National Air Quality Status Report (2005-2007)

Environmental Management Bureau
Department of Environment and Natural Resources

2009

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Preface

This publication is a comprehensive technical report of the air quality situation of the country. It covers discussion on best practices, challenges, efforts on public awareness and environmental education, and recommendations towards improvement of air quality. It also presents the initiatives of the different stakeholders – various national government agencies, the private sector, the civil society, the local government units, and the international development community on their contributions for the betterment of our environment. The report was written solely by the EMB-DENR staff based on the 'Guidelines for the Preparation of Harmonized Regional and National State of Brown Environment Report' developed in 2007. It is therefore a pilot work. Effort has been made to stick to the Guidelines even though several constraints were faced during its writing. First and foremost is the availability of data pertaining to the environment. While it is recognized that such data abound, these are scattered, some are outdated, and come in different formats. Second, time was limited to produce the first report that would faithfully adhere to the outline of the Guidelines. To overcome such constraints, the EMB-DENR staff had to undergo capability building through seminar-workshops on the rigors of data analysis and technical report writing. Truly, this report is a product the EMB-DENR staff could be proud of.

The report is a fact book that monitors air quality over the last three years. It is hoped to be useful for policy and decision makers, planners, researchers, etc. It will also provide valuable information to the general public.

Comprehensive as it is, being a pilot work however, not all information desired could be contained in the report due to the constraints cited earlier. Several lessons have been learned with regard to keeping of an efficient database that would help in providing valuable data for the writing of future reports. Partnership with other government agencies, the civil society, the LGUs and other stakeholders is necessary for ease in the exchange of data.

It is hoped that this report would contribute to better understanding of our environment. We are always reminded by the old maxim – 'what gets measured gets managed'. Some may argue with this assertion. But as far as the environment is concerned, it is always true.

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Sources of Air Pollution

The sources of air pollution are classified into:

a. Stationary source - any building or immobile structure, facility or installation which emits or may emit any air pollutant.
b. Mobile source - any vehicle/machine propelled by or through oxidation or reduction reactions including combustion of carbon-based or other fuel, constructed and operated principally for the conveyance of persons or the transportation of property or goods that emit air pollutants as a reaction product.
c. Area source - relatively large areas of specific activities that generate significant amounts of air pollutants.

Based on the 2006 National Emission Inventory, majority of the regions in the country point to the transport sector as the major source of air pollution. As shown in Figure AQ-1, it was estimated that 21% of the pollutants came from stationary sources, 65% from mobile sources, and the remaining 14% from area sources.

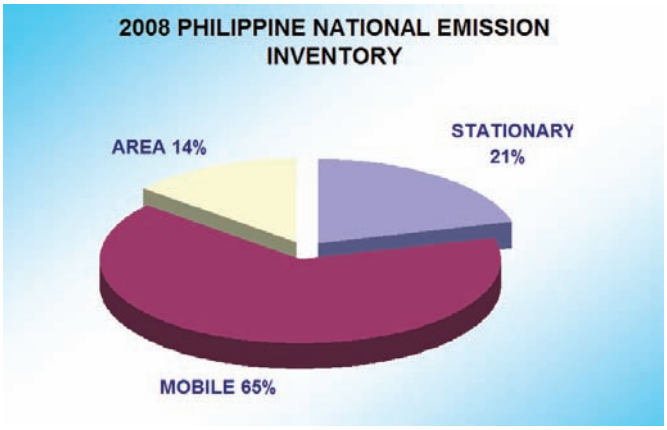


Figure AQ-1 – 2006 National Emissions Inventory According to Criteria Pollutant

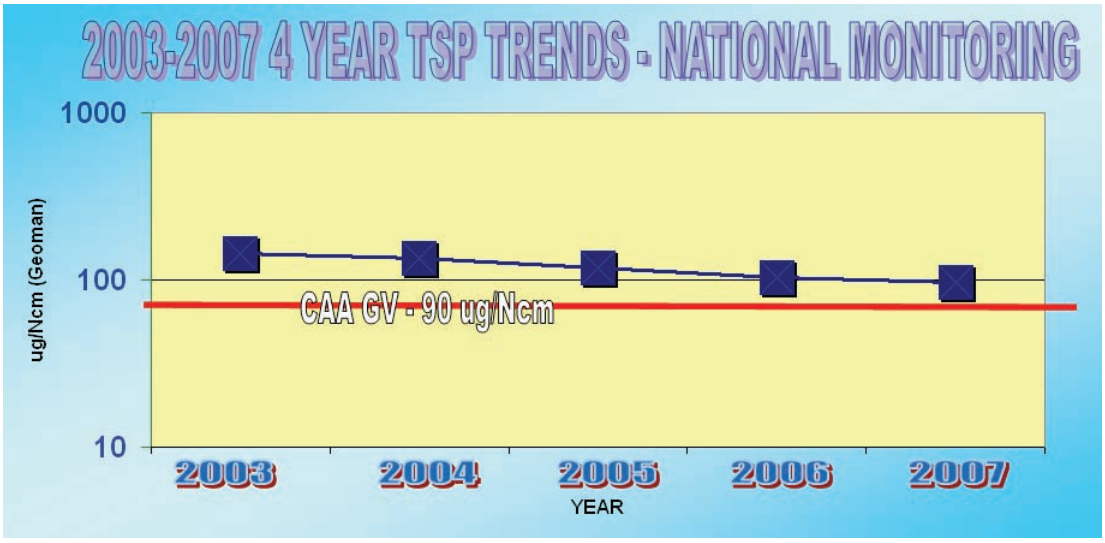
Table AQ-1 shows that CO has the biggest pollution load contribution of 50%. CO emission is relatively caused by the increasing population of gasoline-fed vehicles which include cars (13.58%) and MC/TC (47.88%). Other pollutants' contribution are as follows: NO_x – (15%), SO_x – (9%), PM-(11%), VOC-(15%).

Source	PM (mg/Ncm)	SO_x (mg/Ncm)	NO_x (mg/Ncm	CO (mg/Ncm)	VOC	Total	%
Stationary	110,023	598,634	326,219	360,620	67,859	1,463,385	21
Mobile	244,764	14,309	405,033	2,988,616	914,996	4,567,719	65
Area	423,615.	1,963	327,261	165,647	63,855	982,340	14
Total	**778,402**	**614,937**	**1,058,514**	**3,514,883**	**1,046,710**	**7,013,444**	**100**
%	11	9	15	50	15	100	

Source: EMB

Ambient Air Quality

Figure AQ-2 shows the national total suspended particulate (TSP) monitoring from 2003 to 2007. A significant 33% improvement was observed with concentrations decreasing from 144 to 97 microgram per normal cubic meter (µg/Ncu.m.) Although trends are decreasing, TSP geometric mean concentrations are still above the 90 µg/Ncu.m. annual mean TSP guideline value for one year averaging time. As such, more efforts are needed to comply with the guideline by 2010 as provided in the General Plan of Action for Air Quality Management.



Source: EMB

Figure AQ-2 – National Ambient TSP Trend (1 year 24-hour averaging time), 2003-2007

Management of Stationary Sources

The EMB through its regional offices is in charge of monitoring industrial firms and issuing notices of violations (NOVs) and permit-to-operate (POs). From 2005-2007, a total of 18,697 firms were monitored. Also, a total of 1,676 NOVs and 24,391 POs were issued within the three-year period.

Management of Mobile Sources

The LTO enforces compliance with emission standards for motor vehicles pursuant to pertinent provisions of the CAA of 1999 and its Implementing Rules and Regulations (IRR).

Under the IRR of the CAA, all private in-use motor vehicles and vehicles with updated/enhanced engines whose chassis are pre-registered with the LTO will only be allowed renewal of annual registration upon inspection by the LTO or other authorized private motor vehicle inspection center. The MVIS project involves the construction of motor vehicle inspection system to cover all types and classifications of motor vehicles all over the country. The MVIS centers shall be equipped with the state-of-the-art equipment and shall be fully computerized.

Management of Area Sources

The Philippine Clean Air Act of 1999 (RA 8749) and its IRR defines an airshed as "areas with similar climate, weather, meteorology and topography which affect the interchange and diffusion of pollutants in the atmosphere." The whole country has been divided into airsheds. These airsheds are to be managed by multi-sectoral governing boards which are tasked to formulate policies and standards as well as action plans to effectively manage the air quality situation within their respective areas.

Regulations and Policy

From 2005-2007, the DENR-EMB issued policies on air quality management as shown in Table AQ-2. These directives were issued to further strengthen the implementation of air quality management efforts in the country.

Table AQ-2 Policies Issued from 2005-2007

DENR Administrative Order (DAO) Number	Policy Title	Date of Issuance
DENR- DTI- DOTC Joint Adminstrative Order No. 1 Series of 2007	Amended Guidelines and Procedures for the Monitoring of Accredited and Authorized Private Emission Testing Centers (PETC) and Land Transportation Office (LTO) Emission testing Activities	December 2007
DAO 2007-27	Revised Emission Standards for Motor Vehicles Equipped with Compression-Ignition and Spark-Ignition Engines	31 July 2007
DAO 2007-25	Guidelines for DENR Accreditation of Third Party Source Emission Testing Firms	31 July 2007
DAO 2007-22	Guidelines on the Requirements for Continuous Emission Monitoring Systems (CEMS) and other Accepted Protocols . thereby Modifying and Clarifying Certain Provisions	31 July 2007

Source: EMB

Alternative and Clean Fuels

As a substitute to petroleum, alternative fuels are expected to yield significant energy security and environmental benefits to its consumers. Methanol, denatured ethanol, and other alcohols blended with gasoline, diesel or other fuels are alternative fuels. Those that act as substitutes to petroleum, such as natural gas, liquefied petroleum gas, hydrogen, and coal-derived liquid fuels are also considered as alternative fuels, as are fuels derived from biological materials and electricity.

The Alternative Fuels Program is one of the five key components of the Arroyo Administration's Energy Independence Agenda, which outlines the roadmap that will lead to the country's attainment of 60% energy self-sufficiency by 2010.

The Program has four major subprograms, namely Biodiesel Program, Bioethanol Program, Natural Gas Vehicle Program for Public Transport (NGVPPT), and Autogas Program. Other technologies advocated under the program are hybrid, fuel cell, hydrogen, and electric vehicles.

RA 9367 otherwise known as The Bio-fuels Act of 2006 "An Act to Direct the Use of Bio-fuels, Establishing for this Purpose the Biofuels Program, Appropriating Funds therefor, and for other Purposes" was signed into law by the President on January 12, 2007 and became effective on February 6, 2007. Biofuel refers to fuels made from biomass and primarily used for automotive, thermal and power generation, with quality specifications in accordance with the Philippine National Standards (PNS). The "Bio-fuels Policy" seeks to achieve energy independence and fuel diversification while meeting environmental challenges through the utilization of agricultural-based feed stocks thus increasing economic activity, especially in country side.

As mandated in the Act, bio-diesel blend of 1% by volume is available in all gas/pump stations nationwide since May 2007 (no more 100% conventional diesel). Likewise, 10% bio-ethanol blend (E10) by volume into all gasoline fuel is distributed and sold by all oil companies/dealers in the country. The biofuel and their blends are either manufactured/imported/sold conforming to the Philippine National Standards.

Public Awareness and Education on Air Quality Management

For a couple of years, the EMB-DENR has undertaken various activities focused on public awareness and education on air quality management under the Linis Hangin program of the DENR.

The various activities are in cooperation with different multi-stakeholder partners such as academic institutions, business, local government units, national government agencies, non-government organization, private sector, and even individuals advocating the fight for clean air.

There are several undertakings of the EMB-DENR in this direction from 2005 to 2007. Among them are:

- *Bantay Tambutso sa Eskwela* – The program aimed at (1) involving academic institutions in promoting clean air and (2) increasing and strengthening the advocacy for clean air, especially in the attainment of emission standard for vehicles within school campuses nationwide.

- *Bantay Tambutso sa Malls* – The said program targets mall and business establishments nationwide with the aim of encouraging public and private sector cooperation by conducting free vehicle emission testing in malls and commercial establishments for FX taxi, jeepneys and other public utility vehicles

- *Bantay Sunog Basura* –The said program partners with local government units and encourages them to practice a more ecological way of dealing with solid wastes through issuance of local ordinances that ban open burning of wastes in their localities.

- *Bantay Tsimneya* – This is also a program under the Linis Hangin program that targets industries and encourages them to reduce emissions in their smoke stacks.

Best Practices and Lessons Learned

National Capital Region

Marikina City

The city government of Marikina is a strong advocate of clean air and non-motorized transport. This was manifested through the Marikina Bikeways Project, which aims to promote low cost and environment-friendly transport.

The bikeways program of Marikina City is a holistic social and advocacy campaign that promotes cycling as an alternative public transport. It is holistic in the sense that it involves not only creating the physical requirements for the adoption of bicycling, but also providing an opportunity to own bicycles, educating the public on the social dimension and safety of riding the bike, and putting in place policies that make this program a sustainable one.

Makati's Project Hangin

Healthy Air In Good Indoor Environment (HANGIN) Project, was initiated by the City Government of Makati through the Department of Environmental Services in collaboration with Makati Health Department, Liga ng mga Barangay, Department of Health (DOH), DENR-NCR and the University of the Philippines (UP) College of Public Health. The project officially started on March 12, 2007 through a Memorandum of Agreement that was entered into by the concerned parties.

Cordillera Administrative Region

Efforts of the region is focused more on advocacy for strengthened air quality protection. The advocacy is geared towards increased cooperation and willingness of the people, academe and the youth sector to participate in environmental programs.

Region 1

City of San Fernando, La Union

In 2006, the City of San Fernando enacted its Environment Code. One of its main components is the Tricycle Conversion Program that targeted the conversion of the City's three-wheeler public transport (tricycles) from 2-stroke to 4-stroke engine motorcycles.

Region 2

Region 2 government agencies, private sectors, LGUs, civil society and communities support the mission of improving air the quality and protecting the environment as shown in their advocacy.

The Department of Agriculture (DA) in Quirino Province has intensified its campaign against burning of agricultural waste/debris. Interpretative signs were installed along the national road to strategic locations which read "*Dayami ay huwag sunugin, i-decompose para pataba pagyamanin*".

Penalties are imposed to residents caught burning their agricultural wastes. Positive results were recorded. A high level of awareness among the residents was recorded with no incidence of burning.

Region 3

The DOST Region 3, has, since 1999, been promoting technologies that help minimize air pollution. The program aims to assist Small and Medium-Scale Enterprises to comply with environmental quality standards through reduction of waste generation. The implementation of cleaner production strategies serve as a preparatory stage for the implementation of Environmental Management System (ISO 14000 standards) within the companies' manufacturing operations.

Region 4-A

The Local Government of Cavite prepared the Cavite Environment Code under Provincial Ordinance No. 43-S-2008. Among the salient features of the code are articles on forest, mineral and water resources, waste management, marine and coastal resources, air and noise pollution management, ecotourism, environmental impact assessment and land use planning.

Region 4-B

The local government units of Region 4-B support the air quality management programs of the EMB. As part of their procedure in the renewal of business permits of firms and industries operating in their respective jurisdiction, the local government units require copies of *Permit to Operate Air Pollution Source and Control Installation* issued to them by the EMB Region 4-B to verify if the firms operating are in compliance with the provisions of the CAA. The local government units are also giving support for the maintenance of the air quality monitoring stations established by EMB Region 4-B.

Region 5

The local government of Legazpi City has passed an ordinance banning smoking in public places and conveyances. Also, Naga City and Iriga City have intensified their campaign against smoke belchers by creating Anti-Smoke Belching Units which will provide assistance to LTO and EMB Region 5 deputized agents in the conduct of random roadside vehicle emission testing. The issuance of ordinance by other LGUs regarding ban on open burning also helps in improving air quality in the region.

