TE-TO AD SKOPJE

Combined Cycle Co-Generation Power Plant Project Skopje

Environmental Assessment Report

SECTION D
BASELINE DATA

August 2006

Thermal Energy Plants Department

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1 Assessment of the Study Area

Skopje is the capital city of the Republic of Macedonia that became independent from Yugoslavia in 1991 (see **Section H, Appendix D1).** The town is located in the north central part of the country, in the Skopje National District. It is embedded in the Skopje valley and is spread on the shores of the river Vardar (see Figure D- 1). The territory of the Skopje valley comprises approximately 460 km².

The plant site for CCPP is located in the eastern industrial zone of Skopje, directly adjoining to the existing Heat Power Plant (HPP) "East" "(ISTOK" of Toplifikacija) (see Figure D- 2). The site is flat and can be found at an elevation of 240 m above sea level.

The total size of "ISTOK" is about 4.3 ha and is partly used for the existing heating plant. The new plant will need an area of 13500 m² plus 3900 m² for lay-down areas. The plant site is located at approximately 100 m distance from the river Vardar.

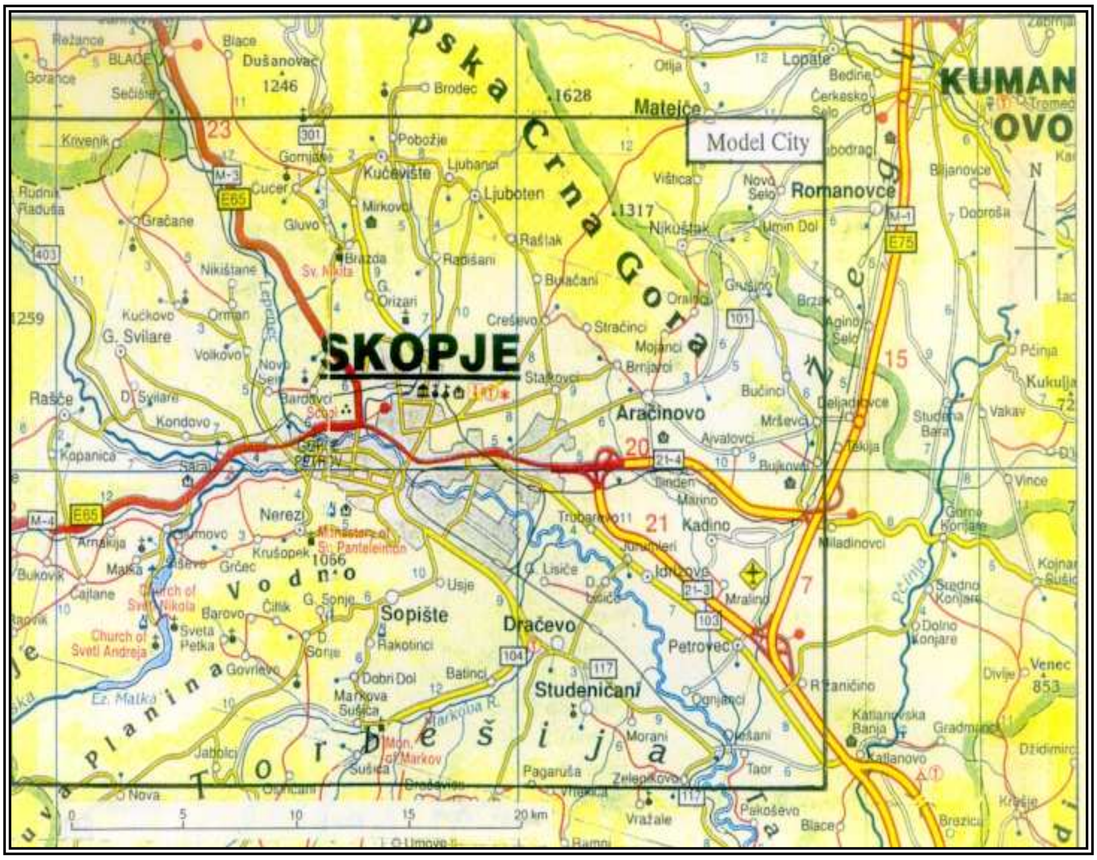


Figure D- 1: Skopje Valley

Depending on the investigated issue, the Study area has a different size. The maximum size of the study area corresponds with the size of the Republic of Macedonia.

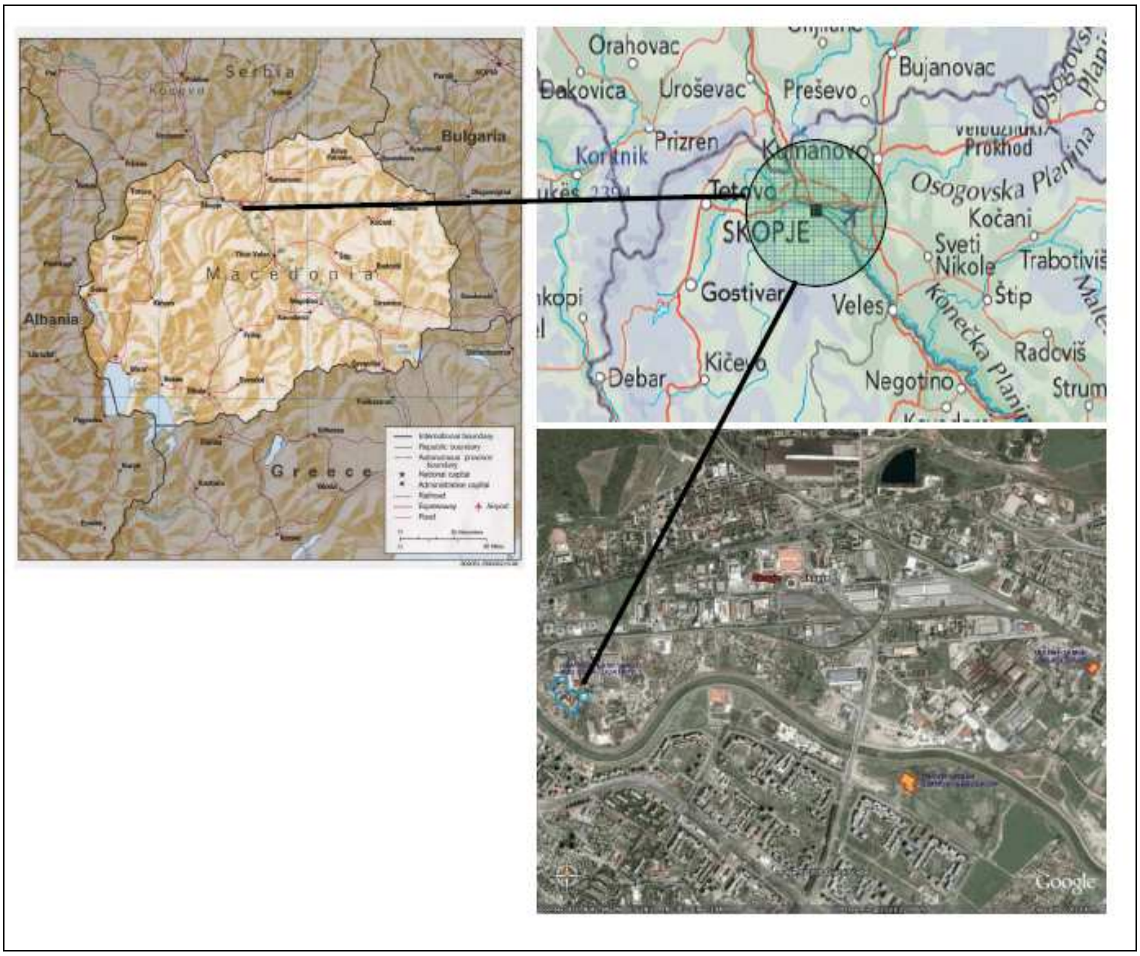


Figure D- 2: Site Location of CCPP Skopje

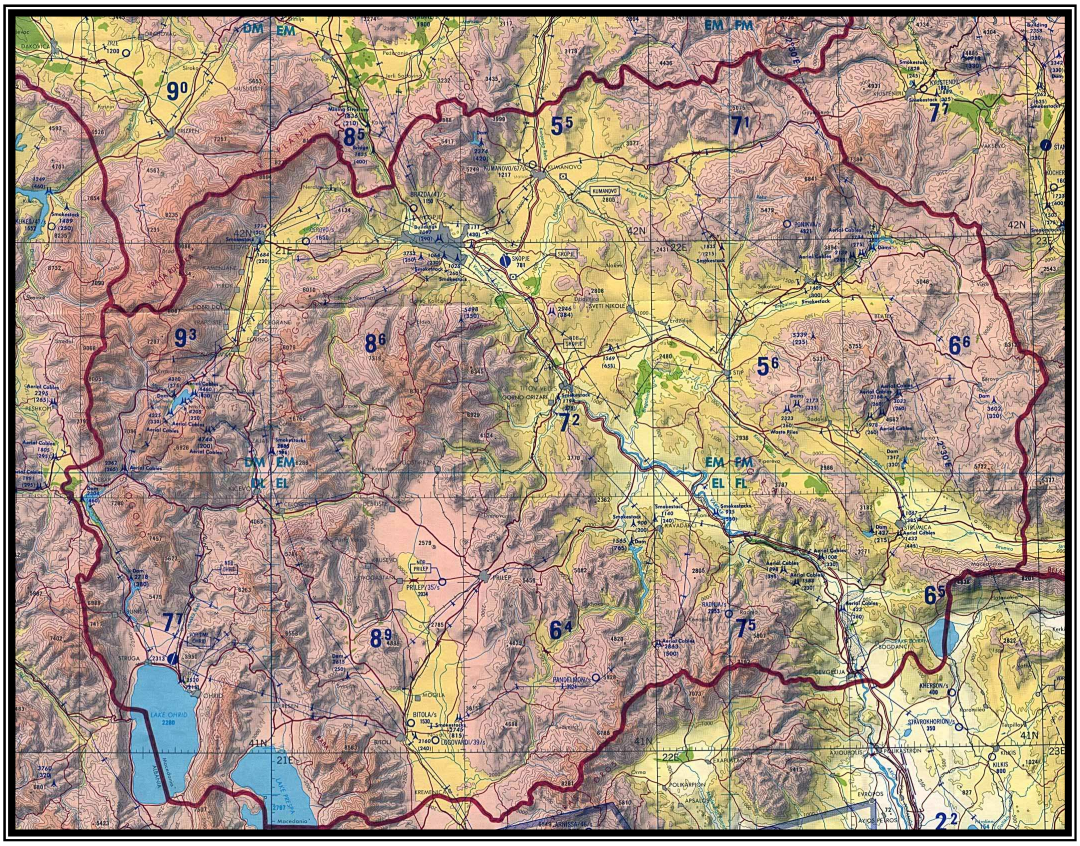
2 Description of the relevant physical conditions

2.1 Topography and Geology

2.1.1 Topography

Macedonia consists mainly of highlands and mountains, with elevations reaching 2,751 m in the Korab range on the Albanian border. Skopje valley is a depression area with a length of about 30 km which is surrounded by mountains (see Figure D- 3). River Vardar flows through the Skopje valley, from north-east to south-west.

In the north - eastern part of the Skopje valley the mountain Skopska Crna Gora is situated, with summits over 1500 m altitude. This massif is aligned in the north-west to south-east direction. Opposite of this mountain massif, in the south-western part of the valley, the mountain Karsijak is located. Its highest peak is Vodno with 1050 m altitude.



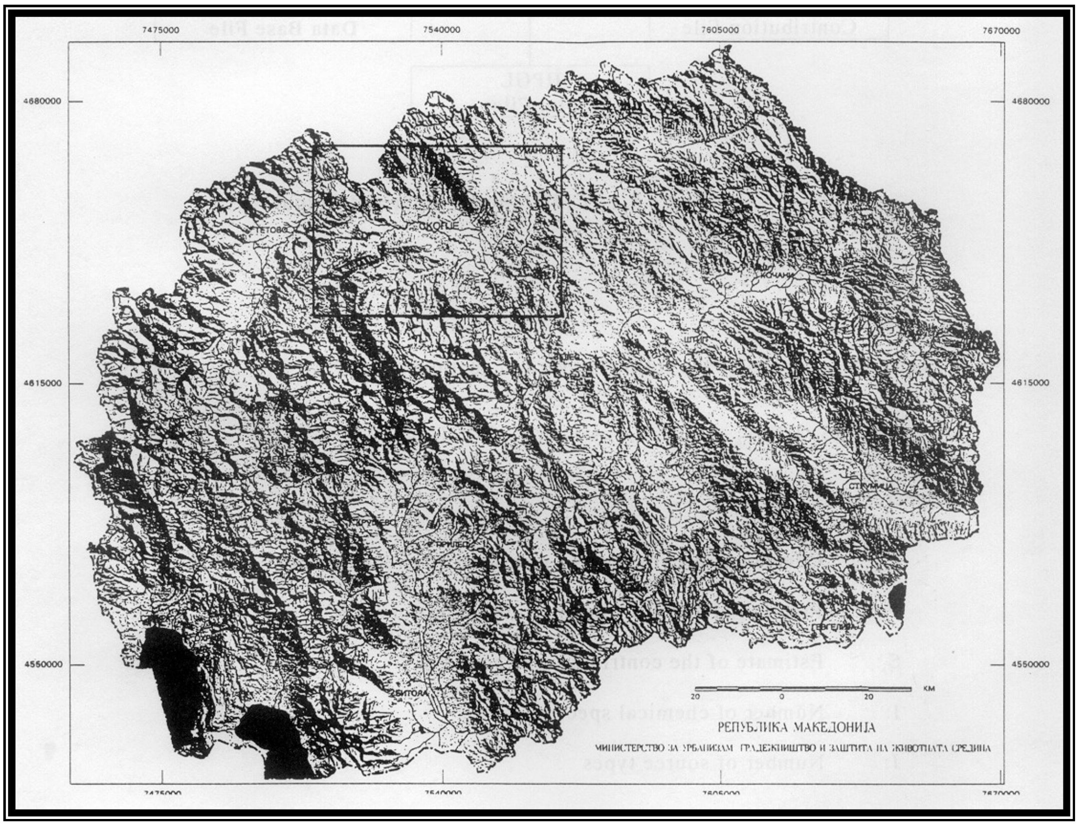


Figure D- 3: Topography of Macedonia (Shaded Relief)

2.1.2 Geological Zones and Tectonic Activities

According to present geological maps (Basic Geological Map 1:100,000, Engineering - Geological Map 1:200,000, Metal - Genetic Map 1:200,000, Hydro-geological Map 1:200,000, Seism tectonic and Neotectonic Map), the area of the Skopje valley consists of litho-stratigraphic units, which can be divided into five structure-tectonic litho-stratigraphical zones:

- Vardarian Zone
- Northern Part of the Pelagonides
- Complex of Palaeogenic Sediments
- Complex of Neogenic Sediments
- Quarternaric Zone

Skopje valley is characterised by complex tectonic activities that can be assigned to these zones and the direct contact between two different structure-tectonic units (Pelagonian and Vardarian Zone). In the following the main characteristics of the five named zones are given:

The Vardarian Zone is located in the northern part of the study area. It is built of Pre-Cambric and Palaeozoic creations like gneiss, schist and marbles. The tectonic evolution of this zone is labile. Schist of the Veles series are significantly disrupted and compressed, and are building a row of symmetric flags aligned north-west to south-east. The Veles series on the Skopska Crna Gora Mountain is dislocated and consists of different types of schist, marbles and quartz. It is representing a synclinal, where existing faulting and shell covering has caused significant disruptions. Bulasan shell is typical in this area. Schist and quartz of the Veles series are covered by young oligocene sediments. Besides characteristic structure-tectonic movements, there are tectonic disruptions in the area aligned north-east to south-west, and young neotectonic movements with direction from east to west. All these components of the Vardarian zone are creating favourable conditions for possible tectonic relaxations and movements of the lithological units.

The Northern Part of the Pelagonides, belonging to the Pelagonic horstanticlinorium, is developed in the south-western part of the area. The lithological composition of this zone is extremely complex. It comprises Pre-Cambrian, Rifei-Cambrian, Palaeozoic, and Mesozoic creations as schist, marbles and limestone of marble, as well as conglomerates, sands and limestone, that can be found in the south-eastern sloping grounds of the mountain Karsijak. Tectonic evolution in the northern part of the Pelagonic horstanticlinorium took part in two basic orogenetic phases. The first phase is represented by folds connected with regional metamorphism and significant structures, building ideal canals for magma with different composition. The second tectonic stage is the Alpine orogenic phase. As a result of total folding in this stage many compressive forms were created, that are aligned north-west to south-east and north-east to south-west. Among many horstanticlinorium forms, segments from “Breznik” anticlinal with bow shape are present, that are built of white-gray mid-granulate dolomites with thin layers of marbles. The upper parts of the Breznic anticlinal consist of creations with Rifei-Cambrian age. Its north-western part is opened on the line Vodno-Osoj. This structure is sinking to the northeast.

The Complex of Palaeogenic Sediments can be found in the north-eastern part of the study area, in the Vardarian zone (Veles series). These sediments are characterised by Oligocene creations built of conglomerates, sands, claystone and sand bar limestone. These creations can be found in the substratum of the Skopska Crna Gora Mountain, between the villages Stracinci and Bulacani. Other lithological creations consist of sand bar coral limestone, which can be found at the northern edges of the area.

The Complex of Neogenic Sediments is very wide spread in the area of the Skopje valley. These sediments are built of shallow lake sediments rich of micro- and macro-fauna. According to appearing fossils, the age of the sediment is stated to be upper-Miocene and upper-Pliocene. In the coastal parts of the Skopje basin, upper-Miocene sediments are built of basic conglomerates, superposed by sands, marbles and marble clays. In these horizontal layers fossils can be found, identifying this complex as upper-Miocene. Younger creations of Pliocene and Quarternaric age are often superposing these sediments. Jackals, sands and sand clays are present all over the territory of the Skopje valley. More frequently, these sediments of upper-Pliocene age are developed in the coastal parts, at the edges of the Skopska Crna Gora and Karsijak mountains. Neotectonic movements are characterized both by horizontal and vertical movements of the old structures aligned north-west to south-east, and by younger structures aligned south-east to north-west up to east-west. Due to these Neotectonic movements Skopje's tertiary basin is presently in a phase of sinking and hence is building a large basin for accumulation of eroded materials from the surrounding mountains.

Creations of the Quarternaric Zone are developed spaciously in the Skopje valley, and are characterised by the presence of various sediments. Depth of these creations varies from few meters to some hundred meters. The sediments consist of peat bog and marsh sediments, that were formed in a lake environment. Banded and porous travertine and tufas can be found in few locations in the Skopje valley. The origin of these sediments is connected with geothermal activities leading to a precipitation of $CaCO_3$ in the lake. The depth of the tufas is normally larger than 20 m. Usually, fossil floristic and faunistic remains are present in the tufas and travertine. Diluvium layers can be found in the northern parts of the area of the Skopje valley, and rarely in its south-eastern parts. The most usual locations are substratum of the Skopska Crna Gora Mountain, but also in the substratum of the mountains surrounding the city of Skopje. These layers are the transition zones from the mountain massif to other quartered creations. Proluvium material is wide spread in the Skopje valley. Alluvium terraces can be found at the course of the larger rivers that are draining into the Skopje valley. They are built of all basic types of rocks that are typical for the massif around Skopje. Their depth varies from 5 m to 70 m over the current level of the rivers. Between quarternaric creations, alluvium layers are reaching the largest horizontal spreading. The building materials originate from the drainage areas, which are gravitating to the river Vardar. The depth of the alluvial creations in the Skopje valley is up to 100 m. The geological profile of the valley shows a consistent geological condition (alluvium) in the study area.

2.1.3 Evolution of the Skopje Valley

The area of the Skopje valley is due to a long evolutionary development. The oldest creations in this area are the Pre-Cambrian gneiss and schist. These rocks represent the fundament for the Pelagonic horstanticlinorium and the Vardarian Zone. The second creation period was the Rifei-Cambrian period. During this time sedimentation took place in the sea at different depths. The final effect of the Rifei-Cambrian activities was the creation of metamorphites up to facies of the green schist. These types of rocks can be found in the northern part of the Pelagonides. The third creation stage resulted in Palaeozoic creations: phyllitoidal formation was built in the Pelagonides, followed by carbonate volcanogenic sediment series finishing with orogenic movements and regional metamorphism. The area of the Skopje valley was subject to a geosynklinal process in the Vardarian zone. In the period of sedimentation conditions for magmatic activities were created. At the end of the Palaeozoic period geosynklinal processes were almost complete and intensive folding and covering with shells started. The next period in the geological development of the Skopje valley is represented by Mesozoic events. Alpine orogenesis was a significant moment concerning the evolution of the valley. The Cretaceous transgression has enabled creation of psammite-pelite and carbonate facies that are lying discordantly over the Paleozoic schist. These developments were noticed in the Pelagonides. During the Tertiary period, intensive movements took place, and oligocene sediments were covered with shells of Paleozoic metamorphites. During the later stadiums of the Alpine orogenesis (Miocene and Pliocene), there were radial tectonic activities along old reactive faults. These tectonic movements created the Skopje depression, which became a place for deposition of eroded materials.

2.1.4 Earthquakes in the Region

Tectonic movements are also present in the contemporary development of the Skopje area, accumulating large amounts of energy. This energy is set free trough periodical earthquakes.

According to the Seismicity Report of the Institute of Earthquake Engineering & Engineering Seismology, University "St. Cyrie and Methodius", Skopje (1998), the territory of Macedonia is an area of high seismicity. In the seismic history of Macedonia, the Vardar zone appears as a region where earthquakes occur quite frequently, and the Skopje region is considered to be the most mobile part of the Vardar zone. This means, that Skopje is situated in a seismically very active area and has suffered earthquakes several times. A preliminary seismic analysis of the site done by the Republic Geological Institute has confirmed this. According to the seismic map of Skopje region of the last 500 years, the intensity of earthquake has to be defined at 9 degrees according to the MCS scale of earthquakes. This is roughly 0.3 g (or 0.3 m/s^2) of horizontal acceleration.

