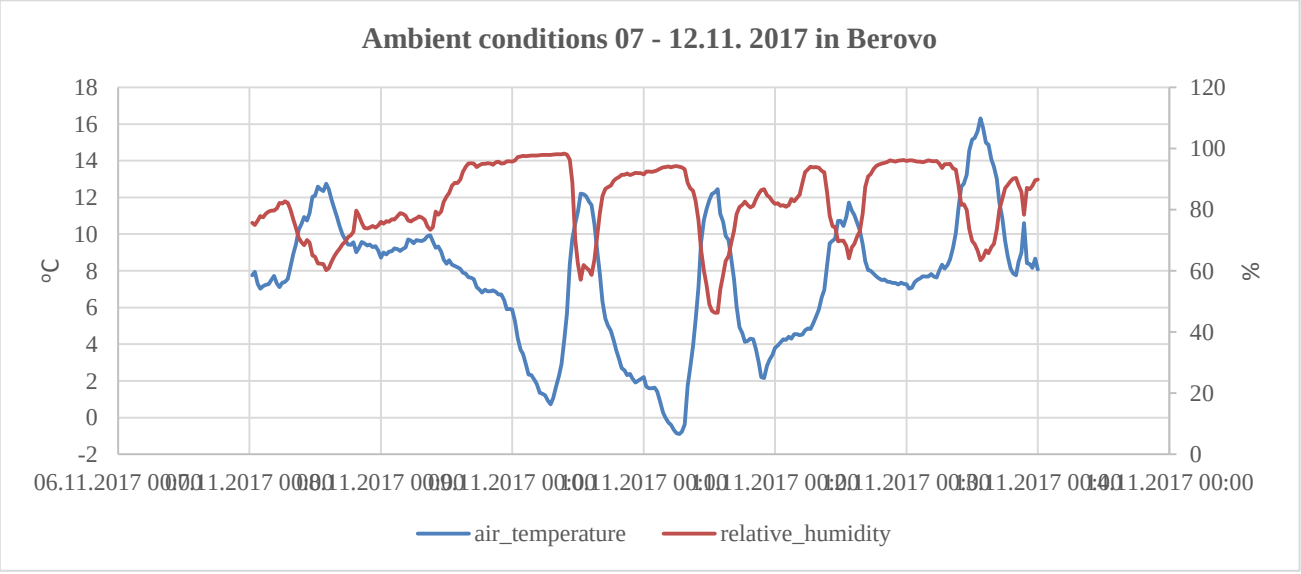
The ambient air parameters in the summer monitoring campaign are given in Table 24.

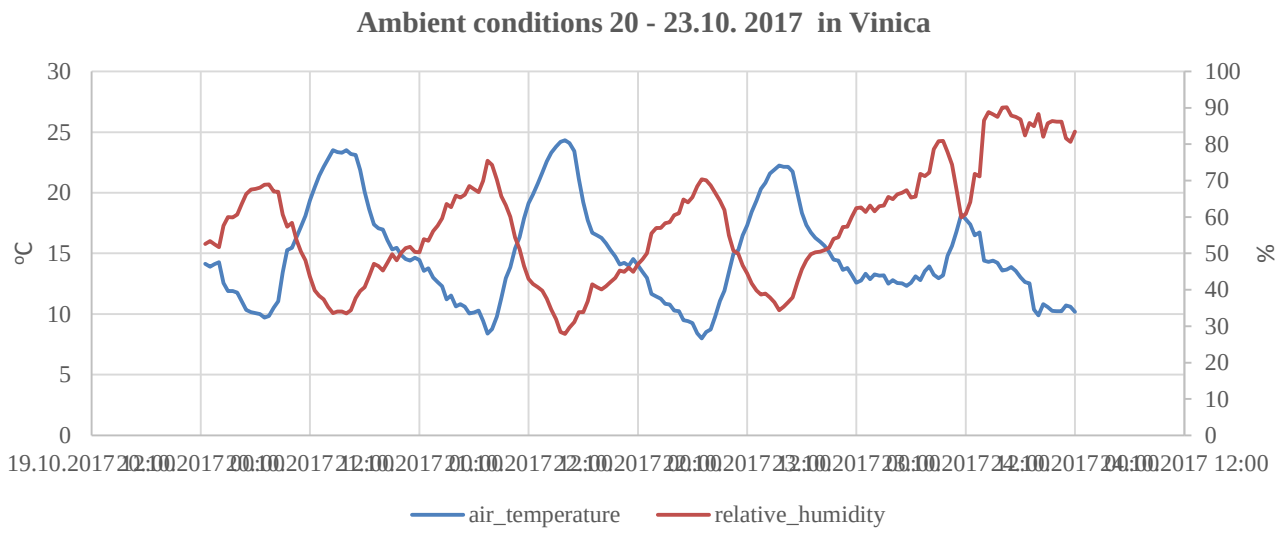
Table 24.

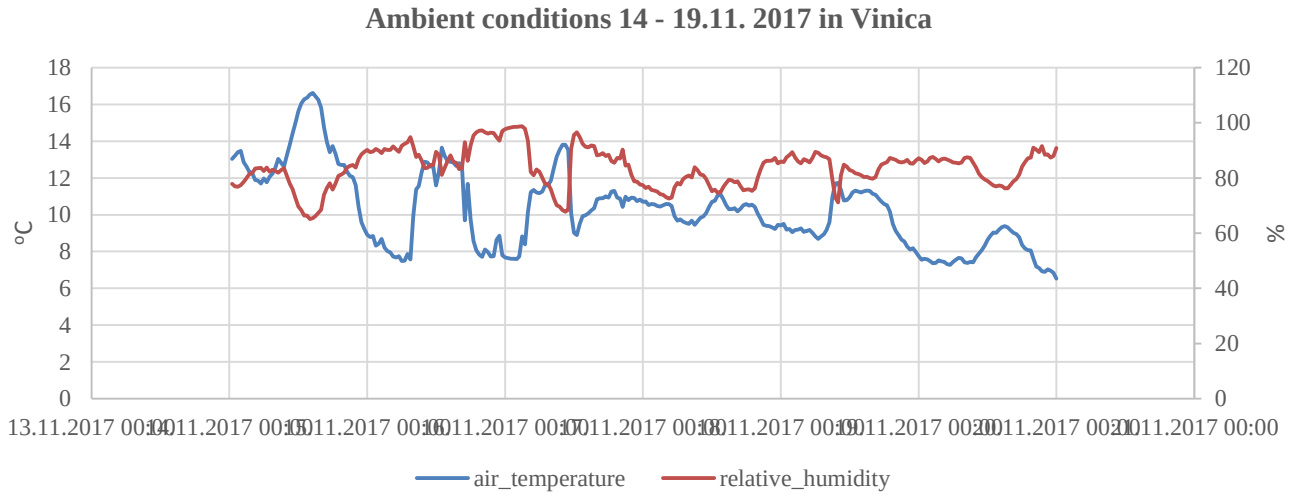
Measuring location	Parameter	Temperature	Air pressure	Relative humidity	Average wind speed
	Date	°C	hPa	%	m/s
Vinica	20.10.17	16,1	973,1	51,0	0,9
	21.10.17	15,6	972,6	50,3	0,9
	22.10.17	14,7	969,4	52,3	0,8