Region 6

Iloilo City has undertaken activities against open burning. The city has likewise actively participated in DENR's Green Philippine Highways Program and continues to implement other urban greening activities.

Region 7

Cebu City

Cebu City takes pride of its comprehensive planning for transport and land use. The city has embarked on a variety of initiatives in traffic management. It has already installed a computerized traffic signal system called SCATS (Sydney Coordinated Adaptive Traffic System) in 1993, the first in the country. In recent years, the city government has been active in its anti-smoke belching efforts and the promotion of the Bus Rapid Transit (BRT) as a mass transit system for the city.

Region 8

EMB Region 8 tied up with industries having initiatives on environmental education and public awareness programs for Air Quality Management and Clear Air. An example is the creation of the Leyte Geothermal Airshed in Ormoc City and Kananga, Leyte thru the initiative of the PNOC-EDC. Since the establishment of Geothermal Areas as Airsheds in 2002, and the organization of the Leyte Geothermal Airshed Governing Board in 2005, various programs and activities were undertaken thru the chairmanship of EMB Region 8 and logistic support of PNOC-EDC.

Region 9

Efforts of the region were focused more on awareness campaigns and advocacy for various environmental programs.

Region 10

Iligan City

The city of Iligan has been a forerunner in the institution of traffic management at the local government level. Through the help of the Asian Development Bank and AusAID, the construction of the north and south bound terminals for buses, and jeepneys, and road widening was made possible. This greatly enhanced the traffic condition of the city and has significantly reduced emissions from inter-city vehicles.

Cagayan de Oro City

The local government of Cagayan de Oro City has prepared a comprehensive land use plan that is intended to decongest its Central Business District (CBD) and identify growth corridors that integrate both land use and transport development.

Region 11

The local government in Davao City has issued policies in support of the Clean Air Act. For 2007, four city ordinances were issued, namely, city ordinances on anti-smoke belching, anti-smoking in public places, no vending of cigarettes within 100 meters from school premises and ban on aerial spraying of pesticides.

Region 12

One of the best practices in the region is the promotion of proper maintenance of motor vehicles. It was observed during roadside inspection of vehicles in 2007 that majority of the vehicles inspected passed the opacity standard. Interviews with vehicle owners revealed that they regularly undertake maintenance check for their vehicles, which according to them, resulted in lower emission.

CARAGA Region

The local government of CARAGA has established a strong linkage with other sectors of society to institutionalize the implementation of the ban on open burning as well as an intensified greening program.

Recommendations for Necessary Executive and Legislative Action

The government should re-direct its effort of controlling and/or minimizing emissions coming from mobile sources. Programs and activities of DENR aimed at improving the air quality of Metro Manila shall continue to be of minimal effect unless other government agencies implement their respective mandates vigorously as provided in the CAA.

To further improve air quality monitoring and assessment, the following are recommended:

- Strengthen industry self-regulation programs;
- Fast track the nationwide implementation of the MVIS;
- Strengthen monitoring of compliance on fuel specifications by oil companies;
- For LGUs to strengthen its programs in prohibition of open burning of wastes;
- Strengthen air-related researches;
- Intensify public awareness and education on air pollution prevention among all stakeholders;
- Strengthen anti-smoke belching operations by LGUs;
- Results of air quality monitoring should be made known to the LGUs concerned particularly those which frequently exceed the guideline values; and
- Encourage the active participation of civil society in the monitoring of the implementation of the Clean Air Act.

Acronyms/Abbreviations Used

ADB - Asian Development Bank
AusAID - Australian Agency for International Development
BTr - Bureau of Treasury
CAA - Clean Air Act
CAI-Asia – Clean Air Initiative for Asian Cities
CAR - Cordillera Administrative Region
CEC - Certificate of Emission Compliance
CFC - Chlorofluorocarbon
CO - Carbon Monoxide
C.O. - Central Office
COC - Certificate of Conformity
COCAP – Concerned Citizens Against Pollution
CRAVE - Champion for Reduction of Air Pollution from Motor Vehicle Emission
DA - Department of Agriculture
DAO - DENR Administrative Order
DENR - Department of Environment and Natural Resources
DILG - Department of Interior and Local Government
DILG-BLGS - DILG-Bureau of Local Government and Supervision
DOE - Department of Energy
DOH - Department of Health
DOST - Department of Science and Technology
DOTC - Department of Transportation and Communications
DOTC-RTAS - DOTC-Regional Traffic Adjudication Service
DTI - Department of Trade and Industry
EANET - Acid Deposition Monitoring in East Asia
EMB - Environmental Management Bureau
EMS - Environmental Management Systems
FMB - Forest Management Bureau
HANGIN - Healthy Air In Good Indoor Environment
IPFI - Infinite Progression Foundation, Inc.
LTO - Land Transportation Office
LGUs - Local Government Units
MAC - Mobile Air Conditioning
MMT - Thousand Metric Tons
MMMT - Million Metric Tons
MMDA - Metro Manila Development Authority
MC/TC - Motorcycles/Tricycles
MVECT - Motor Vehicle Emission Control Technician
MVIS - Motor Vehicle Inspection System
NOV - Notice of Violation
µg/Ncu.m. – Microgram per normal cubic meter
NCPP- National CFC Phase-Out Plan
NCR - National Capital Region
NGVPPT - Natural Gas Vehicle Program for Public Transport
NOx - Oxides of Nitrogen
PM - Particulate Matter
PEP - Philippine Energy Plan

PETCs - Private Emission Testing Centers
PNRI - Philippine Nuclear Research Institute
PNOC-EDC - Philippine National Oil Company- Energy Development Corporation
PNS – Philippine National Standards
PO - Permit to Operate
PUV - Public Utility Vehicle
RA - Republic Act
SCATS - Sydney Coordinated Adaptive Traffic System
SMC - Semirara Mining Corporation
SMR - Self-Monitoring Report
SOx - Sulfur Oxides
SUVs - Sports Utility Vehicles
TESDA - Technical Education and Skills Development Authority
TOGs - Total Organic Gases
TSP - Total Suspended Particulates
UP - University of the Philippines
USAID - United States Agency for International Development
USAID-ECAP - USAID-Energy and Clean Air Project
USEPA - United States Environmental Protection Agency
UVs - Utility Vehicles
VOC - Volatile Organic Compounds

1. Introduction

Clean air is essential for all life on earth. When the air is unhealthy, a host of complications arise that affects both human health and the state of the country's ecological wealth.

2. Sources of Air Pollution

2.1 **Stationary sources**

Stationary source is defined by the Clean Air Act (CAA) as "any building or immobile structure, facility or installation which emits or may emit any air pollutant." Stationary source examples include electricity generating plants, processing plants, manufacturing plants, mills, chemical industries, and other industrial plants. Specifically, these include manufacturing of food and related products, tobacco manufacturing, textile mill products, lumber and wood products, paper and allied products, printing and publishing, chemical and allied products, petroleum and coal products, rubber and miscellaneous plastic products, stone, clay, and glass products, primary metal industries, fabricated metal products, machinery except, electrical and electronic equipment, miscellaneous manufacturing industries.

2.2 **Mobile sources**

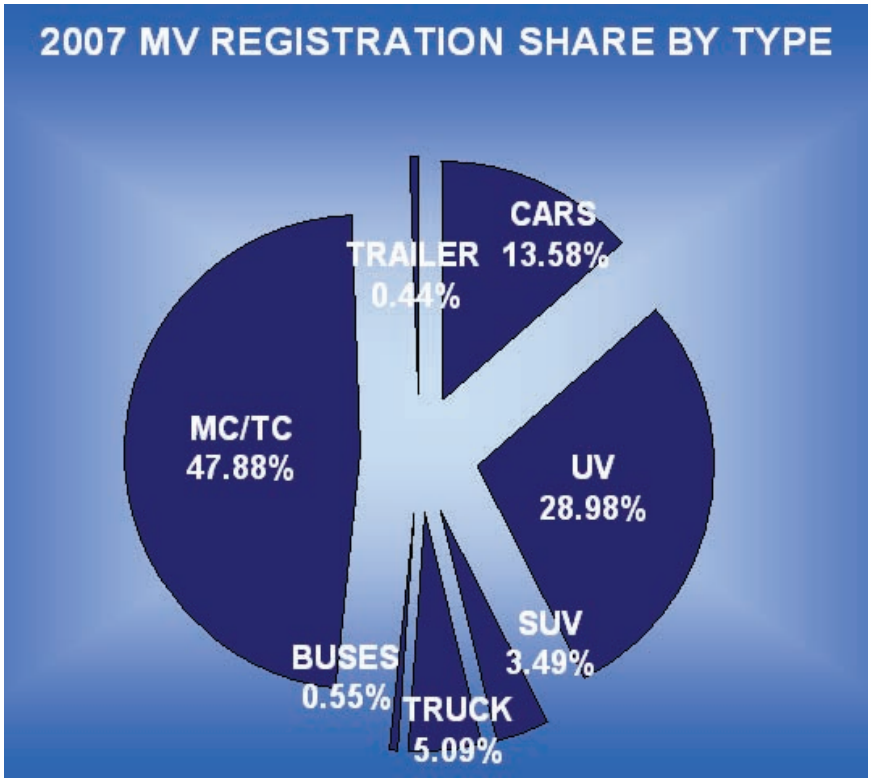
Mobile sources of air pollution are any vehicle/machine propelled by or through oxidation or reduction reactions including combustion of carbon-based or other fuel, constructed and operated principally for the conveyance of persons or the transportation of property or goods that emit air pollutants as a reaction product. These engines are either gasoline, diesel-powered, compressed natural gas (CNG), liquefied petroleum gas (LPG) or other alternative fuels, each contributing a characteristic set of pollutants into the air. These mobile sources are further categorized into cars, utility vehicles (UVs), trucks, buses, motorcycles/tricycles (MC/TC), aircraft and marine vessels. Table 1 shows the annual motor vehicle registration from 2005 to 2007. Note that since 2005, the fastest average annual increase has been with MC/TC (10.77%), most of which have two-stroke engines, followed by sport utility vehicles (SUVs) (10.55%) and trucks (2.75%). Likewise, cars continue to increase by 2.35% annually on the average.

Table 1. National Annual Motor Vehicle Registration by Vehicle Type 2005-2007

MV Type	Mode of Registration	2005	2006	2007
CAR	New	41,175	40,763	46,183
	Renewal	747,233	751,610	704,909
	Sub-Total	788,408	792,373	751,092
UV	New	93,959	88,950	91,518
	Renewal	1,593,897	1,529,151	1,511,101
	Sub-Total	1,633,856	1,618,101	1,602,619
SUV	New	21,554	25,491	27,503
	Renewal	136,384	147,303	165,488
	Sub-Total	157,938	172,794	192,991
TRUCK	New	15,245	16,896	18,439
	Renewal	251,670	269,005	262,822
	Sub-Total	266,915	285,901	281,261
BUS	New	1,738	2,008	2,518
	Renewal	29,239	27,136	27,641
	Sub-Total	30,977	29,144	30,159
MC/TC	New	585,482	605,038	671,588
	Renewal	1,572,255	1,804,325	1,975,986
	Sub-Total	2,157,737	2,409,363	2,647,574
TRAILER	New	1,427	2,595	1,789
	Renewal	22,495	21,303	22,567
	Sub-Total	23,922	23,898	24,356
Sub-total	New	760,580	781,741	859,538
	Renewal	4,299,173	4,549,833	4,670,514
Grand Total		**5,059,753**	**5,331,574**	**5,530,052**

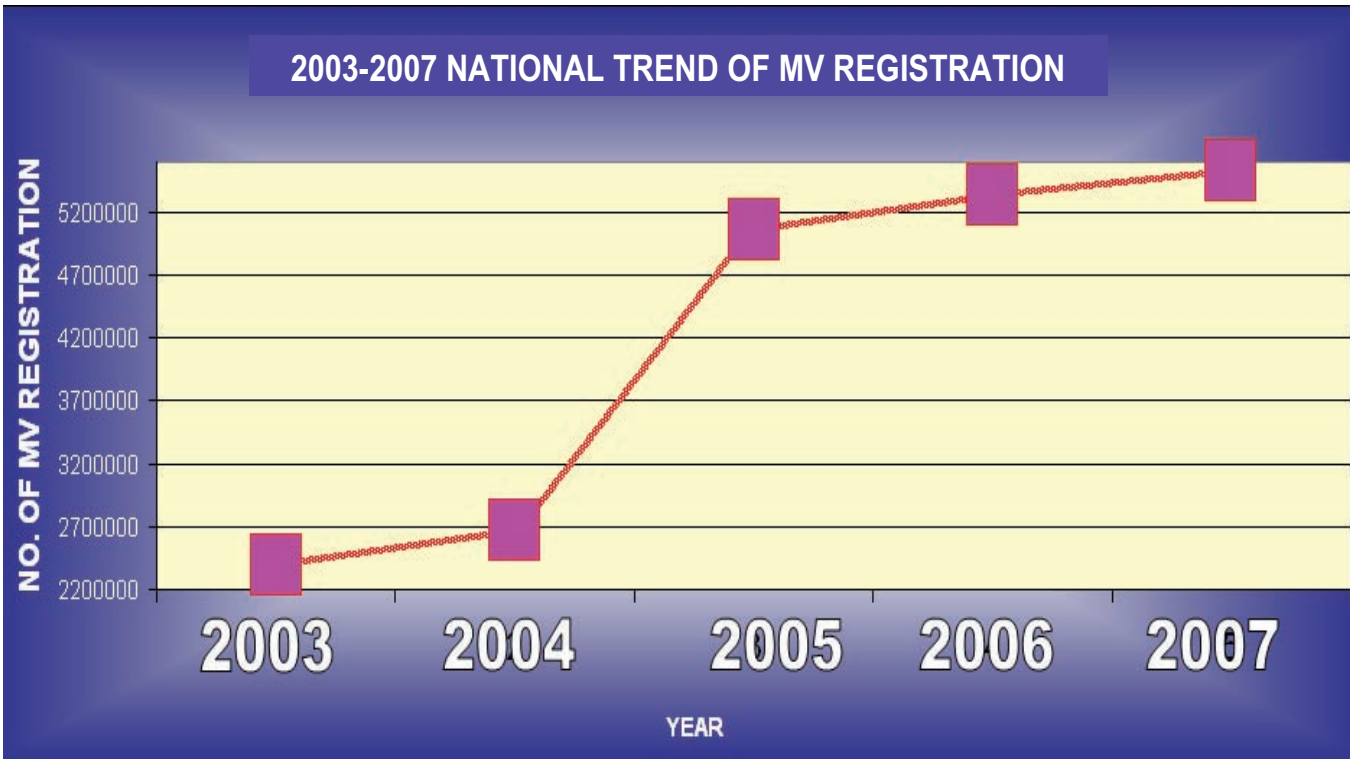
Source: LTO

As shown in Figure 1, MC/TC comprised the largest group (47.88 %), followed by UVs (29.98 %), cars (13.58 %), trucks (5.09 %), SUVs (3.49%), buses (0.55 %), and trailers (0.44 %). Figure 2 further shows that, in general, the number of motor vehicles has increased by more than 100% from 2003 to 2007. The increase of motor vehicle registration from 2003 to 2004 had been attributed to the high number of motorcycle registration.



Source: LTO

Figure 1. Percentage Share of National Motor Vehicle Registration By Vehicle Type



Source: LTO

Figure 2. Trend of National Motor Vehicle Registration , 2003-2007

T**able 2** gives the distribution of motor vehicles by region. The NCR has 29% of the total vehicles registered nationwide. Both Regions III and IV-A have about the same share of 13% of the total.

