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Korea Environmental Policy Bulletin

Emission Reduction Program for In-Use Diesel Vehicles

CONTENTS

Summary

Air pollution in the Seoul metropolitan area (SMA) is 1.3-1.4 times higher than non-SMA regions in terms of nitrogen dioxide (NO_2) and particulate matter (PM_{10}). Vehicles are responsible for more than 65% of total PM_{10} emissions that cause adverse impacts on health and amenity. In order to improve the air quality of the SMA and bring it up to the standards of cities in the developed world within 10 years, the Korean government has promoted a "Master Plan for the Metropolitan Air Quality Management" based on the "Special Measures for Metropolitan Air Quality Improvement" and "Special Act on Metropolitan Air Quality Improvement". As a part of the Master Plan, an emission reduction program for in-use diesel vehicles on road through enforcement of stricter emission standards to specific diesel vehicles running in the SMA has been implemened since 2005. Installation of emission reduction equipment such as Diesel Particulate Filters (DPF), and Diesel Oxidation Catalysts (DOC), or retrofit with low emission engines like Liquefied Petroleum Gas (LPG) engines are required as alternative technologies for vehicles which fail to comply with

the new emission standards in the program. In the case of old and superannuated vehicles which can't be modified, the owners of those vehicles are required to scrap their vehicles. The mayors of Seoul and Incheon and the governor of Gyeonggi province have the authority to enforce the measures on specific vehicles classified by dead-weight ton and vehicles' age based on their registration date. The central government and municipalities provide a financial support to vehicle owners for installing emission reduction equipments or retrofitting low emission engines in their vehicles. For vehicle owners to participate in this program, the central government is conducting benefit measures such as the exemption of environmental improvement charges and periodic vehicle inspection as well. In the near future, this program will be enforced in five metropolitan cities in Korea as well.

I. Background of the Special Measure for Metropolitan Air Quality Improvement

1. Air Pollution Status in SMA

Air pollution in the SMA is more serious than other areas because 47% of the total population and automobiles are concentrated in the SMA which accounts for only 11% of the territory of the Republic of Korea. In 2003, 57% of national ozone warnings were given in the SMA, and the contamination levels of nitrogen oxide (NO_2) and particulate matter (PM_{10}) in the SMA were 1.3-1.4 times higher than non-SMA regions.

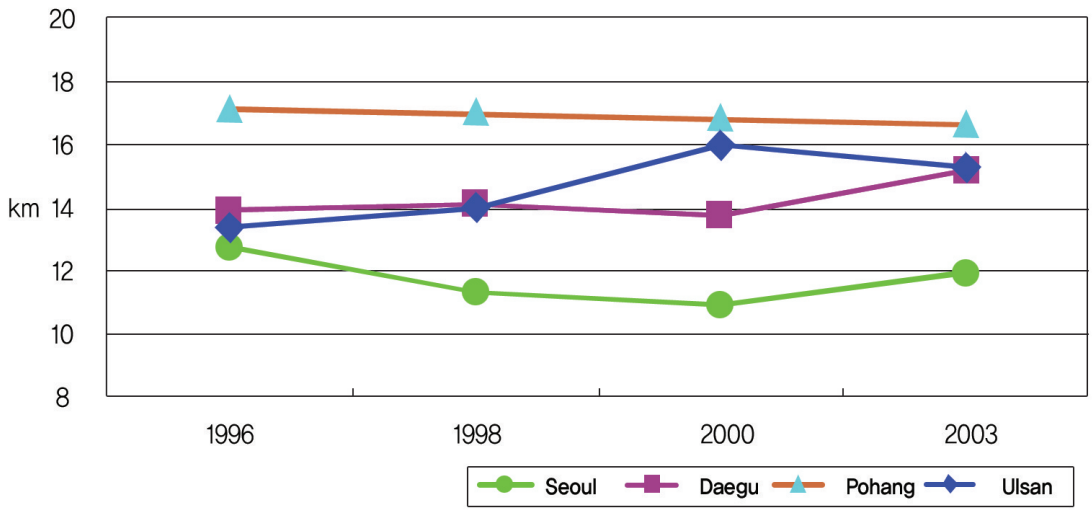
Table 1. Comparison of air pollution in the SMA and non-SMA areas

	2003		
	NO_2 (ppb)	O_3 warning (time)	PM_{10} ($\mu g/m_3$)
SMA	31(38)	27(2)	67(69)
Non-SMA	22	21	53

Unit : 1) annual average concentrations of NO_2 and PM_{10}, 2) times of O_3 warning for whole year, 3) the number in parenthesis indicates the number for Seoul
Source : Ministry of Environment, The master plan for metropolitan air pollution management, November 2005.