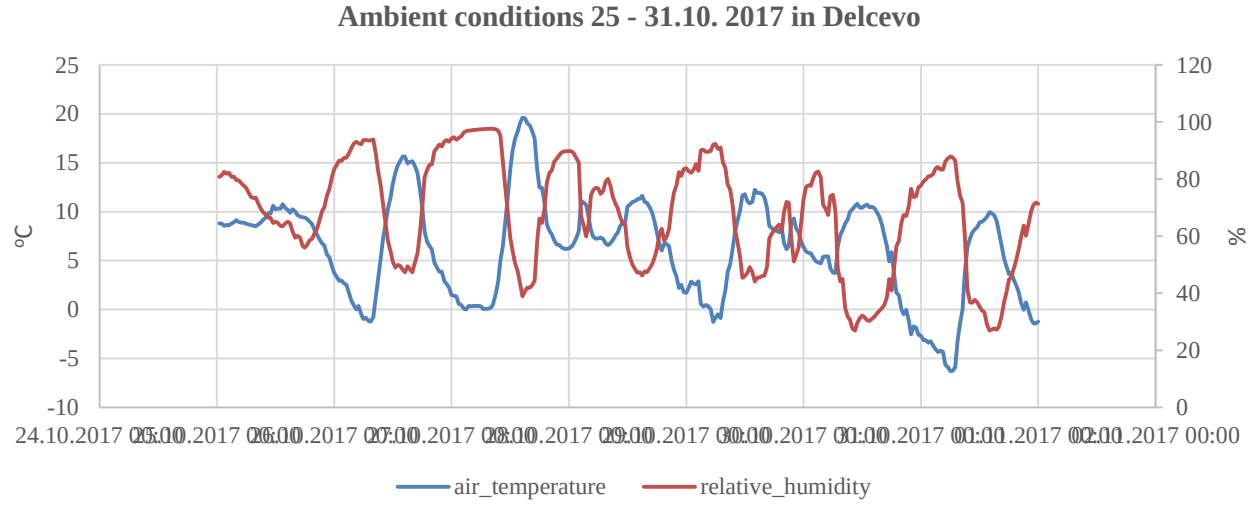
	23.10.17	13,3	960,0	75,7	0,5
Delcevo	25.10.17	8,9	951,5	69,3	1,0
	26.10.17	6,4	957,5	76,3	0,8
	27.10.17	7,6	949,4	78,6	0,6
	28.10.17	8,1	944,0	66,3	1,5
	29.10.17	6,2	940,0	67,7	0,8
	30.10.17	5,9	946,4	53,1	1,4
	31.10.17	1,9	955,1	57,8	0,7
Pehcevo	02.11.17	5,0	908,1	58,4	0,3
	03.11.17	6,6	903,9	59,1	0,2
	04.11.17	5,7	907,1	79,9	0,3
	05.11.17	5,3	907,1	75,0	0,3
Berovo	07.11.17	9,5	924,2	72,7	0,7
	08.11.17	8,4	922,2	85,0	0,8
	09.11.17	4,9	924,3	87,9	0,2
	10.11.17	4,6	924,2	79,4	0,1
	11.11.17	7,4	920,4	85,0	0,2
	12.11.17	10,3	917,3	85,2	0,2
Vinica	14.11.17	13,4	966,5	78,1	0,5
	15.11.17	9,9	973,3	90,0	0,8
	16.11.17	10,6	974,0	86,1	0,9
	17.11.17	10,2	971,4	78,4	1,6
	18.11.17	9,9	968,7	84,4	0,6
	19.11.17	7,9	965,7	84,2	0,5

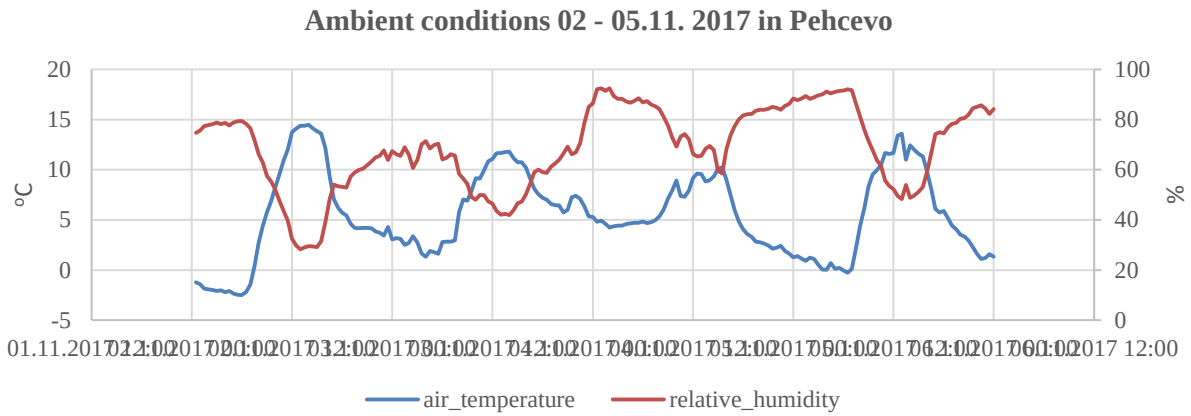
The results given in Table 24 are presented for each city in Figure 102.