Earthquakes of magnitudes 6.0 to 7.8, from ten seismic zones have been historically experienced throughout the country. Prior to 1900, the seismic history of Skopje, as part of the Vardar seismic zone, is practically reduced to a rather brief description of the earthquake catastrophes of Scupi in 518 A.D. and that of Skopje in 1555. The old Scupi was situated about 4-5 km northwest of the center of the present Skopje. As ground fissures extending over 45 km in length and up to 4 m in width are reported for this earthquake, it seems that it is the strongest shock that has ever occurred in Macedonia. The earthquake of 1555 is said to have demolished a part of Skopje. Both earthquakes are estimated to be of an intensity of XII MCS (catalogues of the Seismological Institute of Belgrade). However, it is believed that the reported values are certainly overestimated. During the 20th century, the region of Skopje was affected by a series of damaging earthquakes, centered at the village of Mirkovci, which lasted from August to September 1921 with a magnitude of 4.6 to 5.1 and intensity of I = VII-VIII degrees MCS scale. Besides the local earthquakes, the region of Skopje has suffered several times from relatively distant earthquakes, e.g., from the Urosevac-Gnjilane region in southern Serbia, like in 1921. In 1963 a massive earthquake (M=6.1, I=IX-X MCS) devastated the City of Skopje.

2.2 Climate and Meteorology

Most climate and meteorological parameters of city Skopje valley have been analyzed in long term and have been compiled in the **Environmental Analysis of a preceding CHP project (2000)**. Climate and meteorological baseline data were measured and collected for 40 years period by Republic Hydro Meteorological Institute and Republican Institute for Health Protection.

Basically, the Skopje geographical area can be classified as moderate continental with big influence of Mediterranean climatic basin. It is characterized by cold winters, with not so expressed transition between winter and summer, with very hot and dry summers.

General conclusions are:

- Meteorological characteristic of Skopje valley and the conditions of the atmosphere remains stagnant, which is a factor for serious air pollution in winter (heating) season
- Wind blows along the valley and wind speed is generally low
- Temperature inversion occurs frequently in winter (heating) season, and also in summer (non heating) season, depending on meteorological conditions
- The precipitation is the smallest and fog appears most frequently in Skopje. This is unfavorable from the aspect of influence that air pollution has on human body.

The following descriptions are based on the a. m. Environmental Analysis of a preceding project.

2.2.1 Outside Air Temperature, Humidity and Pressure

Outside air temperature interval measured in Skopje valley for 40 years (, shows that average annual air temperature is stable between 11.1 °C to 14.3 °C, with average value of 11.9 °C through this period. The absolute minimum and maximum temperature were -25.6 and 43.2 °C. The both extreme temperature (minimal and maximal) show high fluctations, and in globaly term, they are unpredictable and dependent on many various factors in wider area of Skopjes valley, whole region and Balkan peninsula.

40 years period characteristic outside air temperature (°C)													
Period	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Absolute Tmin 61-99	-25.6	-21.2	-14.7	-6.0	-1.2	1.2	5.8	6.0	-2.3	-6.4	-12.2	-18.6	-25.6
Absolute Tmax 61-99	16.7	24.3	28.0	34.8	36.1	39.4	42.4	43.2	36.8	32.8	24.5	19.8	43.2
Average Tmin 61-99	-3.4	-1.5	1.7	5.5	9.8	13.1	14.8	14.6	11.2	6.5	2.0	-1.8	6.1
Average Tmax 61-99	4.0	7.9	12.7	17.8	23.3	27.2	29.6	29.8	25.7	19.2	11.0	5.1	17.8
Average Temp 61-99	0.1	2.8	7.1	12.0	16.7	20.6	22.8	22.5	18.3	12.4	6.2	1.3	11.9

Table D- 1: Temperature Characteristics

The fluctuation of daily and monthly average humiduty measured in Skopje, shows that it can be put in correlation with temperature changes, normally in the same period. Through the year, with temperature increase from May to August, humudity decreased, and opposite, with temperature decreasing from September to December, air humidity is increasing. Minimal and maximal average annual humidity, and absolute average humidity measured in Skopje between 1961 and 1999 are shown in table below, sorted by month and period of observation.

Average Air Humidity, measured in Skopje through 40 years period (%)															
Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	H_{min}	H_{av}	H_{max}
61 min	74.0	66.0	55.0	56.0	53.0	47.0	43.0	43.0	50.0	56.0	69.0	73.0	43.0		
max	88.0	85.0	78.0	73.0	74.0	72.0	73.0	73.0	78.0	82.0	88.0	93.0			93.0
99 aver	79.7	76.1	66.9	62.6	63.1	58.8	54.0	54.5	60.9	69.7	78.3	81.7		68.7	
71 min	77.0	66.0	55.0	58.0	53.0	47.0	43.0	43.0	50.0	58.0	71.0	73.0	43.0		
max	88.0	85.0	77.0	73.0	74.0	72.0	73.0	73.0	78.0	82.0	86.0	93.0			93.0
99 aver	79.6	75.5	66.1	62.4	63.0	57.4	53.7	54.8	61.2	69.9	77.6	80.9		69.0	
81 min	77.0	66.0	55.0	58.0	53.0	47.0	43.0	43.0	50.0	63.0	71.0	73.0	43.0		
max	88.0	85.0	77.0	73.0	71.0	72.0	73.0	70.0	78.0	82.0	86.0	93.0			93.0
99 aver	78.4	75.4	64.7	60.8	60.4	55.4	51.5	52.7	57.9	68.5	76.1	79.4		68.3	
91 min	78.0	66.0	60.0	59.0	53.0	47.0	43.0	43.0	50.0	69.0	71.0	73.0	43.0		
max	85.0	81.0	77.0	68.0	68.0	65.0	62.0	66.0	73.0	77.0	83.0	88.0			88.0
99 aver	72.8	72.9	58.4	56.1	54.7	48.6	46.2	47.4	53.4	64.7	70.6	73.3		66.6	

Table D- 2: Air Humidity

Because of lack of the data, statistic of air pressure in Skopje is made in period of 1961-1990 and presented in the figure below. The curves of change show that the pressure is quite stable and changes are small.

2.2.2 Sun Exposure and Cloudness

Significant increase in the solar radiation can be notified in the summer months. The data of solar radiation are available only for a two year period and are shown in the fol-lowed table:

Yearly average sun-exposure by months (W/m²), in Skopje (1998-1999)												
Parameter	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Monthly average	48.0	100.4	131.7	191.2	196.1	289.0	278.2	237.7	153.3	101.1	51.5	45.5
Yearly average	151.7											
Absolute maximal	92.2	174.2	218.0	339.9	317.6	344.5	408.5	279.4	251.4	188.7	116.4	88.8
Absolute minimal	16.0	28.3	29.5	41.6	54.4	212.5	174.0	66.4	19.3	18.7	2.4	9.3
Average - minimal	32.0	72.1	102.2	149.6	141.7	76.5	104.2	171.3	134.0	82.4	49.1	36.2
Maximal - average	44.2	73.8	86.4	148.7	121.5	55.5	130.3	41.7	98.1	87.6	64.9	43.3
Maximal - minimal	76.2	145.9	188.6	298.3	263.2	132.0	234.5	213.0	232.1	170.0	114.0	79.5

Table D- 3: Sun Exposure

In Skopje, the wind is often weak and there are many fair days in the summer season. The atmosphere is strongly unstable in this season when the solar radiation is high. The air pollutants are mixed and dispersed unlike the winter season, i. e. pollution concentration does not get very high.

Skopje valley can be classified as area with approx. 50% cloudiness as average through the year.

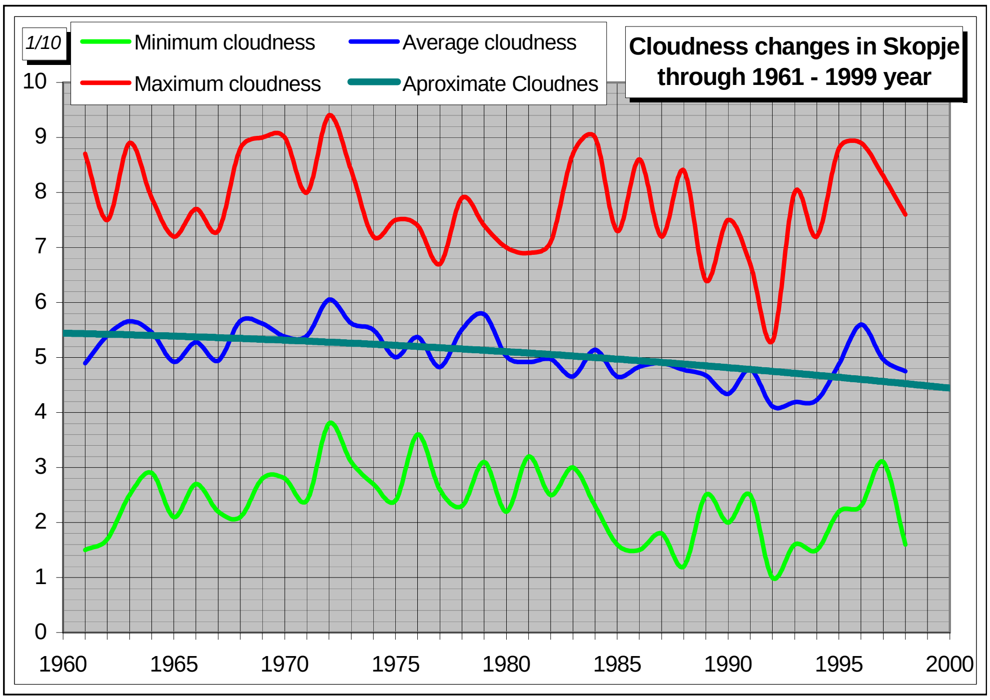


Figure D- 4: Cloudiness over 40 Years

Cloudiness over the year is shown in the following figure (Figure D- 5) where *clear days* mean cloudiness less than 20% and *Myrky days* means higher than 80%.

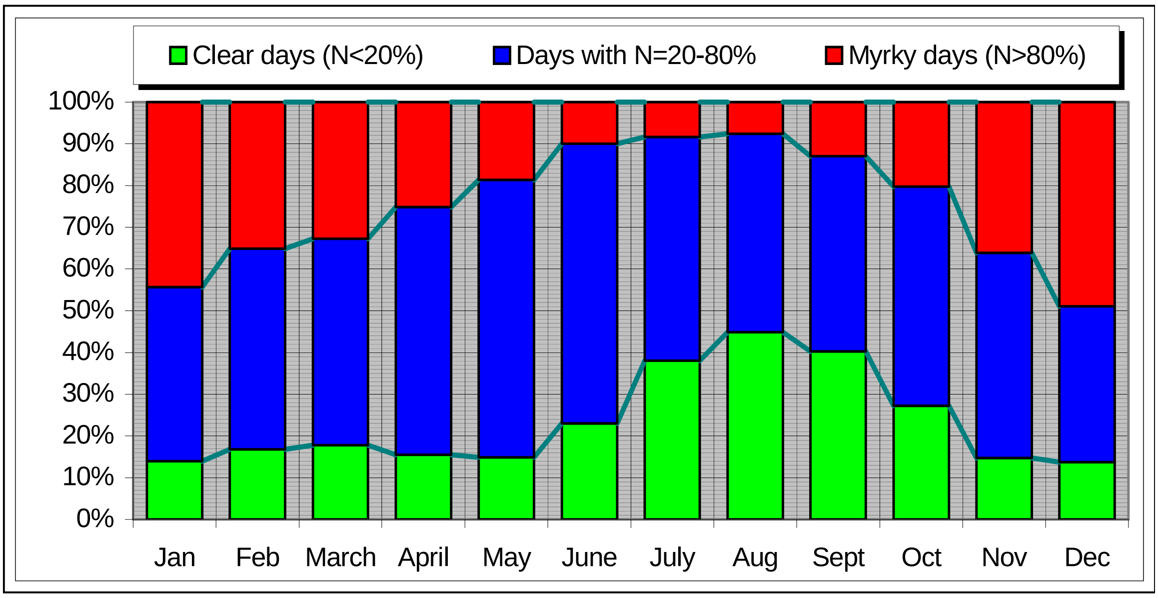


Figure D- 5: Cloudiness over the year

2.2.3 Precipitation and Fog

In Table D- 4 and Figure D- 6, the mean monthly rain precipitation for different time periods through 40 years is summarized. Months with higher rain precipitations are April-June and again November-December. Lower rain precipitations are observed in January-March and July-October. The month with the lowest rain precipitation through the last 40 years was August.

Summary monthly rain precipitation, measured in Skopje through 40 years period (l/m²)															
Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	R_{min}	R_{av}	R_{max}
61sum	1392	1354	1464	1641	2159	1709	1422	994	1349	1607	2070	2013	994	1598	2159
99aver	36.6	35.6	38.5	43.2	56.8	45.0	37.4	26.2	35.5	42.3	54.5	53.0	26.2	42	56.8
71sum	985	1033	977	1237	1601	1238	1067	806	1103	1222	1509	1401	806	1182	1601
99aver	35.2	36.9	34.9	44.2	57.2	44.2	38.1	28.8	39.4	43.7	53.9	50.0	28.8	42.2	57.2
81sum	591	688	609	852	866	840	780	443	547	695	1012	1028	443	746	1028
99aver	32.9	38.2	33.8	47.3	48.1	46.7	43.4	24.6	30.4	38.6	56.2	57.1	24.6	41.4	57.1
91sum	313	289	261	430	366	320	395	181	283	342	383	479	181	337	479
99aver	39.1	36.1	32.6	53.7	45.7	40.0	49.4	22.6	35.4	42.7	47.8	59.9	22.6	42.1	59.9

Table D- 4: Monthly Rain

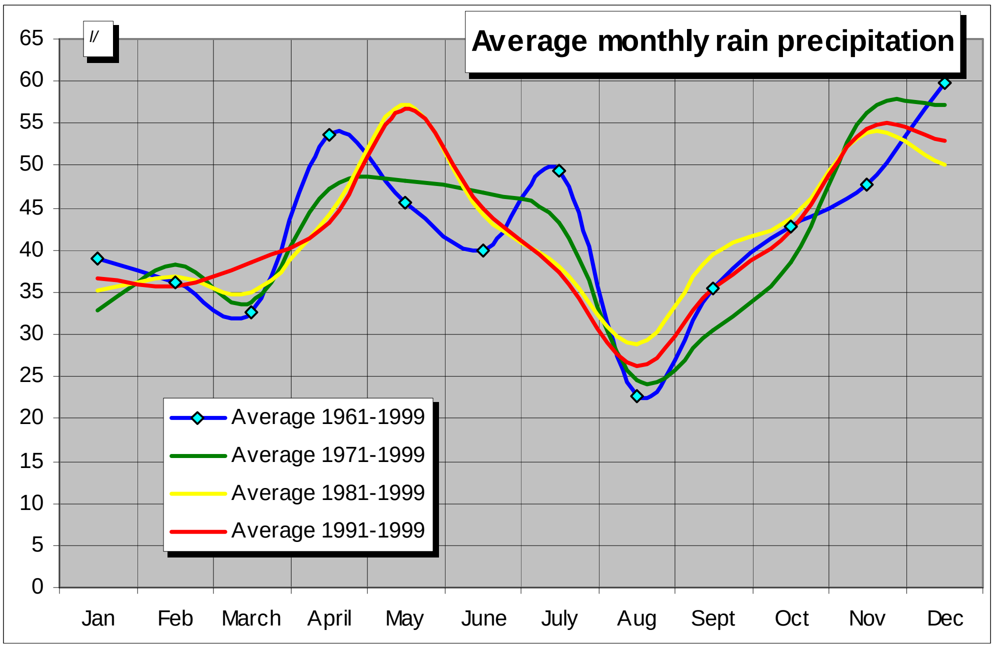


Figure D- 6: Average Monthly Rain (l/m^2)

The yearly averaged values are varying between 25 and to 60 l/m² with a total averaged value of 42 l/m² for the time period between 1961 and 1999.

Snow precipitation can be found only between November and March. The following Table D- 5 summarizes the monthly snow precipitation heights measured in Skopje through 40 years.

Maximal monthly snow precipitation, measured in Skopje through 40 years period (cm)															
Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	S_{min}	S_{av}	S_{max}
61sum	464	319	131	0	0	0	0	0	0	0	95	431	95	288	464
99aver	16.0	11.3	8.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.9	14.9	7.92	11.8	16
71sum	329	198	79	0	0	0	0	0	0	0	92	352	79	210	352
99aver	16.5	9.9	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4	16.8	6.58	11.6	16.8
81sum	229	171	48	0	0	0	0	0	0	0	74	257	48	156	257
99aver	19.1	13.1	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	19.8	8	14.1	19.8
91sum	99	90	30	0	0	0	0	0	0	0	24	58	24	60	99
99aver	24.8	17.9	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	11.6	0.0	14.1	24.8

Table D- 5: Snow Precipitation

Foggy days in Skopje are often observed in late autumn and winter months (Nov-Feb), as can be seen in Figure D- 7**.** Because of the topographic situation of Skopje, the occurrence of fog is often coupled with a strong atmospheric stratification and low wind velocities. For that reason, fog can persist for a longer time with the result of high air pollution concentrations near the ground.

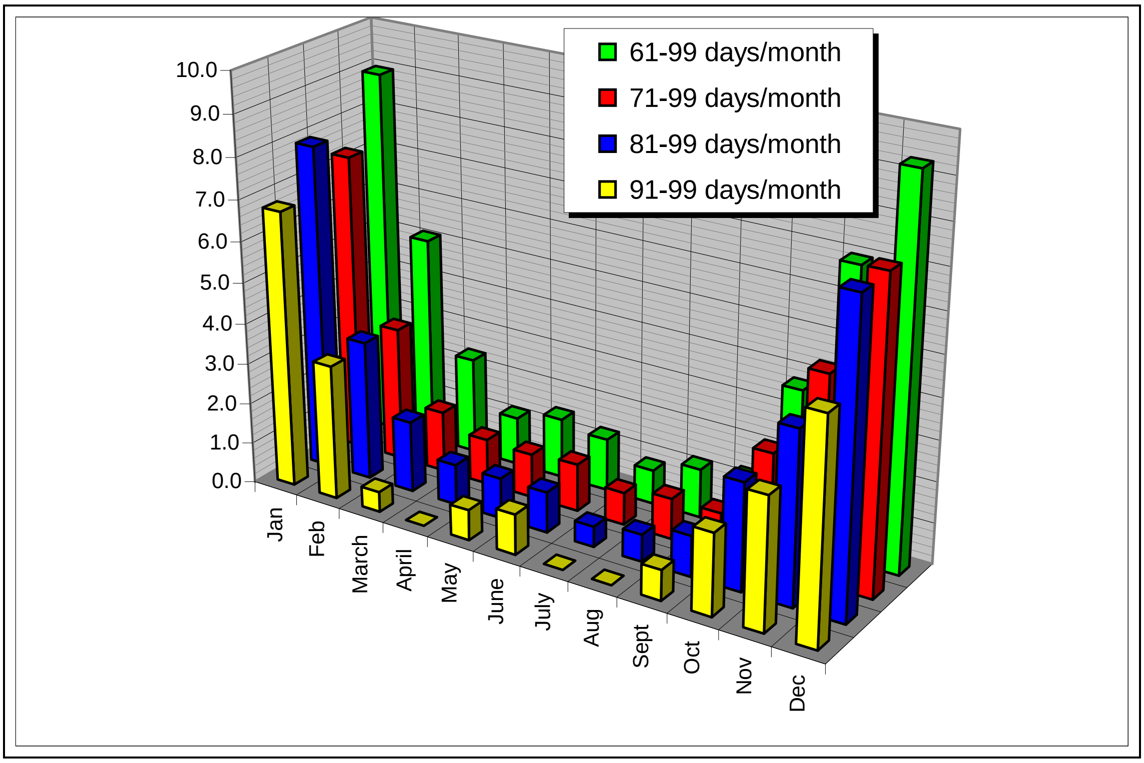


Figure D- 7: Number of days (monthly averaged and summarized) with fog through the last 40 years in Skopje

2.2.4 Wind

The wind velocity and wind direction in general depends on location where they are measured. Since more than 40 years , meteorological data are collected at the stations Petrovec in the east and Zajcev Rid in the northwest from Skopje. Both stations are official measuring stations of the Republic Hydrometeorological Institute (RHI). Readings at these two stations were taken discontinuously. In Table D- 6, for different time periods the minimum, maximum and averaged wind velocities are summarized for each month.

Average Wind Velocity, measured in Skopje through 40 years period (m/s)															
Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	V_{min}	V_{av}	V_{max}
61 min	0.4	0.8	1.4	1.1	0.9	1.0	1.1	0.6	0.7	0.6	0.4	0.4	0.4		
max	2.3	2.1	3.4	2.8	2.7	2.5	2.8	2.4	2.7	1.8	2.4	2.3			3.4
99 aver	1.1	1.6	1.9	1.8	1.5	1.6	1.7	1.5	1.3	1.2	1.1	1.1		1.48	
71 min	0.4	1.1	1.4	1.1	0.9	1.3	1.2	0.6	0.7	0.6	0.6	0.4	0.4		
max	2.3	2.1	3.4	2.8	2.7	2.5	2.8	2.4	2.7	1.8	2.4	2.3			3.4
99 aver	1.1	1.6	1.9	1.8	1.5	1.7	1.8	1.6	1.3	1.2	1.2	1.0		1.5	
81 min	0.4	1.1	1.4	1.1	0.9	1.3	1.2	0.6	0.7	0.6	0.6	0.4	0.4		
max	2.3	2.1	3.4	2.8	2.7	2.5	2.8	2.4	2.7	1.5	2.4	2.3			3.4
99 aver	1.0	1.6	1.9	1.7	1.5	1.7	1.7	1.5	1.3	1.0	1.1	1.0		1.49	
91 min	0.5	1.1	1.4	1.2	1.1	1.3	1.2	0.6	0.7	0.6	0.8	0.8	0.5		
max	1.5	2.0	3.1	2.7	1.8	2.4	2.4	2.1	1.9	1.5	1.6	1.5			3.1
99 aver	0.9	1.5	1.9	1.7	1.4	1.6	1.7	1.4	1.2	1.0	1.1	1.0		1.5	

Table D- 6: Wind Velocities, mesasured in Skopje through 40 years

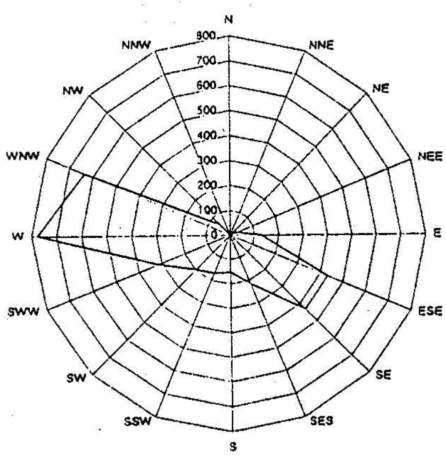
The table shows very low mean wind velocities, especially in winter months. These low values let expect a high frequency of situations with no wind near the ground. This often goes along with ground based inversions during winter and so-called lifted inversions during summer months.