In 2003, the visibility of Seoul (11.9 km) was 20-40% worse than those of Ulsan (13.6 km) and Daegu (15.3 km) due to smog.

Figure 1. Visibility in Main Cities



Source : Ministry of Environment, The master plan for metropolitan air pollution management, November 2005.

In 2003, 44.4% of the nationwide CO emissions, 31.9% of NOx, 14.2% of SOx, 25.5% of PM_{10}, and 38.9% of VOC were emitted from Seoul metropolitan air control areas. Among them, Gyeonggi province, ranked first, and Seoul and Incheon ranked second and third respectively.

Table 2. Emissions by pollutant in 2003

Classification		CO	NOx	SOx	PM_{10}	VOC
Nationwide		857,952	1,167,329	499,010	70,120	730,653
SMA	Total	380,582 (44.4%)	372,305 (31.9%)	70,630 (14.2%)	17,868 (25.5%)	283,955(38.9%)
	Seoul	177,984	108,307	7,636	4,708	86,693
	Incheon	48,949	66,352	15,428	3,112	55,262
	Gyeonggi province	153,649	197,645	47,566	10,048	142,000

Unit : ton/year, the number in parenthesis represents the percent of SMA in emissions nationwide
Source : National Institute of Environmental Research, The air pollutants emission in 2003, August 2005.

The emission of SOx in the SMA is decreasing continuously (an average of 2.1% per year) due to policies to reduce air pollution, including the use of clean fuel, the supply growth of low sulfur fuel, and the supply of low emission vehicles. However, the emissions of NOx, VOC, and CO,

which are the main causes of photochemical pollution in urban areas and mostly discharged by motor vehicles, have increased. Compared to the mid-1990s, PM_{10} from artificial pollutants decreased, but is increasing recently due to the growing number of diesel vehicles (an average of 0.4% per year).

Table 3. Emission of pollutants in the SMA by year

Year	SOx	NOx	PM_{10}	CO	VOC	TSP
1999	545,729	974,760	69,158	805,666	643,953	-
2000	531,059	1,003,958	67,515	825,193	664,852	89,424
2001	552,173	1,050,997	69,881	837,568	712,230	91,597
2002	501,753	1,106,269	68,890	860,584	723,857	89,019
2003	499,010	1,167,329	70,120	857,952	730,653	90,642

Unit : ton/year
Source : National Institute of Environmental Research, The air pollutants emission (http://airemiss.nier.go.kr/, 2008.9.10); National Institute of Environmental Research, The air pollutants emission in 2003, August, 2005.