Ambient conditions 20 - 23.10. 2017 in Vinica
°C
%
air_temperature
relative_humidity

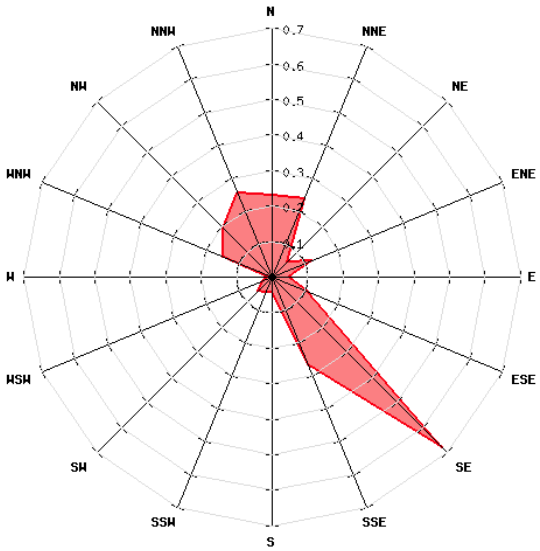

Ambient conditions 14 - 19.11. 2017 in Vinica
°C
%
air_temperature
relative_humidity


Ambient conditions 25 - 31.10. 2017 in Delcevo
°C
%
air_temperature
relative_humidity

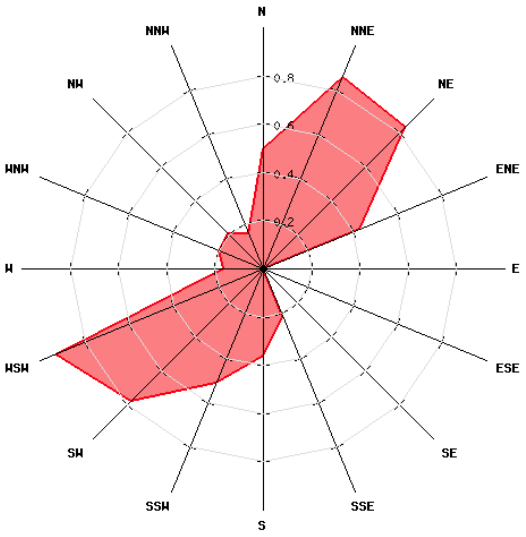


Rose wind for cities in autmn / winter monitoring campaign are given in Figure 103.

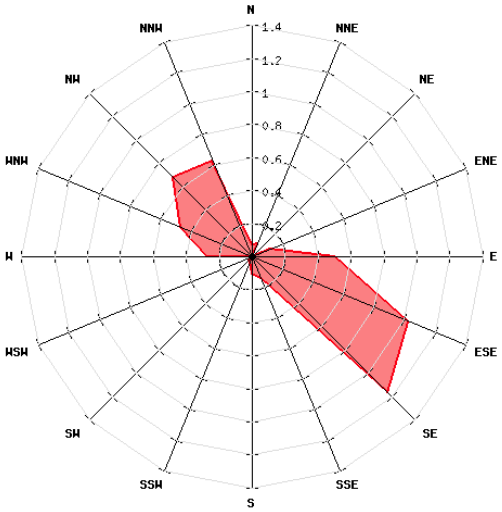
Berovo, measuring period 7 - 12.11.2017 (dominant wind from the southeast direction)



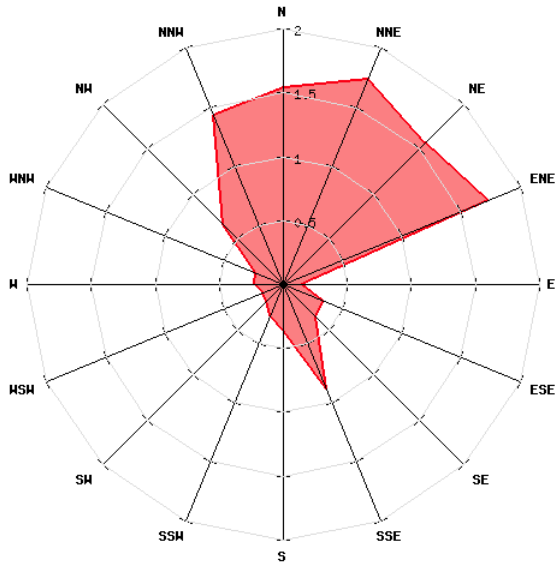
Vinica, measuring period 20 - 23.10.17 (dominant wind from the northeastern and northwestern direction)



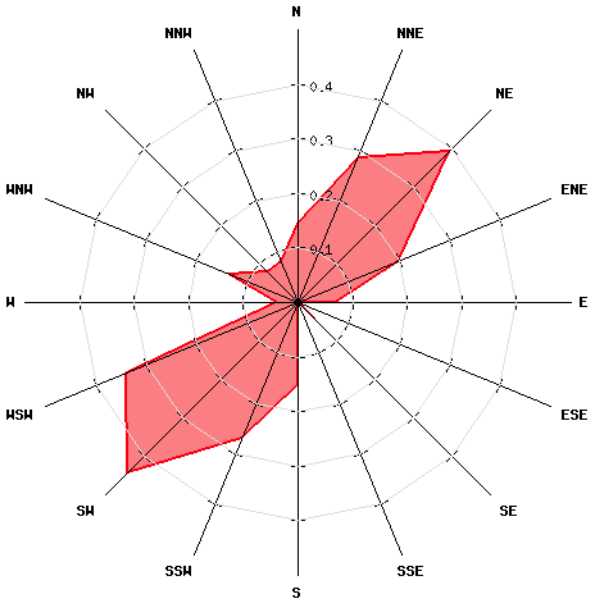
Vinica, measuring period 14 - 19.11.2017 година (dominant wind from the southeast direction)



Delcevo, measuring period 25 - 31.10.2017 година (dominant wind from the northeast direction)



Pehcevo, measuring period 2 - 5.11.2017 година (dominant wind from the northeast and southwest direction)



VII.7 General conclusion

Berovo

There are 7,002 inhabitants in the city of Berovo, while the Municipality of Berovo possesses rich natural resources, forest potential and a clean, unpolluted environment. The main economic branches are: agriculture, livestock, forestry, mining, textile industry, fruit growing, tourism and catering. Public facilities and institutions are pre-heated on oil with built-in central heating. Commercial objects and firms are warmed up in combination with wood, oil and stone. Households of about 95% are warmed up by wood, and the rest are combined with oil, coal and the latest trend of pellets. Certain activities related to energy efficiency of public institutions in the area of central heating of pellets, hot facade, E.E. roofs, insulation carpentry, solar collectors for hot water and energy saving bulbs.

