Air pollution abatement strategy in Moscow

Olga Kislova, Polina Zakharova, Elena Lezina
State Environmental Protection Institution "Mosecomonitoring", Noviy Arbat street, 11/1, office 1512, 119019, Moscow, Russian Federation, tel./fax. +7 495 691 93 92.

Ambient air pollution is the top environmental issue for residents of Moscow. Hence is the attention of the Moscow Government and specifically its Department for Environmental Management and Protection to this issue.

Although Russian Federation has a country scale air quality monitoring system, in Moscow it is supplemented with a local air quality monitoring system. In contrast to the Federal monitoring system this Local Monitoring system (MAQMS) is comprised of solely automatic monitoring stations operating around the clock (as distinct from the manual air quality sampling and analysis 4 times a day on the Federal monitoring network). The advantage of this network is that it provides longer sets of measurements for the measuring period and consequently provides more reliable data on 24 hour, daily, annual etc. average concentrations of pollutants in ambient air and provides better basis for evaluation of high concentrations and health risk assessment.

Moreover, Moscow air quality monitoring system was set up in 1996 with the aim to develop with accordance not only to the Russian, but also to the international air quality monitoring standards and guidance on quality assessment and quality control. Number and location of the automatic air quality monitoring stations, data quality assurance and assessment protocols are designated according to the World Health Organization guidelines [1] and requirements of European Union Directives [2]. Measurement methods are preferably reference methods, approved by the EN standards. Monitoring data are transmitted to the database in the analytical department in real time. Maintenance and analytical departments are in constant cooperation in order to provide prompt response to the emerging data quality issues and equipment malfunction. All monitoring equipment is certified, registered in the State Measurement Equipment Register and is being regularly checked up by the competent organizations.

The system is still in constant development extensively (increase in number of stations) as well as intensively (increase in the number of controlled pollutants on each of the monitoring stations). Currently 43 air quality monitoring stations are operating, of which one is outside the city boundaries (suburb background pollution), one is in the park within the city boundaries (natural background pollution), one is a multilevel monitoring station with measuring equipment on 4 different levels above the ground (2 m, 130 m, 230 m, 305 m), 10 stations are located near the motorways, 10 stations – near industrial enterprises, the rest – in the residential areas in different parts of the city.

The list of controlled pollutants includes 22 substances (CO, NO, NO_2, VOC, CH_4, NMVOC, O_3, PM_{10}, $PM_{2,5}$, SO_2, H_2S, NH_3, CO_2, formaldehyde, benzene, phenol, toluene, styrene, ethylbenzene, meta- and para-xylene, naphthalene, nitrous acid). All monitoring stations in the network measure meteorological parameters, CO, NO and NO_2 concentrations. Other substances are varied across the network depending on the potential emission sources each particular station is targeted to represent.

Air quality pollution in Moscow is defined by its role as the largest economic, transport center of the Russian Federation, attraction point for labour resources (which determines high population density) as well as an industrialized city.

During the last ten years structure of the emissions in Moscow had no significant qualitative changes. Dominant emissions during the whole period were due to automobile transportation (emissions of industrial enterprises were never higher than 10% of the total). Industrial enterprises are only occasionally responsible for exceedance of the air quality limit values (maximum allowable concentrations) for specific substances on nearby territories.