REGIONS	MOTOR VEHICLES REGISTERED			% INCREASE		AVE. %INC.
	2005	2006	2007*	06/'05	07/'06	
I	268,697	288,066	310,783	7.21	7.89	7.55
II	178,501	179,545	192,491	0.58	7.21	3.90
III	628,086	690,411	733,360	9.92	6.22	8.07
IV-A	641,349	681,994	722,767	6.34	5.98	6.16
IV-B	68,735	71,497	72,860	4.02	1.91	2.96
V	151,755	161,442	168,940	6.38	4.64	5.51
VI	276,458	300,353	305,498	8.64	1.71	5.18
VII	400,384	457,816	436,156	14.34	-4.73	4.81
VIII	105,875	110,961	119,996	4.80	8.14	6.47
IX	148,698	147,036	168,635	-1.12	14.69	6.79
X	137,791	154,698	158,416	12.27	2.40	7.34
XI	189,621	205,217	218,951	8.22	6.69	7.46
XII	164,794	205,618	205,211	24.77	-0.20	12.29
NCR	1,580,753	1,555,174	1,592,036	-1.62	2.37	0.38
C.A.R.	63,921	63,505	64,664	-0.65	1.83	0.59
CARAGA	54,335	58,241	59,288	7.19	1.80	4.49
TOTAL	5,059,753	5,331,574	5,530,052	5.37	3.72	4.55

* Excluding the unsubmitted reports of Malabang D.O. (Reg. XII-Oct. 2007); Patin-ay D.O. (CARAGA-Dec. 2007) and E-Patrol (Reg. VII-Sept.-Dec. 2007);Reg. II(Oct. 2007-Dec. 2007) & Rev-Up-Reg. IVA (Sept.-Dec. 2007)

Table 2 Regional Annual Total Motor Vehicle Registration (2005-2007)

Source: LTO

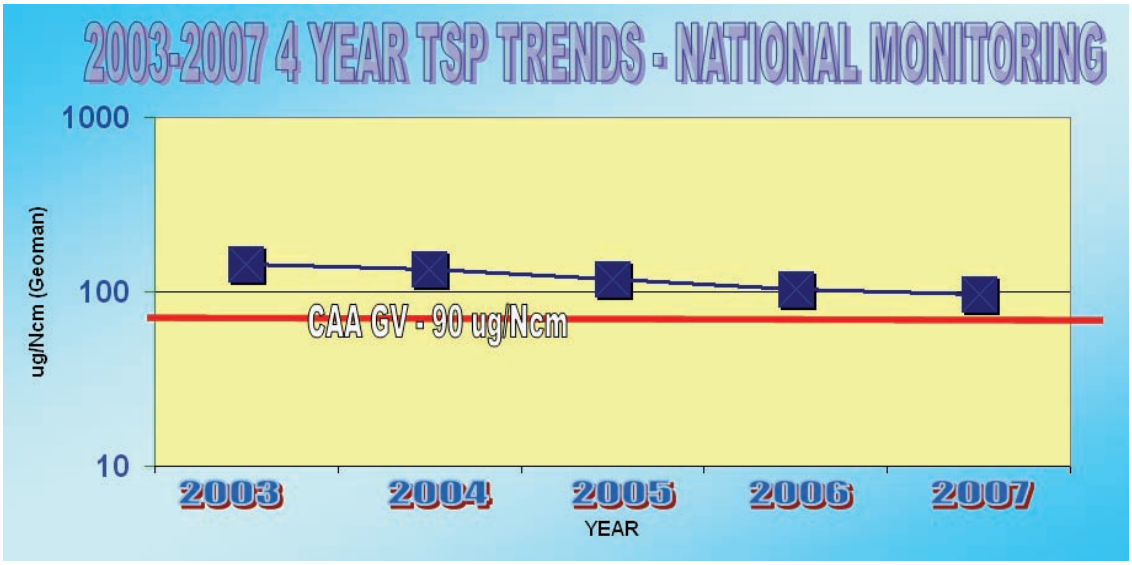
2.3 Area Sources

Area sources are relatively large areas of specific activities that generate significant amounts of air pollutants. These include busy roads and hubs, construction sites, aircraft operations, forest fires or the burning of wastes, residential sites, and similar dispersed sources. Areas sources which may emit relatively small amounts of pollutants when taken individually, but whose combined emissions add significantly to the air pollution in the area. Examples of these area sources of air pollution include:

- The open burning of solid wastes widely practiced in most urban centers including Metro Manila
- The continuing destruction of forests by fire thru kaingin and natural causes
- The burning of agricultural biomass after harvest, including rice, corn, and sugarcane stalks
- The aerial spraying of pesticides

3. Ambient Air Quality

Figure 3 shows the national total suspended particulate (TSP) monitoring from 2003 to 2007. A significant 33% improvement was observed with concentrations decreasing from 144 to 97 microgram per normal cubic meter (µg/Ncu.m.) Although trends are decreasing, TSP geometric mean concentrations are still above the 90 µg/Ncu.m. annual mean TSP guideline value for one year averaging time (Table 3). As such, more efforts are needed to comply with the guideline by 2010 as provided in the General Plan of Action for Air Quality Management. The locations of the ambient (roadside and general area) air quality monitoring stations in the different regions of the Philippines and the corresponding TSP concentrations (1 year 24-hour averaging time) are shown in Table 4.



Source: EMB

Figure 3. National Ambient TSP Trend (1 Year 24-Hour Averaging Time), 2003-2007

Table 3 – National Ambient Air Quality Guideline Values

Pollutants	Short Term[a]			Long Term[b]		
	µg/NCM	ppm	Averaging Time	µg/NCM	ppm	Averaging Time
Suspended Particulate Matter[c] –						
TSP	230[d]		24 hours	90		1 year[e]
PM-10	150[f]		24 hours	60		1 year[e]
Sulfur Dioxide[c]	180	0.07	24 hours	80	0.03	1 year
Nitrogen Dioxide	150	0.08	24 hours			
Photochemical Oxidants as Ozone	140	0.07	1 hour			
	60	0.03	8 hours			
Carbon Monoxide	35 mg/NCM	30	1 hour			
	10 mg/NCM	9	8 hours			
Lead[g]	1.5		3 months[g]	1.0		1 year

a - Maximum limits represented by ninety-eight percentile (98%) values not to exceed more than once a year.
b- Aritmetic mean.
c - SO_2 and suspended particulate matter are sampled once every six days when using the manual methods. A minimun of twelve sampling days per quarter or forty-eight sampling days each year is required for these methods. Daily sampling may be done in the fuutre once continuous analyzers are procured and become available.
d - Limits for Total Suspended Particulate Matter with mass median diameter less than 25-50 pm.
e - Annual Geometric Mean.

Table 4 – Ambient Air Quality Monitoring Stations in the Philippines (TSP) (1 Year 24 hour averaging)

National TSP Trending		2003	2004	2005	2006	2007
REGION	**STATIONS**	**CONCENTRATION (ug/Ncm)**				
National Capital Region (NCR	NCR-Makati NCR-Valenzuela NCR-Congressional Ave. NCR-East Ave. NCR-EDSA NPO Q.C. NCR-Ateneo NCR-Mandaluyong NCR-Manila NCR-Pasig NCR-Las Piñas NCR-Pasay NCR-EDSA MMDA NCR-EDSA MRT	198 247 225 179 157 83 136 180 101 37 178	211 206 275 170 164 105 133 134 109 135 226 236	183 152 129 163 87 124 138 106 134 213 323	153 157 104 138 72 121 111 90 159 159 316	146 146 102 125 65 134 110 92 140 257
Cordillera Autonomous Region	CAR-Plaza Garden	204	229	170	155	201
Region 1 Lingsat, City of San Fernando, La Union	Laoag City (in front of Heroes Bldg.) Alaminos City San Fernando City	130	 312 183	141 179	 153 155	 159 148
Region 2 Cagayan Valley	Tug. Station Brgy. 10 Tuguegarao City	198	59	102	84	98
Region 3 San Fernando	SM Elegant-San Fernando Iba Station Saluysoy Station Cabanatuan Bocaue, Bulacan Meycauayan, Bulacan MEL-VI Bldg., OG Road City of San Fernando Intercity Ind'l Subd. Wakas	117 101 141	 190 84	 309 103 370 309	 186 195	 116 215 457
Region 4A Mainland Provinces	Cavite	79	84	62	59	46
Region 4B MIMAROPA	Batangas Oriental Mindoro	127	144 217	140 86	46 110	49
Region 5 Legaspi City	Barriada, Legaspi City San Nicolas, Iriga City Panganiban Drive, Diversion Road, Naga City	110 110 106	72 108 84	72 88 83	125 95 101	84 76 105

Table 4 – Ambient Air Quality Monitoring Stations in the Philippines (TSP) (1 Year 24 hour averaging)

National TSP Trending		2003	2004	2005	2006	2007
REGION	**STATIONS**	**CONCENTRATION (ug/Ncm)**				
Region 6 – Iloilo City	Jaro Police Station	177	182	141	68	67
	Compound	92	104	81	87	110
	Lapaz Plaza					
Region 7 – Cebu City	Oportos Residence	72				
	Baricuatros residence	117		88		
	Canos Residence	93				
	MEPZI (PM_{10})	36				
	Mandaue Foam-H. Cortes St., Mandaue City		56	24.18		
	Valuerich, Sudlon, Mandaue City		64	42		
			89			
	Wilson Foods, Mandaue City			88	87	80
	Banilad, Mandaue City					
	N. Gupuit Res., Boundary Inuburan & Langtad, Naga, Cebu City				159	137
Region 8-Tacloban City	P&M Bldg. DENR Cpd., Sto. Niño Extn., Tacloban City		73	45		
Region 9-Zamboanga City	Station 1	237	220	154	155	128
	Station 2	226	209	161	149	105
	Station 3	227	218	170	126	110
Region 11-Davao City	Station 1 (5)	90	56	44	44	87
	Station 2 (6)	42			63	63
	Station 3 (7)	182	64	63	66	36
	Station 4 (8)	249	91	66	66	40
	Station 5 (9)	335	89	66		
	Station 6 (10)	39				
Region 12-Cotabato City	Station 1 in front of Palomolog, South Cotabato	99	135	81	85.5	90.17
	Station 2 in front of Mun. Hall Suralla, Cotabato city	93	91.94	80	85.57	87.31
	Station 3 in front of Mun. Hall, Isulan Sultan Kudarat	95	90.56	78	85.37	86.82
Region 13-Butuan City	New Asia, Butuan City	96	83	81	70	71

Source: EMB

The Philippine Nuclear Research Institute (PNRI) continued to monitor particular matter in the PM_{10} range using the Gent sampler at three sites in Metro Manila with two stations co-located with those of the Environmental Management Bureau. The monitoring is being done to identify the major sources of air pollution and to estimate the contribution of these sources to air pollution. Tables 5 and 6 represent the PM_{10} and $PM_{2.5}$ monitoring from year 2001 to 2007. Data show the minimum and maximum concentration of particulates in ug/Ncu.m.

Table 5. 2001 to 2007 PM_{10} Annual Mean Levels and Concentration Ranges at the PNRI Metro Manila Sampling Sites

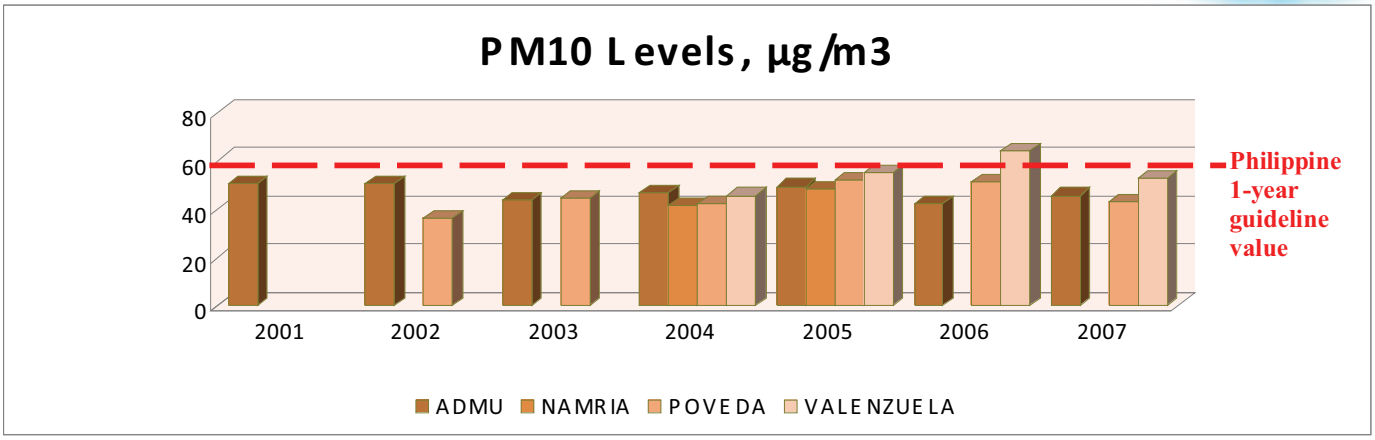
Year	Concentration in ug/cu.m. (range)			
	ADMU	NAMRIA	POVEDA	VALENZUELA
2001	50.4 (23.3-78.9)			
2002	50.3 (21.7-95.0)		36.4 (52-72.3)	
2003	44.0 (17.3-80.3)		44.8 (16.7-92.8)	
2004	47.0 (16.9-82.2)	41.5 (21.0-67.6)	42.6 (16.3-75.0)	45.7 (22.8-81.8)
2005	49.5 (18.5-179.0)	48.3 (19.0-78.4)	52.2 (24.8-89.4)	58.5 (19.7-104.3)
2006	42.5 (13.0-84.1)		51.6 (18.9-61.8)	64.0 (20.9-157.3)
2007	45.7 (22.2-84.0)		43.3 (19.2-85.5)	52.8 (18.0-113.0)

Source: PNRI

Table 6. 2001 to 2007 $PM_{2.5}$ Annual Mean Levels and Concentration Ranges at the PNRI Metro Manila Sampling Sites

Year	Concentration in ug/cu.m. (range)			
	ADMU	NAMRIA	POVEDA	VALENZUELA
2001	27.9 (10.1-49.1)			
2002	27.7 (13.0-50.5)		15.8 (1.1-32.1)	
2003	26.0 (2.8-49.8)		18.5 (3.2-39.0)	
2004	28.0 (11.8-51.4)	15.8 (4.8-33.2)	15.0 (4.3-35.0)	20.1 (9.4-32.6)
2005	30.0 (9.9-113.0)	22.0 (7.8-48.0)	19.6 (9.0-44.0)	25.0 (10.0-63.3)
2006	25.8 (8.2-42.1)		21.7 (8.27-25.3)	29.2 (9.2-68.8)
2007	25.9 (10.6-43.3)		16.8 (2.3-48.0)	19.8 (8.9-39.6)

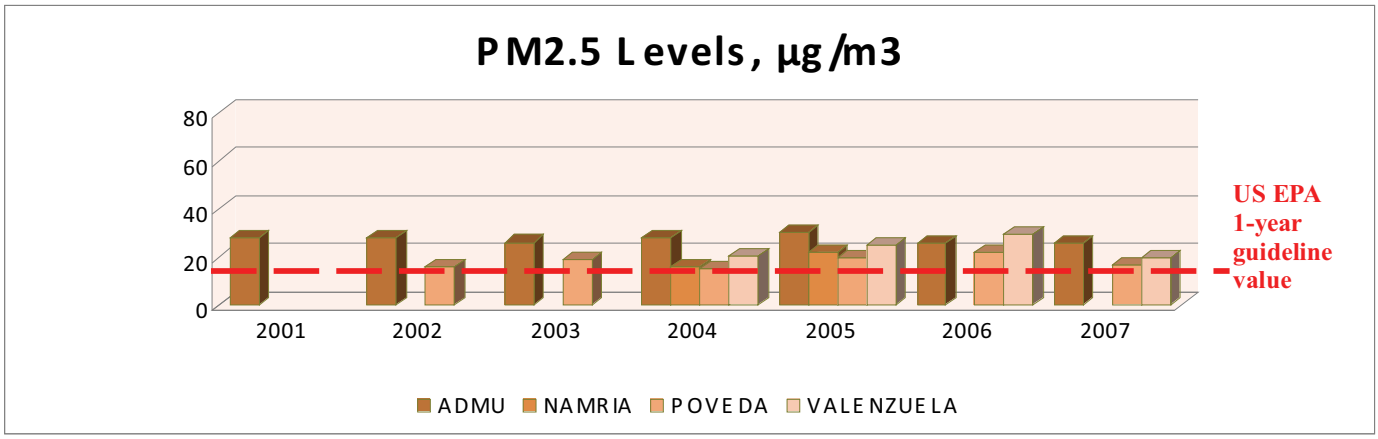
Source: PNRI



Source: PNRI

Figure 4. PM_{10} Annual Mean Levels at the PNRI Metro Manila Sampling Sites 2001 to 2007

Furthermore, PM_{10} annual mean levels in all the PNRI Metro Manila sampling sites are in compliance with the Annual Ambient Air Quality long term guideline value of 60 µg/m3 except for Valenzuela in 2006 and are in general showing decreasing trends in 2007 compared to 2006.