Vinica

In the city of Vinica there are 10.860 inhabitants, whereby in the municipality of Vinica, a municipality in development, the population is mainly engaged in agriculture while in the city there are several industrial objects from different sectors and services (textile, wood industry, construction materials industry and for the production of furniture, as well as for the food industry and floriculture). In the territory of the city of Vinica there are no data related to energy management, as well as undertaken activities in the field of energy efficiency.

Delcevo

There are 11,536 inhabitants in the city of Delcevo. The industry (textile, leather and tobacco industry, as well as the wood processing industry) is dominant in the economic development of the municipality, followed by agriculture and construction, with the emphasis on tertiary sector (trade, catering and little economy). On the territory of the city of Delcevo there are no data related to energy management, as well as on the undertaken activities in the field of energy efficiency.

Pehcevo

There are 3,237 inhabitants in the city of Pehcevo. The wholesale and retail trade dominated the economic development of the municipality; repair of motor vehicles and motorcycles, processing industry and agriculture and forestry. On the territory of the city of Pehcevo most of the households are heated on wood, while in the industry - most of the industrial buildings on the territory of the municipality use wood. Only a small part of them are used for oiling. Activities on energy efficiency (installation, lighting, facade and carpentry as well as in the area of heating system) were carried out on the territory of the municipality of Pehcevo, and additional activities are planned to continue to other public institutions.

Ambient air quality

Cities that were covered by indicative measurements of ambient air quality as well as the city of Kocani which is under the monitoring system of the MOEPP are located at a distance of 10 to 44 km. Because the indicative measurements in the cities of Berovo, Vinica, Delcevo and Pehcevo were carried out in a small number of days, it is not possible to separately interpret the results for the state of the quality of the air, but the results of the indicative measurements were compared with the results from the monitoring system of the city Kocani for which it has data in the past.

PM_{10}

Hourly values

For the measurement parameter PM10, the limit values were not exceeded at the level of 1 hour, but from CITEAIR, the European Union, the Ambient Air Quality Index has been established, which is also applied by the Ministry of Environment and Physical Planning of the Republic of Macedonia.

If we compare the hourly values for PM10 with respect to the index of ambient air quality for the summer period for Berovo, Delcevo, Pehcevo and Vinica, the following conclusion can be drawn:

- Very low pollution during the whole period of examination in the town of Delcevo, ie no peaks were observed.
- Indices of pollution from low to very high were observed for the town of Vinica in the morning (07-09 hours), while in the evening and night (19-22 hours), indices of low pollution were recorded
- Indices of pollution from medium to high were recorded for the town of Pehcevo in the morning (07-09 hours), while in the evening and night (20-23 hours), indices of low pollution were recorded
- For the city of Berovo in the morning (07-09 hours), as well as in the evening and night (20-23 hours), indices of low pollution were recorded

If a comparison of the hourly values for PM10 with respect to the ambient air quality index for the autumn and winter period for Berovo, Delcevo, Pehcevo and Vinica, the following conclusion can be drawn:

- Average pollution during the morning (07-09 hours) and night (19 -23 hours) during the examination in the town of Delcevo.
- For the town of Vinica and Pehcevo, during the morning hours (07-09) and during the evening (19-23h), indices of pollution are from medium to high
- For the town of Berovo in the morning (07-09 hours) an average pollution index was recorded, while in the period from 16 to 23 hours an index of high pollution was registered

24 Hour Values

The limit value for the 24 hour and average annual concentration of PM10 dust is prescribed in the Decree on limit values for levels and types of polluting substances in ambient air and alert thresholds, deadlines for achieving limit values, margins and tolerance for limit values, target values and long-term goals.

The city of Kocani is a metropolitan environment in which it can be concluded that the composition of ambient air quality with PM10 is one of the lowest pollutants by this measurement parameter. If a retrospective of the average annual values of PM10 for the city of Kocani is made, it can be concluded that in the last 3 years the average value has been exceeded and shows a slight downward trend.

If a retrospective of the average monthly values of PM10 for the city of Kocani in 2016 can be concluded that the months from November to February, where the average monthly value of PM10 is from 50 ug / m3 in February to 77, can be characterized as critical months ug / m3 in December.

The comparison of the average concentrations of PM10 in the city of Kocani with the rest of the cities given in Table 23 (summer period) and Table 24 (autumn winter period) is shown in Table 25.

City	Berovo	Kocani-MOEPP	Vinica	Kocani-MOEPP	Delcevo	Kocani-MOEPP	Pehcevo	Kocani-MOEPP
Prameter	**PM10 (µg/m3)**	**PM10 (µg/m3)**	**PM10 (µg/m3)**	**PM10 (µg/m3)**	**PM10 (µg/m3)**	**PM10 (µg/m3)**	**PM10 (µg/m3)**	**PM10 (µg/m3)**
Average value for PM10 for the examined period July and October-November 2017	47,1	51,4	37,3	43,2	23,7	32,8	37,7	60,9
Average value for PM10 for the examined period July 2017	23,8	37,9	23,4	31,3	13,9	28,5	34,4	44,9
Average value for PM10 for the examined period October-November 2017	54,9	55,9	40,1	45,6	26,9	34,3	39,3	68,9

From the comparison for the entire period of examination, summer and autumn winter measuring campaign given in Table 25 it can be concluded as follows:

- Concentration of. PM10 in the city of Kocani is higher than the same in Berovo by 8%.
- Concentration of. PM10 in the city of Kocani is higher than the same in Vinica by 14%.
- Concentration of. PM10 in the city of Kocani is higher than the same in Delcevo for 28%.
- Concentration of. PM10 in the city of Kocani is higher than the same in Pehčevo by 40%.

From the comparison for the period of the summer measurement campaign given in Table 25 it can be concluded that the concentration of PM10 in the city of Kocani is significantly higher than the other cities, ie it is higher by 23% from the city of Pehcevo, 25% from the city of Vinica, 37% from the city of Berovo and 51% from the city of Delcevo.

From the comparison of the average results for PM10 for each city separately in the autumn winter measurement campaign given in Table 25 it can be concluded as follows:

- the concentration of PM10 in the city of Kocani is almost identical to that in the city of Berovo
- concentration of PM10 in the city of Kocani is higher than Vinica by 12%.
- concentration of PM10 in Kocani is higher than Delcevo by 21%.
- concentration of PM10 in the city of Kocani is higher than the same in Pehcevo by 43%.