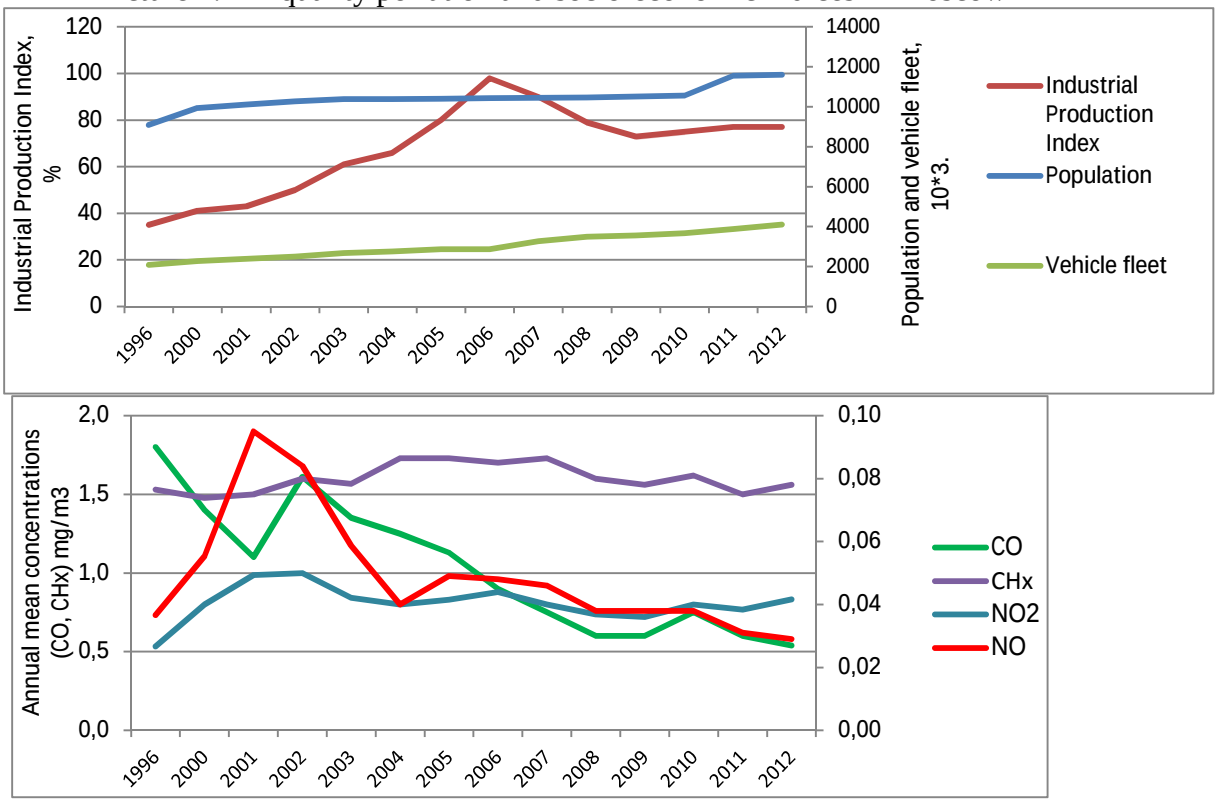
Starting from 1998 automobile fleet in Moscow increased by 2 times (2 mln. vehicles), the growth mostly being due to the private cars, and currently amounts to more than 4 mln. vehicles. At the same time road network density had an insignificant growth and currently amounts only to 3,95 km/km^2, which is 2 to 4 times lower than in large European cities. Road network is estimated to be overloaded by 42%.

Industrial production index has increased since 1996 by two times as well while industrial emissions decreased by two times (table 1).

Table.1. Emissions of industrial enterprises in Moscow, 10^3 tons/year (increase in 2012 is due to increase in Moscow territory by 2,5 times).

Year	1997	1998	1999	2000	2002	2007	2008	2009	2010	2011	2012
Emissions, ktons/year	151,5	131,1	128	115,6	93	78,9	70,2	60,1	62,9	61,2	71,6

