

## **SOME TYPES OF PRESENT URBAN POLLUTION IN THE AREA OF PIATRA NEAMT TOWN**

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**Key words:** emissions of gases, suspended particulates, phonic pollution.

**Abstract.** During the last decades while the market rules have led to an ample process of diminishing and reorganizing the industrial production and territorial relocation of industry, the pollution phenomenon with industrial origin has been decreasing constantly, but other types of pollution have been affecting urban areas. The development of road traffic affects this period the urban area of Piatra Neamt more than ever, with multiple types: emissions of gases, suspended particulates, phonic pollution, etc. The remains of some industrial structures inside the residential districts or some present effects of past industrial activities in some small areas as leakages of substances which can pollute spots of soil and water reunify the pollution image of Piatra Neamt town nowadays. Taking out the heavy traffic by replacing it on detouring belt roads out of the town, decongesting the main roads and central intersections, a more responsible management of the small areas with local risks of pollution and a controlled shifting of the last factories from inner spaces to external locations are only some requirements for a sustainable development of the town.

### **1. The emissions of greenhouse gases (GHG) on the local plan**

According to Annual Reports of Neamt Agency for Environment Protection, the atmospheric pollutants are classified in suspensions or aerosols, gases and toxic vapors. Regarding the theme of this research, we are interested in this first stage in analyzing only the greenhouse gases in Piatra Neamt area. The analysis of greenhouse gases emissions in Piatra Neamt area is based on the inventory of emissions recorded at NT1, an urban background station which is located near Piatra Neamt Meteo Station and has automatic sensors which monitor online the air quality, counting hourly and daily averages. These series of data are delivered to the server of Neamt Environment Protection Agency and then to the public panel in the centre of the town and to Air Quality Evaluation Centre belonging to National Environment Protection Agency at Bucharest.

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The inventory of long-lived GHGs emissions at local level of Piatra Neamt town reveals negligible quantities of halocarbon gases (HFCs, PFCs and SF<sub>6</sub>), but relatively considerable quantities of carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O). Because nowadays in Piatra Neamt there are very few industrial factories with GHGs emission potential in technological process due to the phenomenon of deindustrialization during the last decades and because the local production of electric power is based only on hydroenergy, the main fields which generate GHGs are the production and consumption of thermal energy in industry, the production and consumption of thermal energy for population houses and urban transportation. For technical reasons, we changed the emissions of methane and nitrous oxide in carbon dioxide-equivalent (CO<sub>2</sub>-eq) according to specific global warming coefficients for every gas established by the working group of Intergovernmental Panel of Climate Change (*IPCC's Third Assessment Report, 2001*), as in formula:

$$(1) 1 \times \text{CO}_2 = 21 \times \text{CH}_4 = 310 \times \text{N}_2\text{O}$$

$$(2) 1 \text{ t CO}_2 = 21 \text{ t CH}_4 = 310 \text{ t N}_2\text{O}$$

During 2008, when economic activities were not confronting with the rebound generated by economic crisis, the whole quantity of CO<sub>2</sub>-eq emissions resulting from the economic sphere (technological processes and production and consumption of thermal energy) summed up about 103,897.6 t/year (42%), adding the quantity of CO<sub>2</sub>-eq emissions resulted from production and consumption of thermal energy in population houses based on minicentrals (district centrals and private centrals) and estimated at 67,880.4 t/year (28%), adding also the quantity of CO<sub>2</sub>-eq emissions resulted in urban transport activities counted about 75,000.2 t/year (30%).

It is easy to notice that the largest quantity of CO<sub>2</sub>-eq is produced by economic activities, while the smallest one by the thermal system for population houses. Among all industrial unities, the largest quantity of CO<sub>2</sub>-eq is produced by PETROCART A.S. (factory of cellulose and paper) which generates yearly about 5,000 tons of CO<sub>2</sub>-eq. In fact it is the only one industrial unity in Piatra Neamt that has an agreement for CO<sub>2</sub> emissions, according to Kyoto Protocol, the main emission sources being the thermal central of the factory and drying processes. The whole quantity of CO<sub>2</sub>-eq emitted during 2008 in Piatra Neamt was estimated at 246,778.2 tons which meant 2.3 t/per capita/year, being situated under the national average in 2007 of about 4.4 t/per capita/year (*IEA Statistics, 2010*).