From the locations covered by indicative monitoring in Berovo, Delcevo, Pehcevo and Vinica as well as the stationary mobile station in Kocani with the MOEPP given in Table 23 of the summer period and Table 24 from the autumn winter period a sublimate was made showing the number of exceeding the limit value and the same is shown in Table 25.

Concentration of PM_{10}	Berovo	Vinica	Delcevo	Pehcevo	Kocani - MOEPP
Number of exceedances LV during summer campaign(July 2017 година)	0/2	0/2	0/2	0/2	0/8
Number of exceedances LV during autumn winter measurement campaign (October-November 2017)	4/6	1/10	0/6	0/4	11/30

From Table 25 it can be concluded that in the summer period at no measuring point there are no exceeding of the prescribed limit values, while in the autumn winter period there are overcaps in Vinica, Berovo and Kocani.

In the towns of Pehcevo and Delcevo, the limit value was not exceeded with the remark that during periods of examination in the town of Delcevo there was no exceeding of 24 hour limit value nor in the city of Kocani, while in the period of examination in the town of Pehcevo the monitoring station in Kocani showed values above allowed in the shorter period.

SO2

Hourly values

For the measurement parameter SO2, the limit values at the level of 1 hour both in the summer period and in the autumn-winter period are not exceeded both for Kocani and for the monitoring environments Berovo, Delcevo, Pehcevo and Vinica.

Comparing the measured hourly values for sulfur dioxide with ambient air quality indexes for SO2 established CITEAIR, European Union, which is also applied by the Ministry of Environment and Physical Planning of the Republic of Macedonia it can be conclude that the pollution index for all measuring points is very low.

24 Hour Values

At all measuring points, ie in the cities of Berovo, Delcevo, Pehcevo and Vinica, higher concentrations of sulfur dioxide were observed in the autumn-winter period compared to the summer. The limit value for the 24-hour concentration of SO2 prescribed in the Regulation on limit values for levels and types of pollutants in ambient air and alert thresholds, deadlines for achieving limit values, margins and tolerance for limit values, target values and long-term objectives is not exceeded for any location in the summer and autumn-winter period. Historical data on the city of Kocani show that the average 24 hour concentration of SO2 is not exceeded even once.

NO2

Hourly values

For the measurement parameter NO2, the limit values at the level of 1 hour both in the summer and autumn-winter period are not exceeded for the monitoring areas Berovo, Delcevo, Pehcevo and Vinica: Nitrogen dioxide is not covered for the city of Kocani in the monitoring station MOEPP.

Comparing measured hourly values for nitrogen dioxide with ambient air quality indices for NO2 established CITEAIR, European Union, which is also applied by the Ministry of Environment and Physical Planning of the Republic of Macedonia it can be conclude that for all measuring points, the pollution index is very low, with the exception of the city of Delcevo, in the autumn winter where values with low index of pollution are observed.

24 Hour Values

In comparison with the obtained average 24 hour values for nitrogen dioxide, during summer measure campaign and autumn winter, it can be concluded that for all environments (Berovo, Delcevo, Pehcevo and Vinica) in the autumn winter period the concentrations of nitrogen dioxide are higher than in the summer period . Limit value for the 24 hour concentration of nitrogen dioxide prescribed in the Decree on limit values for levels and types of polluting substances in ambient air and alert thresholds, deadlines for achieving limit values, margins and tolerance for limit values, target values and long term objectives has been exceeded for any location in the summer and autumn-winter period.

CO

Maximum 8 hour average daily concentration

For the measured parameter carbon monoxide, the CO value is set as the maximum 8 hour average daily as in the summer period, so during the autumn-winter it is not exceeded as for the monitored environments Berovo, Delcevo, Pehcevo and Vinica, as well as for the city of Kocani in monitoring station at MOEPP.

Comparing measured hourly values for nitrogen dioxide with ambient air quality indices for NO2 established CITEAIR, European Union, which is also applied by the Ministry of Environment and Physical Planning of the Republic of Macedonia it can be conclude that the pollution index for all measuring points is very low.

By comparing the maximal 8 hour average daily carbon monoxide values between the summer measurement campaign and autumn winter it can be concluded that for all environments in the autumn winter period the concentrations of carbon monoxide are higher than in the summer period. The maximal 8 hour average daily carbon monoxide values in the summer measurement campaign occur during the day (8 to 16 hours), while after the period of the autumn winter measurement campaign, the maximum is most commonly occurring between 16 and 23 hours.

O3

Maximum 8 hour average daily concentration

For the measurement parameter ozone O3, the limit value is given as the maximum 8 hour average daily as in the summer period, and during the autumn-winter period it is not exceeded for all monitoring areas Berovo, Delcevo, Pehcevo and Vinica, as well as for the city of Kocani at the monitoring station with the MOEPP.

Comparing the measured hourly values for ozone with ambient air quality indices for O3 established CITEAIR, European Union, which is also applied by the Ministry of Environment and Physical Planning of the Republic of Macedonia it can be conclude that for all measuring points, the pollution index is from very low to low during the autumn winter, while in the summer period the index is from very low to medium.

When comparing the obtained maximal 8 hour average ozone values between the summer measurement campaign and autumn winter it can be concluded that for all environments in the autumn winter period the ozone concentrations are lower than in the summer period.

VIII Data comparison of monitoring stations Blagoevgrad (Bulgaria) – Kocani (Macedonia)

The city of Blagoevgrad is located in the Republic of Macedonia. Bulgaria with 69,610 inhabitants is located at a distance of 25 to 55 km from the cities of Kocani, Pehcevo, Vinica, Delcevo and Berovo.

The available data from the Изпълнителна агенция по околна среда (Environmental Agency of the Republic of Bulgaria) was used for the quality of the air in the city of Blagoevgrad. The measuring station set in the city of Blagoevgrad measures the following parameters: PM10, sulfur dioxide, nitrogen dioxide, ozone and benzene.

The data on the ambient air quality were compared with the data from the measuring station of the MOEPP in Kocani and the indicative measurements that were carried out in the cities of Vinica, Delcevo, Berovo and Pehcevo.

The monitoring station in the city of Blagoevgrad does not carry out measurements of carbon monoxide, while there are no available data from the monitoring station in the city of Kocani for ozone during the monitored period in 2017 and nitrogen dioxide.