Since April 1998, four measuring stations have been installed at different locations within the urban area of Skopje for air quality monitoring and some meteorological parameters. The distribution of wind directions (wind roses) for the heating and non-heating season for all four measuring stations are shown in below in Figure D- 8 (the location of the 4 automatic monitoring stations is shown in Figure D- 13).

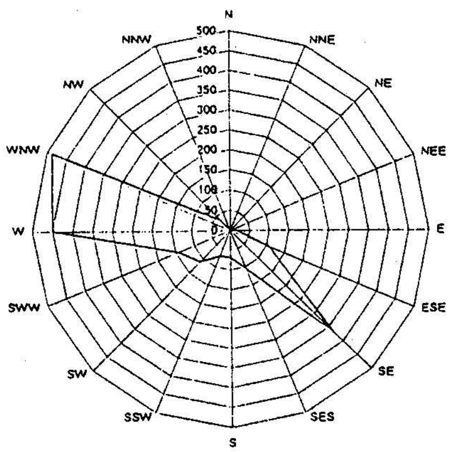
In Table D- 7, analogous Table D- 6, the monthly minimum, maximum and averaged wind velocities, measured in 1998-1999, are summarized for these four stations.

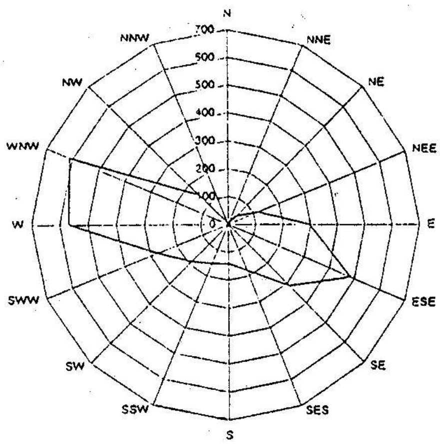
Non-heating season

Heating Season

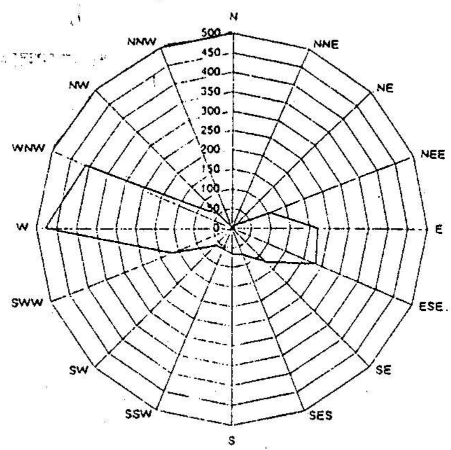


Center





Gazi Baba



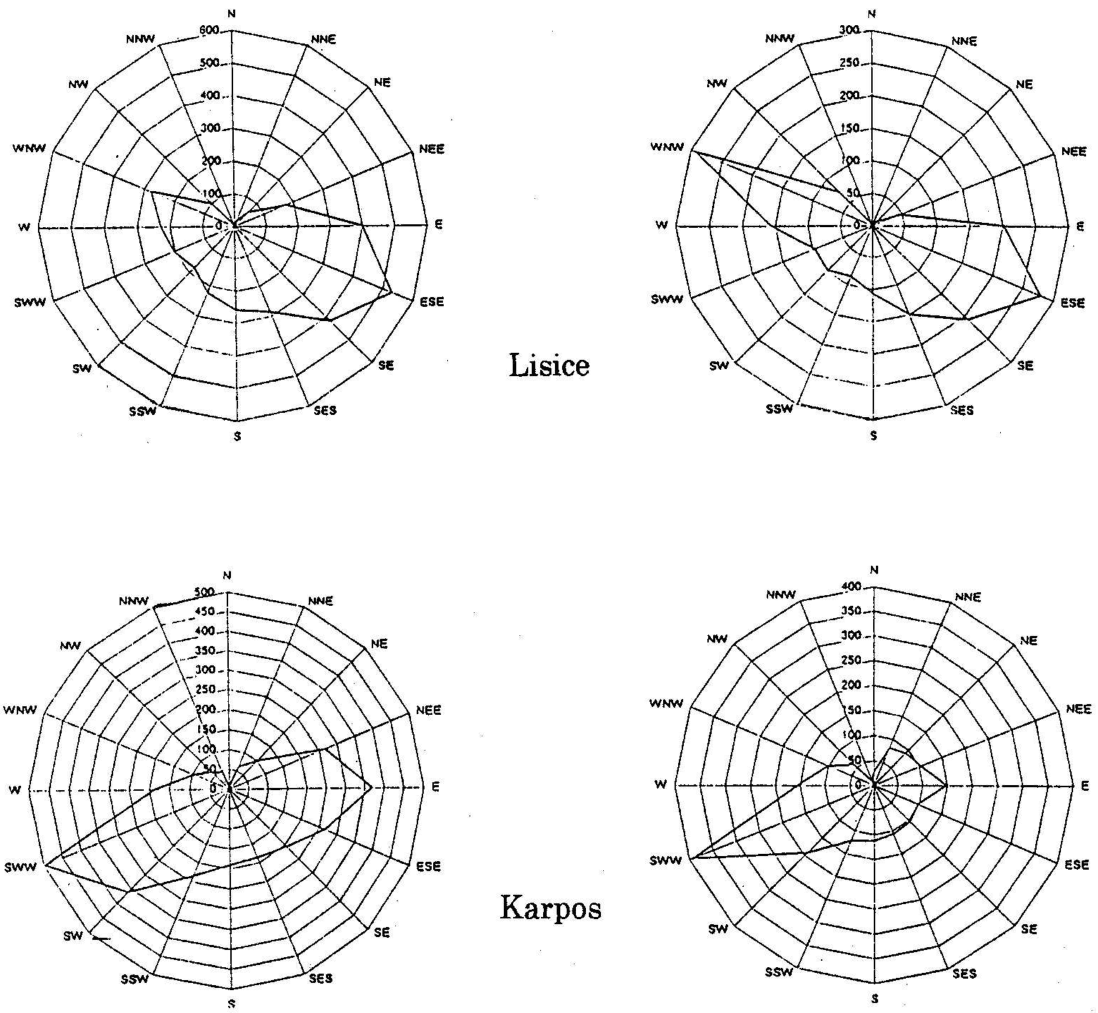


Figure D- 8: Wind Roses measured at four Locations

Measur. Station	Continually measured wind characteristic (speed & direction) in urban area of Skopje (1998-1999)															
	WIND Parameter		Jan	Feb	Mar.	April	May	June	July	Aug	Sept	Oct	Nov	Dec	W_{min}	W_{av}	W_{max}
Center	Speed (m/s)	*min*	0.2	0.3	0.6	0.3	0.3	0.0	0.3	0.4	0.2	0.2	0.3	0.2	0.0	0.3	0.6
		average	1.1	1.9	3.6	1.5	1.5	1.3	1.3	1.4	1.3	1.1	1.1	1.5	1.1	1.5	3.6
		max	4.9	8.4	11.5	5.5	7.8	3.9	5.2	4.6	4.2	4.7	3.7	4.1	3.7	5.7	11.5
Gazi Baba	Speed (m/s)	*min*	0.2	0.3	0.3	0.0	0.3	0.2	0.3	0.3	0.2	0.2	0.3	0.2	0.0	0.2	0.3
		average	1.0	1.6	1.5	1.8	1.6	1.4	1.5	1.4	1.5	1.2	1.1	1.4	1.0	1.4	1.8
		max	3.9	5.6	5.4	6.2	8.7	3.9	6.1	4.3	5.2	4.7	4.0	6.7	3.9	5.4	8.7
Karpos	Speed (m/s)	*min*	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.1	0.0	0.2	0.0	0.2	0.3
		average	0.9	1.3	1.2	1.2	1.2	1.1	1.0	1.1	0.9	0.8	0.9	1.1	0.8	1.1	1.3
		max	4.3	4.8	5.3	5.1	3.5	3.6	4.0	3.8	4.6	3.2	2.8	3.4	2.8	4.0	5.3
Lisice	Speed (m/s)	*min*	0.2	0.2	0.1	0.3	0.2	0.2	0.1	0.2	0.1	0.1	0.0	0.2	0.0	0.2	0.3
		average	0.9	1.4	1.4	1.8	1.7	1.5	1.4	1.3	1.3	1.0	1.0	1.3	0.9	1.3	1.8
		max	5.5	5.4	7.5	7.8	7.1	5.1	6.5	5.9	5.2	5.9	4.5	5.4	4.5	6.0	7.8
Urban Area of Skopje	Speed (m/s)	*min*	0.2	0.3	0.3	0.2	0.3	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.3
		average	1.0	1.5	1.9	1.6	1.5	1.3	1.3	1.3	1.3	1.0	1.0	1.3	1.0	1.3	1.9
		max	4.7	6.1	7.4	6.2	6.8	4.1	5.5	4.7	4.8	4.6	3.8	4.9	3.8	5.3	7.4

Table D- 7: Wind velocities, measured at four locations in the urban area of Skopje (1998-1999)

The data measured in 1998-1999 at four automatic monitoring stations confirm the low velocities measured through more than 40years at the meteorological stations of the RHI.

Figure D- 8 shows for the stations Center, Gazi Baba and Licise the highest frequency for winds from WNW and ESE for both seasons. At Karpos station, a drift to winds to WSW and E can be observed. The wind distributions at the first named stations are strongly influenced by the Skopje valley. At Karpos, situated in the west of Skopje, this channeling-effect is not so pronounced. There some other topographic effects are prevailing.

2.2.5 Stratification and Atmospheric Stability

Beside the wind velocity and the dynamic turbulence the temperature stratification of the atmosphere strongly influences the dispersion of air pollutants. Due to the fact that low wind velocities are frequently observed in Skopje valley, the occurrence frequency of inversion layers with strong temperature gradients is high. One should distinguish between two types of inversions. During winter, so-called ground-based temperature inversions often occur. The high concentrations for SO_2 and PM e.g. are observed during such periods with strong temperature gradients. Under such meteorological conditions, especially air pollutants emitted near the ground (traffic emissions, emissions from domestic fuels e.t.c.) accumulate near the ground; the dispersion is respectively low. On the other side emissions released from high stacks reach the ground far away from the source.

In summer months, so-called lifted inversions are more common, especially in the daytime. These situations are characterized by thermal induced turbulence in the ground-based, unstable to neutral mixing layer with low wind velocities. A strong capping inversion above prevents the air exchange with air masses above the inversion layer. Due to the strong thermal turbulence in the mixing layer emissions from higher stacks can be moved down to the ground near the stack, which results in locally high concentrations near the ground. On the other hand, pollutants emitted from a low stack arise and are easily dispersed; thus the concentration level near the ground rapidly decreases with distance from the source.

By means of so-called stability classes the turbulence types are related to weather conditions. Well known are Pasquill's turbulence types. The stability classes depend from wind speed classes, solar radiation (during daytime) respectively cloud cover (during night time) (see Table D- 8). In the Environmental Analysis of CHP project 2000, overall 7 categories between A (strong instability) and G (strong stability) are given following Pasquill's turbulence types.

Wind speed (u) m/s	***Solar Radiation (R) W/m²***				***Night Cloud Volume (Cloudness in tenth)***		
	R>600	*600>R> >300*	*300>R> >150*	*150>R*	Tottaly Cloud (N>10)	Upper cloud - N=5-10 Middle cloud - N=5-7 Lower cloud - N=5-7	Clear and average days (N=0-4)
u<2	**A**	**A-B**	**B**	**D**	**D**	**G**	**G**
2<u<3	**A-B**	**B**	**C**	**D**	**D**	**E**	**F**
3<u<4	**B**	**B-C**	**C**	**D**	**D**	**D**	**E**
4<u<6	**C**	**C-D**	**D**	**D**	**D**	**D**	**D**
6<u	**C**	**D**	**D**	**D**	**D**	**D**	**D**

Table D- 8: Relation between stability classes, wind speed, solar radiation (day-time) resp. cloud cover (during night)

Remarks:

Stability clases:

A - Strong Instability;

B - Instability;

C - Moderate Instability;

D - Neutral Atmosphere Stability;

E - Moderate Stability;

F - Stability;

G - Strong Stability.

According to the description in chapter 4.1.7, the frequency of the stability class A (strong instability) to D (neutral) dominates at daytime due to the strong solar radiation and low wind speeds. During night the stability classes D – G are prevailing.

In *Table D- 9* and Figure D- 7, the yearly frequency of stability classes as well as the frequency of stability classes for the heating and non-heating season for Skopje area are given, distinguished between day and night.

Time period through Year	**Case number and frequency of Atmospheric Stability in Skopje**											
	Class of stability	*Daily hours*							*Nightly hours*			
		A	***A-B***	***B***	***B-C***	***C***	***C-D***	***D***	***D***	***E***	***F***	***G***
Heating season (1 May.- 31 Sept.)	Hour No.	0	105	904	0	147	0	1388	1096	41	0	1406
	Hour %	*0.0*	*2.1*	*17.8*	*0.0*	*2.9*	*0.0*	*27.3*	*21.5*	*0.8*	*0.0*	*27.6*
Nonheating season (1 Oct. - 30 Apr.)	Hour No.	524	578	417	59	152	33	684	301	40	33	849
	Hour %	*14.3*	*15.7*	*11.3*	*1.6*	*4.1*	*0.9*	*18.6*	*8.2*	*1.1*	*0.9*	*23.1*
YEARLY	Hour No.	524	683	1321	59	299	33	2072	1397	81	33	2256
	Hour %	*6.0*	*7.8*	*15.1*	*0.7*	*3.4*	*0.4*	*23.7*	*15.9*	*0.9*	*0.4*	*25.8*

Table D- 9: Observed frequency of stability classes in Skopje

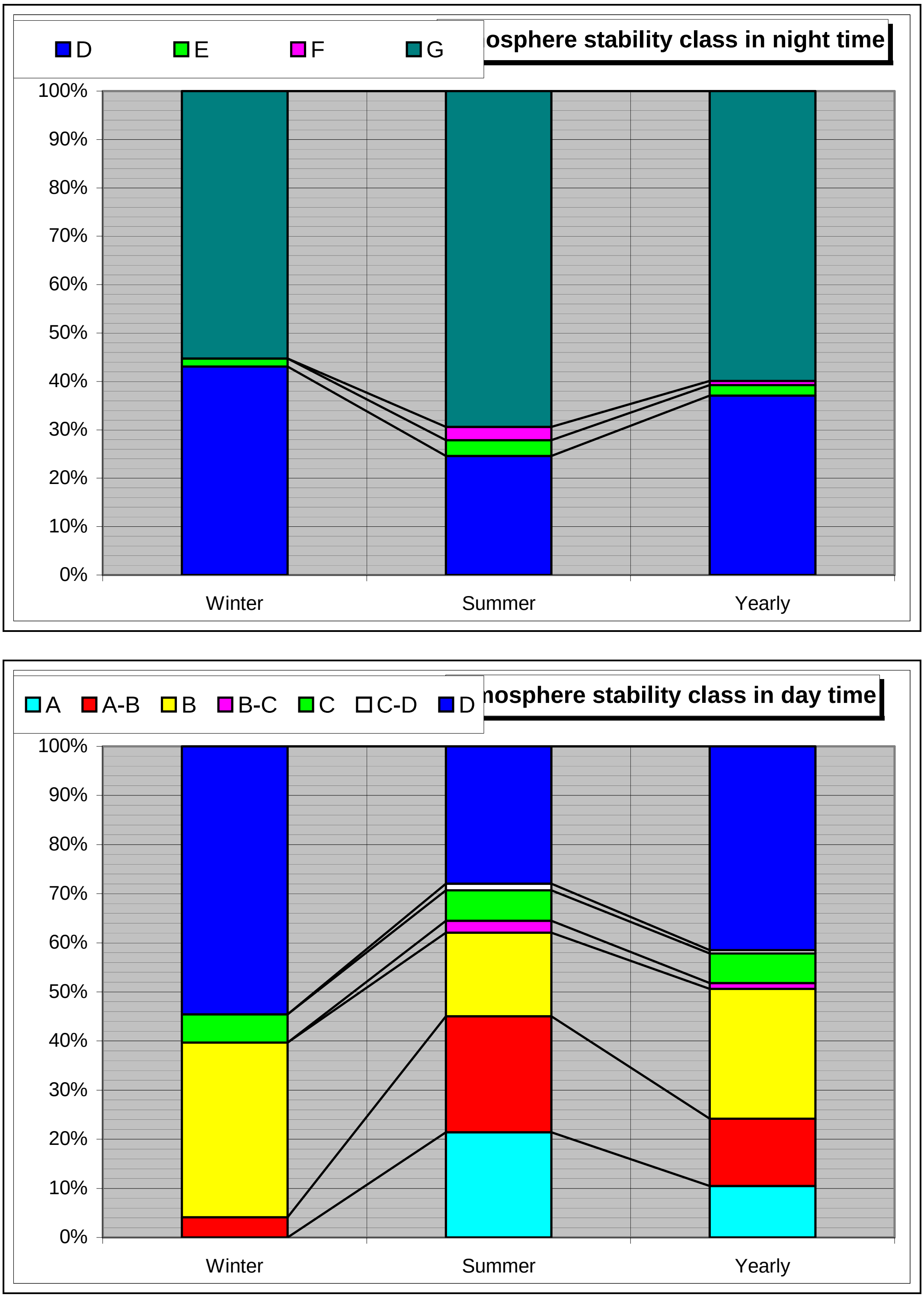


Figure D- 9: Observed frequency of stability classes in Skopje

Finally in Figure D- 10, the number of hours for each stability class, distinguished between day and night resp. summer and winter, is given

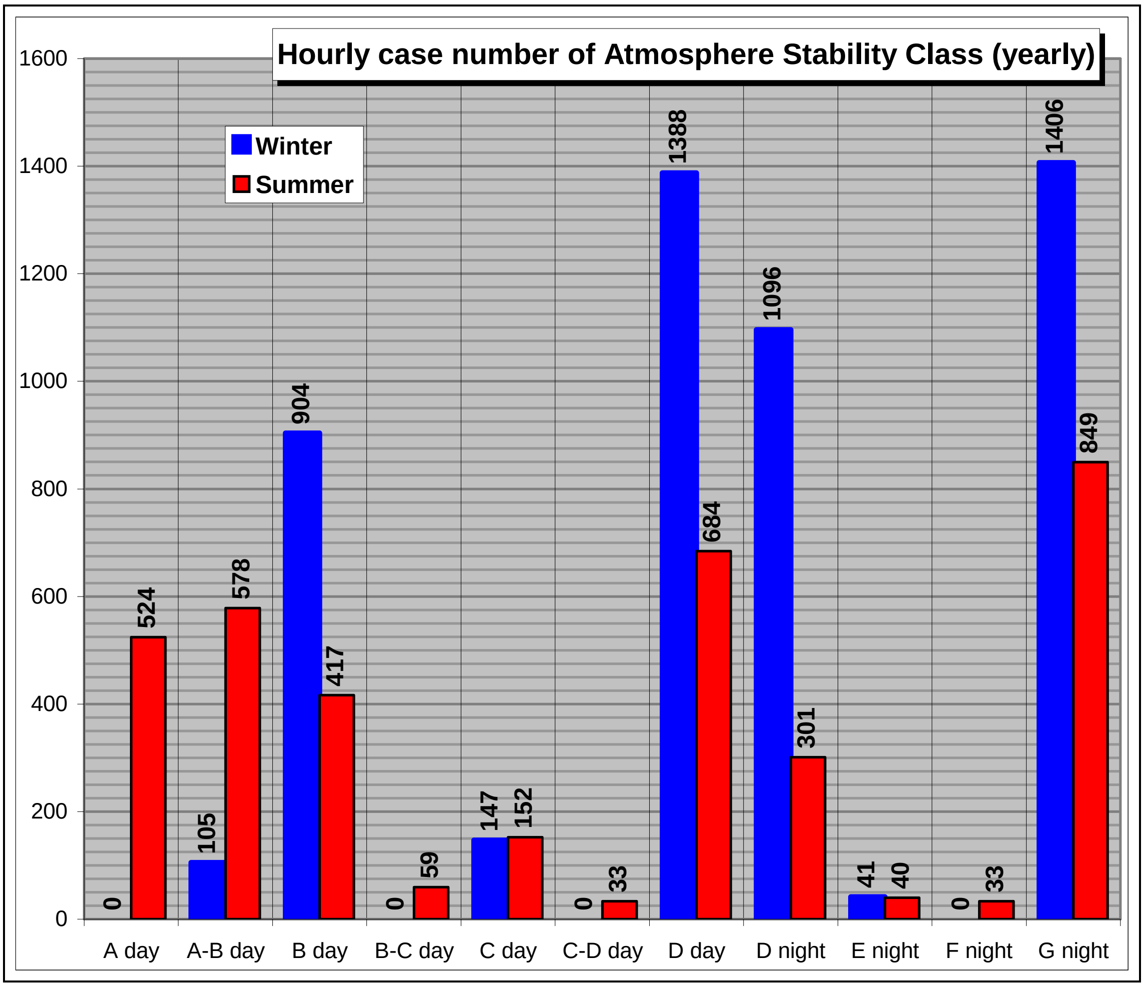


Figure D- 10: Number of hours for each stability class, distinguished between day/night and summer/winter

During winter (heating season), the classes D (neutral) and B (instable) dominate in the daytime, the classes G (strongly stable) and D (neutral) during night.

In the summer (non-heating season), class D and classes A-B (strongly unstable to unstable) dominate in the daytime, class G (strongly stable) and D (neutral) during night.

2.3 Hydrology and Water Bodies

2.3.1 Surface Water

Macedonia is a semi-dry country with the area of Ovce Pole being the driest area in the Balkan Region. The western part of the Republic is richer with water compared to the central and eastern parts of the country. Major watersheds in Macedonia in terms of size are the following:

- Watershed of River Vardar (2053 km2);

- Watershed of River Crn Drim (3350 km2);
- Watershed of River Strumica (1535 km2).

There are three natural lakes in the country: Ohrid, Prespa and Doyran Lakes. Major parts of watersheds of rivers and lakes, as well as parts of the water bodies themselves belong to neighbouring countries. The Vardar River and the Treska River are the most important rivers for the territory of Skopje. The source of the river Vardar is Vrutok, located in the "Sar Planina" mountain in the north-western part of Macedonia at an altitude of 676.34 m. The two main confluents of the river Vardar are the river Treska with 400 m altitude difference regarding the confluence point, and the river Lepenec with 350 m altitude difference. The river Vardar is the longest river in Macedonia. It flows into Greece and drains into the Aegean Sea. The water of the rivers Vardar and Lepenec are used for agricultural irrigation.