Picture 1. Air quality pollution and socio-economic indices in Moscow

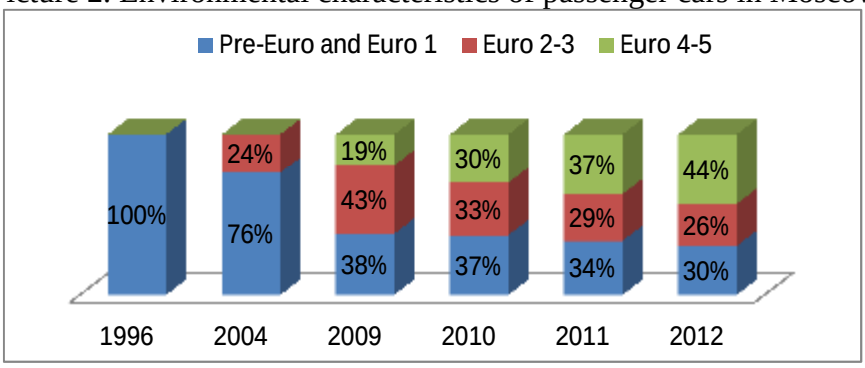


Air quality pollution analysis shows (picture 1) that due to the intensive economic growth, as well as growth in population and automobile fleet in the early 2000s a state of “saturation” (of the transportation system) was reached, with the peak in concentrations of the main pollutants. Subsequent decrease in concentrations is related to the phase of technological improvement of the fleet due to its turnover and replacement of the oldest vehicles with new and more technologically advanced ones (with lower emission rates, picture 2), as well as to the similar process in the industry. Little impact of industry on air quality in Moscow is illustrated by the lack of growth in pollution in 2005-2007 when maximum Industrial production index was reached.

Estimates showed that with the ongoing increase in automobile traffic and rise in traffic jams automobile emissions in Moscow in 2012 could have been 45% greater than they

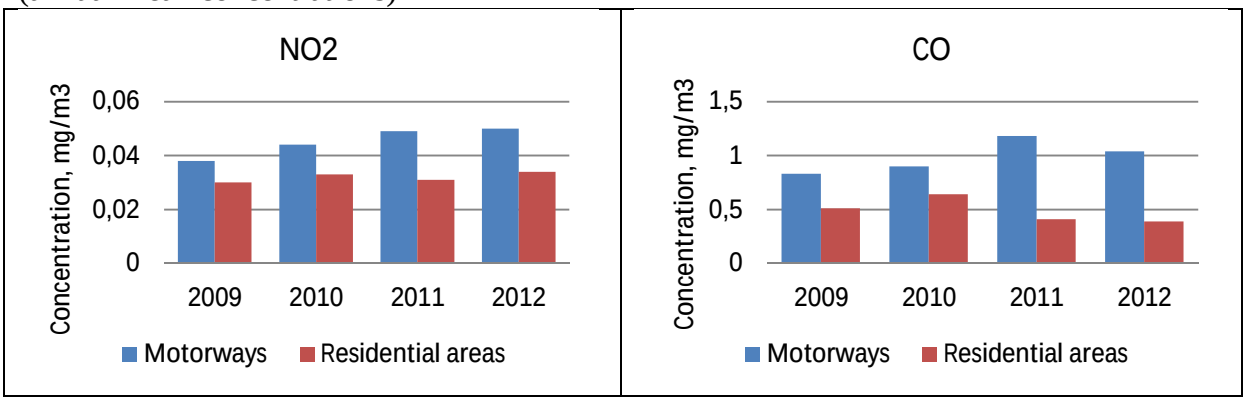
were but for a fleet turnover and decrease in percentage of the old vehicles on the roads (if fleet environmental characteristics had not changed since 2004).

Picture 2. Environmental characteristics of passenger cars in Moscow



Still, comparative analysis of air quality in the residential areas and areas near motorways shows (picture 3) that the letter remain “hotspots” of pollution, and top-priority pollution abatement measures should target automobile transportation emissions (especially in the city center).

Picture 3. Comparison of air quality in the residential areas and near motorways (annual mean concentrations)



The biggest problem for Moscow is that its road network was never planned to support such transportation demand with so many private cars as are used now.

For such a large and diverse city as Moscow there can be no single step to change air quality for the better. It has to be a complex of measures in all directions, with emphasis on the most efficient ones and introduced with regard to social and economic factors.