Summer Monitoring Campaign

Over all measuring points (Blagoevgrad, Kocani, Berovo, Delcevo, Vinica and Pehcevo) for the period from 8th till 20th of July 2017, there were no exceedances of the limit values for the measured parameters, sulfur dioxide, nitrogen dioxide, monoxide, nitrogen dioxide, and PM10. There were no available data from measuring station in Kocani of ozone and nitrogen dioxide, while in the city of Blagoevgrad, no carbon monoxide measurement is performed.

From the results given in the Bulletin of the Environmental Agency of the Bulgaria, which refers to the period from July to September 2017 (НИВА НА ОСНОВНИТЕ ПОКАЗАТЕЛИ ЗА КАЧЕСТВО НА АТМОСФЕРНИЯ ВЪЗДУХ ПРЕЗ ТРЕТО ТРИМЕСЕЧИЕ НА 2017 ГОДИНА) the data for the city of Blagoevgrad have been extracted and they are compared with the results processed for the monitoring station in the city of Kocani, Republic of Macedonia. (table 26)

Table 26.

Monitored period: July - September 2017				
Parameter	**Ozone**	**Nitrogen dioxide**	**Sulfur dioxide**	**PM10**
	µg/m3	**µg/m3**	**µg/m3**	**µg/m3**
Blagoevgrad, R. Bugarija				
Maximum 1 hour value	123,87	58,64	173,17	-
Maximum 8 hours average value	115,47		-	-
Maximum daily average	-	-	49,49	57,71
Average value for the monitored period		-	14,7	26,91
Number of exceedances	no	no	no	2 days
Kocani, Macedonia				
Maximum 1 hour value	-	-	78,25	-
Maximum 8 hours average value	-	-	-	-
Maximum daily average	-	-	5,6	34,8
Average value for the monitored period		-		68,5
Number of exceedances	-	-	no	8 days

Source:
http://eea.government.bg/bg/dokladi/arhiv_trim-bul

From the results given in the table for the summer period, it can be noted that in the city of Kocani there is a significant number of days when the prescribed limit value has been exceeded, while for sulfur dioxide, in both cities, the situation is satisfactory, with higher concentrations in the city of Blagoevgrad.

Autumn / winter Monitoring Campaign

At all measuring locations (Blagoevgrad, Kocani, Berovo, Delcevo, Vinica and Pehcevo), in the period from 20.10.2017 until 19.11.2017, there are no exceedances of the limit values for the parameters ozone, carbon monoxide and nitrogen dioxide.

In the cities of Kocani, Berovo, Delcevo, Vinica and Pehcevo, the prescribed concentrations for sulfur dioxide are within the permissible limits. For Blagoevgrad in relation to SO_2, the limit value for 1 hour on 21.10.2017 has been exceeded, while the daily value for that day as well as for the rest of the days is within the prescribed limit values.

The ambient air quality relative to the concentration of PM10 is shown in Table 27.

Table 27.

Location	Berovo	Vinica	Delchevo	Pehchevo	Kochani - MOEPP	Blagoevgrad - R. Bulgaria	Maximum allowed 24h val
Date	PM_{10} ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)
20.10.17		45,05			53,8	ПГВ	50
21.10.17		36,21			50	ПГВ	50
22.10.17		42,7			48,3	ПГВ	50
23.10.17		42,37			45	ПГВ	50
24.10.17					28,6	ПГВ	50
25.10.17			13,12		31,8	ПГВ	50
26.10.17			33,47		34,8	ПГВ	50
27.10.17			41,61		46	ПГВ	50
28.10.17			18,4		38,7	ПГВ	50
29.10.17			26,2		34,6	ПГВ	50
30.10.17			28,69		19,8	ПГВ	50
01.11.17					37,9	ПГВ	50
02.11.17				38,35	55,3	ПГВ	50
03.11.17				47	87,9	67,5	50
04.11.17				31,42	68,7	ПГВ	50
05.11.17				40,35	63,8	67,5	50
06.11.17					54,9	62,5	50
07.11.17	34,85				43,4	ПГВ	50
08.11.17	42,36				54,3	ПГВ	50
09.11.17	59,73				52,5	ПГВ	50
10.11.17	64,97				73,5	71	50
11.11.17	60,99				72,9	57,5	50
12.11.17	66,38				39	ПГВ	50
13.11.17					40	ПГВ	50
14.11.17		50,05			48,5	58	50
15.11.17		43,08			46	ПГВ	50
16.11.17		39,14			48,3	ПГВ	50
17.11.17		30,91			34,8	ПГВ	50
18.11.17		34,79			40,6	ПГВ	50
19.11.17		36,68			41	ПГВ	50
	ПГВ - испод гранична вредност пропишана за 24 часа						

From the previous table it can be concluded that the city of Kocani, in relation to the city of Blagoevgrad has a greater number of exceedances of the limit value for PM10, ie in the city of Kocani the limit value was exceeded 11 times in 30 days, while in the city of Blagoevgrad for 30 days in 6 days the limit value has been exceeded.

IX MEASURES FOR PROTECTION, MAINTENANCE AND IMPROVEMENT OF AMBIENT AIR

The proposed measures in this document are based on the situation with the ambient air quality in the cities of the East Planning Region (Berovo, Delcevo, Vinica and Pehcevo), the state of ambient air quality, the city of Kocani, where the monitoring system monitors the MEPP monitoring system while reasonably relying on the local economic development of the community and the scattered experiences in this area from the countries in the region as well as from the European developed countries that refer to the measures for improving the quality of the ambient air.

The measures listed in the National Plan for Ambient Air Quality in the Republic of Macedonia for the period 2013-2018 by the MoEPP, and under the authority of its municipalities are:

- Protection of green space in urban areas from usurping;
- Taking into consideration the protection and improvement of the quality of ambient air when preparing urban plans;
- Establishment of local monitoring networks for air quality by the local government officials;
- Preparation of plans for improving air quality in certain zones and agglomerations;
- Preparation of planning documents for the reduction of air emissions;
- Replacement and reduction of fuel oil and diesel, used for heating, with biodiesel fuel;
- Increased use of biomass and biogas as fuel;
- Increased use of natural gas in all sectors, especially in households, industry and district heating plant;
- Increased use of renewable energy sources;
- Implementation of energy efficiency practices;
- Implementation of energy efficiency measures in the commercial and services sector;
- Energy savings in the transport sector;
- Ongoing implementation of the system for Integrated Pollution Prevention and Control (IPPC) for installations;
- Introducing organized transport as practice in urban areas and in major companies;
- Promoting public transport;
- Promotion of Intensive use of alternative transportation;
- Minimizing waste generation, recycling, re-use and exploitation of waste as an energy source before final removal;
- Storage of waste in properly equipped landfills;
- Implementation of systems for collecting gases deriving from landfills;
- Reduction of methane and nitrogen dioxide in air;
- Raising awareness to prevent uncontrolled waste ingeneration;
- Reducing the extent of everyday activities that can contribute to air pollution.