The confluence terrain of the river Vardar has a surface of 4650 km², and consists of the Vardar River's upper flow (1607 km²), the Treska River's confluence terrain (2068 km²), and the Lepenec River's confluence terrain (770 km²).

2.3.1.1 Classification of Surface Waters

The National Hydro-Meteorological Agency has divided the surface waters of Macedonia into four water quality classes (WQC) according to the "Regulation on Water Classification" (see Section B, Chapter 4.3). Data from 25.10.1998 on the classification of the rivers Vardar, Lepenec, Bistrica and Treska as published in the internet (www.moe.gov.mk) are presented in Table D- 10 in comparison to legal requirements of the water quality.

	Total Quality	
Watercourse, river, lake, measuring point	**Legal requirement of water quality**	**Estimated overall quality based on research**
River Vardar Skopje - Saraj	II	II
River Vardar Skopje – Jurumleri	III	III-IV
River Lepenec – east of the Vardar River	II	III – IV
River Bistrica – east of the Vardar River	II	IV
River Treska Skopje – Saraj	II	II

Table D- 10: Surface Water Quality and Classification

Table D- 10 shows that, in most cases, water quality of the monitored surface waters deviates from the quality proscribed by the relevant regulations. The water quality ranges between class II and class IV. Further information on the named website reveals that only the water in the upstream (spring) sections of the rivers Vardar, Treska and Radika can normally be classified as class I waters. Waste water discharges from settlements and industry into the rivers lead to a clear degradation of the river water quality downstream their spring section.

2.3.1.2 Water Quality and Classification of the River Vardar

Information from the internet (www.moe.gov.mk) reveal, that after its spring section, the river Vardar receives waste waters from the settlements situated downstream (e.g. from the sewage systems of the city of Skopje) and industrial discharges, leading to a clear degradation of the river water quality.

The National Institute of Health Protection was monitoring water quality of the river Vardar from 1995 to 1999 (in each case from April to September) at a measuring point located 250-300 m before the location of HPP "East". These data are presented in summary (minimum, average and maximum values for each year) in **Section H, Appendix D3.2**. Further tables showing the complete monitoring data of the Vardar River and related graphs are presented in the **Environmental Analysis of CHP Project (2000).**

When compared to relevant national standards (see Section B, Chapter 4.3) the results of water quality monitoring (see Tables in **Section H, Appendix D2.3**) show, that the river Vardar has a low water quality at HPP "East" Location. Indeed, physical characteristics like oxygen content and oxygen-demand indicate good water quality conditions but total suspended materials and particularly heavy metals like iron, lead, copper and zinc are exceeding clearly national Maximal Water Allowed Concentrations (MWAC). This conclusion is manifested in case of bacteriological analysis, where it is evident that the measured data are many times higher than it is permitted by regulation.

This situation can be drawn back mainly to the low water content and river flow at the time of measuring. Recent data of the Hydro-Meteorological Institute indicate that in the last few years rainfalls have decreased. As a result of this and due to an inefficient water utilization plan in Macedonia, there are shortages of water and low water levels in the rivers, bringing about droughts and increased water pollution in the rivers (www.soros.org.mk). During the period from April to September the water flow of the river Vardar can be very small. In some cases the river water flow through this period (especially in the summer months July and August) can be less than the minimum necessary for the survival of water organisms (see Chapter 2.3.1.3). Then, the influence of water pollution on the river water quality is biggest and the river water can have the same quantity and quality of water discharged by the sewage system of the city and connected industries. Therefore, it is not assumed that the proven low water quality at HPP "East" location is the result of enhanced water pollution from the city or from industry. Indeed, due to production decrease there has been a significant reduction of industrial waste waters during the last years. Statistical data show that, in 1994, the quantity of waste water that was discharged in the major watershed Vardar River was 265,557 m^3/day. According to information from the internet (www.soros.org.mk, www.moe.gov.mk) several intoxications and pollutions of River Vardar, particularly in the vicinity of Veles, occurred in the past. There is no sufficient quality monitoring of waste water produced both by settlements and industrial polluters existing in the region. The greatest problem occurs with the partial discharge of inappropriately treated industrial and urban sewage waters into River Vardar. This problem especially occurred in the recent drought years. From the total quantity industrial waste waters (420 million m^3) only 6 % is treated in Macedonia, where only three waste water treatment facilities exist. Furthermore, waste water treatment is performed with out-dated and inefficient technology in a limited number of facilities. Untreated sewage waste water can be found in the river Vardar in Tetovo, Skopje and Veles. In its section after Skopje and Veles up to Gradsko the river Vardar belongs to the most polluted rivers in the country. Even after the river Vardar receives water from its tributary Crna Reka, it does not achieve the legally prescribed quality, but reaches class III-IV. Downstream

Gradsko, where no industrial waste waters are discharged into the Vardar River any more, its water quality improves again. At the point where the river Vardar leaves the country, the river water finally belongs to quality class II.

In the following, a rough estimation of the River Vardar's water class at HPP "East" location is done according to the presented quality characteristics in this Chapter. The data reveal that the water quality of Vardar River at HPP "East" location tends to be stable in the months April to September and indicates a WQC for the river Vardar between III and IV during this period. In the late summer and in the beginning of autumn water quality of Vardar River tends to a stable WQC IV. From 1995 to 1999 there have not been significant variations concerning the water quality of Vardar River. In the months October to March the water quality of the river improves and indicates a WQC between II and III. This is expected to be due to the higher water flow in the river and the connected thinning effect during this period. In general, the current status of waste water treatment and monitoring is expected to be improved in the near future so that also the water quality of the River Vardar will improve.

2.3.1.3 Hydrology of the River Vardar

Hydrology data were derived from the National Hydro-Meteorological Agency that was monitoring the water flows of the river Vardar from 1961 to 1999 at a measuring point located 250-300 m before HPP "East". Tables and graphics showing the complete data of measured water flows of the river Vardar are given in the **Environmental Analysis of CHP Project (2000).**

The water flow of the River Vardar varies strongly. As can be seen in the following Table D- 11, the period between January and June is the period when the absolute minimum of river water is higher than the minimum amount of water needed for survival of water organisms. The rest of the year (period between July and December) the absolute minimum of the river Vardar's water flow is lower than this necessary water amount. Water flow in the river Vardar reaches it maximum in the months of January, June and November.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
61-99 absolute minimum	14.6	20.4	20.4	19.7	23.6	10.6	5.4	5.2	6.1	8.4	8.5	8.5
61-99 absolute maximum	673	526	451	280	439	644	247	127	135	288	1108	357
61-99	65.2	60.4	86.7	103.6	106.2	65.7	33.9	25.4	31.9	37.3	54.0	62.8
71-99	59.5	52.5	78.0	96.2	101.0	59.5	30.7	24.4	32.2	37.6	51.1	60.8
81-99	53.1	38.4	77.0	94.5	91.3	53.1	30.4	24.4	28.6	31.6	39.2	55.0
91-99	54.4	11.3	50.0	90.6	99.6	42.9	18.7	24.8	38.7	32.6	37.9	76.8

Table D- 11: River Vardar Water Flow (m^3/s) from 1961 to 1999

It is assumed, that in the near future there will be no problems in reaching the minimum necessary water amount for survival of water organisms due to the erection of two dams on the river Treska allowing the regulation of the minimal river flow.

Periodical variations of the water flow in the river Vardar through the years 1961 to 1999 can be seen in the following Figure D- 11 and Figure D- 12. The maximal peaks in 1962, 1970, 1976 and 1979 were caused by extreme high water flows during one or two months of the year.

Both figures show that in the same year, the water flow of the river Vardar can vary strongly. In extreme cases (e.g. in 1962) this variation can be between 5 and 1110 m^3/s (see Figure D- 12). If the maximal water flow 1100 m^3/s is set 100 %, the minimal water flow will be in this case only 0.45 % thereof. Due to a reconstruction of the river Vardar in 1979, a minimal water flow of 14.5-15.0 m^3/s (see Figure D- 11) will normally be achieved in the Vardar River. With an average water flow of 51 m^3/s, the minimal flow will be 1.35 %, and average will be 4.6 % of the maximum possible flow. The average water velocity of the river Vardar is 1.43 m/s.

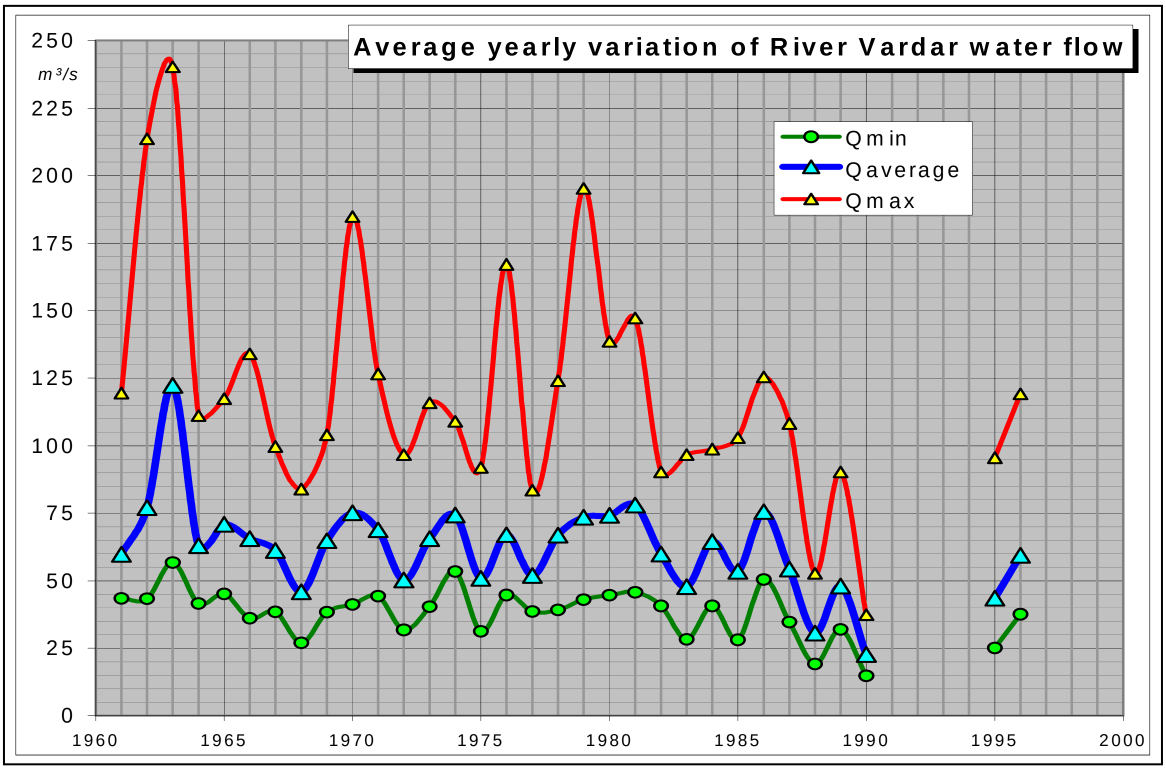


Figure D- 11: Average yearly Variation of River Vardar Water Flow

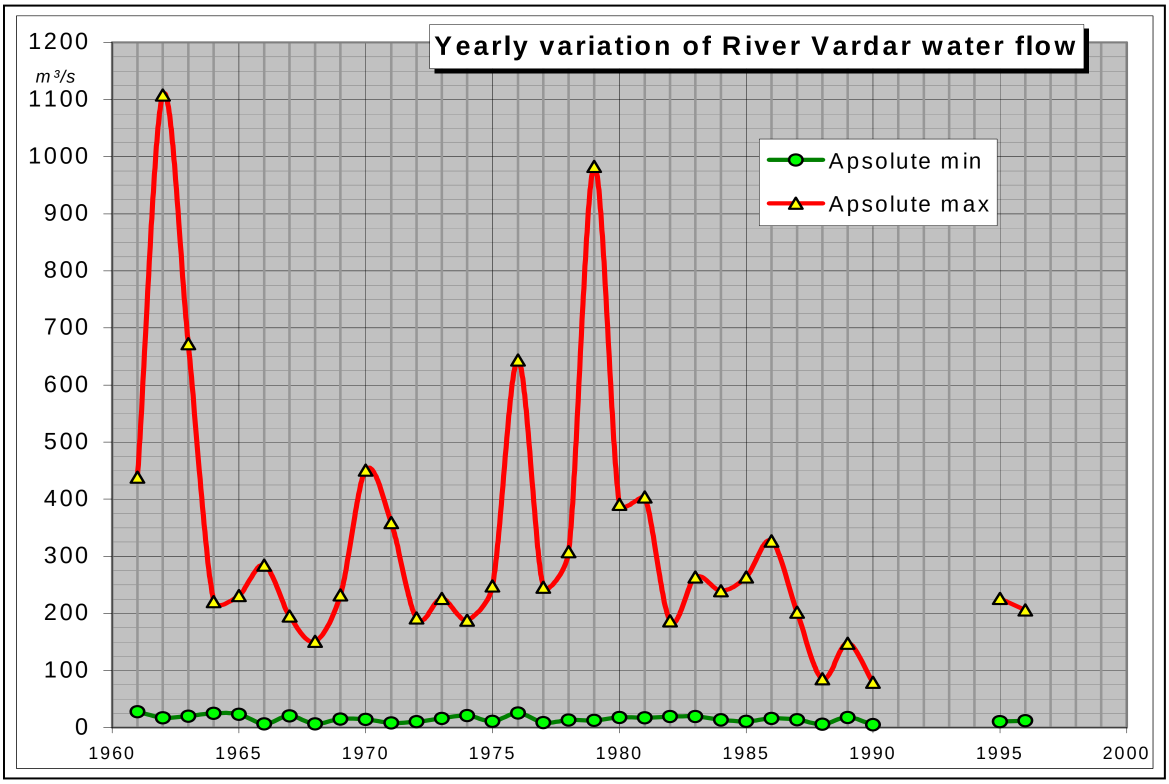


Figure D- 12: Yearly Variation of River Vardar Water Flow

2.3.1.4 Water Temperature of the River Vardar

Data on the water temperature of the river Vardar was available from the relevant authorities for the years 1975-1999. Monthly and yearly monitored data are presented in Table D- 12 **and Section H, Appendix D 2.3**. Tables and graphics showing the complete data of measured water temperature of the river Vardar are given in the **Environmental Analysis of CHP Project (2000).**

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
75-99 abs. T min.	0.0	-1.0	2.0	5.4	8.0	10.4	14.0	13.4	10.0	6.8	2.6	1.0	-1.0
75-99 abs. T max.	8.5	9.5	12.5	15.2	17.0	20.5	25.0	21.5	22.0	16.5	14.0	10.4	25.0
75-99 aver. T min.	2.0	3.1	4.8	7.6	10.1	13.1	16.1	15.7	12.7	8.8	5.8	3.2	2.0
75-99 aver. T max.	6.7	7.7	10.0	12.1	14.8	18.0	20.1	19.7	17.8	14.8	10.8	8.4	20.1
75-99 Aver. Temp.	4.6	5.4	7.3	9.9	12.6	15.6	18.1	17.8	15.1	12.0	8.0	5.8	11.0

Table D- 12: Water Temperature of the River Vardar (°C) from 1975 to 1999

The extreme water temperature values reached in the winter months (January and February) and in summer (July) are highlighted grey in Table D- 12. The average annual temperature in the river Vardar water in Skopje is 11.0 °C. Months from May to October show higher monthly average temperatures than the annual value; in the period from November to April lower monthly temperatures are reached. In general, the water temperature of the river Vardar shows high stability without extreme peak temperatures, not only regarding monthly periods, but also concerning yearly periods. It was found that yearly minimal and maximal values fluctuate in intervals from -1.0 to +1.0 °C (1.5°C for maximal values). The average registered yearly temperatures are fluctuating in intervals from -0.4 °C to +0.3 °C. The water temperature of the River Vardar is mainly depending on hydro-meteorological parameters and on the water temperature of the rivers Treska and Lepenec, flowing into the river Vardar in Skopje valley.

2.3.1.5 Profile of the River Vardar

The relevant profile of the river Vardar is situated at 1.5 km distance from the hydrological station. A detailed calculation of the river profile was done in the **Environmental Analysis of CHP Project (2000).**

In November 1962 there was a big flood in Skopje with a water flow of 1110 m³/s. In 1979, the bank and profile of the river Vardar were reconstructed in the city of Skopje so that the river can collect higher quantities of water today than it was the case in 1962. With the regulation of the river Vardar, the riverbank was dimensioned for a maximum capacity of 1150 m³/s, including both the minor and major bank. Hence, the possibility of a flood in Skopje is low these days. This reconstruction together with the erection of two dams on the river Treska, representing the biggest portion of water flow to the river Vardar, leads to a flood probability in Skopje of less than 1 %. If the 100 years water level is reached (1250-1300 m³/s) in the River Vardar, 241.13 m above sea level, the water will gush into the surrounding.

2.3.1.6 Water Turbidity of the River Vardar

The water turbidity of the river Vardar depends mainly on the intensity of precipitation and on spacious disposal and erosion in the territory of the river Vardar and its confluent rivers Treska and Lepenec, which are transporting large amounts of alluvial river-bank sediments. Characteristic oscillations of the turbidity of the river Vardar near the future CCPP plant location are given in the following Table D- 13**.** The yearly characteristic sediment flow of the river Vardar is shown in a figure in **Section H, Appendix D2.3.**

S-kg/s	Year	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1994	1995	1996	1997	1998
minimal	min.	1.06	0.24	0.33	0.01	0.05	0.24	0.12	0.80	0.27	0.17	1.07	2.12	3.14	2.78	2.68
	ave.	3.07	1.22	2.37	0.54	0.62	1.65	1.67	4.00	1.87	2.46	3.54	4.70	5.77	4.95	4.20
	max.	12.00	4.06	7.54	2.99	3.28	5.16	6.62	10.20	6.16	10.80	5.85	22.10	11.40	6.76	6.20
annual	Min.	4.18	2.00	2.20	3.44	4.66	3.70	4.91	3.10	4.90	3.09	6.63	13.80	27.30	25.20	14.60
	ave.	21.70	15.60	27.00	14.90	22.80	88.40	27.40	30.40	21.70	13.80	16.90	34.30	65.60	56.50	33.30
	max.	108.0	145.00	280.00	69.70	95.30	911.00	126.00	186.00	97.90	57.50	29.10	131.00	198.00	138.00	111.00
maxi-mal	Min.	14.30	7.57	8.49	17.50	29.10	9.56	9.65	8.06	21.00	5.63	23.80	56.80	131.00	83.30	45.90
	ave.	67.20	48.80	126.00	84.20	156.00	290.00	118.00	133.00	155.00	59.20	48.50	122.00	229.00	244.00	86.30
	max.	372.0	533.00	1424.0	400.00	698.00	8288.0	733.00	1211.0	798.00	303.00	88.70	681.00	494.00	670.00	347.00

Table D- 13: Characteristic Oscillations of the Turbidity of the River Vardar near the future CCPP

In the first measuring period (1974-1983) the annual turbidity of the river Vardar near the future CCPP location shows oscillations from 2 to 911 kg/s with an absolute maximum of 8288 kg/s. In the second measuring period (1994-1998) the annual turbidity of the river Vardar was more moderate with oscillations between 6.6 and 198.0 kg/s and an absolute maximum of 681 kg/s.

The monthly oscillation of the average disposal of the Vardar's river bank flow is shown in the following Table D- 14 and in a corresponding figure in **Section H, Appendix D2.3**.

S-kg/s	month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1974-1978	S min.	2.50	2.37	2.62	10.80	3.96	3.80	1.24	0.62	1.36	0.54	4.66	5.62
	S ave.	15.40	23.30	11.10	24.00	54.00	20.30	4.08	3.02	4.03	13.40	30.80	32.00
	S max	46.00	81.20	18.00	48.80	156.00	34.00	9.97	8.82	7.47	31.80	111.00	126.00
1979-1983	S min.	5.33	5.38	8.64	10.90	7.00	7.19	1.65	1.67	1.74	1.87	2.20	6.21
	S ave.	17.10	67.40	37.80	44.30	49.40	26.70	15.40	5.76	4.32	13.60	130.00	23.30
	S max	30.70	290.00	133.00	155.00	118.00	53.10	59.20	10.10	10.80	31.40	610.00	52.20
1974-1983	S min.	2.50	2.37	2.62	10.80	3.96	3.80	1.24	0.62	1.36	0.54	2.20	5.62
	S ave.	16.30	50.40	24.50	34.20	51.70	23.50	9.76	4.40	4.18	13.50	80.60	27.70
	S max	46.00	290.00	133.00	155.00	156.00	53.10	59.20	10.10	10.80	31.80	610.00	126.00
1994-1998	S min.	15.60	15.60	14.70	43.10	42.60	6.01	4.70	3.54	4.95	6.33	7.15	8.30
	S ave.	42.10	31.60	34.70	105.00	137.00	24.70	6.65	7.56	14.70	9.13	15.90	61.20
	S max	78.30	57.40	56.50	154.00	244.00	44.10	11.30	16.00	42.80	15.60	22.30	122.00

Table D- 14: Monthly Average Oscillation of suspended River Vardar Water Bank

Table D- 14 shows, that the values are increasing from November to May (except for March) and decreasing in the other months (corresponding to the water flow).

Based on the previous data it can be concluded that that the oscillations near the future CCPP location vary regarding intensity and duration. From 1974 to 1983 the average flow reached 28.4 kg/s, and from 1994-1998 the average flow was 33.0 kg/s.

2.3.2 Groundwater

The regime of underground waters on the site of the future power plant was determined according to data from hydrologic stations or piesometers that are located near the site. There is no hydrologic station present directly on the site. Data on the level of the groundwater are given in Table D- 15**.** Hydroisoplates for the years 1971-1990 are shown in **the Environmental Analysis of CHP Project (2000).**

Measuring Identification			Absolute Water level			Relative Water level (above sea level)		
Piesometer No.	Ground level	Measuring tube Level	min. (cm)	ave. (cm)	max. (cm)	min. (m)	ave. (m)	max. (m)
133	264.71	265.31	1384	1166	1074	251.47	253.65	254.57
151	257.66	258.25	805	667	484	250.20	251.58	253.41
156	255.92	256.12	672	588	533	249.40	250.24	250.79
615	235.07	235.71	506	315	177	230.65	232.56	233.94
G - 44	244.19	244.99	1281	1196	848	232.18	233.03	236.51

Table D- 15: Groundwater Level

The groundwater level in the area reaches between 235 m and 250 m above sea level. The maximum level is achieved during the spring period, when the level of surface water is highest. It varies between 1.77 m and 10.74 m. Accordingly, the minimum groundwater level is reached during the summer period with minimum values between 5.06 m and 13.84 m. The groundwater moves in direction to the river Vardar. Maps showing the depth of the underground water or hydroishobates are part of **the Environmental Analysis of CHP Project (2000)**. These maps show that the maximum groundwater level on the site reaches about 2-6 m, the average level is 4-8 m, and the minimal level can be found 6-10 m under the ground level. Amplitudes between extreme values of the groundwater level are relative high reaching between 1.39 m and 4.33 m. The level of the groundwater varies and is connected with the level of the surface waters of the river Vardar. There is a groundwater well station located on the plant site.