Processing series of metadata from Neamt Agency for Environment Protection collected during 2011, it can be noticed that the whole quantity of CO<sub>2</sub>-eq

emissions was 178,916 t/year (with about 28% less than in 2008). The main reduction was registered in economy, summing 32,154 t/year (18% of the whole quantity), that meant only the consumption of thermal energy, because production processes are negligible. The other two fields, production and consumption of thermal energy in population houses and urban transport activities registered small increases in the rough quantities but large increases in percentage, getting to 70,562 t/year for the first indicator (40%) and 76,200 t/year for the second one (42%).

A small part of the CO<sub>2</sub> quantity is taken off through absorption by vegetation, in this case local forests, because the other types of vegetation and agricultural lands are negligible as area and absorption capacity. So, according to absorption average capacity of CO<sub>2</sub> by forests in boreal hemisphere (age 50-70 years) estimated about 0.95 t/ha/year (Global Change Biology, 1998), there is a result of 3,351.6 t/year of CO<sub>2</sub> (for those 3528 ha) which are taken off from the initial quantity. Thus the final balance for 2008 was of 243,426.6 t/an CO<sub>2</sub> –eq and 175,564.4 t/year CO<sub>2</sub> –eq for 2011.

## 2. The pollution of industrial origin with other substances than GHG

Even though the economic productive field, mainly industrial activities, has been restructured, there are still some small bastions for emitting gases and suspended particulates in the air, organic and chemical substances in the air, water and soil.

From the quantitative perspective, the emissions of PM10 (suspended particulates, including also PM2.5) with industrial origin and from building activities were at about 5.297 Mg/year in 2009 and the quantity was diminished with about 25% in 2011, the largest quantities were emitted in wood industry (SEF PETROFOREST, 3/4 in the total quantity) (APM NT, 2009, 2011). The effects of those suspended particulates upon human health are multiple. By inhaling these particles they get to the deepest places of the breathing system, being able to cause serious deteriorations of the pulmonary tissue and to make worse the chronic respiratory diseases. In those areas with a faint air circulation or during foggy periods, the effects of those emissions are multiplied.

Acidifying substances like sulphur dioxide (SO<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>) and nitrogen oxides (NO<sub>x</sub>) amounted and expressed in SO<sub>2</sub> equivalent (SO<sub>2e</sub>) according to the formula (by AFM):

$$1 \times \text{SO}_2 = 0.7 \times \text{NO}_2 = 0.85 \times \text{NO}_x \rightarrow 1 \text{t SO}_2 = 0.7 \text{t NO}_2 = 0.85 \text{t NO}_x$$

registered an average quantity of 40.84 ug/m<sup>3</sup>/year in 2008 and 33.65 ug/m<sup>3</sup>/year in 2009, 25.20 ug/m<sup>3</sup>/year in 2011. MAQ (CMA) stipulated in Official Normative No. 592 since 25th June 2002 a limit of 20 ug/m<sup>3</sup>/year for SO<sub>2</sub> or 30 ug/m<sup>3</sup>/year for NO<sub>2</sub> and NO<sub>x</sub> as the accepted threshold for maintaining air quality

and avoiding the acidifying of the environment. The acidifying phenomenon of the environment starts when the pH of the atmospheric environment gets under 7 (pH = 6 → means a ten times more acid environment than pH = 7, pH = 5,6 is the limit for acid rains, according to APM NT).

### 3. Local transportation and urban pollution

*3.1. The local system of transport as premise of pollution.* Urban transport is an economic activity with a great impact upon other economic fields but also upon the social and natural environment. Its developing level puts the print upon the attendance manner of the production activities and also of urban population, meanwhile its efficiency derives from the density of urban transport network, the modernization degree of transport infrastructure and of the rolling stock, the intensity of daily urban traffic, the degree of population satisfaction and the level of urban pollution due to the urban transport, etc.

In the local area of Piatra Neamt, road transportation holds the absolute monopoly in the urban traffic of passengers and goods. There aren't other alternatives but for external transport relations, where road transportation is competing with railway transport on the axis Bacau-Bicaz. The total length of urban transport network is 151 km, which in relation with the administrative area (77.47 km<sup>2</sup>) gives an average density of 1.94 km/km<sup>2</sup>. The length of modernized roads is 123 km, which represents 81.45 % in the total length of roads (Indicator 2). Correlating the two indicators we can notice that Piatra Neamt has a relatively well developed network of road transport, most of it being modernized.

