

RESULTS FACTSHEET

ENV02: AIR POLLUTION

DEFINITION OBJECTIVE

The indicator records the impact of the Egnatia motorway, as a linear pollutant emission source, on the atmospheric burden of the areas crossed by it, particularly, as regards the emissions of CO (carbon monoxide), NO₂ (nitrogen dioxide), SO₂ (sulfur dioxide), O₃ (ozone), BTX, PM₁₀ (airborne particulate matter), Pb (lead).

Additionally, the indicator examines the degree in which the road axis contributes to global/regional scale environmental issues, e.g. to the average increase of the Earth's temperature, the ozone layer depletion and the acidification of precipitations.

RESULTS - ASSESSMENT

In order to determine the impact of the Egnatia Motorway operation, measurements of air pollutants have been carried out, paying particular attention to the road sections presenting intense traffic flow, as well as to those running along environmentally sensitive areas.

The sample measurements of atmospheric pollution were carried out by the Environment Department of the Maintenance Directorate of the Operation & Maintenance Division, and regarded the air pollutants listed below:

<i>s/n</i>	<i>Air pollutants</i>
1	Carbon monoxide (CO)
2	Nitrogen dioxide (NO ₂)
3	Sulfur dioxide (SO ₂)
4	Ozone (O ₃)
5	Benzene & BTX
6	Airborne particles PM ₁₀
7	Lead (Pb)

Processing, analysis and presentation of the above results have been carried out by Mrs. Thalia Valkouma, Head of the Environment Department of the Maintenance Directorate of the Operation & Maintenance Division, EGNATIA ODOS AE.

Although the measurements of Ozone, Sulfur Dioxide and Lead could have been omitted, as Ozone is a secondary pollutant and its presence is not due only to the operation of a motorway such as Egnatia Motorway, while Sulfur Dioxide and Lead are not considered to be important pollutants any more, because of the improvement in the quality of fuels, it was considered necessary to include those pollutants as well.

Ozone, Nitrogen Dioxide, Sulfur Dioxide, Benzene, Ethyl benzene, Toluene and Xylene were measured by means of passive samplers, PM₁₀'s and Lead by means of filter samplers, while Carbon Monoxide was measured by using an automatic electrochemical instrument.

The table presented below shows the measurements carried out, the types of pollutants monitored and the respective road sections.

<i>EGNATIA MOTORWAY SECTIONS</i>	<i>TYPES OF POLLUTANTS</i>	
	<i>NO₂, SO₂, O₃, BTX</i>	<i>PM₁₀ & Pb & CO</i>
<i>Epirus, Prefecture of Thesprotia</i>	<i>3 locations</i>	<i>2 locations</i>
<i>Western Macedonia, Prefectures of Grevena & Kozani</i>	<i>4 locations</i>	<i>2 locations</i>
<i>Western and Central Macedonia, Sections: Polymylos-Galani and Veroia-Kouloura, Prefectures of Kozani and Imathia</i>	<i>4 locations</i>	<i>2 locations</i>
<i>Central Macedonia, Thessaloniki area from IC 1 to IC 4, Prefecture of Thessaloniki</i>	<i>6 locations</i>	<i>3 locations</i>
<i>Central and Eastern Macedonia, Prefectures of Thessaloniki and Serres</i>	<i>3 locations</i>	<i>1 locations</i>
<i>Eastern Macedonia, Prefecture of Kavala</i>	<i>3 locations</i>	<i>2 locations</i>

The measurements carried out are representative of the existing situation, while in the cases of passive samplers they regard typical week average values. Therefore, the following conclusions are considered well-grounded:

- Airborne Particulate Matter (PM₁₀): The PM₁₀ measurements were carried out for a period of 24 hours at each geographical location. Efforts were made for the sampling to be as representative as possible (sampling location, wind direction). The results show that at the locations GIROKOMEIO, MAGNISIA, TAXIARCHIS air pollutant values exceed the daily limit value of 50mg/m³. In accordance with legislation, this limit value is the mean daily value, which should not be exceeded more than 35 times yearly. Even in the cases where

excess daily values are observed, it is important to calculate the total of days per year these values have been recorded.