Source: PNRI

Figure 5. $PM_{2.5}$ Annual Mean Levels at the PNRI Metro Manila Sampling Sites

Also, $PM_{2.5}$ annual mean levels in all the PNRI Metro Manila sampling sites, although showing a general decreasing trend in 2007 compared with 2006, have consistently been in exceedance of the US EPA long term guideline value of 15 µg/m3 indicating a need to address fine particulate pollution.

4. Air Quality Management

4.1 Emissions Inventory

Emission Inventory is an estimation of the sources, extent, and future trends of air pollutants in a given area. Although inventories are merely approximations, results serve as basis in the prioritization of air quality regulations. The conduct of emission inventory is required by the CAA of 1999 or RA 8749 once every three years. Emissions inventories use information submitted by companies as part of their self monitoring and permitting requirements. The previous emissions inventory was conducted in 1990 and was updated in 2001-2004, and continuously three years thereafter. The Philippine emissions inventory covers criteria pollutants which include PM, sulfur oxide, nitrogen oxide, carbon monoxide, volatile organic compounds, and total organic gases from mobile sources.

Emission inventory in the Philippines utilizes emission factors. These are numerical values relating the quantity of pollutants released from a source to some activity associated with those emissions. It is an excellent tool in conducting emission inventories used in quantifying and identifying the extent of air pollution emitted by a certain source. With regards to motor vehicles, local emission factors were developed under the 1992 vehicular emission control program funded by the Asian Development Bank. For stationary sources, the USEPA AP-42 is used.

Based on the 2006 National Emission Inventory, majority of the regions in the country point to the transport sector as the major source of air pollution. As shown in Figure 6, it was estimated that 65% of the pollutants came from mobile sources, 21% came from stationary sources, and the remaining 14% from area sources.

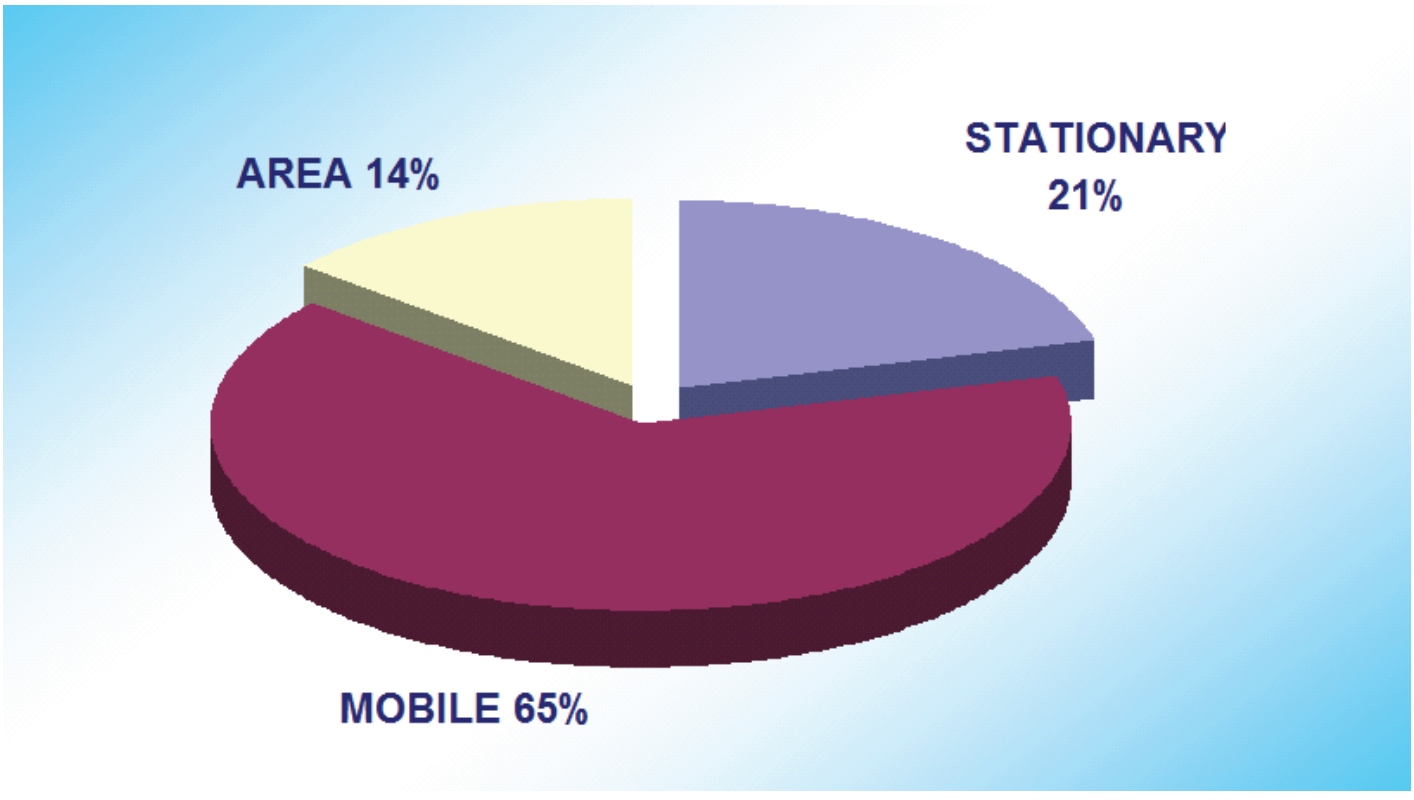


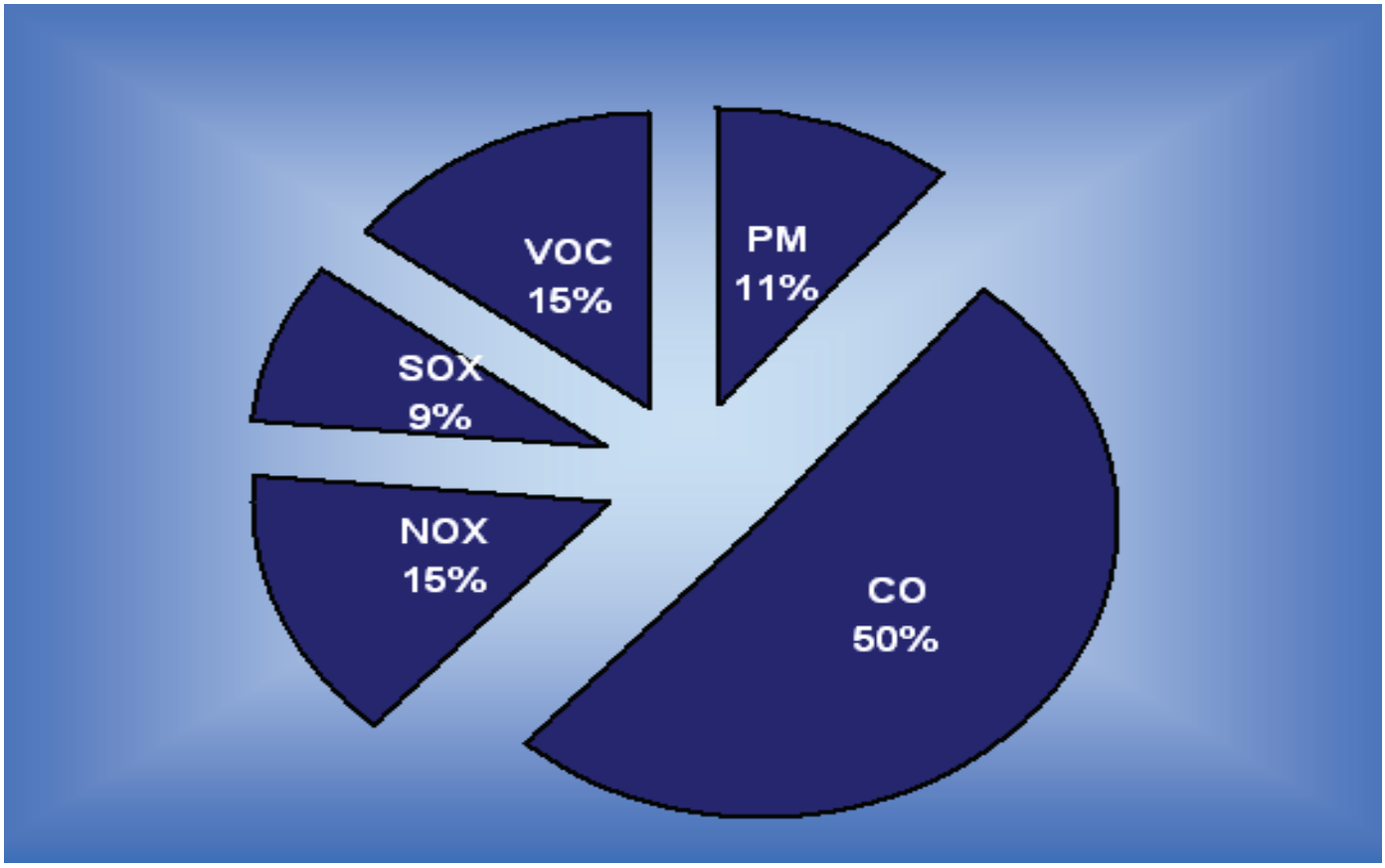
Figure 6. 2006 National Emissions Inventory According to Source of Air Pollution

Table 7 shows that CO has the biggest pollution load contribution of 50%. CO emission is relatively caused by the increasing population of gasoline-fed vehicles which include MC/TC (47.88%) and cars (13.58%). Other pollutants contributions are as follows: NOx – (15%), VOC-(15%), PM-(11%), SOx – (9%).(see Figure 7).

Table 7– 2006 National Emissions Inventory (in tons/year)

Source	PM	SOx	NOx	CO	VOC	Total	%
Stationary	110,023	598,634	326,219	360,620	67,859	1,463,385	21
Mobile	244,764	14,309	405,033	9,988,616	914,996	4,567,719	65
Area	423,615	1,963	327,261	165,647	63,855	982,340	14
Total	**778,402**	**614,937**	**1,058,514**	**3,514,883**	**1,046,710**	**7,013,444**	**100**
%	11	9	15	50	15	100	

Source: EMB



Source: EMB

Figure 7. 2006 National Compilation of Emissions Inventory According To Criteria Pollutants

4.2 Management of Stationary Sources

The EMB, through its regional offices, is in-charge of monitoring industrial firms. For complying industries, permit to operate (PO) are issued with a maximum of five years. For companies found to violate environmental laws, notices of violations (NOVs) are issued and for non-complying companies a Cease and Desist Order (CDO) will be issued by the Pollution Adjudication Board (PAB).

From 2005-2007, a total of 18,697 firms were monitored. Also, a total of 1,676 NOVs and 24,391 POs were issued within the three-year period. The breakdown of NOVs and POs for all regions is shown in Table 8. Compared to the other regions, the NCR has the most number of NOVs issued annually. Region 4-a, where most of the industries are located, has the highest number of POs.

Establishments that emit air pollutants are required to submit to EMB a self monitoring report (SMR) that demonstrates their compliance with environmental regulations, including the CAA. The SMR, which is submitted on a quarterly basis, contains among others, concentration and flow rate of air pollutants emitted by the establishment.

The EMB, through its regional offices, validates compliance of establishments with CAA through stack sampling.

Major industrial facilities such as power plants and cement plants are required to install continuous emissions monitoring systems.

Table 8 - Notice of Violations (NOV) and Permit to Operate (PO) Issued, 2005-2007

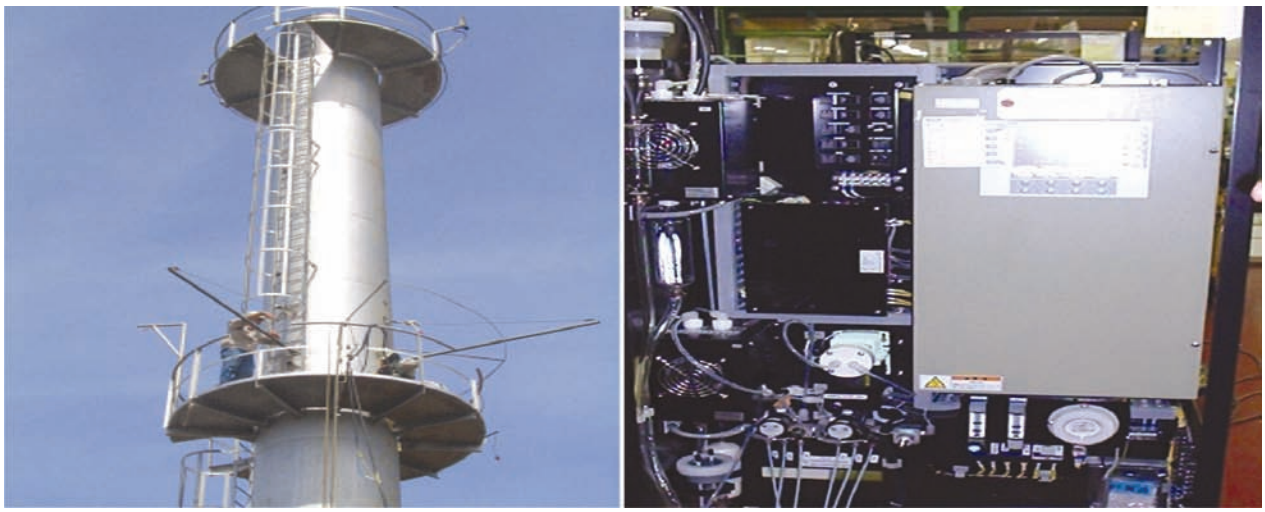
Region	2005		2006		2007	
	NOV	PO	NOV	PO	NOV	PO
NCR	216	1,795	209	907	218	727
CAR	-	264	10	168	11	132
1	23	510	-	475	40	353
2	37	330	40	458	-	308
3	52	673	36	584	46	644
4a	-	2,438	5	1,281	11	1,727
4b	-	379	20	321	48	285
5	41	416	71	655	70	800
6	148	608	33	541	16	458
7	20	687	50	698	31	662
8	-	217	5	224	6	280
9	3	139	-	145	-	180
10	16	535	10	233	1	334
11	46	364	30	400	21	223
12	8	184	8	80	9	93
13	1	120	5	171	5	185
Total	**611**	**9,659**	**532**	**7,341**	**533**	**7,391**

Source: EMB

EMB technical personnel doing stack sampling work

Accreditation of Third Party Source Emission Testing Firm

Accreditation of Source Emission Testing Firm aims to provide assurance to stakeholders, regulators and the public of the reliability of source emission test results; and to ensure that accredited firms are fully capable of conducting source emission tests in accordance with the Implementing Rules and Regulations (IRR) of RA 8749 DENR Administrative Order (DAO) 2000-81. There are six accredited firms that provide source emission testing services to demonstrate compliance with the CAA IRR standards. The firms have undergone performance test that include oral and written examination and on-site demonstration.