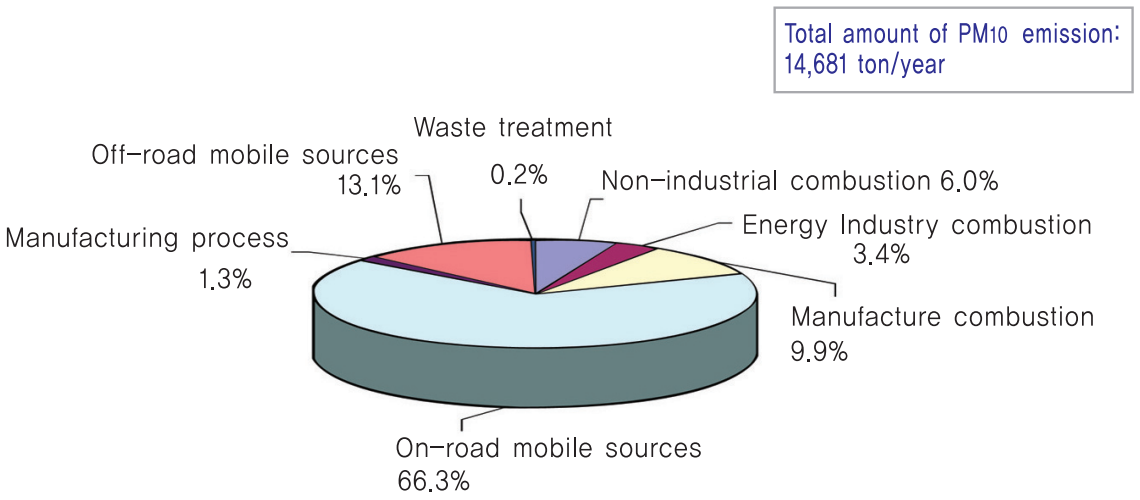
2. Hazards of Particulate Matter

The socio-economic damages caused by air pollution are so serious that it even impedes national competitiveness. Research results show that the number of premature deaths caused by particulate matter in the SMA is estimated to be more than 10,000 people[1)] and that the socio-economic cost projected is approximately 10 trillion Korean won per year[2)]. According to a US Environmental Protection Agency (EPA) report, more people (1.5%) will die of stroke because of an increase of particulate matter. Particulate matter aggravates respiratory diseases such as asthma and hampers lung function. Particulate matter also worsens visibility, causes sediment that obstructs the metabolism of plants and is corrosive to cultural relics and statues[3)].

Particulate matter is a mixture of solid and liquid particles and their diameter is less than 10 micrometers. The shape and size of the matter is very different, since they are emitted from not only natural but also different kinds of point and non-point sources. Particulate matter is emitted directly from the source or is formed secondarily by gas materials such as SOx and NOx. Referring to the figure2, approximately 66% of particulate matter is emitted from motor vehicles which are the main part of on-road mobile sources.

[1)] Gyeonggi Research Institute (2003), Estimating Social Cost of Air Pollution and Developing Environmental Control Strategies for Gyeonggi province
[2)] Korea Environment Institute (2003), Cost-Effectiveness on Special Measures for Metropolitan Air Quality Improvement
[3)] National Institute of Environmental Research (2005), Annual report of atmospheric environment 2004

Figure 2. Emission of PM_{10} by source in SMA (2001)



Source : Ministry of Environment, The Master Plans for Metropolitan Air Quality Management, November 2005.

Of the total amount of air pollutant emissions, 51% of NOx and 66% of PM_{10} are from motor vehicles. Half of registered motor vehicles are in the SMA and the number of registration in the SMA increased 26-fold from 270,000 in 1980 to 6,920,000 in 2004. In 2014, the number of registered motor vehicles is expected to reach about 9,412,000. In 1994, only 1.0% of motor vehicles running on the road were more than 10 years old based on their registration date. In 2002, however, the percentage of old and superannuated vehicles increased to 9.1%, so that the emissions from those vehicles aggravated air pollution in SMA.

At the same time, as diesel recreational vehicles (RVs) increased from 135,000 in 1995 to 929,000 in 2002, PM_{10} and NOx emissions from diesel RVs have shown the tendency to increase, too.

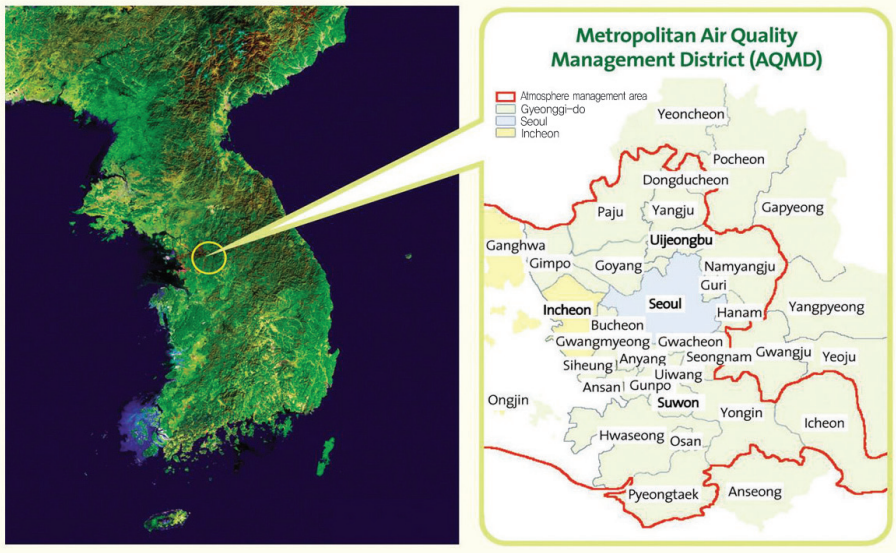
In 2001, the total number of motor vehicles in the SMA was 5,780,000, with 62%, 27%, and 11% being gasoline, diesel, and LPG vehicles, respectively. Interestingly, diesel vehicles that account for 27% of the total number of vehicles emit 100% of the particulate matter and 71% of the NOx. Considering the fact that 75-77% of diesel vehicle pollutants were emitted from old and superannuated vehicles more than five years old, proper emission control measures should be enforced for those in-use diesel vehicles.