At TAXIARCHIS, high HGV traffic volumes were observed on the sampling day due the execution of construction works in the area, a fact that significantly affected the results of the measurements. In addition, in Kozani region, the measurements were affected by the transportation of dust from other regions due to the adverse weather phenomena during the measurement period (northern wind coming from the Public Power Corporation plants in Ptolemaida - Kozani). Consequently, these measurements have been affected by factors not related to the actual operation of the Egnatia Motorway.

In the area of Thessaloniki Outer Ring Road the increased values are mainly due to the great development of the urban agglomeration and the presence of a large number of industries and craft enterprises (e.g. TITAN). These units are typical “producers” of airborne particulate matter and, therefore, the increased results represent the general pollution problem in the area and not the impacts of the Egnatia Motorway operation. Finally, based on the results of the annual air pollution measurements performed in the Region of Central Macedonia, it seems that there is no difference between the air pollutant percentages recorded before and after the Egnatia Motorway operation.

- Lead (Pb): At all positions, the results of the daily measurements of Lead (Pb) have been lower than the annual limit of 0.5 mg/m^3 . All values, except those recorded in TAXIARCHIS, are below the detection limit of the analytical instrument used in the laboratory ($0.1 \text{ } \mu\text{g/m}^3$). Even in TAXIARCHIS, the value recorded was low ($0.13 \text{ } \mu\text{g/m}^3$), close to the detection limit and clearly lower than the limit value.
- Carbon Monoxide (CO): At all positions, the results of the Carbon Monoxide (CO) measurements have been below the 10 mg/m^3 limit on an 8-hour basis (while even on a 15-minute basis the CO values have never exceed 3.5 mg/m^3).
- Nitrogen Dioxide (NO₂): At all positions, Nitrogen Dioxide (NO₂) typical measurements have been below the annual limit of 40 mg/m^3 . The highest values closer to the limit ones were recorded to the locations EFKARPIA-DIAVATA (27.7 to $33.4 \text{ } \mu\text{g/m}^3$).
- Sulfur Dioxide (SO₂): At all positions, the Sulfur Dioxide (SO₂) typical measurements have been below the daily limit 125 mg/m^3 . All values have been below the detection limit of the method used (28.5 mg/m^3) and much lower than the daily limit.
- Benzene: At all positions, the Benzene typical measurements have been below the annual limit of $5 \text{ } \mu\text{g/m}^3$. All values have been below the detection limit of the method used (1 mg/m^3), except for the location GIROKOMEIO,

where the value recorded was still lower, i.e. $1.4 \mu\text{g}/\text{m}^3$. Additionally, the parameters of xylene, toluene and ethyl benzene have also been recorded. There are no statutory limits for these parameters. Their measurement has been carried out only in order to have a clearer image of the situation, as these elements are typically classified among harmful parameters.

- Ozone (O_3): At all positions, the Ozone (O_3) typical measurements have been below the limit of $120 \text{ mg}/\text{m}^3$ on an 8-hour basis. The highest value was recorded at the location ASPROVALTA ($78.9 \mu\text{g}/\text{m}^3$). During the measurement, there was sunshine.

Within the context of these investigations, the results of the measurements performed have been processed in detail and the conclusions drawn indicate that in the stage of the Egnatia Motorway operation and given the existing traffic volumes, the permanent air pollution measurement stations that need to be installed are limited and can be restricted to the geographical positions with the highest values recorded.

There follow tables presenting the totality of the areas where measurements were performed.