Information on groundwater quality was not available. According to the National Hydro-Meteorological Agency (www.soros.org.mk) groundwater pollution in Macedonia is mainly due to the deposition of untreated industrial and household waste.

2.3.3 Drinking Water

Most of the drinking water in Macedonia is derived from non-polluted mountain springs and sources (www.soros.org.mk). The City of Skopje is currently drawing drinking water for its population from different springs via the city water supply system. Officially published analysis data of drinking water from the city supply system (measurements

1995 to 1999), as obtained from the National Institute for Health Protection is presented in summary (average values for each year) in **Section H, Appendix D2.3**. Complete tables are part of the **Environmental Analysis of CHP Project (2000)**. A relevant measurement point for the Project is located in the city community Avtocomanda, where the HPP "East" is connected to the central water grid system of the city. This measurement point is obtaining water from the main water supply spring “Rasce”, which is located at the entrance of Skopje valley, where also industry and further infrastructure is present. A comparison of the drinking water analysis data with EU quality standards as published in the Council Directive 98/83/EC, Annex I, shows that the number of aerobic germs in drinking water exceeds the given EU standard (0/100 ml). According to information from the internet (www.soros.org.mk) toxins have been found in the underground waters in the valley of Skopje (Dracevo and near the oil rafinery), however these wells are not used for drinking water.

2.4 Ambient Air Quality

The new combined cycle heat and power plant as well as the existing district heating plant are located in an industrial zone of the city of Skopje. Besides the heating and power plant, there are several emission sources contributing to the ambient air quality of the city of Skopje, like industrial factories, household heating and of course urban traffic.

Four measuring stations have been installed at different locations in Skopje, equipped with automatic and continuous analyzers for SO2, NOx, CO, particulates and some meteorological parameters.

The location of these 4 automatic ambient air quality monitoring stations is described in Table D- 16. The Figure D- 13 shows the stations on a picture of Skopje.

Measurement Station location parameters			
Measuring Station	longitude	latitude	altitude (m)
Karpos	21°23’46’’	42°00’13’’	250
Center	21°25’45’’	41°59’31’’	243
Gazi Baba	21°27’49’’	42°00’13’’	250
Lisice	21°28’12’’	41°58’42’’	235

Table D- 16: Location of 4 Automatic Monitoring Stations

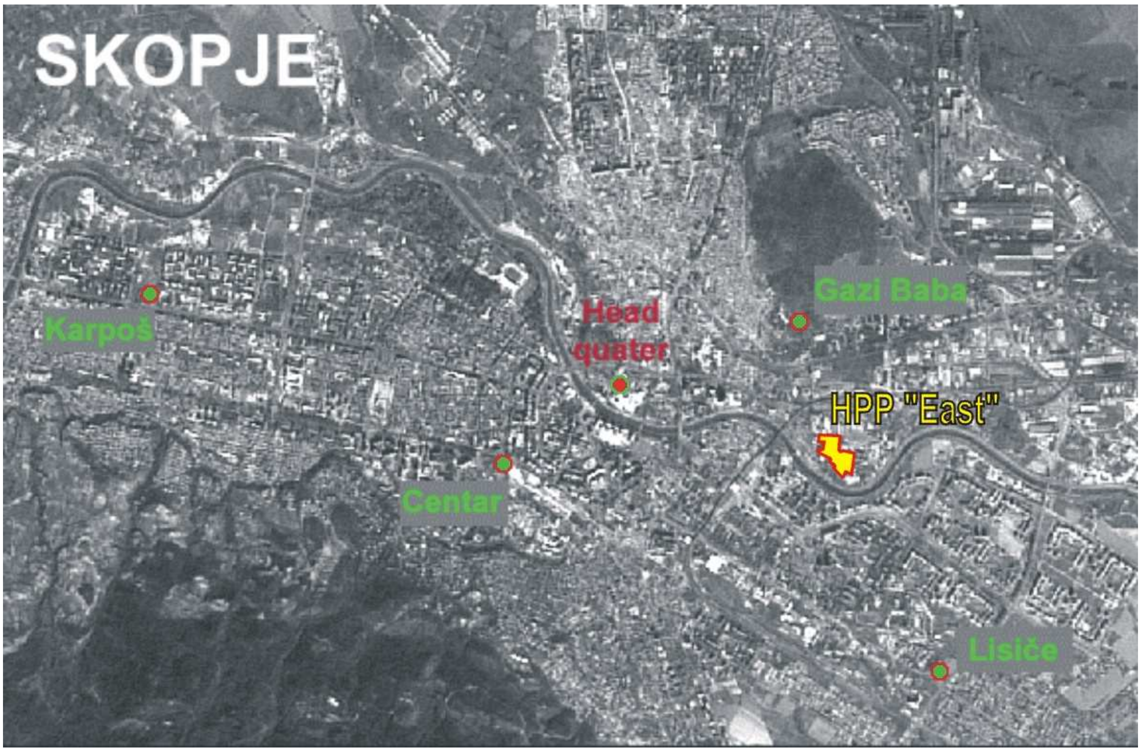


Figure D- 13: Picture with Location of 4 Automatic Monitoring Stations

The location of the heating plant and the new CCPP respectively is middle between the stations Gazi Baba, Lisice and Center.

The measuring data of these stations are recorded as hourly values. Daily averages as well as monthly values are derived from the hourly values by aggregation.

The automatic ambient air quality monitoring stations are operated by the Ministry of Environment and Physical Planning of the Republic of Macedonia. Monitoring data of the last years have been provided to Colenco. As main basis for the following description of the existing ambient air quality situation in Skopje, data of 2004 and 2005 have been analyzed.

In addition to these data information from some manual measurements of SO_2 in ambient air in Skopje are available. Manual measurment have been done by State Hydro-Meteorological Institute (HMI) and State Health Protection Institute (HPI). The location of the measuring points of the manual measurements is listed in Table D- 17.

Measurement Points location parameters (HMI)			
Measur. Point	longitude	latitude	altitude (m)
AMSM	21°26’	42°00’	249
Avtocomanda	21°29’	42°00’	250
Dracevo Settlement	21°33’	41°56’	242
J.B.Tito Gimnasium	21°26’	42°26’	245
Karpos IV Settlement	21°23’40’’	42°00’15’’	255
New Lisice Settlem.	21°28’51’’	41°58’59’’	242
HMI	21°24’	42°01’	301
University Library	21°26’40’’	41°59’52’’	247
State Fruit Institute	21°28’	41°58’13’’	243

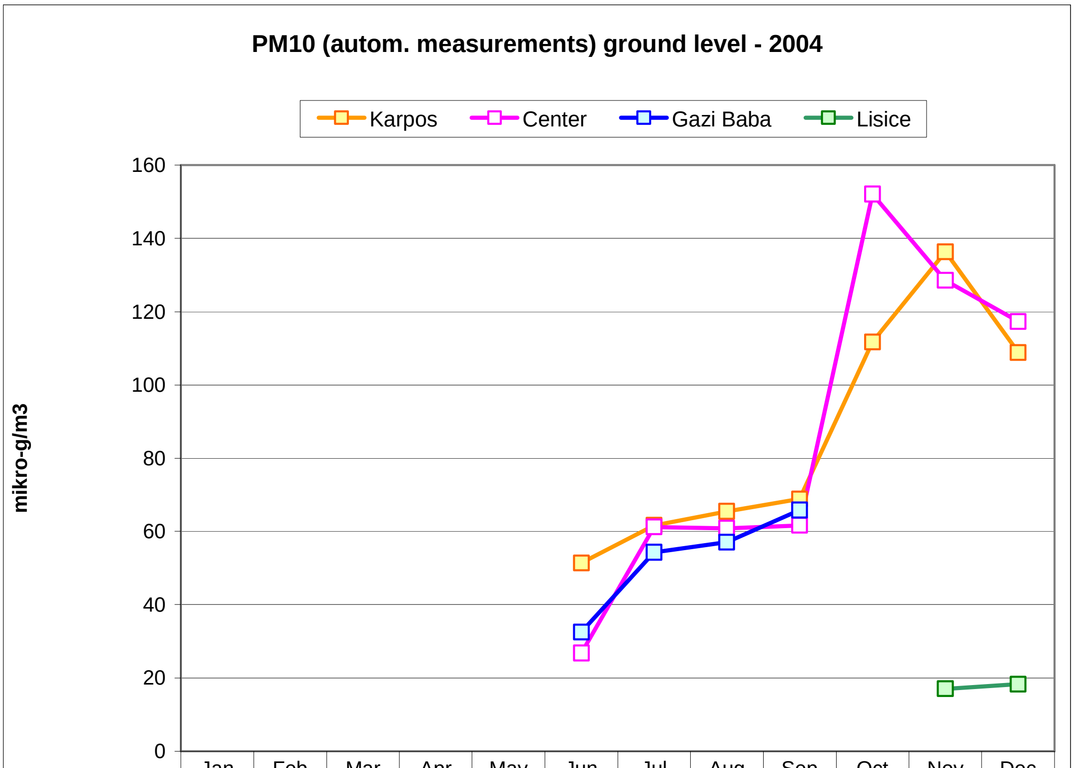
Measurement Points location parameters (HPI)			
Measur. Point	longitude	latitude	altitude (m)
DDD	21°27’21’’	42°01’20’’	274
Dimo Hadzi Dimov	21°22’50’’	42°00’19’’	254
Panorama	21°25’35’’	41°58’54’’	340
Pivara	21°28’15’’	41°59’54’’	239
Srnicka	21°28’33’’	41°59’10’’	231
USJE Cement Fact.	21°27’50’’	41°58’08’’	241
HPI	21°26’49’’	41°59’14’’	249

Table D- 17: Location of HMI and HPI Measuring Points

In the following the ambient air quality in Skopje is described by means of measured concentrations of particulates (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2).

2.4.1 Particulates

Evaluable data of particulate measurement are available for the second half of 2004. The summarised results of the PM10 ground level measurements of the automatic stations are shown in Figure D- 14. Even though not many data could be analysed the sesonal development can be seen. During summer the values are approx. 30- 50 $\mu g/m^3$ and increase to the 3-fold in the winter season. This behaviour is explainable by the much higher emissions due to industrial and household heating and the traffic situation as the case may be in combination with adverse meteorological conditions.



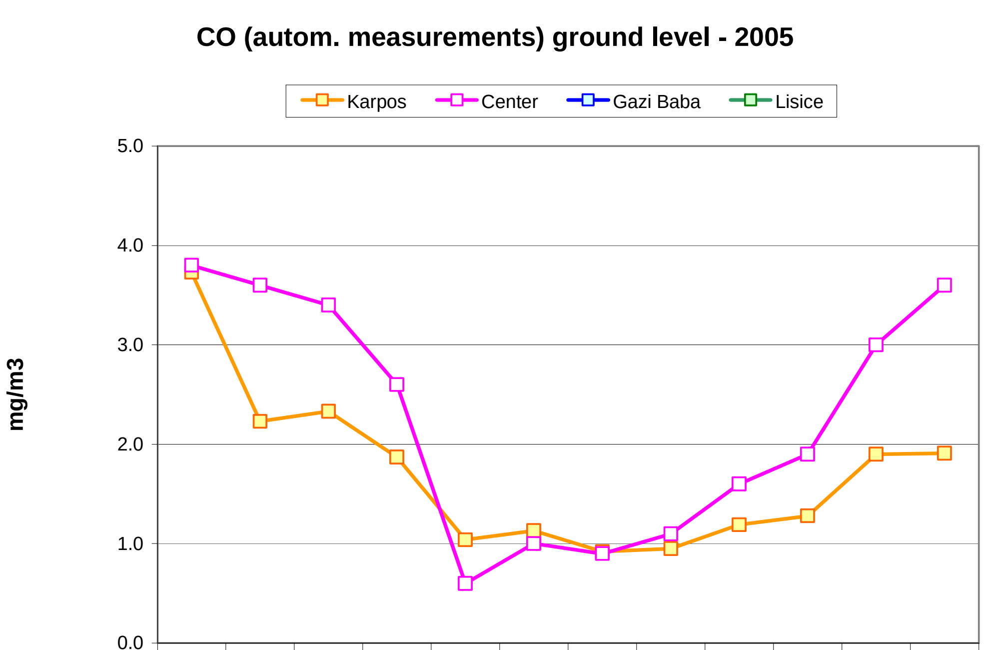
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Karpos						51	62	65	69	112	136	109
Center						27	61	61	62	152	129	117
Gazi Baba						32	54	57	66			
Lisice											17	18

Figure D- 14: PM_{10} Ground Level Measurements 2004

2.4.2 Carbon Monoxide

Evaluable CO measurements are available for the year 2005. The monthly averages are summarized in Figure D- 15.

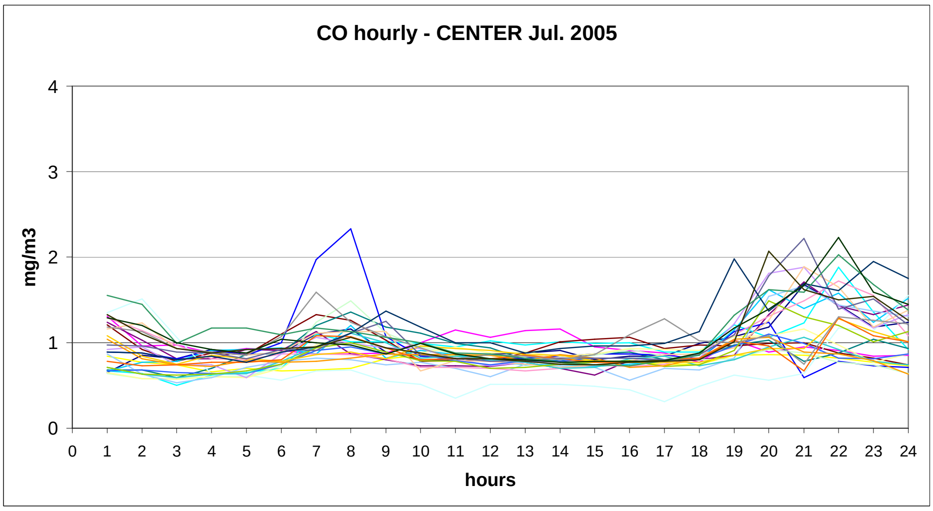
In summer the average CO ground level concentration comes close to 1 mg/m^3 whereas during winter increases approx. to the 3-fold, i. e. shows the same seasonal development as particulate matter.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Karpos	3.7	2.2	2.3	1.9	1.0	1.1	0.9	1.0	1.2	1.3	1.9	1.9
Center	3.8	3.6	3.4	2.6	0.6	1.0	0.9	1.1	1.6	1.9	3.0	3.6
Gazi Baba												
Lisice												

Figure D- 15: CO Ground Level Measurements 2005

Figure D- 16 shows two examples (summer and winter) for the daily trend of the CO ground level concentration. The hourly concentration levels show a tendency to rise in the night despite the fact that the number of automobiles decreases. The reason for this behaviour is mainly due to meteorological conditions (stability). Additionally, there seem to be some peak in the morning, probably due to starting urban traffic.



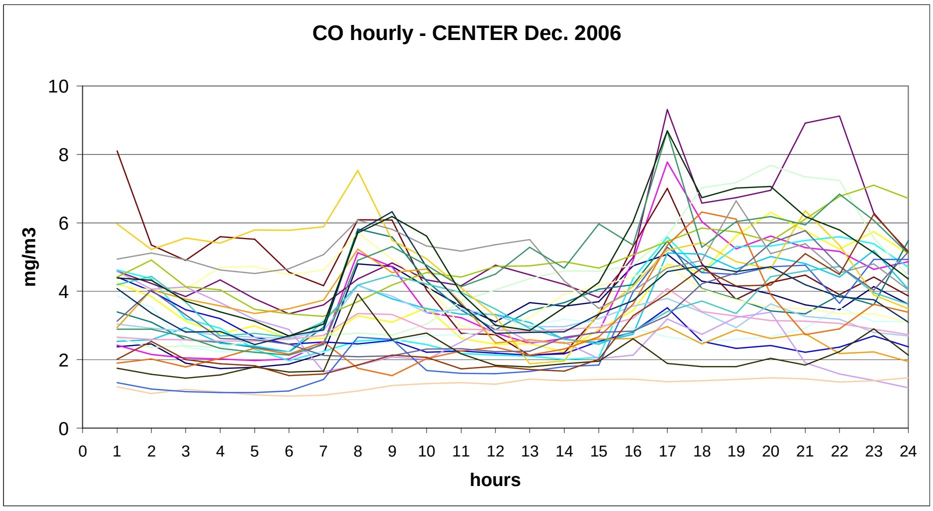


Figure D- 16: CO Hourly Values (Daily Trend)

2.4.3 Nitrogen Oxides

The NOx analyzers (chemiluminescense with NO_2 converter) of the automatic stations principally can measure NO and NO_2 separately. But for the recent years 2004 and 2005 we have only for the component NO_2 data in sufficient scope and which are evaluable. For this reason the component NO_2 is taken to describe the situation.

To get an idea on the NO/NO_2 ratio in the ground level concentrations in Skopje we investigated some old measurements (taken by the 4 automatic stations end of the nineties and separately presenting both species (reported in the Environmental Analysis of CHP project 2000) and measurements of the year 2003 (two locations, NO and NO_2 values; reported in an year 2003 environmental report). The NO mass concentrations have been calculated as NO_2 (by multiplying with the molar mass ratio 46/30 = 1.53) before the NO/NO_2 ratio calculation. The results of this investigation are summarized in Figure D- 18 and Figure D- 18.

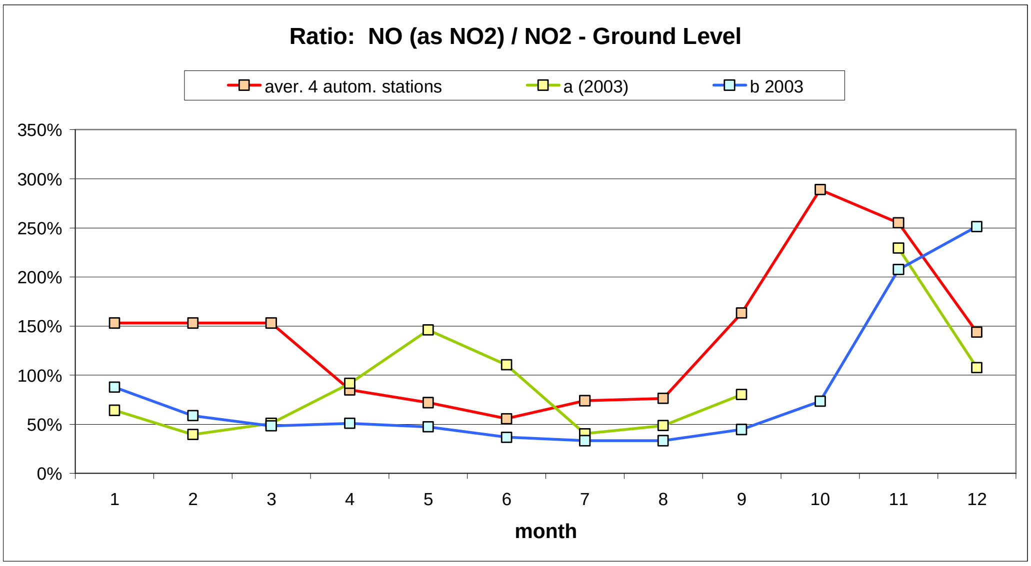
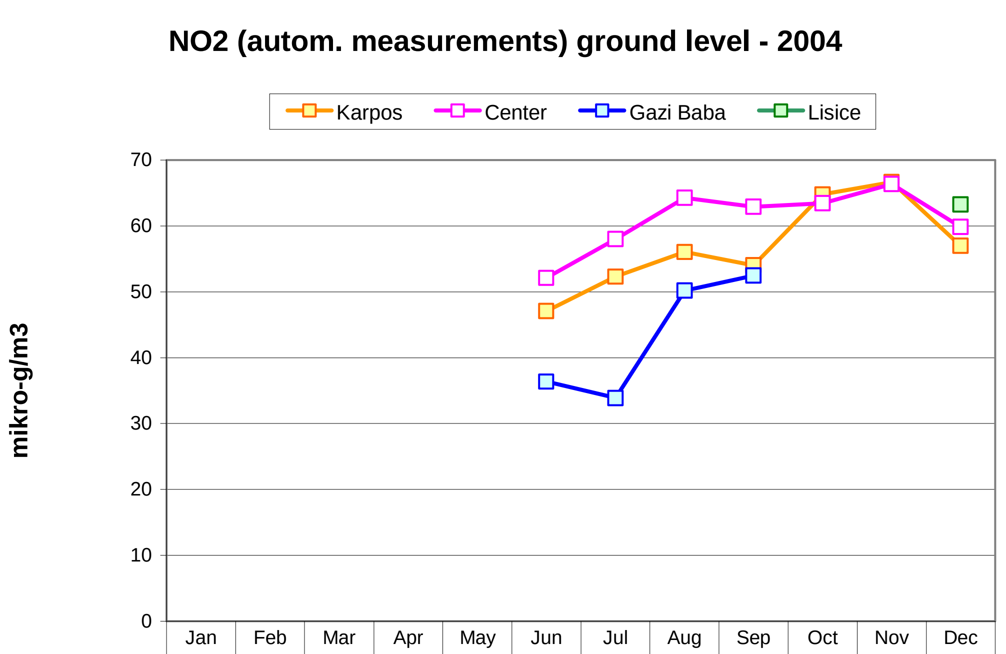
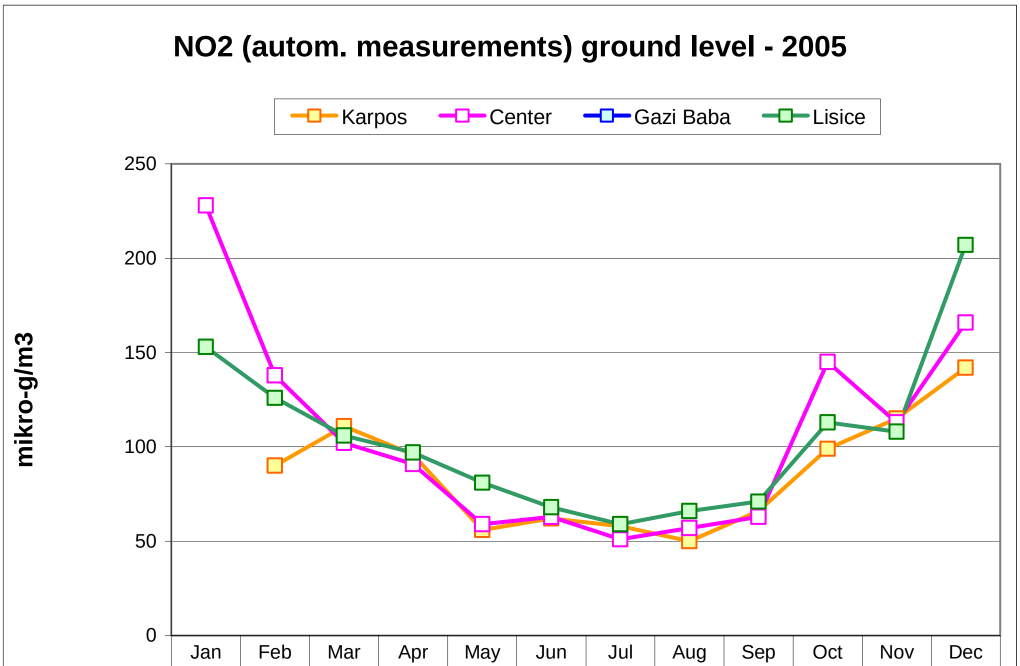