In case of Moscow the most efficient way of reducing emissions up until now is the “natural” turnover of the fleet with replacement of the oldest vehicles with new and more technologically advanced ones. But this “natural” turnover, although produced by the economic growth would have had much lesser effect had it not been for the Government induced standards for emissions of the produced and imported vehicles (Federal Rules). These standards go along with the standards for motor fuels.

The measures taken by the City of Moscow to reduce air pollution include the following:

- government support for the innovations in industry, especially those leading to the reduction of emissions, replacement of the industrial equipment, requirements to install local emissions monitoring systems on the largest enterprises with data transfer to the special monitoring unit (helps to improve labour discipline), state environmental inspectorate with sampling of emissions and comparison to the assigned limit values, air quality and emissions sampling (in some cases for days or months) on demand of the residents (in several cases enterprises were shut down due to exceedances of limit values);

- reduction of automobile emissions, including: 1) incentive measures for behavioral change to reduce private car use, such as: introduction of paid parking in the city center together with strict control measures such as patrol cars with automatic fixation and high penalties (led to reduction in traffic up to 25% and 6-9% increase in mean vehicle speed), improvement of public transportation system in terms of comfort and speed (including introduction of special bus lanes on the most busy roads, which led to increase in mean speed up to 30%); 2) improvement of environmental characteristics of automobile transport (federal rules for produced and imported vehicles as well as for in-use vehicles, in Moscow – purchase of new public transport (municipal buses) Euro-5 or EEV (compressed gas vehicles), city rules for emissions of buses owned private companies dealing in public transportation, including intercity and international bus transportation); 3) improvement of road traffic network, intellectual transportation systems for road traffic regulation; 4) special regulations for freight transport in order to optimize its routes in the city and its load, low emission zone in the city center – only freight transport with engines Euro 2 or higher is allowed to enter the city center; in 2015 these requirements will be hardened up to Euro 3 while Euro 2 zone will be enlarged to cover parts of the city with the highest population density (about half of the city territory); 5) city parking space programme, which includes construction of intercepting parkings near the underground railway stations (setting up park-and-ride system) and increase in number of parking spaces throughout the city in order to free roadside from parked vehicles; 6) improvement in urban planning (including improvement of interconnections between peripheral areas of the city, areas divided by the rivers and railroads; better planning for "bedroom communities" to provide easy, pedestrian access to the trade, entertainment, educational and healthcare facilities); 7) introduction and consecutive tightening of city rules for fuel quality (these rules are stricter than those for the Russian Federation as a whole, for example, since 2006 sulfur content for gasoline should not exceed 150 mg/kg (350 mg/kg for diesel), since 2013 – 50 mg/kg (the same for diesel); 8) incentives for electric vehicles (import tax is 0% since February 2014 until February 2016; free parking in the paid parking zone, which can help save up to 2,400-3,200 Euro/year). In 2012, 46 electric charging stations are set up in the city and close neighborhood. Electric cars are used in the Protected Nature Areas for patrolling and for guided tours. In 2014, an agreement is reached with grid companies to install about 100 charging stations in the paid parking zone and about 100 are planned in other areas; 9) a three-year program to stimulate use of midget cars (provided free fuel talons for buyers of midget cars, finished in 2011, about 2300 cars sold).

- planting of trees and shrubs (a "Million trees" program is under way, which aims to plant a million trees throughout the city, in places chosen by the residents), strict rules for construction companies (in case of construction all trees and shrubs have to be either replanted or if there is no place for them near the construction site a large sum of money has to be transferred to the city Government in order to use it to plant trees someplace else).

Literature:

1. Monitoring ambient air quality for health impact assessment. WHO Region publications, European Series, No 85. WHO; 1999. - 293 p. http://www.euro.who.int/__data/assets/pdf_file/0010/119674/E67902.pdf

2. Directive 2008/50/EC of the European Parliament and the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

3. Air quality monitoring in Moscow. Newsletter No. 46, 2010. 2010; Berlin WHO Collaborating Centre for Air Quality Management and Air Pollution Control 9–14
Available at: http://www.umweltbundesamt.de/whocc/archiv/NL-46.pdf.