IX.1. Aims to protect and improve ambient air quality and timetable for their implementation

A) Preventive aims

A.1 Local economic development in the region with activities that do not have a negative impact on the environment

A.2 Achieving of limit values for emission from stationary sources. Reduction of emissions / imissions in the air on the territory of Berovo, Delcevo, Vinica and Pehcevo. The installations in Berovo, Delcevo, Vinica and Pehcevo should meet the criteria prescribed in the Integrated Pollution Prevention and Control (A and B) licenses and the Environmental Policies.

For the construction of new installations, in accordance with the legislation, to carry out Environmental Impact Assessments and Strategic Assessments for the impact on the environment

A.3 Carrying out gasification and encouraging reduction of emission of harmful substances from the industry sector

A.4 Setting up local monitoring network for ambient air quality in areas in the cities of Berovo, Delcevo, Vinica and Pehcevo, primarily for the measurement parameter PM10 and delivering data to the information system for monitoring the ambient air quality in the MOEPP. In order to obtain an appropriate picture of the quality of the ambient air, it is necessary to flush 70% of the calendar year, with the indicative measurements not exceeding the value of 3,2% of the calendar year.

B) Medium-term aims

B.1 Replacement of heating appliances with efficient fuel combustion, whereby the emission limit values specified for individual dwellings will be met.

B.2 Promotion of energy efficiency and use of alternative and "cleaner" fuels such as natural gas, liquefied petroleum gas and biofuel in a habitat, public institutions, transport and industry as well as collaboration with professional institutions and public sector as consulting parties for realization of this project for improvement of quality of ambient air

C) Long-term aims

C.1 Reaching and sustaining the level of air quality specified for air quality within the permitted limits

IX.2. Measures for protection and improvement of ambient air quality

Measures for improving ambient air quality should be designed to:

- provide system solutions,
- use own knowledge and domestic labor,
- use accessible technical solutions,
- consider the financial possibilities of the institutions and legal entities responsible for implementation of the measures.

At the same time, measures need to be:

- specific, to refer to solving specific problems,
- measurable regarding their realization (it is possible to verify the quantitative indicators)
- realistic and achievable within the estimated period.

Key evaluation criteria of the measures are:

- The impact on human health;
- Impact on ecosystems;
- Sustainability;
- Socio-economic benefits;
- Financial and technical feasibility of the project;
- Benefits and losses analysis;
- Fulfillment of the international obligations;
- Interest of donor institutions.

The measures in this plan are grouped into five main groups. Three groups relate to the main sectors that directly affect the quality of ambient air: industry, transport and energy sector. The other two groups have intersectoral character and can be categorized in several sectors at the same time.

1) Measures to reduce emissions of harmful substances into the air from stationary emission sources;
2) Measures to reduce the emission of harmful substances into the air from road traffic;
3) Measures for increasing energy efficiency and use of clean fuels, and renewable energy sources;
4) Supervisory, organizational and administrative measures;
5) Measures in case of exceeding the informing and alerting threshold.

IX.3 Measures to reduce the emission of harmful substances into the air from stationary emission sources

M1. Compliance with measures foresight with the IPPC permit and the elaborates for environmental protection.

The main measures and activities related to the control of emissions from large industrial facilities are to be found in Directive 96/61 / EC on integrated pollution prevention and control of pollution (Integrated pollution prevention and control - IPPC Directive). IPPC Directive was transposed in the Law on Environment ("Official Gazette" no.53 / 05, 81/05, 24/07, 159/08, 83/09, 48/10, 124/10, 51/11 and 123/12), which regulates the issuance of environmental permits. Authorities for the implementation of procedures are:

- The Ministry of Environment and Physical Planning for issuing of A - integrated environmental permits,
- The Municipalities for issuing B - integrated ecological permits (for installations that are located in the City) and
- The Municipalities for approval elaborates for environmental protection.

In accordance with these documents, the facilities are reconciling in terms of the permitted limit values for emission, specified in the Regulation on limit values for permissible emission levels and types of pollutants in waste gases and vapors released from stationary sources into the air (Official Gazette no. 141 / 10).

For the construction of new installations, in accordance with the legislation, to carry out Environmental Impact Assessments and Strategic Environmental Assessment Assessments followed by public tribunes.

IX.4 Measures to reduce the emission of harmful matter from road traffic

M.2 Modernization of the public transport companies car park

The trend of modernization of new vehicles that meet the most stringent European standards for motor vehicles emissions from in the Public Transport Company and other transport companies should continue.

M3. Testing of emission from passenger cars according to Regulation on technical inspection of vehicles (Fig. Gazette of RM br.81 / 2010).

The institutions responsible for the control of motor vehicles do not perform measurement of emission of harmful substances in the air. If during a regular checkup, a control of emissions from motor vehicles is carried out, vehicles which do not meet the conditions laid down in the above Regulation should be removed from traffic. More frequent controls of the vehicles are needed that will be carried out by the traffic police in urban areas.

M4. Washing and cleaning of the streets on a regular basis

Regular washing of the streets in the warm months is necessary, as well as “vacuum” cleaning of busy streets. The measure should be implemented within a shorter period of time, after which they would evaluate the success of its application by monitoring concentrations of PM10 for the same period. Based on these results, further activities as well as the frequency of the measure will be determined.

M5. Construction of roads with porous asphalt.

According to some indicators, in Germany for quite some time, in the construction of roads and streets, hollow asphalt (stone cast) is used, so the drainage of the rain water from the road is faster, and dust particles are collected in the asphalt cavities. Due to these characteristics of the hollow asphalt and the ability of delayed wash of asphalt cavities, a reduction of air pollution particles should expect.