Table 1 The structure of the rolling stock and its importance for local transport of passengers in 2010

Types of transport means	Number of motor vehicles	Number of daily passengers	Percentage in daily transport of passengers
Cars	25,489	31,000	50 %
Active minibuses	37	13,000	21 %
Active buses and trolleybuses	47	18,000	29 %
Utilitarian vehicles	2,525	-	-
Total means of transport	28,098	62,000	58 % (in total population)

Sources: Townhall, URBTRANS, Direcția Taxe și Impozite

Taking into account the structure of rolling stock and the number of daily passengers we can find out some interesting data concerning the contribution of local transport to the urban pollution.

### 3.2. *The contribution of local passenger transportation to urban pollution.*

Correlating the detailed analyses of local urban passenger transportation with the rolling stock for 2010, we notice that the ratio between public passenger transportation and private cars transport is 1/1. It means that inside the about 62,000 persons that participate to daily urban passenger transportation (58 % of total population) half of them use public means of transport and the other half use private (own holder) means.

The rolling stock of Piatra Neamt town for 2010 is huge (Table 1), the local number of cars related to the number of inhabitants implies that there is a car for about 4.19 inhabitants. The ratio of passenger transportation is 91% from all kinds of transport.

Besides those 62,000 passengers with the residence in Piatra Neamt who travel every day into the urban space there are also other about 6,500 persons who reside in the neighboring localities and convey in transit the urban space using both public means of transport and private cars. Summing all, there are about 70,000 persons who travel into the urban space and about 30,000 motor vehicles which use the urban net roads (*URBTRANS*). Joining the quantitative and qualitative points, there is a good level of development of local transport for passengers and there is a good service for population.

3.3. *The contribution of local utilitarian transport to urban pollution.* The utilitarian means of transport holds a percentage of 9% in the composition of the local rolling stock, in which 6% represent light utilitarian vehicles (under 3.5 t) and 3% heavy utilitarian vehicles (over 3.5 t). Regarding the tonnage of transport, the utilitarian rolling stock holds about 32% in the total local tonnage of transport, having implicitly an increased contribution to the emissions of gases and suspended particulates. Besides the own rolling stock of utilitarian means of transport the town is transited monthly by a number of utilitarian vehicles as big as the first. Taking into account the presented data, we can consider that there is a good level of development for the utilitarian transport and also for servicing the town but in the same time being an important element of polluting mainly on the belt roads.

3.4. *The level of urban pollution due to road transportation.* As industry has a modest level of development in the town, urban transport represents the main source of urban pollution with its specific types: emissions of gases, suspended particulates, noise etc. The analysis of the types of pollution caused by transport can be useful for a knowledge data base upon the phenomenon and then for identifying concrete solutions in order to decrease the specific effects.

Only a small percentage in the urban transport is ecological, taking into account the trolleybuses which represent about 28.5% in the rolling stock for public transport of passengers. Perhaps that is a model which can be modernized and extended for a sustainable perspective.

The percentage of CO<sub>2e</sub> emissions proceeded from transport in the total emissions of CO<sub>2e</sub> has been oscillating in the last years, from 30.6% in 2008 to 42% in 2011, in the conditions in which industrial production has been diminishing a lot and the rolling stock has increased, even though there were a renewal process for the rolling stock. Most of old motor vehicles were replaced by new others which respect the European ecological rules concerning emissions.

Taking into account the emissions of CO<sub>2e</sub> resulted from local transportation in relation with the tonnage and the framing into the emissions standards, the transport for passengers has a detached percentage with 55.4 % in 2008 and 67.6% in 2009 (APM NT) and 65% in 2011. That increase is due to the growing in the number of new registered cars in the last years.

The medium concentration of PM<sub>10</sub> emissions (suspended particulates) resulted from transport exceed the MAQ (CMA) for 24 hours according to Official Normative No. 592 since 25th June 2002 (50 µg/m<sup>3</sup>), so that it was registered in the monitoring area (mobile station at the location „*Statia de Salvare*”, on the belt road Dimitrie Leonoda) to 68.42 µg/m<sup>3</sup> in 2008, 64.39 µg/m<sup>3</sup> in 2009 and 58 µg/m<sup>3</sup> in 2011 (annual average for 24 hours, indicator 16 Annex). The frequency of the exceeding of the PM<sub>10</sub> emissions during 24 hours resulted from transport (MAQ/CMA in 24 hours) registered 65.6% in 2008, 60.78% in 2009 and 55.35% in 2011 for the same monitored area, proving a high level of pollution on the belt roads where heavy traffic is frequent (APM NT).