TABLE 1. RESULTS OF AIR POLLUTANTS MEASUREMENTS: NO₂, SO₂, O₃, BTX

S/N	Area	Egnatia Motorway section	Average concentration µg/m ³						
			NO ₂	SO ₂	O ₃	Benzene	Toluene	Ethyl benzene	Xylene
1.	Igoumenitsa	IC 00 - IC 01	12.4	28.5	49.6	<1	<2	<3.5	<1
2.	Gkrika	IC 01A - IC 02	10	28.5	51.7	<1	<2	<3.5	<1
3.	Koumaria	IC 02 - IC 03	4.7	28.5	43.8	<1	<2	<3.5	<1
4.	Taxiarchis	IC 09 - IC 09A	5.3	28.5	47.9	<1	<2	<3.5	<1
5.	Kalamia	IC 10 - IC 11	10.5	28.5	71.2	<1	<2	<3.5	<1
6.	Koila - Kardia	IC 11 - IC 12	16.7	28.5	55.1	<1	<2	<3.5	<1
7.	Drepano	IC 12 - IC 13	10.7	28.5	61.8	<1	<2	<3.5	<1
8.	Koilada	IC 12 - IC 13	5.1	28.5	49.5	<1	<2	<3.5	<1
9.	Polymylos	IC 13 - IC 14	17.9	28.5	67.7	<1	<2	<3.5	<1
10.	Mesi	IC 14 - IC 15	7.5	28.5	2.1	<1	40	5	<1
11.	Kouloura	IC 15 - IC 16	14.3	28.5	45.8	<1	3.8	<3.5	<1
12.	Magnisia	IC 21 - IC 22	24.4	28.5	44.9	<1	9	<3.5	<1
13.	IC 2 - IC 4 (I)	IC 22 - IC 23	33.4	28.5	40.1	<1	9.7	<3.5	1
14.	IC 2 - IC 4 (II)	IC 22 - IC 23	27.7	28.5	34.5	<1	9.5	<3.5	<1
15.	IC 2 - IC 4 (III)	IC 22 - IC 23	29.7	28.5	45.7	<1	11	<3.5	1,4
16.	Girokomeio	IC 23 - IC 23A	21.3	28.5	41.3	1,4	6.4	<3.5	1
17.	Efkarpia	IC K4 - IC K5	24.4	28.5	60.2	<1	6.8	<3.5	<1
18.	Vrasna	IC 26 - IC 27	9	28.5	68.2	<1	2.7	<3.5	<1
19.	Asprovalta	IC 27 - IC 28	9.4	28.5	78.9	<1	0.8	<3.5	<1
20.	Kerdylia	IC 27 - IC 28	7.8	28.5	76.5	<1	1.8	<3.5	<1
21.	Kavala (I)	IC 29 - IC 30	7	28.5	30.6	<1	<2	<3.5	<1
22.	Kavala (II)	IC 29 - IC 30	8.1	28.5	34.5	<1	<2	<3.5	<1
23.	Kavala (III)	IC 30 - IC 31	7.7	28.5	13.2	<1	4.2	<3.5	<1
24.	Kavala (IV)	IC 31 - IC 32	8.3	28.5	17.3	<1	<3	<3.5	<1

TABLE 2. RESULTS OF AIR POLLUTANTS MEASUREMENTS: CO, PM10, Pb

S/N	Areas	Egnatia Motorway section	Average concentration $\mu\text{g}/\text{m}^3$		
			CO	PM ₁₀	Pb
1.	Igoumenitsa	IC 00 - IC 01	<3	24.78	<0.1
2.	Gkrika	IC 01A - IC 02	<1	7.59	<0.1
3.	Taxiarchis	IC 09 - IC 09A	<2,5	58.12	<0.1
4.	Mesi	IC 14 - IC 15	<1,5	22.53	<0.1
5.	Kouloura	IC 15 - IC 16	<3,5	50	<0.1
6.	Magnisia	IC 21 - IC 22	<2	60	<0.1
7.	Girokomeio	IC 23 - IC 23A	<2	110	<0.1
8.	Efkarpia	IC K4 - IC K5	<2,5	50	<0.1
9.	Asprovalta	IC 27 - IC 28	<2	40	<0.1
10.	Kavala (I)	IC 29 - IC 30	<1	28.5	<0.1
11.	Kavala (II)	IC 29 - IC 30	<1	28.5	<0.1

METADATA

Sources

The air pollutants' concentration measurements and the processing of the relevant data have been carried out by the Environment Department of the Maintenance Directorate of the Operation & Maintenance Division of EOAE.