The CEMS consists of a probe installed in a smoke stack (photo at left) which is connected to an analyzer (photo at right) to continuously measure the concentration of air pollutants.

Continuous Emission Monitoring Systems

Continuous Emission Monitoring Systems (CEMS) "means the total equipment required under the Clean Air Act's Implementing Rules and Regulations or as directed by the EMB, used to sample and condition (if applicable), analyze, and provide a permanent record of emissions or process parameters. Such record shall be the basis of the firm's compliance with the emission standards. Further, it may be an approved monitoring system for continuously measuring the emission of a pollutant from an affected source or facility and as such, may be used in computing annual emission fees."

Stationary sources with actual emissions per year of 750 tons per regulated pollutant are reqiured to install CEMS to monitor and report compliance to emission standards.

4.3 Management of Mobile Sources

The LTO enforces compliance with emission standards for motor vehicles pursuant to pertinent provisions of the CAA of 1999 and its Implementing Rules and Regulations.

Motor Vehicle Inspection System (MVIS) Project

Under the IRR of the CAA, all private in-use motor vehicles and vehicles with updated/enhanced engines whose chassis are pre-registered with the LTO will only be allowed renewal of annual registration upon inspection by the LTO or other authorized private motor vehicle inspection center.

The MVIS project involves the construction of motor vehicle inspection centers to cover all types and classifications of motor vehicles all over the country. The centers shall be situated in areas with high motor vehicle density such as the National Capital Region (NCR), Metro Davao, and Metro Cebu, and in urban areas with satellite city/townships as clusters. The MVIS centers shall be equipped with the state-of-the-art equipment and shall be fully computerized. The IRR of the Clean Air Act directed the LTO to establish MVIS in Metro Manila by 2003 and nationwide implementation shall follow in 12 to 18 months thereafter. Upgrading and rehabilitation shall be given priority in the existing six LTO MVIS (NCR-North and South, Regions III, IV-A, VII and XI).

Private Emission Testing Center (PETC) Program

A PETC is a privately – owned facility for determining the level of opacity and testing the gaseous content of motor vehicle emissions. Its job is to determine if the vehicle emissions conform to the standards set by the DENR under the CAA.

The Department of Trade and Industry (DTI) and the Department of Transportation and Communications (DOTC) issued a Joint Administrative Order (JAO) setting the guidelines for the accreditation of PETCs for motor vehicles. There are currently 575 PETCs nationwide.

Certified technicians perform emission tests on vehicles

Compliance with emission standards of all motor vehicles has been started in January 2003 in a nation-wide scope through the operationalization of PETCs. The DOTC through the LTO authorizes PETCs that have been previously accredited with the DTI. The DENR, on the other hand, is responsible for regulating the specifications of the emission testing equipment by PETCs.

Renewal of vehicle registration as well as retrieval of confiscated licensed plates due to smoke belching requires the presentation of Certificate of Emission Compliance (CEC) to LTO. Activities involved in this program are the interconnectivity between the LTO and the PETCs for real time monitoring and validation of data prior to motor registration; and strict monitoring of PETC operations via decentralized setup with the LTO regional offices directly responsible for PETCs operating within their respective areas of responsibility.

The Technical Education and Skills Development Authority (TESDA) is in charge of implementing the assessment and certification program for the Motor Vehicle Emission Control Technician (MVECT). All certificates relating to the national trade skills testing and certification system shall be issued by the authority through the TESDA Secretariat. In addition, the Secretary of Labor and Employment shall determine the occupational trades for mandatory certification.

Private industry groups and trade associations are accredited to conduct approved trade tests, and the local government units to promote such trade testing activities in accordance with the guidelines to be set by the Authority. Accreditation of technicians that is provided by MVECT is a requirement of the PETC program. With the issuance of the DENR-DTI-DOTC Joint Administrative Order No.1 series of 2007 or the Amended Guidelines and Procedures for the Monitoring of Accredited and Authorized Private Emission Testing Centers (PETC) and LTO emission testing activities, the compliance with the provisions of the Philippine Clean Air Act is monitored and ensured.

Roadside Smoke Emission Apprehension and Testing

Vehicles observed to be emitting excessive smoke while operating in any public highway may be subjected to an emission test by properly-equipped law enforcers and other deputized agents from the

Table 9 – Anti-Smoke Belching Apprehensions for 2005-2007

REGIONS	Apprehensions		
	2005	2006	2007
I	18	4	11
II	65	8	867
III	7	469	499
IV-A	199	704	285
IV-B	2		
V		64	189
VI	67	127	118
VII	966	331	754
VIII	294	284	228
IX	10	103	8
X	27	14	58
XI	2	7	3
XII			
CAR	1,279	1,051	32
CARAGA			
C.O.	12,922	12,110	8,504
TOTAL	**15,858**	**15,276**	**11,556**

Source: LTO

DOTC-LTO, Metro Manila Development Authority (MMDA), and local government units in strategic points in Metro Manila.

Table 9 shows the total number of apprehensions of smoke belching vehicles. For 2005, a total of 15,858 apprehensions were made by the LTO. Meanwhile, for 2006, a total of 15,276 vehicles were apprehended. For 2007, apprehensions reached a total of 11,556.

Under the "Bantay Tambutso" program, the DENR-EMB-NCR intensified its anti-smoke belching campaign through roadside apprehension along the stretch of EDSA and other high traffic density areas in Metro Manila. Some of the anti-smoke belching activities conducted were held in the cities of Caloocan, Quezon, Mandaluyong, Makati, Pasay, Mandaluyong and Muntinlupa.

As of December 2007, the DENR-EMB-NCR Anti-Smoke Belching Unit (ASBU) Team, inspected a total of 15,238 vehicles and apprehended a total of 12,497 vehicles for failing the emission standards. This was made possible through the combined efforts of the DENR ASBU Team, local government units and non-government organizations.

Emission Control for Motor Vehicles

- Emission Limits for Type Approval and In-use Emission Standards

The adoption of EURO 2 type approval standards for new motor vehicles was signed in 2007 to take effect in 2008, pursuant to DENR Administrative Order 2007-27. In-use vehicles shall comply with stringent emission standards for vehicles registered after 31 December 2007.

- Certificate of Conformity

A COC is issued by the DENR, through EMB, to a motor vehicle manufacturer, assembler, or importer certifying that a motor vehicle type complies with the numerical emission standards stipulated in DAO 2000-81 and DAO 2007-27, using the relevant Economic Council for Europe (ECE) test procedures or their equivalent as approved by the DENR. No new motor vehicle is allowed initial registration unless a valid COC is issued by the Department through the Bureau.

Table 10 shows the total number of COC issued for passenger vehicles, light commercial vehicles, heavy duty vehicles and motorcycles for the period 2005-2007. In 2005, a total of 96 COCs were issued for passenger vehicles and light commercial vehicles, nine COCs for heavy duty vehicles and 38 COCs for motorcycles. In 2006, a total of 125 COCs were issued for passenger vehicles and light commercial vehicles, 31 COCs for heavy duty vehicles and 23s COC for motorcycles. Finally, in 2007, a remarkable increase in the number of COCs issued was recorded, with a total of 343 COCs for passenger vehicles and light commercial vehicles, 81 COCs for heavy duty vehicles and 171s COC for motorcycles. This is largely attributed to the computerization of LTO's registration process.

Table 10. Certificate of Conformity (COC) Issued, 2005-2007

Class/Type of Motor Vehicles	No. of COCs Issued
PASSENGER VEHICLES/LIGHT COMMERCIAL VEHICLES (M1, N1)	564
HEAVY DUTY VEHICLES	121
MOTORCYCLES	232

Source: EMB

4.4 Regulations and Policies

From 2005-2007, the DENR-EMB issued policies on air quality management as shown in Table 11. These directives were issued to further strengthen the implementation of air quality efforts in the country.

Table 11. Policies Issued from 2005-2007

DENR Administrative Order (DAO) Number	Policy Title	Date of Issuance
DENR- DTI- DOTC Joint Adminstrative Order No. 1 Series of 2007	Amended Guidelines and Procedures for the Monitoring of Accredited and Authorized Private Emission Testing Centers (PETC) and Land Transportation Office (LTO) Emission testing Activities	December 2007
DAO 2007-27	Revised Emission Standards for Motor Vehicles Equipped with Compression-Ignition and Spark-Ignition Engines	31 July 2007
DAO 2007-25	Guidelines for DENR Accreditation of Third Party Source Emission Testing Firms	31 July 2007
DAO 2007-22	Guidelines on the Requirements for Continuous Emission Monitoring Systems (CEMS) and other Accepted Protocols . thereby Modifying and Clarifying Certain Provisions	31 July 2007

Source: EMB

4.5 Clean Fuels and Fuel Quality

As mandated, the Department of Energy (DOE) and the Department of Environment and Natural Resources (DENR) co-chair the Technical Committee on Petroleum Products and Additives (TCPPA) which sets specifications of all types of fuel and fuel-related products to improve fuel composition for increased efficiency and reduced emissions. Aside from DOE and DENR, the TCPPA is composed of representatives of DTI-Bureau of Product Standards (BPS), the Department of Science and Technology (DOST), the fuel and automotive industries, academe and the consumers. Specifications of all types of fuel are adopted by the BPS as Philippine National Standards (PNS).

Likewise, the DOE, specifically the Oil Industry Management Bureau, is mandated to monitor the compliance of the oil companies/dealers nationwide.

RA 9367 otherwise known as the Bio-fuels Act of 2006 “An Act to Direct the Use of Bio-fuels, Establishing for this Purpose the Biofuels Program, Appropriating Funds therefore, and for other Purposes” was signed into law by the President on January 12, 2007 and became effective on February 6, 2007. The “Bio-fuels Policy” aims to achieve energy independence and fuel diversification while meeting environmental challenges through the utilization of agricultural-based feed stocks thus increasing economic activity, especially in country side. A National Biofuel Board was established as an advisory body to DOE. Biofuel refers to fuels made from biomass and primarily used for automotive, thermal and power generation, with quality specifications in accordance with the Philippine National Standards (PNS).

As mandated in the Act, bio-diesel blend of 1% (B1) by volume is available in all gas/pump stations nationwide since May 2007 (no more 100% conventional diesel). Likewise, bio-ethanol blend of 10% (E10) is distributed and sold by some oil companies/dealers in the country. The biofuel and their blends are either manufactured/imported/sold conforming to the Philippine National Standards.

Table 12 shows the fuel properties critical under CAA and closely monitored by the DOE.. The level of compliance of oil industry players nationwide with the benzene and aromatics standard for gasoline was 100%, while that for sulfur in automotive diesel oil was 97%.

Table 12. Critical Fuel Properties under CAA

Fuel	Parameter	Level
Gasoline	aromatics	35% by vol. (maximum)
	benzene	2 % by vol. (maximum)
	AKI	87.5 (minimum)
	Reid Vapor Pressure	9 psi (maximum)
Automotive Diesel	sulfur	0.05% by wt. (maximum)
	Cetane index	48 (minimum)

Source: CAA

Coal Consumption and Importation

Coal is a black or brownish black, solid combustible rock used mainly in the generation of electricity and manufacture of cement. Currently, coal-fired thermal power plants remain as the number one producer of electricity and account for a total of 3,967 MW or 25% of the country's total installed powered generating capacity.

Coal deposits are scattered over the Philippines but the largest deposit is located in Semirara Island, Antique. The country's largest coal producer is Semirara Mining Corporation (SMC), which contributes about 92% of the local coal production. Coal mines are also located in Cebu, Zamboanga Sibuguey, Albay, Surigao and Negros Provinces.

Based on the 2006 Update of the Philippine Energy Plan (PEP), coal production in 2004 surpassed the 2003 level by 34 percent from 2.0 MMMT in 2003 to 2.7 MMMT in 2004. Improved coal production of big mining companies such as the Semirara Mining Corporation (SMC) as well as good weather conditions contributed to this positive development. SMC produced a total of 10.09 MMBFOE of coal from its Panian Pit on Semirara Island, Antique, increasing by 1.39 MMBFOE from its 2004 production level.

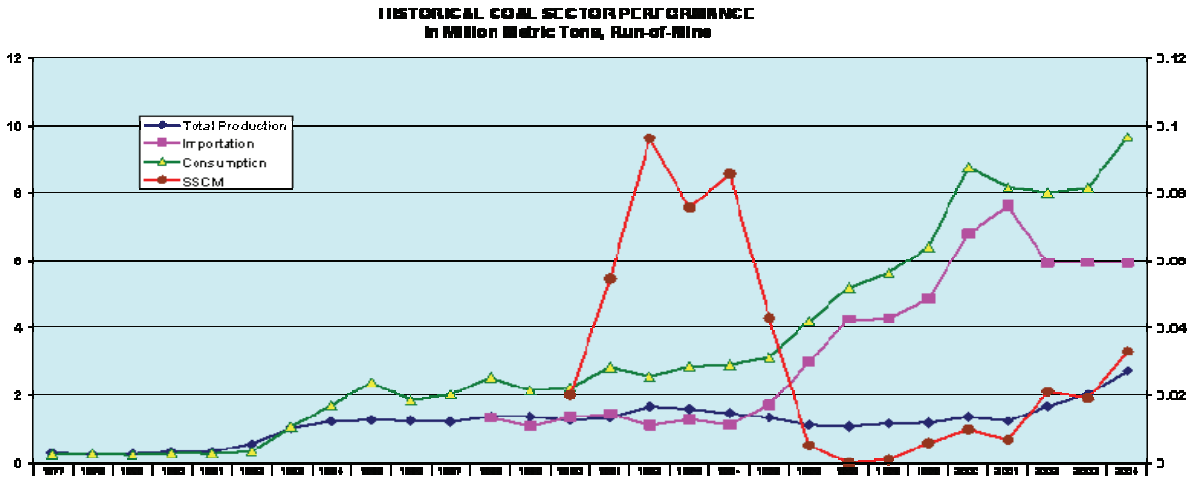


Figure 8. Historical Coal Sector Performance

The local coal consumption for 2006 as of December 12 was 9.5 MMT, 73% of which was for power generation, 22.5 % for cement production, and 3.75% for other industrial operations. In 2005, local coal production reached 3.1 MMMT, an increase of 16% from the 2004 level. Domestic coal production is estimated to yield a 12.5% increase in the next 10 years from 3.1 MMMT in 2005 to 6.6 MMMT in 2014 at 10,000 BTU/lb. Coal production in 2006 was 2.5 MMMT run-of-min, 2.5% of which came from small-scale coal mining operations. With the cement industry, power generating plants and process industry as major coal users, coal consumption for the year 2005 reached 36.22 MMBFOE or 4.80 percent higher than the 2004 consumption of 34.56 MMBFOE. Coal consumption of the industrial sector reached 32.91 MMBFOE in 2005, 18.69 percent higher than the 2004 level of 27.75 MMBFOE. This is primarily due to the increased consumption of some of the local cement factories and coal-fired power plants.

The country's coal requirements are sourced from domestic production and importation. For 2005, total importation reached 7.0 MMMT, 49% of which came from Indonesia, 32% from China, 10% from Australia and 7% from Vietnam (Figure 9).