Figure D- 17: Examples of NO/NO_2 Ratio

The diagram indicates that NO (as NO_2) can reach in summer roughly 50 - 100 % of the NO_2 value, in winter it can reach the same order or even exceed NO_2. In consequence, the sum of nitrogen oxides NOx (usually calculated as NO_2) must be expected higher than the nitrogen dioxide data shown in the following figures.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Karpos						47	52	56	54	65	67	57
Center						52	58	64	63	63	66	60
Gazi Baba						36	34	50	52			
Lisice												63

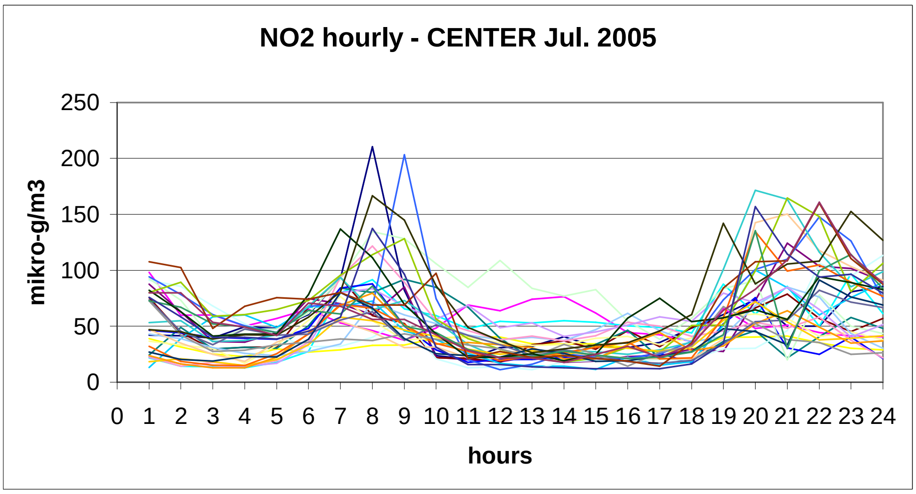


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Karpos		90	111	96	56	62	58	50	66	99	115	142
Center	228	138	102	91	59	63	51	57	63	145	113	166
Gazi Baba												
Lisice	153	126	106	97	81	68	59	66	71	113	108	207

Figure D- 18: NO_2 Ground Level Measurements 2004 - 2005

Also the nitrogen oxides show the seasonal behaviour with higher values in winter months. In winter the NO_2 ground level concentration can reach 100 - 200 µg/m^3. Considering the additional NO share, the total NOx concentration (as NO_2) in the winter months could be readily expected double.

The daily development of the hourly measured nitrogen oxides ground level concentration is shown in the following example for a summer as well as a winter month.



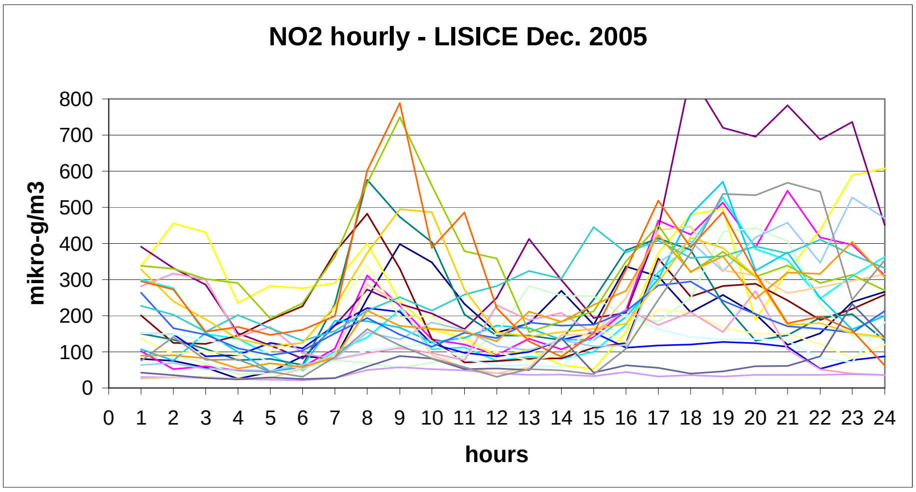


Figure D- 19: NO_2 Hourly Values (Daily Trend)

The general behaviour in both seasons is the same. The concentration rises in the night (similar as for CO) and shows peaks in the morning (Figure D- 19). The peaks in the morning are probably due to the starting urban traffic.

The daily development of the ground level concentration of NOx and CO are also an indication that besides industry and the district heating plant other emission sources contribute to the resulting situation. The urban traffic obviously plays a major role in this context.

2.4.4 Sulfur Dioxide

For the SO_2 ground level concentrations the most data are available, both manual measurements and data from the 4 automatic monitoring stations.

2.4.4.1 Manual SO_2 Measurements

The manual measurements of the Health protection Institute in the year 2004 are compiled in Figure D- 20.

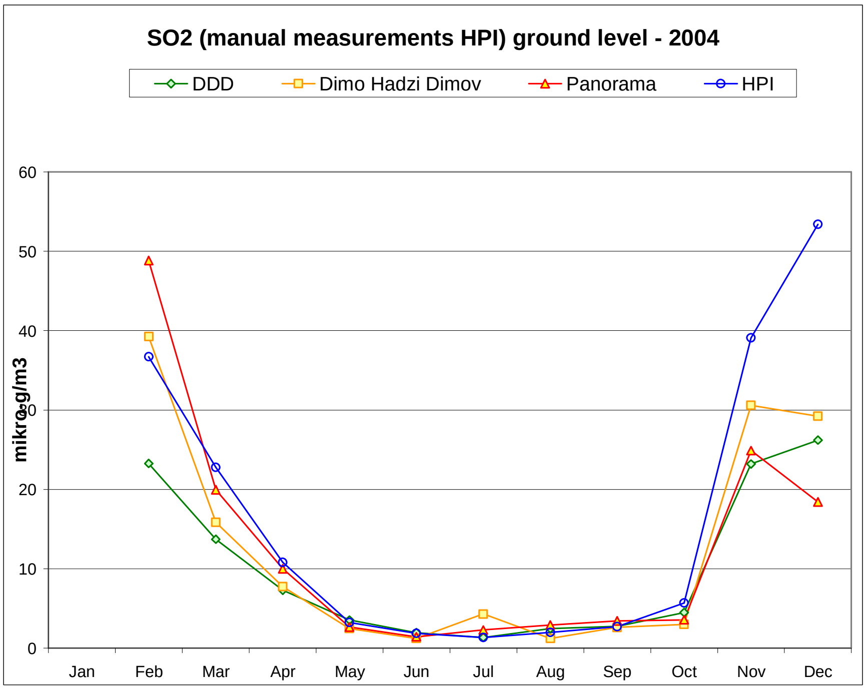


Figure D- 20: SO_2 Ground Level Measurements HPI

The follwing Figure D- 21 summarises the measurements of the Hydro-Meteorological Institute in the year 2004.

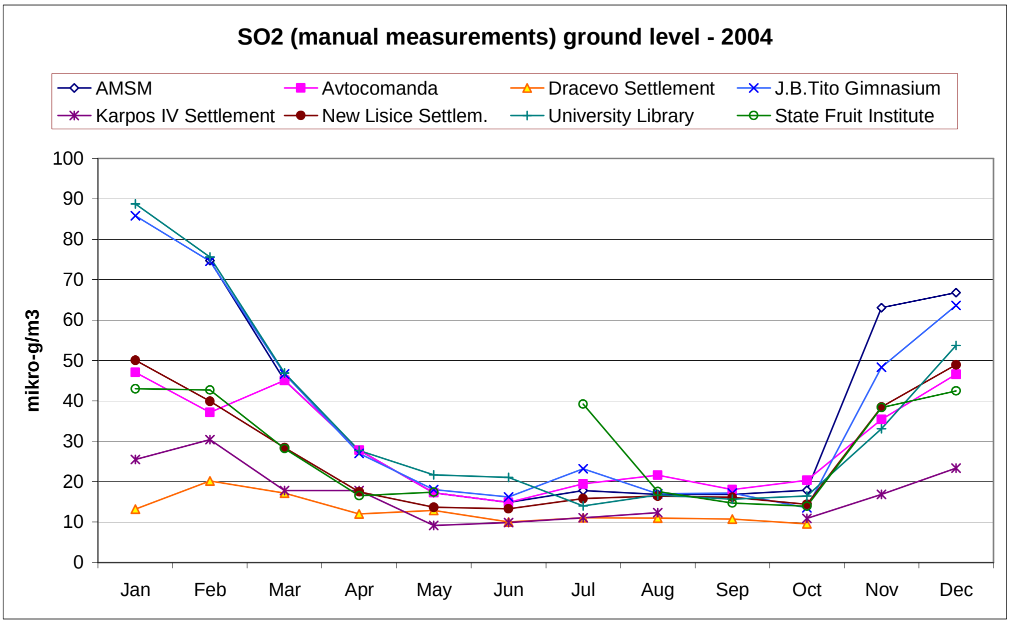
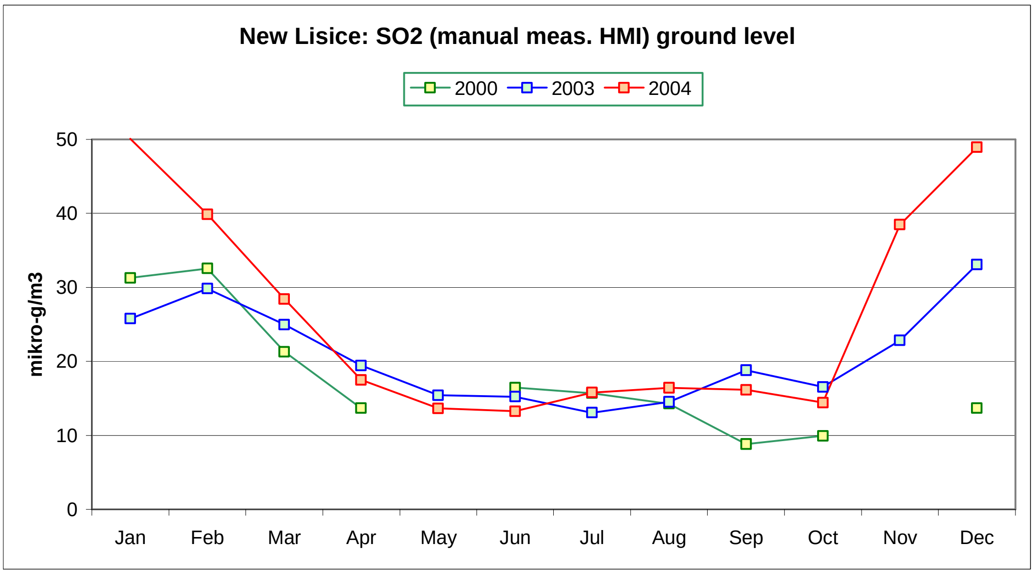


Figure D- 21: SO_2 Ground Level Measurements HMI

Manual measurements of different years are compared in Figure D- 22.



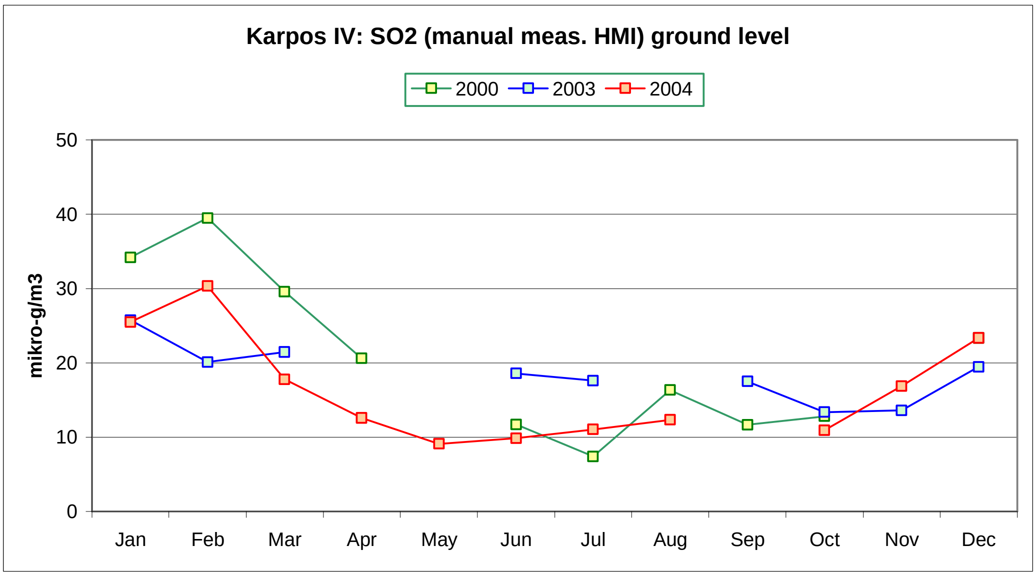


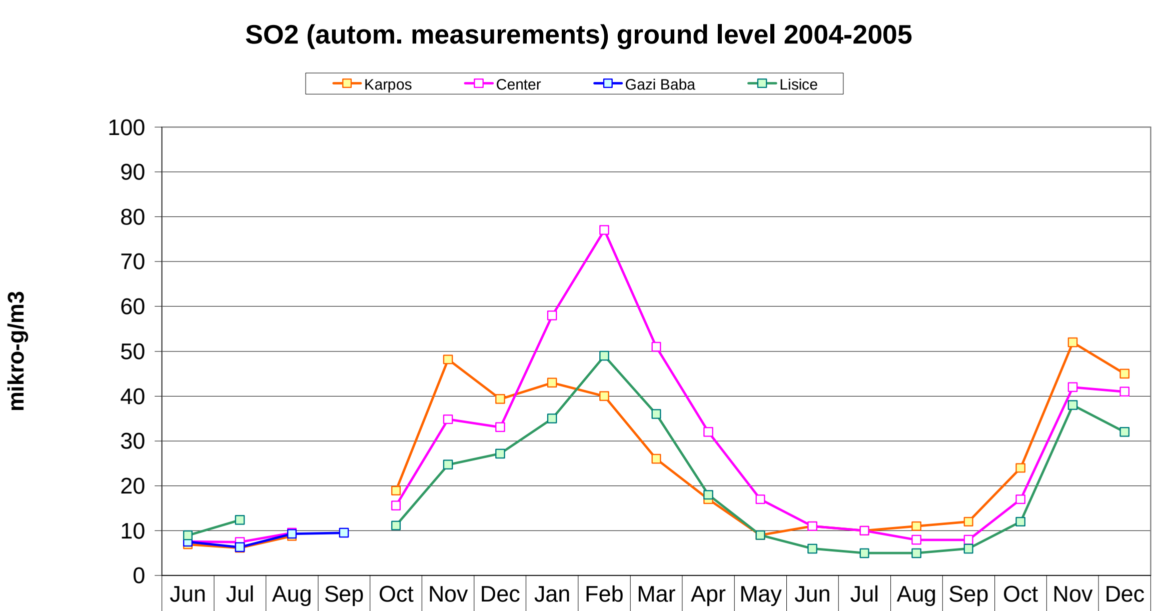
Figure D- 22: SO_2 Ground Level Measurements (HMI) of different years

All presented manual SO_2 ground level concentration measurements in Skopje show the same behaviour (see Figure D- 22). The concentrations are on a low level between 5 and 20 µg/m^3 during summer months and show a distinct increase in winter.

2.4.4.2 SO_2 Measurements Automatic Stations

SO_2 ambient air quality data for the years 2004 and 2005 are also available from the automatic stations. The results in form of the monthly averages are presented in the next figure. The covered time period lasts from June 2004 till end of 2005. In general, the results are very similar as for the manual measurements. The concentration level in summer is about 10 µg/m^3 and increases up to 40 - 80 µg/m^3 in winter.

As for the other pollutants also, sulfur dioxide shows the clear seasonal development with substantial higher concentration levels during the winter months (see Figure D-23). The big difference from summer to winter underlines the significance of burning fossil fuels in industry, district heating plants and households.

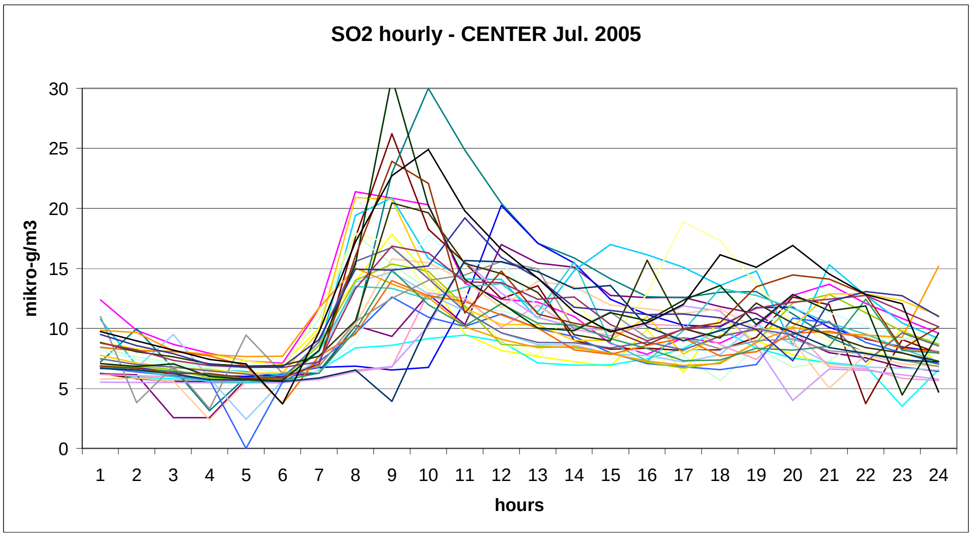


	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Karpos	7	6	9		19	48	39	43	40	26	17	9	11	10	11	12	24	52	45
Center	8	7	10		16	35	33	58	77	51	32	17	11	10	8	8	17	42	41
Gazi Baba	8	6	9	10															
Lisice	9	12			11	25	27	35	49	36	18	9	6	5	5	6	12	38	32

Figure D- 23: SO_2 Ground Level Measurements Automatic Stations 2004-2005

Figure D- 24 and Figure D- 25 show typical examples for the daily development of the hourly measured SO_2 ground level concentration in Skopje, both for summer and heating season.

In both seasons the SO_2 concentration levels are highest during daytime and decrease in the night. During the heating months, besides the fact of a distinct higher level, the concentration maximum in the daytime is stronger pronounced and more concentrated around noon. Different from CO and NOx, there is no increase in the night. In this context it shall be mentioned that the district heating plant normallly is shut down during night time. SO_2 shows no peaks in the morning due to the fact that traffic is of minor importance.