IX.5 Measures to promote and stimulate energy efficiency and usage of renewable energy sources

Energy efficiency and renewable energy indirectly contribute to reducing air pollution, and therefore it is necessary to increase energy efficiency and focus on the use of renewable energy sources. These measures are not preliminary, but on a long-term basis they give positive results in terms of protection and improvement of air quality. The cities have no legal instrument for their implementation, but should promote them in collaboration with the Ministry of Economy and Ministry of Environment and Physical Planning and use of other fond or grants.

The housing sector, according to the latest research and analysis is a very important cause of the deteriorating quality of ambient air from the aspect of PM10, because the greatest potential for reducing particulate matter is reflected in this segment.

On the other hand, high consumption of thermal energy for heating of the premises is due to the low level of installed thermal insulation. Housing facilities are designed, built and used without definable conditions for energy efficiency, they have no thermal insulation and most of them have energy inefficient carpentry.

The measures in this sector should be proposed and implemented in a way that the citizens will be left with the possibility of selecting the energy source, i.e. the possibility to extend the use of solid fuels, while the financial saving and reduction of harmful emissions are to be sought with construction and re-construction of energy efficient buildings.

M6. Promotion of efficient use of energy and use of renewable energy sources.

The objectives of the new energy strategy are reduction in costs, improvement of performance of energy technologies for residential and commercial buildings and development of methods for measuring and improving comfort in buildings and the quality of environment.

Certification of energy efficiency of objects, public / private, should be carried out with the support of the municipalities and the Government in two stages:

1) priority - setting up thermal insulation of facades (saving up to 30% energy and reduce emissions 30% of solid particles in the air);

2) change of carpentry and repair of roof construction (saving up to 25% energy and reduce 25% of emissions of solid particles).

This measure also applies to the following practices:

- Construction of low-energy and passive solar objects;
- Education at all levels, from the clients through designers and contractors, on the importance of energy efficiency;
- Modernization of existing power plants;
- Creation of database on the percentage of facilities that have or do not have built-in thermal insulation and energy-efficient carpentry.

M7. Conducting energy efficiency control

Implementation of practice of energy efficiency control on energy use, the possibilities to reduce energy consumption and achieving savings should be realized in accordance with the Regulation on Energy Control (Official Gazette No.94 / 13).

M8. Support of the installations that use renewable energy sources (non-combustion installations) for energy production.

According to the State Statistical Office, the use of renewable energy sources (solar and geothermal) in relation to the usage of total available energy, is insignificant and is ≤ 0, 1%. The use of renewable energy sources in the form of biomass and hydro energy in the overall energy being used annually is from 7 to 11%.

M9. Construction of sanitary landfills that will meet the required standards

Construction of a sanitary landfill in the region and remediation of illegal landfills (wild and under the municipalities) located on the territory of the region in question.

In a sanitary landfill, landfill gas should be used as a renewable energy source for the production of electricity and daily coverings of the landfill site in order to reduce the emission of harmful substances in the air.

IX.6 Supervisory, organizational and administrative measures

IX.6.1 Supervisory measures

M10. Developing of cadaster of air pollutants for the City of Skopje.

The cadaster of pollutants of the municipality should represent a base for the monitoring trends of air quality indicators, as well as for controlling the effectiveness of the measures taken for improving the air quality.

The cadaster is needed to make qualitative and quantitative records of pollutants and sources of ambient air pollution, and preferably should contain information on the activities of the operator and the installations which are subject to IPPC procedure, i.e. that endanger or can endanger the environment.

M11. Preparation of register of air pollutants for the cities

The Registry of polluters should be made for activities that are not covered by cadaster which would represent its conclusion. The expansion would be at the local level and will include even the smallest potential polluters which should not be ignored.

M12. Procurement of new monitoring stations for monitoring the ambient air quality

In the monitored region there is no monitoring system for parameters in the ambient air. Indicative results for all gas compounds in ambient air have shown satisfactory results, both for summer and autumn/winter season. Regarding the situation with RM10, it can be concluded that in all environments the situation is better than the city of Kocani, both for the summer and winter period, however certain areas (Berovo, Vinica, Delchevo) during the autumn winter season showed that the values are moving similarly as in the city of Kocani, while in the town of Pehcevo, the results yielded significantly better results compared to the same in the city of Kocani. Setting up the monitoring system especially for the measuring parameter PM10 should be a tool that should be used:

- for informing citizens about actual air quality, especially during the heating season
- undertaking measures by the Municipalities
- promotion of rural tourism if the situation with PM10 is satisfactory.

M13. Preventing fire and fire from burning agricultural waste.

Official bodies of the municipalities should inspect, educate and sanction the citizens, especially in rural areas, not to dispose the agricultural waste by burning it outdoors.

M14. Additional inspection surveillance

Unexpected inspections and controls, under which additional measurements of emissions and immissions are performed on the perimetric points of areas owned of the installations, are of great importance especially for determination of the working conditions under which the installations are operating. Also, an enhanced surveillance is necessary especially in periods of poor air quality when restrictive measures are being applied.

IX.6.2 Organizational measures

M15. Organization of educational campaigns

The goal of the campaign is to inform and guide the public on the need for energy efficiency, use of renewable energy sources, and also to promote walking and usage of bicycles, financing of civic associations that promote these activities, promotion of the use of vehicles with lower emissions, holding lectures in educational institutions on the traffic impact in terms of using different modes of transport, etc.

M16. Collaboration with specialized institutions as well as the public as advisory parties in implementation of projects to improve the state of the environment, especially in terms of improving the situation of ambient air.

M17. Activities for creating conditions for the development of the bicycle traffic

Tho be undertook reconstruction activities, actions for completion and marking of bicycle paths. These activities should be implemented in phases annually, which will constantly improve conditions for cycling, not only as a means of recreation, but as an alternative means of transport, which is economical and healthy and does not have negative environmental impacts. Therefore it is necessary

to expand the existing network for renting bicycles, to ensure secure parking for bicycles at public areas and near workplaces and the to increase the number of available bikes for renting.

IX.6.3 Administrative measures

M18. Passing a Decree on cleaning or maintaining the exhaust channels.

Maintenance of chimneys, smoke devices, systems, air systems, systems for air and water heating, fireplaces - boilers for central heating in buildings, industrial and artisan facilities is regulated by a Rulebook (Official Gazette no. 146/10), adopted on the Law on the Protection and Rescue (Official Gazette no.36 / 04, 49/04, 86/08 and 124/10).

It is necessary the municipalities to adopt the Decree for maintenance of the exhaust channels by which the established activities by the Rulebook will specify the means of implementation within the city.

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