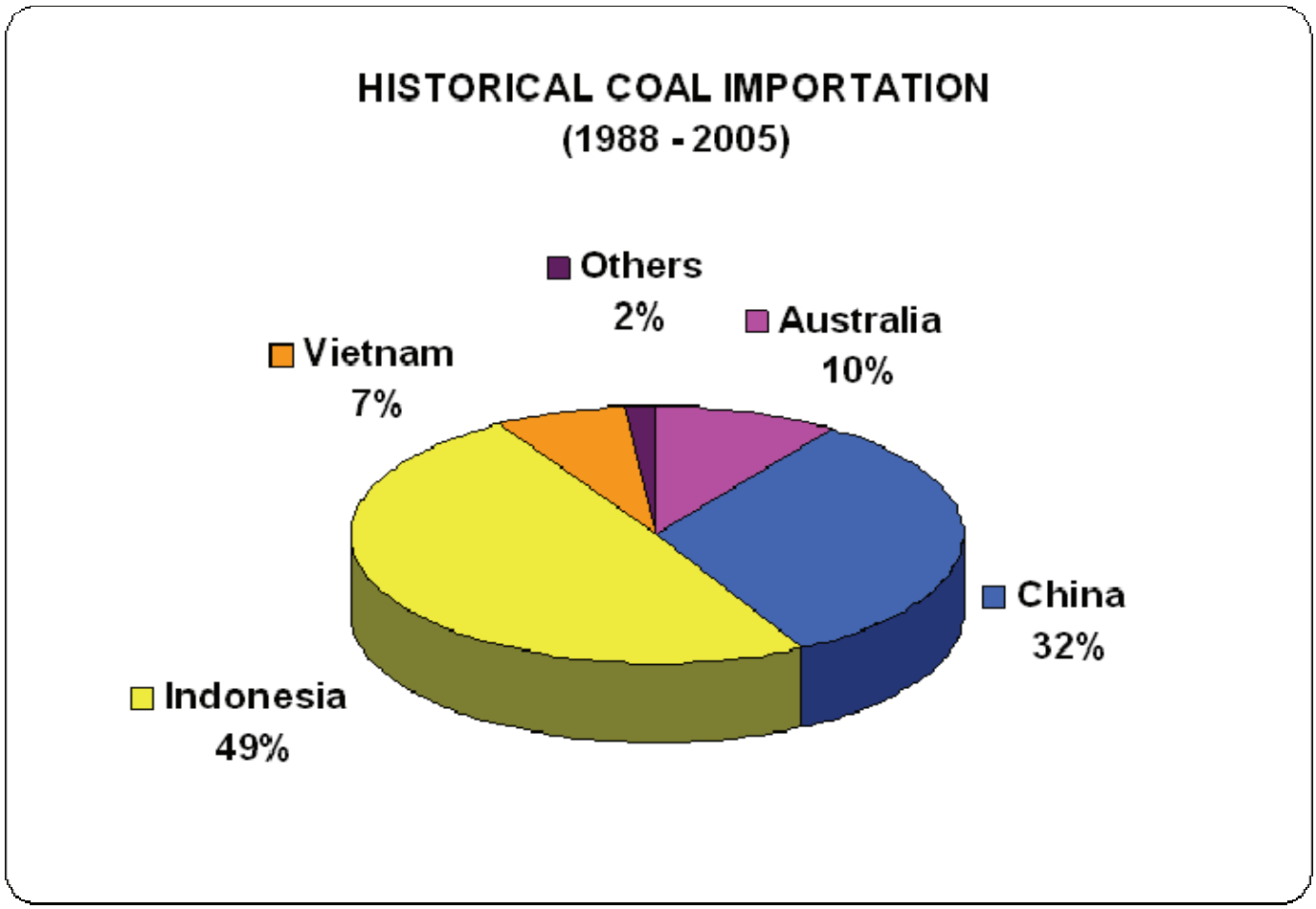


Figure 9. Sources of Coal Importation

Clean Coal Technologies

The combustion of coal and other fossil fuels emits oxides of Sulfur (SOX) and Nitrogen (NOx) as well as Carbon dioxide (CO_2) to the atmosphere. However, these are minimized or eliminated through the use of clean coal technologies such as fluidized bed combustion, flue gas de-sulfurization and electrostatic precipitation.

To address environmental concerns, the DOE encourages the operation of coal power plants that utilize clean coal technologies. Efforts to educate the public are likewise intensified to better inform them of such clean coal technologies.

Alternative Fuels Program

Alternative fuels are fuels that are not composed substantially of petroleum and thus, are alternatives to petroleum. As a substitute to this "traditional" fuel, it is expected to yield significant energy security and environmental benefits to its consumers. Methanol, denatured ethanol, and other alcohols blended with gasoline, diesel or other fuels are alternative fuels. Those that act as substitutes to petroleum, such as natural gas, liquefied petroleum gas, hydrogen, and coal-derived liquid fuels are also considered as alternative fuels, as are fuels derived from biological materials and electricity.

The Alternative Fuels Program is one of the five key components of the Arroyo Administration's Energy Independence Agenda, which outlines the roadmap that will lead to the country's attainment of 60% energy self-sufficiency by 2010.

The Program has four major subprograms, namely Biodiesel Program, Bioethanol Program, Natural Gas Vehicle Program for Public Transport (NGVPPT), and Autogas Program. Other technologies advocated under the program are hybrid, fuel cell, hydrogen, and electric vehicles. As of 2007, twenty two (22) commercial buses have been utilized under the NGVPPT.

The Department of Energy (DOE) is implementing a long-term Alternative Fuels Program to reduce the country's dependence on imported oil and provide cheaper and more environment-friendly alternatives to fossil fuels. Through the said program, the DOE intends to tap the country's domestic produce as viable sources of energy. The goal is to develop indigenous and renewable energy fuels for long term energy security, which will be a pillar for our country's sustainable growth.

4.6 Airsheds

An airshed is a part of the atmosphere that behaves in a coherent way with respect to the dispersion of atmospheric emissions. The Philippine Clean Air Act of 1999 (RA 8749) and its Implementing Rules and Regulations defines an airshed as "areas with similar climate, weather, meteorology and topography which affect the interchange and diffusion of pollutants in the atmosphere." Table 11 provides the list of designated airsheds nationwide.

From 2005 to 2007, two (2) airsheds were additionally designated. These are the Metropolitan Iloilo Airshed (Region 6) designated in 2005 which covers the areas of Oton, Pavia, Leganes, San Miguel and Iloilo City, and the Baco-Naujan-Calapan (Region 4-B) Airshed designated in 2006 which covers the municipalities of Baco and Naujan as well as the entire Calapan City. Airsheds are to be managed by multi-sectoral governing boards which are tasked to formulate policies and standards as well as action plans to effectively manage the air quality situation within their respective areas.

Table 13. Designated Airsheds Nationwide

Name of Airshed	Region	MC No. and date signed	Coverage
Metro Manila Airshed	NCR, 3 and 4A	DAO No.2002-05 dated January 23, 2002	17 cities and municipalities in Metro Manila. Part of Region 3 (Bataan, Bulacan and Pampanga) and part of Region IV (Cavite, Laguna, Rizal and part of Quezon Province)
BLIST Airshed	CAR	MC No. 2002-03 dated February 12, 2003	City of Baguio and Municipalities of La Trinidad, Itogon, Tuba and Sabang
Northeastern Pangasinan	1	DAO No. 07 Series of 2004 dated March 23, 2004	Binmaley, San Fabian, Lingayen, Laoac, San Jacinto, Calasiao, Mangaldan, Manaoag, Binalonan, Malasiqui, Mapandan, Pozorrubio, San Carlos City, Sison, Sta. Barbara, Urdaneta City, Dagupan City, San Manuel
Metro Tuguegarao (PIESTTA) Airshed	2	DAO No. 05 Series of 2004 dated March 23, 2004	Peñablanca, Iguig, Enrile, Solana, Tuguegarao City, Tuao, Amulong
Baco-Naujain-Calapan Airshed	4B	DAO No. 02 Series of 2006 dated January 16, 2006 published January 19, 2006	Baco, Naujan municipalities and Calapan City
Naga City Airshed	5	DAO No. 2003-33 dated July 14, 2003	Abella, Balatas, Bagumbayan Norte, Lerma, Liboton, Bagumbayan Sur, Pacol, Sta. Cruz, Concepcion, Pequeña, Sabang, San Isidro, Dayangdang, Dinaga, Triangulo, Del Rosario, Tabuco, Cararayan, Panicuason, Tinago, Igualdad Peñafrancia, Calauag, San Felipe and San Francisco
Bacon-Manito Geothermal Airshed	5	DAO No. 11 Series of 2004 dated May 18, 2004	Ranges: **Latitude** $12^0$59"58.0897-$13^0$4"37.2524 **Long:** $123^0$51"41.1827-$123^0$59"32.0355
Metropolitan Iloilo Airshed	6	DAO No. 2005-11 dated June 10, 2005	Oton, Pavia, Leganes, San Miguel, Iloilo City

Name of Airshed	Region	MC No. and date signed	Coverage
Southern Negros Geothermal Airshed	7	DAO No. 14 Series of 2004 dated May 18, 2004	Ranges: **Latitude** 9^{0}15'38.2244 to 9^{0}20'5.4437 **Long**: 23^{0}7'18.0068 to-123^{0}12'45.2140"
Metro Cebu Airshed	7	DAO No. 2002-21 dated October 7, 2002	Cities of Mandaue, Cebu, Lapu-lapu and Talisay Municipalities of Naga, Manglanilla, Cordova, Liloan, Compostela and Consolacion
Leyte Geothermal Airshed	8	DAO No. 12 Series of 2004 dated May 18, 2004	Range: **Latitude** 11^{0}5'14.1879" to 11^{0}12'17.1161" **Long.** 123^{0}36'20,000 to 124^{0}41'9.6469
Zamboanga Airshed	9	DAO No. 47 Series of 2003 dated September 2003	A. City Proper (Zone I, II, II, IV) B. North-West Coast Area (Ayala, Canclar, Recodo, Baliwasan, Capisan, San Ramon, Baluno, Cawit, Caragasan, San Roque, Cabatangan, Sinunuc, Calarian, La Paz, Sta. Maria, Camino Nuevo, Maasin, Sto. Niño, Pitogo, Tulungatung, Malagutay, Talisayan, Pamucutan, Upper Pasonanca (Dulian), Pasonanca C. East Coast Area (Arena Blanco, Lumayan, Sangali, Boclan, Lumbangan, Sta. catalina, Cabaluay, Cacao Lunzuran, Talaboan, Mampang, Talon-Talon, Culianan, Manicahan, Talon-Talon Loop, Divisoria, Mariki, Taluksangay, Guisao, Mercedes, Tetuan, Guiwan, Pasobolon, Tugbunga, Kasanyangan, Putik, Tumaga, Lamisahan, Rio Hondo, Victoria, Lampacan, Salaan, Zambowood Lanzones
Cagayan de Oro	10	DAO No. 45 Series of 2003 dated September 12, 2003	Cagayan de Oro City and Municipalities of Jasaan, Villanueva, Tagoloan, Opol and El Salvador
North Cotabato Geothermal Airshed	11	DAO No. 13 Series of 2004 dated May 18, 2004	Ranges: **Latitude** 6^{0}59'9.3947 to 7^{0}240.3374 **Long:** 125^{0}12'13.3856 to -125^{0}15'19.7223"

Name of Airshed	Region	MC No. and date signed	Coverage
South Cotabato Airshed	12	DAO No. 2004-22 dated August 3, 2004	Gen. Santos City, Koronadal City, Tupi, Polomolok, Tampakan, Tantangan, Banga, Surallah, Norala, Sto. Niño, T'boli, Lake Sebu
Agusan del Norte Airshed	CARAGA	DAO No. 2003-16 dated June 6, 2003	Butuan City, Buenavista, Cabadbaran, Carmen, Jabonga, Kitcharao, Las Nieves, Magallanes, Nasipit, Santiago, Tubay, and Remedios T. Romualdez
Metro Manila Airshed – revising the Initial Area Coverage of Metro Manila Airshed	NCR, R4-A, R3	DAO No. 07, Series of 2007	Bulacan, 16 Municipalities & 1 City: Pampanga-one-Eco Zone, 1 city & 20 municipalities; Bataan – 10 municipalities; Cavite-21 municipalities & 1 City; Laguna-4 municipalities & a City; Rizal-14 municipalities and a City; NCR- 17 cities

4.7 Air Quality Management Fund

The Air Quality Management Fund (AQMF) was established as a special account in the National Treasury to be administered by the DENR to finance containment, removal, and clean-up operations of the Government in air pollution cases; guarantee restoration of ecosystems and rehabilitate areas affected by the acts of CAA violators; and support research, enforcement, monitoring activities and capabilities of the relevant agencies pursuant to Section 14 of the Philippine Clean Air Act of 1999. The AQMF can also be used by the Airshed Governing Boards. The AQMF was assigned Fund Code 155 by the National Bureau of Treasury (BTr) in April 2004.

Sources of the Fund include the following: 1) air emission charges from industrial and mobile sources; 2) fines and penalties for non-compliance with environmental standards; 3) grants, donations and endowments from both private sector and donor organizations; 4) fees collected from the processing of permit; and 5) fines and penalties for violation of the other provisions of the Act and its Implementing Rules and Regulations. So far, only the Environmental Management Bureau of the Department of Environment and Natural Resources (EMB-DENR) and the Land Transportation Office of the Department of Transportation and Communications (LTO-DOTC) have been remitting to the Fund. The latter's collection of fines largely comes from the Anti-Smoke Belching operations.

In addition to the DENR-DBM Joint Memorandum Circular (JMC) No. 2004-01 dated November 8, 2004 on the operational guidelines of the AQMF, the "Criteria in the Selection and Implementation of Qualified or Eligible Project and Activities to be Supported pursuant to Rule XVI, Section 4 of DAO 2000-81 or the Implementing Rules and Regulations of the CAA" was established on 15 July 2005 in the DENR Memorandum Circular No. 2005-010 dated on July 15, 2005. Likewise, a Special Review Committee (SRC) composed of EMB officials was created pursuant to DENR Special Order No. 867 on 15 December 2004 to review, evaluate, and recommend such eligible and qualified projects/activities using the criteria set forth under MC 2005-10.

The first request for fund release was made in July 2005 but no release was effected as of December 31, 2007.

Table 14 shows the total amount of Php 184,994,118.00 deposited to the BTr under the AQMF as of December 2007. Of this amount, Php 60,103,314.00 has been certified by the BTr.

Table 14. LTO and EMB Deposited Collections for the Air Quality Management Fund

Regional Office	LTO		EMB	
	DEPOSITS	BTr CERTIFIED	DEPOSITS	BTr CERTIFIED
CO	94,556,370.00	17,797,095.00	57,350.00	-
NCR	25,326,500.00	-	18,355,499.00	10,248,986.00
Region 1	37,000.00	3,000.00	5,941,662.00	5,527,387.00
Region 2	941,000.00	9,000.00	522,770.00	44,010.00
Region 3	802,680.00	9,680.00	4,495,664.50	2,953,527.50
Region 4-A	1,519,115.00	65,115.00	9,655,577.50	9,566,352.50
Region 4-B	2,000.00	-	248,232.50	-
Region 5	117,095.00	12,000.00	940,376.50	383,687.50
Region 6	-	-	602,249.53	129,864.25
Region 7	2,523,059.00	51,925.00	8,258,638.79	8,258,638.79
Region 8	1,260,935.00	10,000.00	889,898.00	626,143.50
Region 9	143,225.00	8,000.00	532,881.10	407,415.10
Region 10	115,900.00	9,900.00	169,862.50	-
Region 11	14,000.00	2,000.00	1,446,718.20	1,073,294.20
Region 12	-	-	1,095,400.00	1,095,400.00
CAR	2,402,285.50	-	926,555.00	926,555.00
CARAGA	209,281.00	-	884,338.00	884,338.00
TOTAL	**129,970,445.50**	**17,977,715.00**	**55,023,673.12**	**42,125,599.34**

Total Deposited	**184,994,118.62**
Total Btr Certified	**60,103,314.34**

4.8 Civil Society Initiatives

Bantay Kalinisan Task Force, Inc.