Ⅱ. Special Measures for Metropolitan Air Quality Improvement

1. Legislation for the Special Act on Metropolitan Air Quality Improvement and subordinate regulations

In order to set up a basic strategy to improve the air quality of the SMA, the "Special Measures on Metropolitan Air Quality Improvement" (hereinafter referred to as 'the special measures') were devised by the Ministry of Environment in April 2002. The special measures aimed to reform the ex-post control system into a prevention-oriented one and to introduce a wide area management system covering the entire SMA by complementing the dispersed management system operated by each municipality individually. The special measures is to establish an air quality management system with a mid-to long-term plan and goal by 2014. Later, the "Special Act on Metropolitan Air Quality Improvement" (hereinafter referred to as 'the special act') and its subordinate regulations were enacted in December 2003 and December 2004, respectively. The goal of the special act is to develop an institutional framework for the effective implementation of the special measures. The special act includes main policy measures such as the total air pollution load management system for region and industrial sectors, emission trading system, control measures for on road mobile sources, mandatory purchasing of low-emission vehicles, environmentally friendly energy and city management, etc. Some areas in the SMA where air pollution is especially severe or air pollutants emitted have heavy influence on the entire SMA were designated and managed as Metropolitan Air Quality Management District (AQMD).

Figure 3. Map of Metropolitan Air Quality Management District in SMA

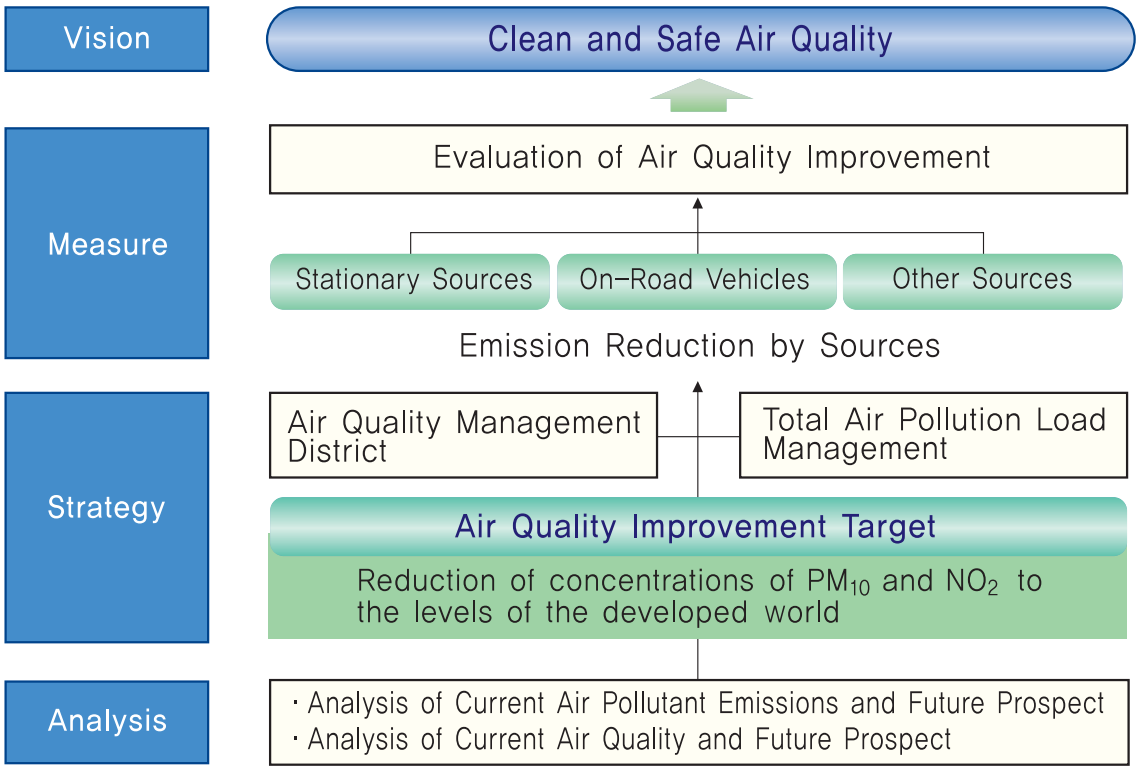


Source : Ministry of Environment, Special Measures on Metropolitan Air Quality Improvement, December, 2004 (http://eng.me.go.kr/docs/cyber/cyber_view.html, 2008.10.5)