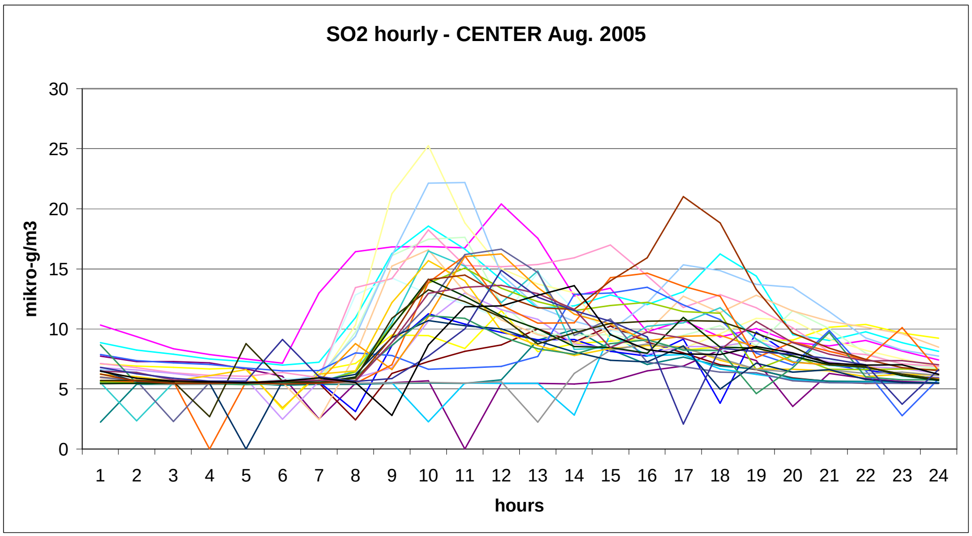
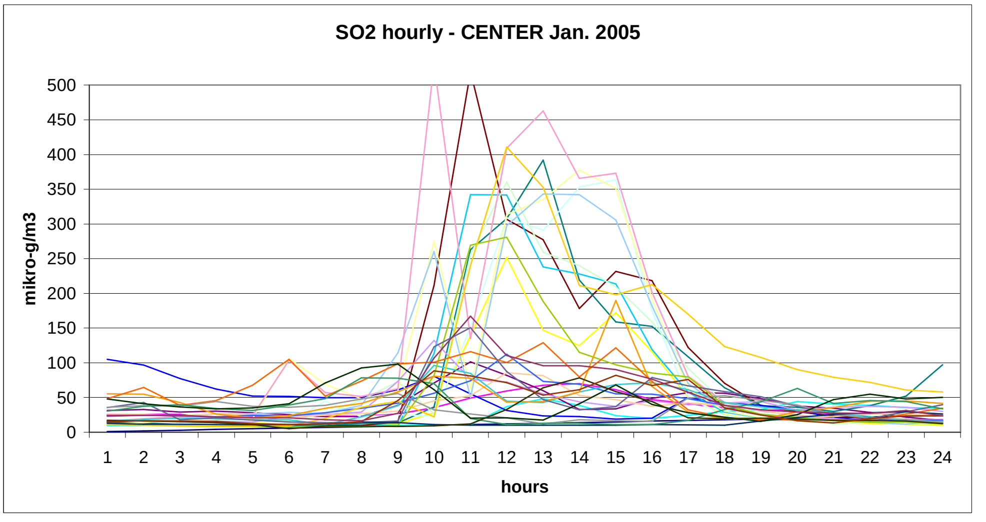


Figure D- 24: SO_2 Hourly Values (Daily Trend) Summer



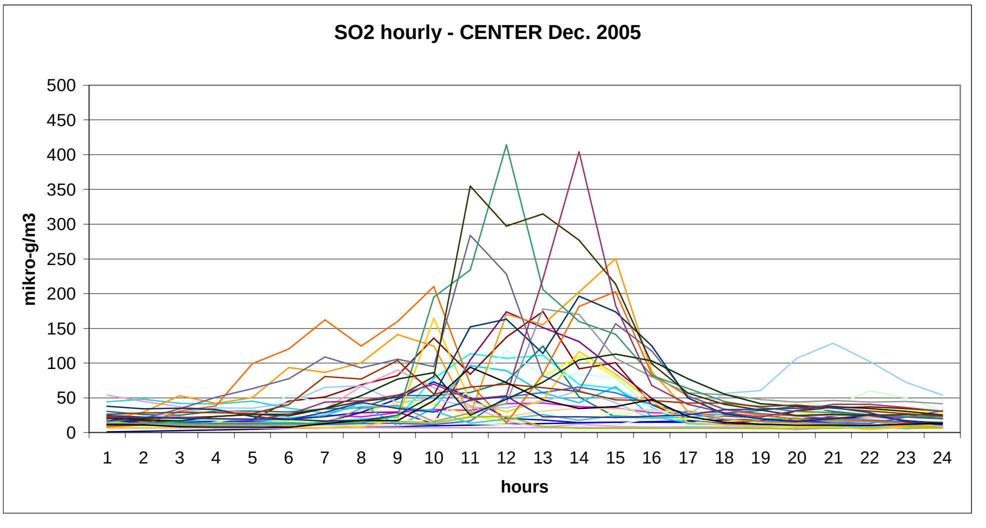
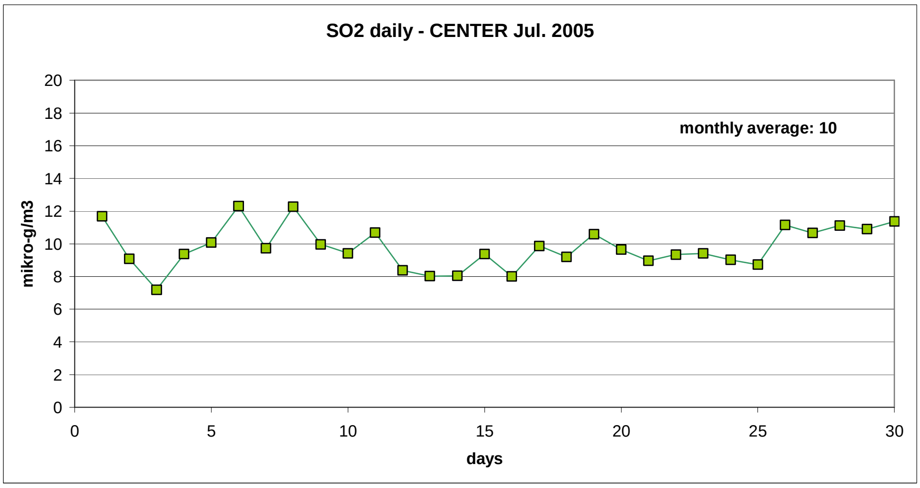


Figure D- 25: SO_2 Hourly Values (Daily Trend) Winter

Figure D- 26 shows the daily averages of SO_2 during one month in summer and in winter. These curves do not follow a trend, shall just illustrate the levels and the range of variation.



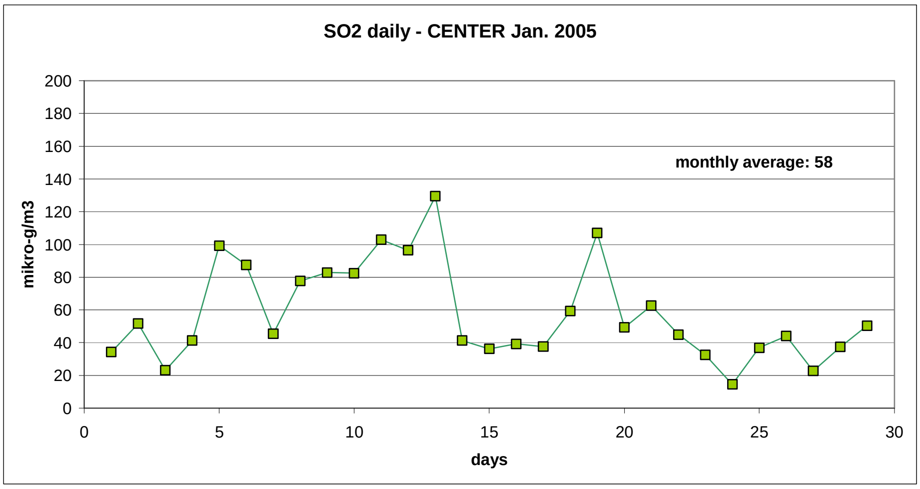


Figure D- 26: SO_2 Daily Values

2.4.5 Conclusion

Summarising the above information on the existing ambient air quality situation the last 2 years in Skopje, the following conclusions can be drawn:

- Generally, the ambient air quality in Skopje is substantial worse in the high winter months than during summer. This applies for all investigated pollutants (PM, CO, NOx, SO2). This is mainly due to the strong increase in the use of fossil fuels by industry, heating plants and private sector.
- It appears that the emission sources are not common for the different pollutants.
- For the CO and NOx ground level concentrations the urban traffic seems to play a major role besides industrial and other sources like the district heating plant.
- Concerning SO_2, industrial sources and burning fossil fuels in industry, district heating plants and private households seem to play the major role, especially for the strong increase in the heating season.

Comparing the above described ground level concentration data with ambient air quality standards (see Section B), the following statements can be made.

For all investigated components the exceeding of ambient air quality standards has been assessed or can not be excluded.

SO_2 is well below the standards during summer, in the high winter months during heating season a sporadic exceeding can not be excluded.

The other components show a more critical behaviour as they exceed the standards in winter and partly in summer. The following table summarises the ambient air quality standards and the main findings concerning evaluated baseline ambient air quality.

Ambient Air Quality Standards		max. single	average			Remark concerning ambient air quality measurements
		1/2 h	1 h	1 day	annual	
Macedonian Standard						
PM10	µg/Nm3					
CO	mg/Nm3	3		1		1/2 h value partly exceeded in summer; exceeded in winter.
NOx (as NO2)	µg/Nm3	85		85		Mostly exceeded in winter. Partly exceeded in summer.
SO2	µg/Nm3	500		150		Below standards in summer. In winter sporadic exceeding possible.
European Standard						
PM10	µg/Nm3			50 4)	40	1 day aver. exceeded in most cases, espec. in winter. Annual average probably exceeded.
CO	µg/Nm3					
NOx (as NO2)	µg/Nm3		200 2)		40	1 h value probably mostly exceeded, in winter and peak time. Annual value exceeded.
SO2	µg/Nm3		350 3)	125 5)	20 1)	1h and 1 day values below standards in summer. In winter sporadic exceeding possible. Annual average partly exceeded.
	1)	protection for biological environment				
	2)	not to be exceeded for more than 24 times				
	3)	not to be exceeded for more than 24 times				
	4)	not to be exceeded for more than 35 times				
	5)	not to be exceeded for more than 3 times				

Table D- 18: Comparison with Standards

2.5 Noise Pollution

2.5.1 Noise Situation in Skopje

Noise level measuring and monitoring data were obtained from the Ministry of Urban Planning, Construction and Environment. Data of measured traffic noise in the centre of Skopje is shown in the following Figure D- 27:

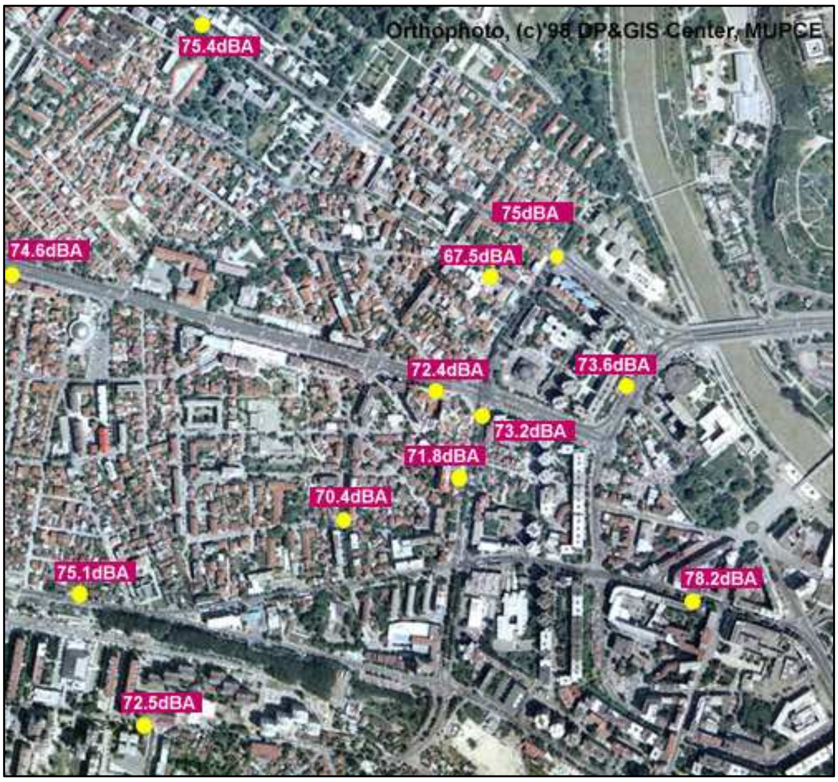


Figure D- 27: Traffic Noise in the Centre of Skopje

The centre of Skopje mainly comprises residence areas but also some industrial areas, where e.g. the site of the future CCPP is located. Figure D- 27 shows that the levels of the traffic noise ranges between 67.5 dB(A) and 78.2 dB(A) in the centre of Skopje. In most areas the Maximal Permitted Levels of Noise (see Section B, Chapter 4.4) are exceeded.

2.5.2 Noise Situation near HPP “East” Site

Long term noise measurements (24 h) were performed by Toplifikacija during the period of one week at eight measuring points near HPP “East” site. During this period HPP “East” was in operation, but also non-operational periods occurred, that have been considered by the measurements. Hence, these measurements are applicable to reveal the present noise impact of HPP "East" to the surrounding areas of the city of Skopje. It was considered that the potential noise emissions from the Power Plant are resulting from individual point sources representing each item of equipment or structure that may produce a significant amount of noise. These individual noise sources are: machine hall, main transformers, gas reducing station, water preparation plant, air compressors, and steam turbine generators

The measured level in the boiler building was around 90-95 dB(A) at the locations of burners, pumps and ventilators, and approximately 80-85 dB(A) at the bottom part of the boilers. During operation of the plant the noise level at 1 m distance from the building was about 78-83 dB(A).

As it is shown in Figure D- 28, the area of noise impact around the site can be roughly divided in two main areas: zone of high density residential area (“Residence-Business Region” on the south and west side of the site), and industrial zone (eastern industrial zone of Skopje on the north and east side of the site). Furthermore, residential areas with a very low density of buildings and areas anticipated for settlement (according to the architectural plan of the city) are present in the vicinity of the site. Four measuring points were defined in the residential area, another four in the industrial area.

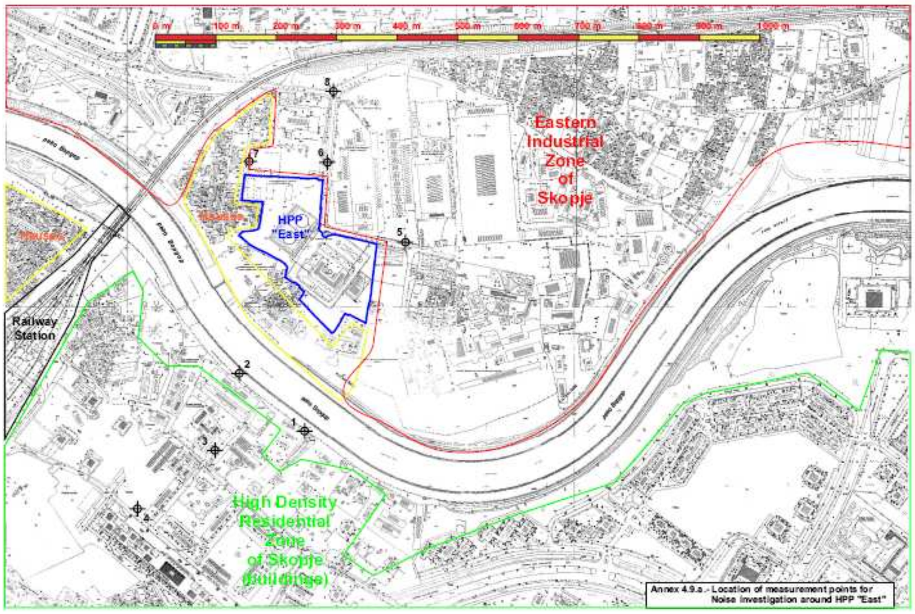


Figure D- 28: Location of Measuring Points for Noise Investigation around HPP “East”

Average values of the performed 24 h noise measurements are given in the following Table D- 19.

	Situation when HPP “East” is not in operation								Situation when HPP “East” is in operation							
Time	Noise level in dB(A) at measuring point								Noise level in dB(A) at measuring point							
h	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
07:00	52	50	51	65	58	55	54	56	56	55	55	67	65	56	58	59
08:00	55	54	58	70	64	60	59	65	58	56	62	71	69	65	60	66
09:00	54	55	56	68	66	62	60	66	56	59	58	69	68	63	63	66
10:00	49	54	62	64	65	60	58	63	51	59	63	66	71	62	59	65
11:00	52	56	68	65	64	62	58	65	54	60	71	66	66	65	60	66
12:00	50	56	70	67	70	60	59	68	51	60	71	69	70	62	62	69
13:00	55	60	65	70	68	62	55	70	58	64	66	71	71	66	56	71
14:00	58	60	65	72	66	58	56	68	62	63	66	73	71	62	57	70
15:00	60	65	70	75	70	64	65	70	63	68	71	76	71	65	68	73
16:00	52	62	64	72	65	62	62	68	53	64	67	73	70	64	65	69
17:00	55	60	65	70	60	60	64	66	56	65	66	72	65	61	66	68
18:00	58	60	62	72	56	65	62	65	61	62	63	73	62	67	66	68
19:00	58	58	65	72	56	64	64	64	62	60	65	74	60	66	67	66
20:00	56	58	68	70	58	64	62	62	59	60	70	71	60	65	65	63
21:00	58	56	62	68	55	62	64	64	60	58	63	69	59	63	65	66
22:00	55	58	60	68	55	62	64	60	55	58	60	68	55	62	64	60
23:00	54	55	55	62	54	64	62	62	54	55	55	62	54	64	62	62
00:00	50	51	52	63	55	64	63	65	50	51	52	63	55	64	63	65
01:00	50	51	51	62	54	62	64	65	50	51	51	62	54	62	64	65

	Situation when HPP "East" is not in operation								Situation when HPP "East" is in operation							
Time	Noise level in dB(A) at measuring point								Noise level in dB(A) at measuring point							
h	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
02:00	48	50	50	63	54	62	60	62	48	50	50	63	54	62	60	62
03:00	46	48	52	60	52	60	58	60	51	49	54	61	59	65	62	62
04:00	48	46	50	65	55	60	55	62	49	51	54	67	59	65	57	65
05:00	50	48	52	64	55	58	54	62	51	54	55	65	61	59	55	64
06:00	52	50	50	62	58	55	54	58	53	56	53	64	65	59	55	61
Day	53	55	59	67	60	61	60	64	55	58	61	68	63	63	62	65
min.	46	46	50	60	52	55	54	56	48	49	50	61	54	56	55	59
max.	60	65	70	75	70	65	65	70	63	68	71	76	71	67	68	73

Table D- 19: Noise Measurements near HPP "East" Site

During the measuring period, an average noise level of 59 dB(A) and a maximal noise level of 75 dB(A) were determined in the residential area when the HPP "East" was out of operation. At the same time, the identified average noise level in the industrial zone was 61 dB(A) and the maximal noise level reached 70 dB(A). During operation of HPP "East" an increase of the average noise level was observed: the level in the residential zone was rising for approximately 1 dB(A), and the level in the industrial zone was escalating for about 2 dB(A), respectively. The maximal noise level in the residence area was then 76 dB(A), and in the industrial zone 73 dB(A).

A comparison of the measured noise levels with the national standards (MPLN) given in **Section B, Chapter 4.4,** which are corresponding with World Bank standards, shows, that the limit values effective for residential areas (55 dB(A) for day-time and 45 dB(A) for night-time are exceeded all the time, both when HPP "East" is in operation and is not in operation. In the industrial area the effective limit values (70 dB(A) for day- and night-time) are rarely reached when HPP" East" is not in operation and slightly exceeded in the after-noon when the plant s in operation.

The difference between operation and non-operational phase of HPP "East", registered at all measuring points, is shown in the following Table D- 20:

Time	Change of the noise level in dB(A) at measuring point							
h	1	2	3	4	5	6	7	8
07:00	4	5	4	2	7	1	4	3
08:00	3	2	4	1	5	5	1	1
09:00	2	4	2	1	2	1	3	0
10:00	2	5	1	2	6	2	1	2
11:00	2	4	3	1	2	3	2	1
12:00	1	4	1	2	0	2	3	1
13:00	3	4	1	1	3	4	1	1
14:00	4	3	1	1	5	4	1	2
15:00	3	3	1	1	1	1	3	3
16:00	1	2	3	1	5	1	3	1
17:00	1	5	1	2	5	1	2	2
18:00	3	2	1	1	6	2	4	3
19:00	4	2	0	2	4	2	3	2
20:00	3	2	2	1	2	1	3	1
21:00	2	2	1	1	4	1	1	2
22:00	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0
00:00	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0

Time	Change of the noise level in dB(A) at measuring point							
h	1	2	3	4	5	6	7	8
02:00	0	0	0	0	0	0	0	0
03:00	5	1	2	1	7	5	4	2
04:00	1	5	4	2	4	5	2	3
05:00	1	6	3	1	6	1	1	2
06:00	1	6	3	2	7	4	1	3
Day	2	3	2	1	3	2	2	1
min.	0	0	0	0	0	0	0	0
max.	5	6	4	2	7	5	4	3

Table D- 20: Increasing of the ambient Noise Level according to HPP "East"

The results show a high noise burden in the vicinity of the future CCPP plant. They reveal also, that the present noise impact from HPP "East" to the surrounding area is minor due to technical isolation measures in the plant. It is obvious that the influence of HPP's most noisy machines have only low influence on the measured noise in the environment. This is especially the case for the noise measured in the nearest residential area (measuring points 1 to 4, see Figure D- 28). The proportion of the HPP Plant regarding the total noise level in the area is only low and local traffic and the railway station have the highest influence on the present noise level in the area.

2.6 Soil

The composition of the soil in the study area depends strongly on its geological equipment (see Section D, Chapter 2.1) as well as on the prevailing climatic conditions and the present topography. The site is located in the regime of the river Vardar with alluvial accumulation of gravel and sand. In the first 3.0 m depth below the ground level clay lenses may be found. The soil of the expansion area for the new plant is free of contaminations and is partly sealed (e.g. by concrete pavement and asphalt ways). The unsealed soil of the site possesses natural soil functions, e.g. filter and buffer function and habitat function for plants and animals. Generally, gravel and sand soils have a relative low buffering capacity.

A typical texture of the soil layers (top soil, sand coarse gravel) is shown in the following Figure D- 29**.**

Figure D- 29: Soil Layer Texture

No sensitive soil features have been found on the site. Toplifikacija will perform further soil investigations on own behalf prior to the start of the construction period, comprising test drills and corresponding analysis.

In the vicinity of Skopje soil is mainly used for agriculture but nothing is known about its status (soil quality and pollution). According to information from the internet (www.mo.gov.mk) the level of knowledge on soil quality in Macedonia is generally low, as it is the case for the study area. As an example, the heavy metal presence in the soil has not been fully investigated, yet. There is also no measurement (monitoring) network for the monitoring of soil pollution status existing in the country. Furthermore, there are no maximum allowed concentrations of harmful substances in the soil specified by the Law. This prevents the continuous control of the soil pollution.

In general, the predominant pollution and damaging factors for soil in Macedonia include the intrusion of polluted waste waters and air-bound particles, excavation activities for surface coal and mineral raw material, erosion, improper use of chemicals in agriculture, traffic burden, presence of landfills on karst soil, urban, rural and weekend settlements etc. About 11,000 ha in Macedonia are classified as saline soil (www.soros.org.mk).

2.7 Solid waste

Solid wastes in the Macedonia are generated within the following sources:

- human everyday activities (communal wastes);
- operation of mining, metallurgy and energy industries- technological wastes;
- wastes from industry (processing industries) and organic and inorganic technology industries (industrial wastes);
- wastes from medical facilities (hospital wastes)

- radioactive waste.

There is no regulation concerning solid waste management in Macedonia (www.soros.org.mk).