The Bantay Kalinisan Task Force, Inc., an organization of concerned volunteers, was conceptualized and initiated by the DENR EMB-Cordillera Administrative Region (CAR) during the middle part of 2005. Using the precept of volunteerism, the group conducts on-the-spot vehicle emission testing and road-side apprehensions during surprised but planned "operations" at identified major roads and entry points to the City of Baguio.

In its operation on August 1, 2005 until September 8, 2005, the group reported 632 apprehensions of smoke belching vehicles; 475 (76.37%) of which were already settled with a total fines of PhP 493,000.00 collected by DOTC-Regional Traffic Adjudication Services (RTAS); fines still to be collected amounted to PhP 157,000.00. For year 2006, there were 942 vehicles flagged down and tested 709 (75.27%) of which failed the standard emission level. The simultaneous roadside apprehensions conducted by five teams of the Task Force did not only help improve the air quality in the City but have caused warning too to the transport group, and even owners of private motor vehicles, that indeed, violators are apprehended and penalized.

Concerned Citizens Against Polllution (COCAP)

COCAP, a non-government organization, has initiated public awareness projects with various transport organizations in Metro Manila. These projects include information campaigns on the shift from two-stroke to four-stroke engines, health and economic benefits of clean engines, and of using bio 2T on two-stroke engines.

In addition, COCAP has likewise conducted workshops on coconut methyl ester (CME) production from used cooking oil and 2T oil production using CME. These workshops were coupled with actual monitoring of emissions on test vehicles to illustrate the effectiveness of using CME.

MIRIAM P.E.A.C.E. (Public Education and Awareness Campaign for Environment)

Technology Options for 2-Stroke Powered Tricycles is a quasi participatory research conducted last 2006 by Miriam P.E.A.C.E. It studied the effectiveness of four current technologies namely: a) Alternative fuel (Ethanol 10), b) Bio 2T oil (CME-blended), c) Air Bleed Technology (Cyclos) and d) Retrofit Technology (Direct Injection). The project is made up of three components namely Market Scan and Information Dissemination, Technology Verification and Social Benefit-Cost Analysis. It was sponsored by Peace and Equity Foundation (PEF) and undertaken mainly by academic institutions, headed by the Environmental Studies Institute (ESI) of Miriam College in collaboration with National Center for Transport Studies (UP-NCTS), Technological University of the Philippines (TUP), Don Bosco Technical College (DBTC) and the SKY Group (Suzuki, Kawasaki and Yamaha). In conclusion, the study showed that the four technologies –Direct Injection, Air Bleed, Bio 2T and E10 - brought about improvement on specific parameters in varying degrees, with Direct Injection technology topping positive changes in all parameters. However, it is recommended that a large scale pilot testing should be undertaken to ensure that technical problems resulting to long-term use are addressed and costing can be refined. The Social Benefit-Cost Analyses also showed remarkable benefits to the general public as well as to the tricycle operators.

Another project undertaken is Air Care: A Community-Based Air Quality Management Program. It aimed to improve local ambient air by involving academe in air quality monitoring, the tricycle sector in regular

preventive maintenance practices and community leaders in clean air policies/projects. Several collaterals have been produced through the project: Manual for Schools, posters and video on Preventive Maintenance, etc. The project was implemented in the Katipunan, UP, Balara corridor of Quezon City.

4.9 International Development Programs/Projects

Metro Manila Air Quality Improvement Sector Development Program (MMAQISDP)

The MMAQISDP is an Asian Development Bank (ADB) loan-financed program implemented by various national government agencies headed by the DENR. Its general objective is to promote policy reforms to improve air quality through the abatement of mobile and stationary sources of air pollution. It focuses on the Metro Manila air shed, the location of the main concentrations of air pollution, but policies developed have nationwide implications and/or may be replicated in other airsheds.

The MMAQISDP was completed on December 2007. An initial assessment of its activities' environmental impact was conducted in 2006 which yielded the following results:
1. 87% reduction in ambient lead concentration from 1999 to 2000 as a result of the gradual phase out of lead in gasoline beginning 1994;
2. 10% reduction in TSP from 1999 to 2005; and
3. 87% reduction in total mass of SOx emitted by mobile sources was achieved due primarily to reduction in sulphur content of automotive diesel fuel.

The same Program was able to reap the following benefits in improving air quality management in the Metro Manila airshed: (1) a delineated Metro Manila Airshed and a working Governing Board; (2) issuance and implementation of policies on emission standards for both mobile and stationary sources of pollution, emission testing, incentives for industries, fuel standards and clean fuels; and (3) capacity building for the EMB in the following areas: ambient air quality monitoring, stack testing and monitoring, enforcement of Clean Air Act, permitting, and public awareness.

Vehicle Emission Reduction Programs

The United States Agency for International Development (USAID) in its response to the worsening air quality brought about by excessive pollution for motor vehicle emissions in Metro Manila, entered into a cooperative agreement with Infinite Progression Foundation, Inc. (IPFI) for a two-year project that aims to promote public awareness and actions to reduce vehicle emissions in Metro Manila by addressing the problem of poorly maintained public utility vehicles plying the roads of Metro Manila with uncalibrated fuel injection pumps.

The strategies to implement the preventive maintenance system include: 1) comprehensive training and technical consultancy assistance on proper vehicle maintenance and injection calibration; 2) coalition building of PUV operators and drivers as leaders in advocating for preventive maintenance practices; 3) establishment of reputable calibration centers; and 4) program for monitoring and documentation for skills upgrading and technology transfer. The target beneficiaries are jeepney and bus drivers/operators and the general public in Metro Manila.

The project, through USAID assistance, organized the Champion for Reduction of Air Pollution from Motor Vehicle Emission (CRAVE), a coalition of 30-50 core group leaders from public utility transport sector that aims to continue the project's Preventive Maintenance advocacy work. It has conducted a number of seminars and trainings on preventive maintenance system to about 900 jeepney/bus drivers and operators in Metro Manila.

USAID-Energy and Clean Air Project (ECAP)

The USAID-ECAP is a four-year project which started last October 2004. The project provided technical assistance to government agencies and selected civil society partners that are working on power sector reforms and cleaner air. ECAP operates in four project sites, namely: Metro Manila, Baguio, Cebu and Davao by partnering with key academic institutions as ECAP's project offices. Some of its initiatives include strengthening local governance for clean air; strengthening motor vehicle inspection and maintenance; enabling public utility transport sector compliance with emission standards in the Clean Air Act; and sustaining constituencies for clean air and power sector reforms.

4.10 Research and Development

Characterization and Source Identification of Ambient Air PM_{10} in Metro Manila by Nuclear and Related Analytical Techniques

The Philippine Nuclear Research Institute (PNRI) has continued research to generate information on the sources of particulate pollution and their contribution through the use of nuclear and related analytical techniques. Data for PM_{10} and $PM_{2.5}$ (Figures 4 and 5, Tables 5 and 6 shown in Section 3 on Ambient Air Quality)., black carbon and elemental concentrations such as that of Pb are also generated.

Air pollutants at receptor sites, anthropogenic and/or natural origin, may be in different mixed-up forms. With the use of nuclear and related analytical techniques such as the X-ray Fluorescence Spectrometry (XRF) to generate multi-element data for receptor modeling, the research aimed to address the following questions:

WHAT are the sources of air pollutants?
HOW MUCH is the contribution of each?
WHERE? From which direction/s are these coming from?

Phase-out of the use of leaded-gasoline has been very effective in reducing Pb levels in ambient air as shown in the decreasing trend of Pb levels at the ADMU sampling station (Figure 10). Continuous monitoring is helpful in documenting the impact of government policies such as that seen in ADMU where the reduction of Pb levels coincided with the phase-out of leaded-gasoline.

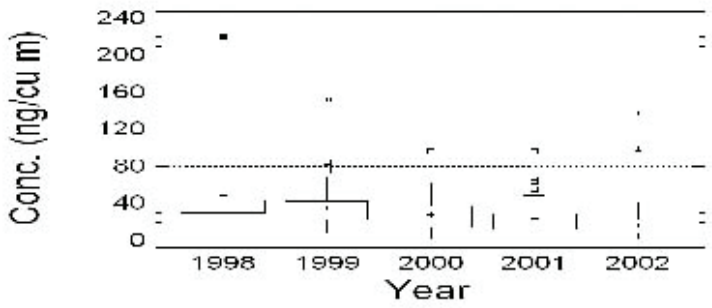


Figure 10. Pb levels at the ADMU sampling station from 1998-2002

Figure 10 shows decreasing Pb levels in the fine fraction coinciding with the introduction of unleaded-gasoline and the eventual phase-out of the use of leaded-gasoline.

Of particular great concern especially in the residents of the area is the Pb levels in Valenzuela City since Pb levels in this part of Metro Manila are generally very much higher compared with Pb levels in the other sampling sites (Figure 11). The high Pb condition can only come from sources other than leaded gasoline. This condition is reflected in the source apportionment studies with Pb sources showing up in both the coarse ($PM_{10-2.5}$) and the fine fractions ($PM_{2.5}$) (Figure 12) as compared with that of ADMU (Figure 13).

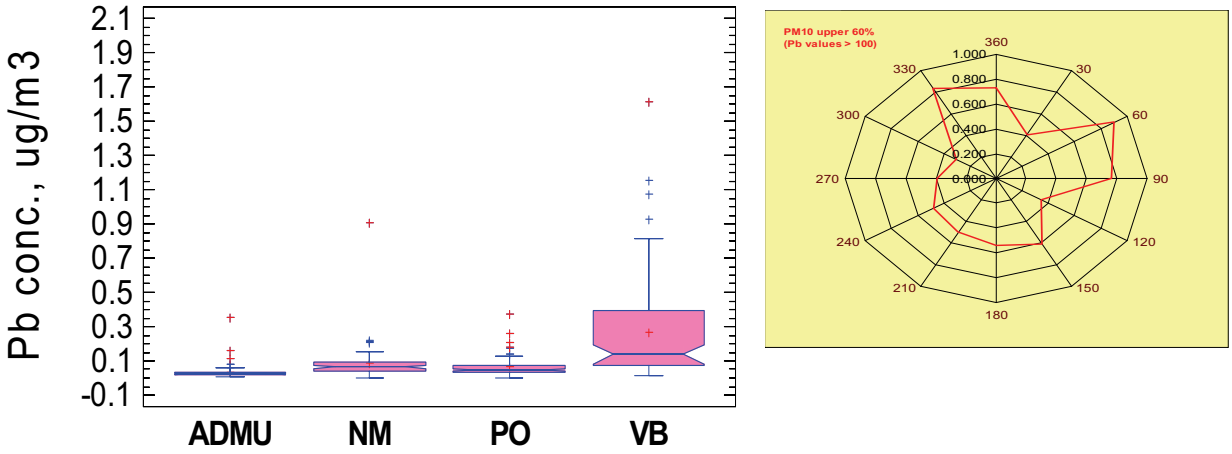


Figure 11. Comparison of PM_{10} Pb levels in Valenzuela City and other Metro Manila Sampling Sites in 2005

PM_{10} Pb levels in Valenzuela City are significantly higher than those in the other PNRI sampling stations in Metro Manila. Data analysis using the Conditional Probability Function (CPF) indicates large source contributions coming from about NNW-N, ENE-E and SSE-W of the sampling station.

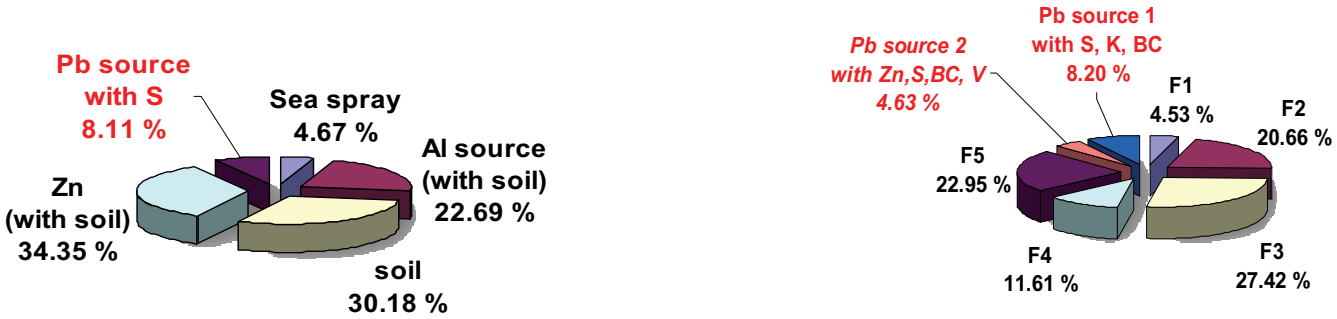


Figure 12. Source Apportionment Studies in Valenzuela

Pb source pollutants in Valenzuela (2005 preliminary results) show up in both the coarse (left figure) and fine fractions (right figure).

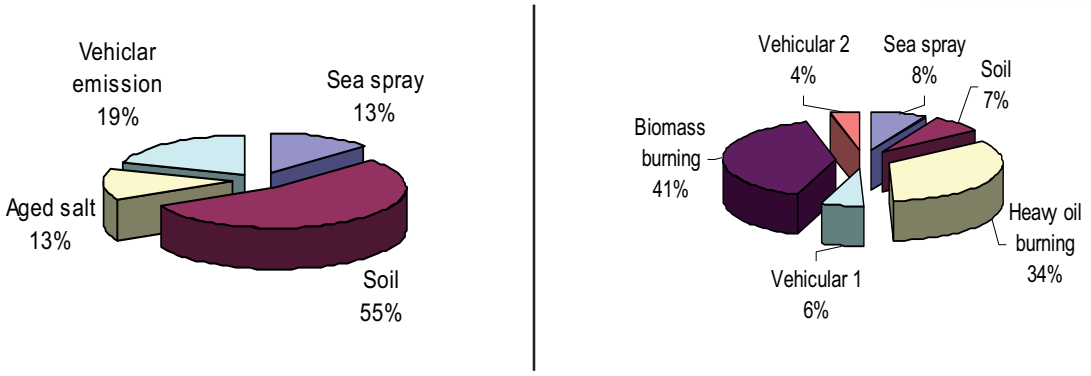


Figure 13. Principal sources of particulate pollution in the coarse (left figure) and the fine (right figure) fractions from ADMU, Metro Manila

Of particular great concern especially in the residents of the area is the Pb levels in Valenzuela City since Pb levels in this part of Metro Manila are generally very much higher compared with Pb levels in the other sampling sites (Figure 10). The high Pb condition can only come from other sources other than leaded gasoline. This condition is reflected in the source apportionment studies with Pb sources showing up in both the coarse ($PM_{10-2.5}$) and the fine fractions ($PM_{2.5}$) (Figure 12) as compared with that of ADMU (Figure 13).

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PM_{10} Pb levels in Valenzuela City are significantly higher than those in the other PNRI sampling stations in Metro Manila. Data analysis using the Conditional Probability Function (CPF) indicates large source contributions coming from about NNW-N, ENE-E and SSE-W of the sampling station.

Figure 12 refers to Source Apportionment Studies in Valenzuela.

Pb source pollutants in Valenzuela (2005 preliminary results) show up in both the coarse (left figure) and fine fractions (right figure).

Figure 13 shows principal sources of particulate pollution in the coarse (left figure) and the fine (right figure) fractions from ADMU, Metro Manila.

The project resulted in a better understanding of the sources of particulate pollution in Metro Manila, in addition to generating basic data for air quality management.
Results show that continuous monitoring is helpful in documenting impact of government policies such as that seen in the ADMU data showing reduction of Pb levels in the fine fraction coinciding with the phase-out of leaded-gasoline. Results in Valenzuela City indicate the need to do a more comprehensive evaluation of the area to determine the sources of Pb and formulate measures to bring down its ambient levels.