The level of phonic pollution is monitored periodically by some mobile stations belonging to APM NT and placed on the main roads, in those intersections with the most intense traffic and in areas with low admitted limit for noise (schools, parks, hospitals, public institutions etc.). In Piatra Neamt there are 17 locations for observing and monitoring the noise level as: 8 intersections, Central Park (interior and limit), Central Market (interior and limit), 2 schools (interior and limit), Town Stadium, where there are registered the average values for the equivalent noise level, L<sub>Aeq</sub> (dBA). The average for the town is about 70 dB (A), but according to every location and its specific received limit for noise, there are many exceedings of this limit as: Petrodava intersection, Central Hospital intersection, Pietricica intersection, Regiment intersection, where the admissible limit is 70 dB (A) but the registered values are a little more; in Central Park area the admitted limit is 45 dB (A) (at external limit) but the registered values exceed 60 dB (A). Not very often but periodically, the admitted limit is exceeded in the close area of the Town Stadium. In other areas the registered values are at the

admitted limit: Unic intersection, Orion intersection, Central Hospital (interior), etc. The frequency of exceeding regarding phonic pollution over the whole town is 68 % (APM 2009, 2011), proving a high level of phonic pollution. If we take into account the recent European standard regarding the maximum limit of noise at 50 dB (A), we can notice a general exceeding of this limit in the whole town.

The population perception level regarding phonic pollution expressed during a poll made in 2010 (April – May period) shows that 65.68 % of respondents with the residence in Piatra Neamt (67 among 102) estimate a high and a very high level and only 30.39 % of respondents (31 among 102) estimate a low or very low level.

The urban pollution degree owed to the transport is high almost in the whole town and its specific effects generate a moderate negative impact upon the local environment and upon the population life.

**4. Local pollution of soil and water**

The general level of pollution for water is low (SGA NT), but locally in particular conditions, underground water can register a high level of pollution as in the area of the old waste deposit (Vânători district) which is in conserving after the new ecological one was built, where some infiltrations generate exceedings of 4.5 times more than MAQ/CMA (meaning 6 times more for ammonium ions and 3 times more for organic substances) (according to APM NT, 2007), even though the reports for the last years didn't give any details. Also, the potential leakages of used waters with phenols in the area of SIL Foresta (from wood steaming) and ether of oil in the area of Petrom Gas Station No. 12 show local risks of soil and water pollution.

**Table 2 Some potential contaminated sites**

Cod of Site	Name of site / Type of property upon the land	Type of pollutant	Potential contaminated surface / Observations
RO1 APMNT00001 APM Neamt	Petrom Gas Station No.12 public + private	ether of oil, CCO-Cr, pH	No details about the surface
RO1 APMNT00025 APM Neamt	The old waste deposit (Vanatori district) / public	No details specified	There are some hydro-observer drillings for phreatic quality și F <sub>13</sub> )
RO1 APMNT00015 APM Neamt	SC Piatra Neamt Developn SRL (Reconstructia) / priv	Sulphurets, Cu, Zn, Pb,	0,314 ha
RO1 APMNT00017 APM Neamt	SIL Foresta Piatra Neamt / private	Potential leakages of us waters with phenols	No details about the surface

Source: APM NT – Raportul 2011

Summing all the values regarding local radioactivity (gross Beta) monitored on the Platform of Piatra Neamt Meteo Station and expressed in annual average,

concerning the specific environment elements (soil and vegetation), the analysis made by SSRM Piatra Neamț and presented into the annual reports of APM NT points out the value of radioactivity index as 455.7 Bq/kg, in a decreasing process comparing with the last years for the local area, taking into account also the values reordered at Toaca Meteo Station (Ceahlau Mountain).