About 25 landfills exist in the country but there is only one modern communal waste landfill with appropriate technical solutions, located in the capital of Skopje (landfill Drisla). All other landfills are located in the immediate vicinity of major settlements. Landfill locations have been specified without applying the modern criteria for landfill location selection. Landfills in the country are, therefore, located mostly on inadequate sites. There is no technical or other legal documentation on any of these landfills. In the smaller settlements and villages the waste is dumped unorganized in various places. Often the waste ends up near the lakes, rivers and springs polluting their waters. The landfill Vardariste in Skopje belongs to the most potentially dangerous landfills of the country (www.soros.org.mk).

The gathering, management and treatment of communal waste is the competency of public communal enterprises that cover major municipal centres. Rural settlements and minor newly-established municipalities have not been covered by organized communal waste gathering. In most of such cases, so called illegal landfills have emerged.

Technological wastes are mostly stored in the vicinity of their places of origin / generation. At these sites no previous analyses are performed of terrain natural features and of possibilities and options to store such wastes. Some industrial wastes are selected and re-used, but most of them end up on landfills within industry facilities' main yards. Hospital wastes are currently treated as communal and are disposed of on communal landfills. An appropriate storing facility for radioactive wastes has not been constructed yet; these wastes are thus disposed together with non-radioactive wastes.

The public communal enterprises have been facing severe financial difficulties during the last years, and today have to operate with obsolete machinery etc. The improper treatment and management of solid wastes coming from sources mentioned above have resulted in numerous and permanent environment degradation cases. Negative impacts of these conditions may be noticed, for instance, by monitoring of groundwater, surface waters and observation of the soil. Impacts due to improper treatment and disposal of wastes have even affected areas under protection (e.g. some national parks in the country) and other fragile eco-systems.

The technological / industrial waste management is the competency of relevant facilities such as mines, factories etc. Very little attention is currently paid to the re-use of these wastes.

To improve the situation concerning waste management, the “Law on Waste” and the “Law on Communal Works” have been passed. Macedonia has signed the “Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal” and has been carrying out some of the activities planned by the Secretariat of the Basel Convention)

Activities planned to improve the solid waste status have also been based on the „National Environmental Action Plan (NEAP)” which includes a special Study on Solid and Hazardous Waste Management. Activities have started related to the development of the national solid waste management strategy with the financial support from the PHARE Co-operation Programme. At the same time, experts are intensively working on concrete solutions for the most endangered parts of the country, as for now mostly with the financial support from domestic sources.

2.8 Landscape

The site of the future CCPP plant is situated next to the existing HPP "East" in an industrial area in the centre of Skopje. There is no natural landscape existing at the site or in its direct vicinity. The direct surroundings of the site are mainly characterized by urban development. This situation reveals a high visual burden of the landscape in the direct vicinity of the site. Outside Skopje the natural landscape is superimposed by agricultural use.

2.9 Cultural Heritage

According to a baseline study performed by the Goverment of Macedonia, the cultural heritage of the country is characterized by a high variety, starting from pre-history and leading to ancient Greece, the period of the Roman Empire, the Middle Age, the Osmanli Empire and the reformation of peoples in this region. All these epochs have left numerous proofs of essence. The neolithic man established settlements in a continuity of over 5 millenniums, leaving traces of the Hellenic, Roman, Byzantium and Slavic cultures.

In many towns of Macedonia there are major sacral (Christian and Islamic) and architectural structures existing. The old town of Skopje belongs to the main settlements bearing middle-age features. The region possesses significant cultural and historical values like archaeological sites, basilicas, churches dating back to the XIV century, carvings and a huge stock of icons from the XI and XIX centuries.

No available information was found in the baseline study which identified any archaeological, historic or cultural remains on the site or in the surrounding area.

3 Description of the Relevant Biological Conditions

3.1 Protected areas

Macedonia has designated protected areas in the country according to the "Law on Natural Rarity Conservation" (1973) and regarding the natural heritage categorization outlined by international law (IUCN criteria of 1996), respectively. Altogether, 6.6 % of the territory of Macedonia is designated as protected area including three national parks with an area of 108,388 ha, three areas with exceptional natural characteristics (2,388 ha), 14 reserves with special plant and animal species (2,709 ha) and 48 natural monuments (56,850 ha) (www.soros.org.mk).

The site does not belong to any protected area. No national parks, no strictly protected natural reserves and no areas protected for their conservation value can be found in the vicinity of the plant site. The Canyon Matka, located 15 km southwest of Skopje, is a monument of nature covering an area of around 5.000 ha. Another monument of nature, the Vrelo Cave, is located in the Canyon of Matka, near Skopje, on the right bank of the Treska River, next to the springs of Koritiste (approximately 20 km south of Skopje) (www.moe.gov.mk). The Vodno mountain is part of an area with exceptional natural characteristics (1953 ha). It is situated on the southern side of the Skopje valley. "Vodno" is also designated as a natural reserve area.

Concerning environmental protection, the high importance of the Vardar valley, including the river and its tributaries, can be seen from the fact that it absorbs 80 % of the total basin area in Macedonia.

3.2 Vegetation

Macedonia possesses a rich variety of plant species. About 3,500 species of plants are recorded in the country, among them many endemic and relict species of which some are very rare. From a bio-geographical point of view, the country belongs to the Aegean province from the Mediterranean region, to the Mezisic province from the Eurosybirean - North American region and to the Alps - Nordic region. Regarding forest areas, oak and beech forests are predominant in Macedonia, followed by other types of forests (www.soros.org.mk).

In the geographical region of Skopje 23 areas with different biocoenosis types exist, which can be divided into the following five **vegetation zones**:

- High-Mountain Zone;
- Forest Zone on Mountains;
- Forest Zone on Hills;
- Forest Zone in Lowlands (Valleys);
- Zone of Open Terrains.

Vegetation communities as well as most significant plant species in these vegetation zones including their protection / endangering status are listed in **Section H, Appendix D3**.

The High-Mountain Zone of Skopje valley (Jakupica, Karazica and Salakova mountains) spreads above the upper mountain forest level (1700 m), occupying large areas with different types of biotopes, which are dominated by mountain and high mountains pastures (grassland) and rocks. One of the most important plant biocoenoses in this area is the relict hasmophit community.

The Forest Zone on Mountains is spread on an altitude from 800 m to 2400 m. It includes forests of dwarf pine, which are limited in subalpine and alpine zones of the Jakupica Mountain. Dominant within this zone (in the other parts of the valley) are spruce forests, beech forests, beech sub-forests, acidophilic beech forests as well as forests of beech and red maple. These forest zones are occupying large areas in the Mumdzica, Salakova, Saskovica, Alijagica, Karadzica, Kitka, Skopska Crna Gora-Ramno, Crn Kamen and Banjasnica mountains.

The Forest Zone on Hills is vertically spread from an altitude of 250 m to 800 m in Skopje valley. Dominant forest communities in this zone are cer forests, macedonian oak forests, and domestic chestnut forests. They form a ring in the low altitudes of the valley, starting in the east with Taor Canyon, Katlanovo, leading through Skopska Crna Gora, Zeden, Matka and Osoj mountains, and the base of Karaxica, Kitka and Lisec mountain. In the lowest levels of this zone bush communities are present with the following dominant representatives: phillyrea forests and white hornbeam forests, lilac and box-tree forests, and blagun-white hornbeam forests. Also, in this zone orchards and vineyards can be found, especially near the village settlements Zelenikovo, Oresani, Dracevo, Dolno i Gorno Lisice, Butel, Saraj.

The Forest Zone in Lowlands can be found in the lowest part of the Skopje valley up to 300 m altitude. This level, where the anthropogenic influence is the highest, consists of riverbank forest communities, mud and swamps, and humid lowland meadows. Riverbank communities consist predominantly of willows and poplars, that are growing along the rivers Vardar, Pcinja and Lepenec, and along down course of the Treska and Markova rivers. Mud and swamps occupy only small areas in the Skopje valley, predominantly in its southeast and east part (Katlanovo and Aracinovo mud, being almost dried out), and can be found in the area of little lakes near the village Smilkovci. In this zone, fragment mud associations are registered. Meadows as separate vegetation type in this zone are growing on small areas, near village settlements.

The Zone of Open Terrains is spread at the lowest levels of the Skopje valley up to 1300 m (1500 m) altitude. It consists of hill pastures, rocky places, cultivated areas, as well as village and town settlements. Hill pastures, as secondary vegetation formations in this zone, which occurred by gradual and long-term usage of forests, are spread continually on the inclined edges of the valley up to 1300 m altitude. These pastures are common in the basic area of the mountains Kitka, Vodno, Matka, Osoj, Zeden, Skopska Crna Gora, and in the surrounding of the villages Zelenikovo, Katlanovo, Kondovo, Volkovo, Cresevo, and Rastak. In this zone of open terrains, mainly in the canyon of river Treska, between Matka and Kozjak, and in some places in the canyon of the river Pcinja near Katlanovo, rocky (hasmophit) plant communities are growing. On large agricultural areas that are continually reduced by permanent urbanization, different cereals (wheat, barley, rye, oat, and corn), fruits and vegetables (potato, paprika, tomato, onion, garlic, leeks, melon and etc.) are cultivated.

This is also the zone where Skopje and the plant site are located. Grass, trees and bushes are growing on the unsealed parts of the site. The plant site does not show sensitive habitats for plants and animals. Forest areas, e.g. the forest "Vodno", can be fond south-west, south and south-east of Skopje, cultivated land is located north-east, north and north-west of the town. Due to increased transport communications in the study area, a lot of adventive plant species are in expansion. The most endangered plant communities and plant species can be found in the lowest levels of the study area, in the zone where the anthropogenic influence is strongest. Particularly mud and meadow communities (association *Phragmition communis* W.Koch 1926 and association *Trifolion resupinati* K. Micevski 1957) are almost or totally destroyed, or are in a fragment condition. The same refers to the forest community (chestnut, oak, beech and conifer forests), that are under permanent exploitation and have suffered from acid rains in recent years. More than a third of forest land in Macedonia is barren (degraded forests with bushes and shrubs) (www.soros.org.mk). Vegetation types that grow in the hill and mountain pastures are in permanent expansion.

Relict and endemic species building a significant component of the biodiversity in the Skopje valley, are also endangered in areas where anthropogenic activities are performed, like construction of hydro-accumulations, drying of mud and swamps (despite their status as protected areas), forests cutting, and different construction activities. The construction of the hydro-accumulation "Kozjak" will cause a significant reduction of vegetation areas, thus affecting the following relict and endemic species: *Thymus oehmianus, Viola kosaninii, Ramonda nathaliae, Veronica kindli, Centaurea grbavacensis, Dianthus kapinensis*. Drying of the mud areas and reducing meadow areas in the valley endangers the following species: *Merendera sobolifera, Salvinia natans, Nuphar lutea, Cyperus longus, Butomus umbellatus, Leucojum aestivum, Carex distans*.

3.3 Terrestrial Fauna

Macedonia is a country with a large number of diverse terrestrial eco-systems. 55 important species of fish, 78 species of mammals and 330 species of birds are recorded, among them many endemic and relict species of which some are very rare. The animal community is divided into four parts: animals living a) in the ravines and river valleys, b) in the oak forest region up to 1,100 m height, c) in the beech forest region and d) in the region of high mountain pastures (www.soros.org.mk).

The five vegetation zones defined in **Chapter 3.2** comprise habitats with a rich variety of animal species. Dominant and most significant animal species (amphibians, reptiles, birds, mammals and invertebrates) in these vegetation zones including their protection / endangering status are listed in **Section H, Appendix D3**.

Animals living in the High-Mountain Zone are for example the Yellow Fiery Frog (*Bombina variegata*), the Common Viper (*Vipera berus*), several rapture bird species (Imperial Eagle *Aquila heliaca,* Golden Eagle *Aquila chrysaetos*, Bonelli's Eagle *Hieraaetus fasciatus*, Bearded Vulpture *Gypaetus barbatus*) as well as lynx (*Lynx lynx*), wolf (*Canis lupus*) and chamois (*Rupicapra rupicapra*). The Forest Zone on Mountains offers habitats for the Yellow Fiery Frog and the Mediterranean Frog (*Rana graeca*), the Green Lizard (*Lacerta viridis*), a couple of rapture birds (Imperial Eagle*,* Golden Eagle, Black Vulpture *Aegypius monachus*), lynx, wolf and bear (*Ursus arctos*). The most important animal species of the Forest Zone on Hills are the Yellow Fiery Frog and the Forest Frog *(Rana dalmatina*), the Green Lizard and the Hop-Sneak *(Vipera ammodytes*), some rapture bird species (Imperial Eagle*,* Golden Eagle, Black Vulpture and White-Headed Vulture *Gyps fulvus*), wolf and bear. In the Forest Zone in Lowlands the Balkan Garlic Frog (*Pelobates syriacus balcanicus*) and Forest Frog, Mud Turtle (*Emys orbicularis*), Water Snake (*Natrix tesselata*) and Grass-Snake (*Coluber jugularis caspius*), a few rapture birds (White Sparrow-Hawk *Falco naumanni*, Golden Eagle) as well as Black Luna (*Milvus migrans*) and otter (*Lutra lutra*) can be found. The most important animal species in the Zone of open Terrains are the Green Scrubby Frog (*Bufo viridis*), the Common Turtle (*Testudo hermani*) and the Mediterranean Turtle (*Testudo graeca*), the Leopard Grass-Snake (*Elaphe situla*) and the Balcanic Gekon (*Gyrtodactylus kotschyi*), some rapture birds (Gray Falcon *Falco peregrinus***,** White-Headed Vulture*,* Eurasian Thick Knee *Burhinus oedicnemus,* Little Bustard *Otis tetrax)* and the otter (*Lutra lutra*).

No wildlife corridors are evident in the study area. A lot of endangered animal species found in the study area belong to biocoenoses depending on wet habitats. This fact can be traced back to the 1960's when a significant number of mud areas in the Skopje valley (e.g. Katlanovo and Aracinovo mud), that were inhabited by migratory birds, were dried up. Legal and illegal hunting in Skopje valley as well as poisoning of predatory animals are also significant factors endangering many proven animal species in the study area. For these reasons, the lynx has almost disappeared in the Skopje valley in the last few decades and the number of bears has decreased significantly. The situation is similar concerning rapture bird species. An example for this is the destruction of the colony of the White-Headed Vulture by poisoning the wolves in the Matka canyon. The absence of predatory birds has lead finally to a massive expansion of some types of rodents in the area. The fauna is further negatively concerned by changing the original land use, forest cutting, and the use of pesticides, herbicides and insecticides leading to a loss of suitable habitats.

3.4 Aquatic Fauna

No actual data on the aquatic fauna of the river Vardar were available within the scope of preparing this study. In general, the river Vardar represents a habitat for fishes and other aquatic organisms (e.g. macrozoobenthos organisms). But, due to its high water pollution, the river is not a good habitat for water organisms. According to information from the internet (www.soros.org.mk) some fish species are burdened with heavy metals due to the pollution situation of the river Vardar.

4 Description of the Socioeconomic Conditions

This Chapter includes a summarised description of the socio-economic situation in Macedonia and in the study area, respectively. Referring detailed Tables are presented in **Section H, Appendix 4**. More detailed data can be found in the **Environmetal Analysis of CHP Project (2000)**.

4.1 Overall situation

The first official census concerning the **population number** of Macedonia was carried out in 1921. The following Table D- 21 provides and overview of population trends (number of inhabitants) in the Republic of Macedonia, in the period between 1921 and 1994.

Year	1921	1931	1948	1961	1971	1981	1994
No. of inhabitants	808'724	949'958	1'152'986	1'406'003	1'647'308	1'909'136	1'945'932

Table D- 21: Population Number in Macedonia

It shows that the total population number in the Republic of Macedonia has been constantly increasing since 1948 and amounts to approximately 2 million inhabitants today. The present average population density is 75.7 inhabitants per km^2. More than half of the population (54.7 %) lives in the capital of Skopje, which has 504,932 inhabitants, and in the four municipalities Bitola, Gostivar, Kumanovo and Tetovo. 22.86 % of the Macedonian population is living in seven municipalities of Skopje. The total growth of the population in Skopje between 1961 and 1994 is shown in the following Table D- 22**.**

<table>
<tr><th>Population/year</th><th>1961</th><th>1971</th><th>1981</th><th>1994</th></tr>
<tr><td>Wide Skopje area</td><td>241,919</td><td>383,680</td><td>500,339</td><td>545,228</td></tr>
<tr><td>Town area (7 Mun.)</td><td>197,341</td><td>312,980</td><td>408,143</td><td>444,760</td></tr>
<tr><td rowspan="3">Indexes of growth (%)</td><td colspan="4">225</td></tr>
<tr><td></td><td colspan="3">70</td></tr>
<tr><td colspan="2"></td><td colspan="2">92</td></tr>
<tr><td>In period 1991/1953</td><td colspan="4">264</td></tr>
</table>

Table D- 22: Population Growth in Skopje (1961 – 1994)

The population growth depends not only on the birth and dead rate of the population, but also on migration processes.

The municipalities which are covered by DHS service comprise approximately 74.0 % of Skopje's population, 95,229 households (76.33 %), 103,541 dwellings (76.15 %), and 6,528 agricultural holdings (77.19 %).

Regarding age structure of the population, most of Skopje's inhabitants are of younger or middle age, and the percentage of old people is low.

The Republic of Macedonia is a multiethnic society with many different ethnic groups and minorities (e.g. Albanian, Turks, Romanians, Vlachs, Serbs) and referring "mother languages". The official language in the Republic of Macedonia is Macedonian language. There are also many different religions existing today in the country, e.g. Christians, Orthodox, Catholics, Protestants, Islamic. According to the "Macedonian Law for Education" visiting elementary school is obligatory. Major ethnic groups have elementary and secondary schools in their mother language.

Concerning Working People in Macedonia, the total population is subdivided into the so called "active" population, (40.6 %) and farmers (11.6 %). Nearly 62 % of Skopje's inhabitants are in a "working age", 30 % are too young and 8 % are too old for the job market.

4.2 Present Land Use

The total area of Macedonia comprises 26,000 km^2, of which about 25 % are pastures, 25 % are used as arable land, meadows, vineyards and fruit plantations, 8 % is barren land, 37 % belongs to forest land, 2 % are occupied by lakes, and 2.5 % belong to urban and industrial land (www.soros.org.mk).The pastures are spread out and comprise about 634,000 hectares. However, the yields (in average about 270 kg/ha) are much lower than the yields that can normally be expected (800 kg/ha). The poor arable land and pasture management and the degrading of forests has caused erosion to a large part of the land. About 38 % of the land is considered significantly eroded. The average loss of land per annum is about 17 million m^3 of which about 7.5 million m^3 of deposited material is carried outside Macedonia through the rivers. Hence, the economic loss due to erosion is enormous. Erosion takes away the most fertile land, thus the average annual loss of land is about 308,000 m^3.

The plant site is part of an existing industrial zone of Skopje. Its direct vicinity is characterised by urban areas and further industrial zones. Outside the town the land is mainly used for agriculture, with agricultural areas being reduced continually by permanent urbanization. Forests areas are also declining permanently in the vicinity of Skopje, due to usage by the population. People also use the river Vardar for fishing.

4.3 Health

According to the National Institute for Health Protection cancer, circulatory system diseases and respiratory diseases were the most frequent causes of peoples' death in the years 1991 to 1997. In 1997, 4.75 % of all death cases in Macedonia could be attributed to respiratory diseases (national average). There are 11 municipalities who have Respiratory System Attributed (RSA) cases of death among the total deaths being higher than 10 %. The City of Skopje shows an average of these cases of death of 4.81 %, which is lower than the maximum values in these municipalities, but still above the national average. Conditions seem to be worst in the municipalities of Cair, Kisela

Voda and Centar, with values being significantly higher than either Skopje or Country averages.

Even more pronounced is the weight of respiratory disorders in the statistic morbidity. A check of the number admitted by hospitals for pulmonary diseases and tuberculosis in the period from 1995 to 1997 suggests a rising trend. The morbidity of children due to respiratory diseases is at the top of the morbidity structure. Specific morbidity rates are highest in densely populated urban zones in the winter periods. They are especially extant in the age groups between 0 and 14. A report of the National Institute for Health Protection from 1998 has pointed out markedly higher incidence of non-specific respiratory morbidity in the pre-school (0-7 years) than in the school (7-18 years) age population. Also, the correlation between average monthly concentrations of black smoke and SO_2 and chronic respiratory diseases was found most robust in infant morbidity. Looking across the year, the morbidity rate is high for the first and fourth quarter of the year, in the winter period.

It is assumed that present air pollution parameters like SO_2, NOx and SPM contribute to the development of the reported respiratory diseases.

4.4 Infrastructure

Skopje has well developed connections via road, railway and air. The international highway Belgrade-Athens and other important road connections to the city of Tetovo and Prishtina (Kosovo) are located in the direct vicinity of Skopje. The main railway station of Skopje is connected to the railway grid of the Balkan Peninsula. Two smaller railway stations (Lisice and Butel) are usually used for heavy transport and maintenance. Petrovec is Skopje's international civil and military airport located approximately 15 km east of Skopje. Another little airport, mainly used for sport activities is Stenkovec, located about 7-8 km northwest of Skopje.

The main transport of people in Skopje is done by car. There are about 6000 taxis available in the town.

4.5 Economic Situation

According to information from the internet (www.soros.org.mk), the Gross Domestic Product for 1994 was as follows:

- Industry and mining 35.0 %
- Agriculture, fishery, forestry and water management 21.9 %
- Trade 20.3 %
- Tourism 3.0 %
- Construction 6.4 %
- Transport and Communication 5.0 %
- Guilds 2.5 %

- Other 5.9 %

The economic situation of Skopje can be described on the basis of available statistics from 1995. According to these statistics it is obvious that Skopje and especially two of its municipalities (Centar and Gazi Baba) are preponderant in the national economy regarding total social product, national income, investment and fixed assets. Centar municipality alone had as much investment in 1995 as the rest of the country apart from Skopje. It is also relevant to note that there is 3.72 times more social product produced in Centar per inhabitant than regarding the national average. The same general trend can be seen regarding industry, which is centralized in Skopje. If mining were not included in the statistics, the weight of Skopje and its two most influence municipalities (Gazi Baba and Centar), would be even more pronounced.

5 Current and proposed development activities within the project area

Currently no major activities are planned in the project area.

However, due to the project a future development is targeted, since as a follow-up of the refurbished gas-pipeline infrastructure together with the increased gas-volume imported into the Republic of Macedonia an improvement of the gas supply in general is expected. The reliability and availability shall be improved as a consequence.

Therefore an increased number of manufacturing and probably households might be connected to the gas supply, which will increase the development of the project area in a second step.