Statutory framework

The statutory limits that are or will be in force in all EU countries and the objectives of the World Health Organization (WHO) follow below.

National Limits in force

Pollutant	Limit value for the protection of human health
Nitrogen Dioxide (NO ₂)	200 µg/m³ 98 th percentile calculated on the basis of average values per hour or shorter time periods, which are recorded throughout the year
	The annual reference period starts on 1 st January of a calendar year and ends on 31 st December of the same year.

Limits set by the European Union in force as of 01/01/2005

Pollutant	Limit value for the protection of human health
Carbon monoxide (CO) 2000/69/EC of 16/11/2000	10 mg/m³ As the maximum daily 8-hour mean value
Airborne particulate matter (PM10) 1999/30/EC of 22/4/1999	50 µg/m³ As the daily mean value, not to be exceeded more than 35 times in any calendar year
	40 µg/m³ As the mean annual value
Lead (Pb) 1999/30/EC of 22/4/1999	0.5 µg/m³ As the mean annual value
Sulfur dioxide (SO ₂) 1999/30/EC of 22/4/1999	125 µg/m³ As the daily mean value, not to be exceeded more than 3 times in any calendar year

Air quality guidelines by the World Health Organisation (WHO):

Pollutant	Value guideline	Time base
Nitrogen dioxide (NO ₂)	200 µg/m ³	1-hour mean
	40-50 µg/m ³	Annual mean
Carbon monoxide (CO)	100 mg/m ³	15 min
	60 mg/m ³	30 min
	30 mg/m ³	1-hour mean
	10 mg/m ³	8-hour mean

European Union Limit Values to be in force as of 2010

Pollutant	Limit value for the protection of human health
Nitrogen dioxide (NO ₂) 1999/30/EC of 22/4/1999	200 µg/m³ As the mean hourly limit value, not to be exceeded more than 18 times a calendar year
	40 µg/m³ As the mean annual value
Benzene 2000/69/EC of 16/11/2000	5 µg/m³ As the mean annual value
Ozone (O ₃) 2002/3/EC of 12/2/2002	120 µg/m³ As the maximum daily 8-hour mean, not to be exceeded more than 25 days per calendar year

Methodology

Measurements of air pollutants have been carried out in selected areas of the Egnatia Motorway, on the basis of the requirements set out in the relevant Joint Ministerial Decisions approving the Environmental Terms.

For the execution of the sampling measurements, passive samplers have been used (for the parameters of Ozone, Nitrogen Dioxide, Sulfur Dioxide, Benzene, Ethyl Benzene, Toluene, Xylene). The passive samplers, which contain a special material capable of absorbing specific substances, have been placed for a time period of about one week at each position, thus giving average values which constitute a very reliable indicator for the total atmospheric burden of an area. The samplers have been placed high on road lighting poles, in order to be protected from vandalistic



actions, and in small cabinets, in order to be protected from rain. The collected samples have been sent to an accredited chemical laboratory for analysis and calculation of the relevant concentrations.

For the measurement of PM₁₀, filter samplers have been used. For the measurement of Lead, the same samplers used for PM₁₀'s have been used. The Carbon Monoxide measurements have been carried out using an automatic electrochemical instrument.

The PM₁₀ sampler and the Carbon Monoxide analyzer have been placed in a moving station and have been taking samples for a period of 24 hours at each position. The filter has been weighed before and after the collection of the sample. The concentration has been calculated on the basis of the difference in mass and volume of the air collected. This filter has been sent to an accredited chemical laboratory where an analysis for the detection of lead has been carried out.