### **Conclusions**

In what regards urban pollution as a complex and changeable process with variable indexes and parameters according to European standards for a post-industrial and a sustainable society, regarding the present characteristics of this process in Piatra Neamț town, it can be concluded that:

- The pollution of industrial origin registers a reduced level having only two centres in the west and south parts of the town;
- GHG's emissions have reasonable limits;
- There is a medium risk of the environment acidification;
- Pollution due to the transport activities has a high level in space, intensity and frequency:
  - High level of pollution with suspended particulates along the belt roads;
  - High level of phonic pollution in the central intersections with the most intense traffic, in some areas with low admitted limit for noise (Central Park) and along the belt roads with heavy traffic;
  - Local pollution of soil and water in those small areas with leakages of organic substances, used waters with phenols and ether of oil;
  - Requirements from the sustainable point of view:
    - Taking out the heavy traffic from the western, southern and eastern parts of the town and replacing it on detouring belt roads out of the town;
    - Change the present belt roads into modern roads for light traffic in order to decongest the main roads and central intersections;
    - A more responsible management of the small areas with local risks of pollution;
    - A controlled shifting of the last factories from the interior to external locations far away from the residential areas.

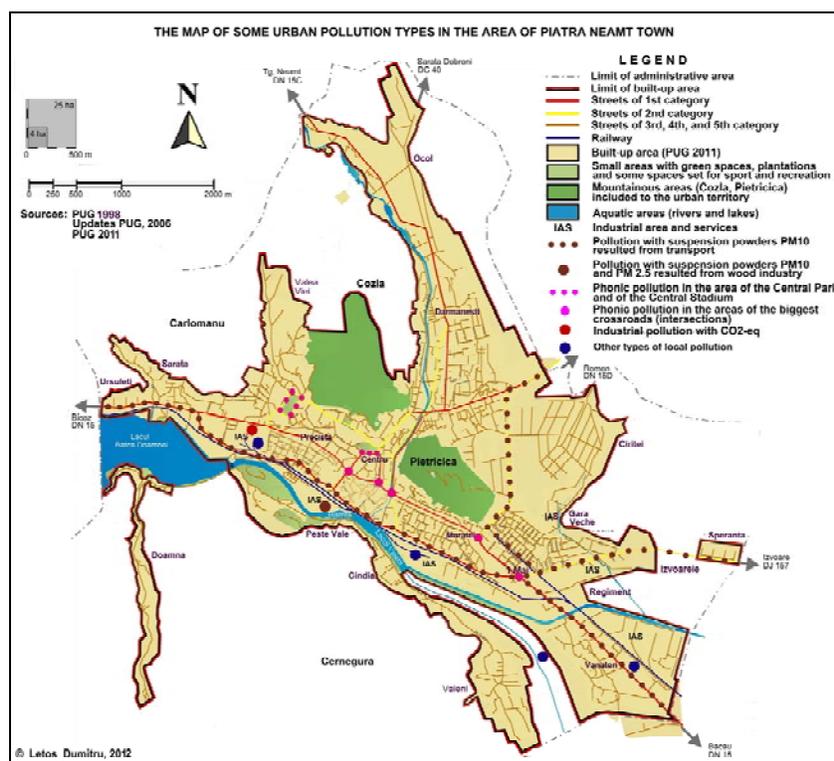


Fig. 1

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#### **Abbreviations**

AFM – Administrația Fondului pentru Mediu  
 APM NT – Agenția pentru Protecția Mediului Neamț  
 CMA – Concentrația Maxim Admisă  
 CO<sub>2e</sub> – Dioxid de Carbon Echivalent  
 DTI PNT – Direcția de Taxe și Impozite Piatra Neamț  
 EMS - European Macroseismic Scale  
 GHG – Green Houses Gases  
 HCF – Hidrofluorurocarburi  
 IEA – International Energy Agency  
 IPCC – Intergovernmental Panel on Climate Change  
 NT<sub>1</sub> – Stația Meteo Nr. 1 Piatra Neamț  
 OPT Journal – Optimum Population Trust Journal  
 pc – per capita  
 PFC – Perfluorurocarburi  
 PM10 – Pulberi în suspensie (particule cu dimensiuni de 10 μ)  
 PRIM MUN – Primăria Municipiului  
 PUG - Planul Urbanistic General  
 SF<sub>6</sub> – Hexafluorura de Sulf  
 SGA NT – Sistemul de Gospodărire a Apelor Neamț  
 SSRM PN – Stația de Supraveghere a Radioactivității Mediului Piatra Neamț