2. Master Plan for the Metropolitan Air Quality Management

The special act has been in force since January 2005. According to the special act, the Ministry of Environment established the "Master Plan for the Metropolitan Air Quality Management" (hereinafter referred to as 'the master plan') as a 10-year framework plan including a 5-year implementation plan in November 2005. In December 2006, the three municipalities, namely Seoul, Incheon and Gyeonggi province, in SMA set their own implementation plans to carry out the master plan.

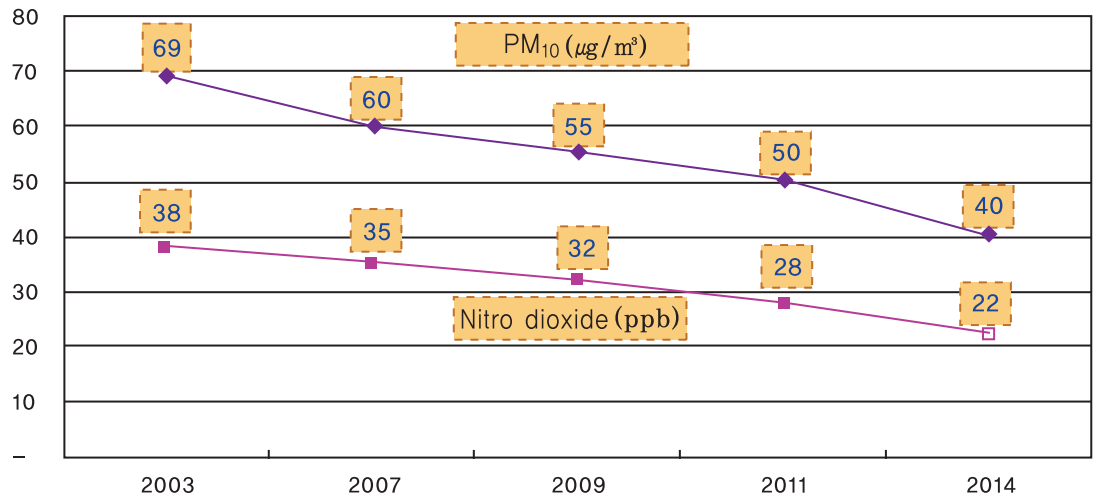
Figure 4. The Master plans for the metropolitan air quality management



Source : Ministry of Environment, the master plan for the metropolitan air quality management, November, 2005.

The main air quality improvement targets of the master plan are to reduce the concentrations of PM_{10} and NO_2 to the levels of the developed world by decreasing their emissions in the SMA by half compared to 2001 by 2014. The air pollutants to be controlled in the master plan are PM_{10}, NOx, VOCs, SOx, etc. To meet this emission reduction target, the targets for each year and detailed implementation measures have been set up as follows.

Figure 5. Air Quality Improvement Targets of PM_{10} and NO_2 by 2014



Source : Ministry of Environment, The Master plan for the metropolitan air quality management, November, 2005

Detailed Implementation Measures of Master Plan

Control Measures for On-Road Mobile Sources

- Newly Manufactured Vehicles
  - ·Strengthening Emission Standards in accordance with the EU standards, Low Emission Vehicles (LEVs) Supply, Stronger Enforcement of Emission Testing
- In-Use Vehicles
  - ·Installation of Emission Reduction Equipment, Retrofit with Cleaner Engines, Early Scrapping of Old and Superannuated Vehicles, Replacement of Metropolitan Buses with CNG Buses
  - ·Promotion of Vehicle Inspection System, Strengthening Education and Management of Auto Repair Shop, Strengthening Standards on Fuel Quality

Control Measures for Stationary Sources

- Large Sized Enterprises
  - ·Allocation of the Annual Allowable Emission Loads, Strict Control of Emission within Allocated Amount,

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