Dry Deposition Monitoring in Metro Manila and Los Baños, Laguna (Acid Deposition Monitoring Network in East Asia)

The Philippines is a participatory country to the Acid Deposition Monitoring Network in East Asia (EANET). Since 2001, the EMB being the country's National Center for the EANET is conducting dry deposition monitoring to study the concentration levels of SO_2, HNO_3, HCl, and NH_3 in gases in Metro Manila and Los Baños, Laguna.

Dry deposition samples are collected using the filter pack method on a weekly basis. Samples are analyzed by ion chromatography method for SO_4^{2-}, NO_3^-, and Cl^- while NH_3 is measured using the colorimetry method. HNO_3, HCl, and NH_4+ are calculated from their respective ion concentrations. Table 1 shows the annual mean levels of the gas species in the two stations during the period 2005 – 2007.

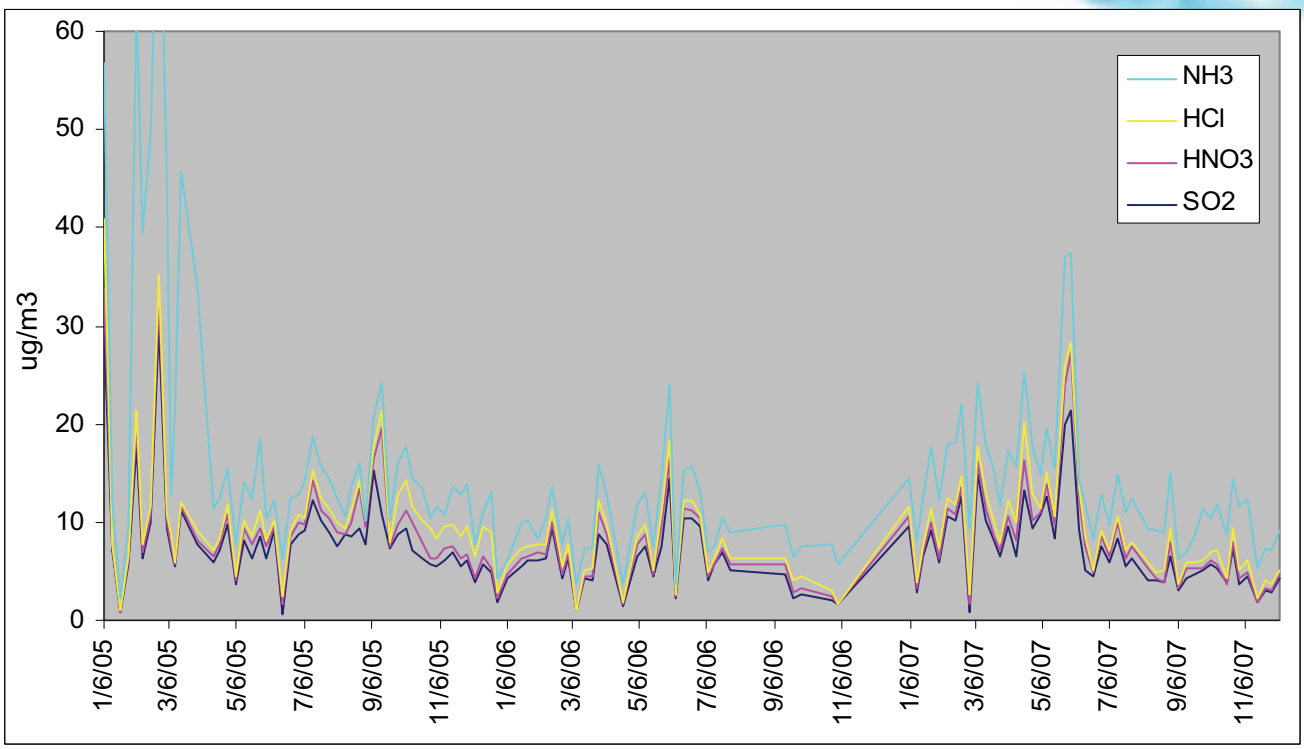
During the 2005-2007 monitoring activities, all the measured gas species in the urban site (represented by Metro Manila) had higher concentration levels than those in the rural site (represented by Los Baños). SO_2 had the highest concentration level in the urban site while NH_3 had the highest concentration level in the rural site. In both sites, HNO_3 had the least concentration level followed by HCl. Comparing the overall mean values, Metro Manila's SO_2 concentration level was almost eight times more than that the concentration level in Los Baños. HNO_3 concentration level in Metro Manila was almost four times the Los Baños level, while NH_3 and HCl were twice the concentration levels in Los Baños.

Figures 14 and 15 show the time series concentration of gases in Metro Manila and Los Baños. A clear trend is yet to be determined for the gas concentration levels in both stations.

Table 15 - Annual Mean Levels of SO_2, HNO_3, HCl and NH_3 in Metro Manila and Los Baños for the period 2005-2007

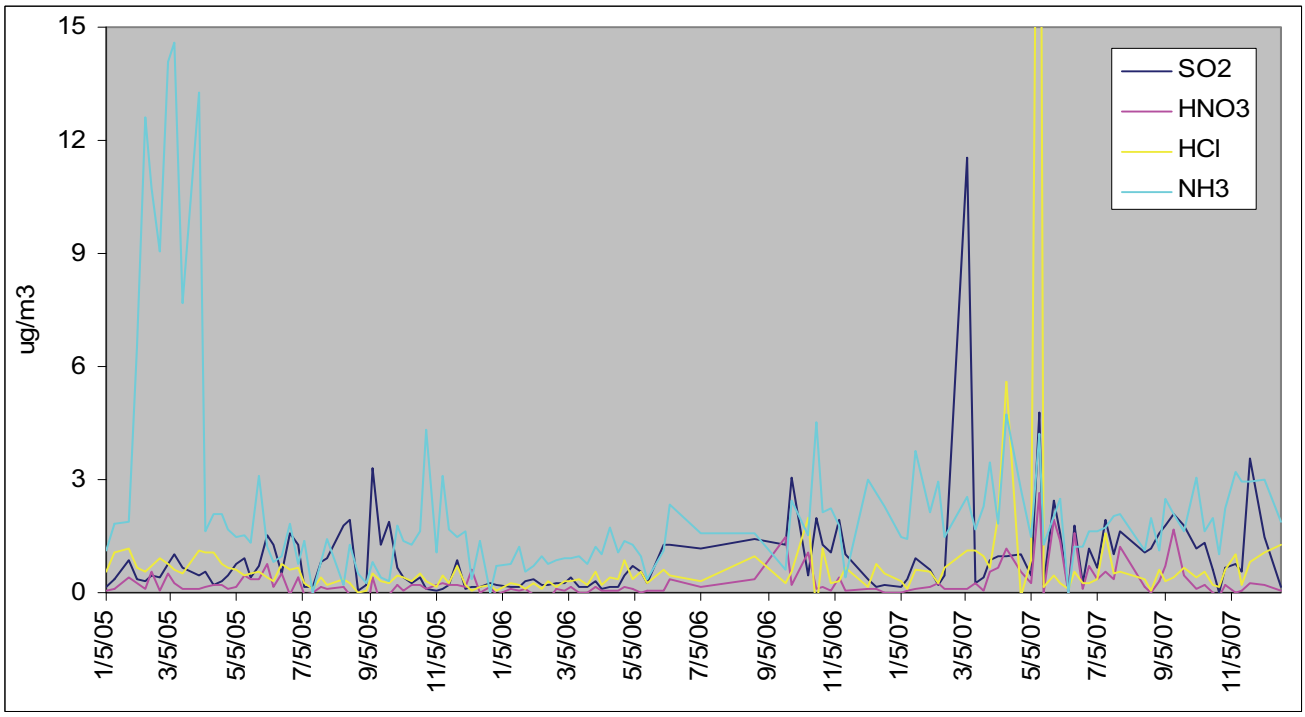
Station	Year	Concentration in ug/m^3			
		SO_2	HNO_3	HCl	NH_3
Metro Manila	2005	8.40	1.23	1.44	7.94
	2006	5.77	0.710	0.808	2.74
	2007	7.28	1.02	1.05	4.63
	Overall Mean	7.15	0.987	1.10	5.10
Los Baños	2005	0.663	0.162	0.489	2.92
	2006	0.683	0.163	0.427	1.43
	2007	1.34	0.462	1.40	2.14
	Overall Mean	0.895	0.262	0.772	2.16

Source: EMB



Source: EMB

Figure 14 - Time Series Concentration of Gases in Metro Manila (2005-2007)



Source: EMB

Figure 15 - Time Series Concentration of Gases in Los Baños (2005-2007)

4.11 Public Awareness and Education on Air Quality Management

For a couple of years, the EMB-DENR has undertaken various activities focused on public awareness and education on air quality management under the Linis Hangin program of the DENR.

The various activities are in cooperation with different multi-stakeholder partners such as academic institutions, business, local government units, national government agencies, non-government organizations, private sector, and even individuals advocating the fight for clean air.

The campaign is done on a year-round basis but highlighted mostly every November of each year as this is declared as the National Clean Air Month by virtue of Presidential Proclamation No. 1109 issued in 1997. The declaration aimed at involving the public on initiatives for cleaner air.

There are several undertakings of the EMB-DENR in this direction from 2005 to 2007. Among them are:

Bantay Tambutso sa Eskwela – This program was formally launched in November 2005 under the Linis Hangin Program. The program aimed at (1) involving academic institutions in promoting clean air and (2) increasing and strengthening the advocacy for clean air, especially in the attainment of emission standard for vehicles within school campuses nationwide.

There had been a move also under the program to encourage schools nationwide to adopt the program yearly by writing heads of the schools nationwide through partnership with the Department of Education, Catholic Educational Association of the Philippines, Philippine Association of Tertiary Level Educational Institutions in Environmental Protection, Commission on Higher Education and Technical Education and Skills Development Authority.

To date, about 100 universities and colleges nationwide vowed to support the program, and close to 50 universities and colleges nationwide had already participated in the one-day nationwide banning of entry of smoke-belching vehicles within their campus premises in a particular day in November.

Bantay Tambutso sa Malls – One of the programs under the Linis Hangin is the Bantay Tambutso sa Malls. This program is geared towards intensifying the government's anti-smoke belching campaign in order to reduce total suspended particulate emissions and safeguard the health of the public consistent with the mandates of the Philippine Clean Air Act of 1999.

The said program targets mall and business establishments nationwide with the aim of encouraging public and private sector cooperation by conducting free vehicle emission testing in malls and commercial establishments for FX taxi, jeepneys and other public utility vehicles

To date, there are several big business establishments that have supported the program such as the SM Supermalls and other prominent commercial establishments nationwide.

Bantay Sunog Basura – This is also under the Linis Hangin Program which aims to address the open burning of wastes nationwide.

The said program partners with local government units and encourages them to practice a more ecological way of dealing with solid wastes through issuance of local ordinances that ban open burning of wastes in their localities.

Bantay Tsimneya – This is also a program under the Linis Hangin program that targets industries and encourages them to reduce emissions in their smoke stacks.

Under the program, EMB Regional Offices conduct visual monitoring and testing of smoke stack emissions of industries using the Opacity Testing Methodology. This program also allows the EMB to check the efficiency of the air pollution control installations of these industries vis-à-vis their compliance to the regulations set under the Philippine Clean Air Act.

The Environmental Education and Information Division (EEID) of the EMB Central Office, with its EMB Regional Environmental Education and Information Sections support the heightened information and education campaign for the popularization of the Clean Air Act.

Since the passage of the Act in 1999, the EMB has produced quite a number of information materials to increase awareness on the salient features of the Act. The EMB Central and Regional Offices have conducted several seminars, fora, and trainings for their stakeholders such as the industries, transport operators, drivers, local government units, the academic sector, among others.

5. Best Practices and Lessons Learned

National Capital Region

Marikina City

The city government of Marikina is a strong advocate of clean air and non-motorized transport. This was manifested through the Marikina Bikeways Project, which aims to promote low cost and environment-friendly transport.

The bikeways program of Marikina City is a holistic social and advocacy campaign that promotes cycling as an alternative public transport. It is holistic in the sense that it involves not only creating the physical requirements for the adoption of bicycling, but also providing an opportunity to own bicycles, educating the public on the social dimension and safety of riding the bike, and putting in place policies that make this program a sustainable one.

Marikina City has constructed 32 km of bikeways (out of the 50-km target) which connects residential areas to major transport terminals, markets, schools, commercial and industrial establishments.

The Bikeways program is funded by the World Bank with a grant of USD 1.1 million. Aside from construction of bikeways, the program also offers activities focusing on safe cycling education, bicycle loan and lending program, bicycle ownership survey, Marikina cycling festival, cyclists organization, bicycle clinic, and creating ordinance mandating the use of bicycle lanes.

Makati's Project Hangin

Healthy Air In Good Indoor Environment (HANGIN) Project was initiated by the City Government of Makati through the Department of Environmental Services in collaboration with Makati Health Department, Liga ng mga Barangay, Department of Health (DOH), DENR-NCR and the University of the Philippines (UP) College of Public Health. The project officially started on March 12, 2007 through a Memorandum of Agreement that was entered into by the concerned parties.

The project is an offshoot of the study conducted by the DOH in collaboration with the ADB and the World Health Organization Eastern Pacific Region entitled "Public Health Monitoring: a Study under the Metro Manila Ambient Air Quality Improvement Sector Development Program", which aims at filling the gaps that limit the identification of relationship between severity of air pollution and health effects of exposed communities in Metro Manila.

Five monitoring stations were identified/established within the locality of Makati. Sources of particulate matter monitored are from the motor vehicles and area sources as the sampling stations were situated on the road side. However, due to limited resources, only one sampling equipment could be utilized and this is being transferred to another station after a week of sampling in a particular site.

Cordillera Administrative Region

Efforts of the regions are focused more on advocacy for strengthened air quality protection. The advocacy is geared towards increased cooperation and willingness of the people, academe and the youth sector to participate in environmental programs.

Region 1

In 2006, the City of San Fernando enacted its Environment Code. One of its main components is the Tricycle Conversion Program that targeted the conversion of the City's three-wheeler public transport (tricycles) from two-stroke to four-stroke engine motorcycles.

Region 2

Region 2 government agencies, private sector, LGUs, civil society and communities support the mission of improving air quality and protecting the environment as shown in their advocacy.

The Department of Agriculture (DA) in Quirino Province has intensified its campaign against burning of agricultural waste/debris.

Interpretative signs were installed along the national road to strategic locations which read "Dayami ay huwag sunugin, i-decompose para pataba pagyamanin".

Region 3

The DOST Region 3, has, since 1999, been promoting technologies that help minimize air pollution. The program aims to assist Small and Medium-Scale Enterprises to comply with environmental quality standards through reduction of waste generation. The implementation of cleaner production strategies serve as a preparatory stage for the implementation of Environmental Management System (ISO 14000 standards) within the companies' manufacturing operations.

Region 4-A

The Local Government of Cavite prepared the Cavite Environment Code under Provincial Ordinance No. 43-S-2008. Among the salient features of the code are articles on forest, mineral and water resources, waste management, marine and coastal resources, air and noise pollution management, ecotourism, environmental impact assessment and land use planning.

Region 4-B

The local government units of Region 4-B support the air quality management programs of the EMB. As part of their procedure in the renewal of business permits of firms and industries operating in their respective jurisdiction, the local government units require copies of Permit to Operate Air Pollution Source and Control Installation issued to them by the EMB Region 4-B to verify if the firms operating are in compliance with the provisions of the CAA. The local government units are also giving support for the maintenance of the air quality monitoring stations established by EMB Region 4-B. The establishment of the new monitoring station in Baco, Oriental Mindoro was made possible with the signing of the Memorandum of Agreement by the Municipal Government of Baco.

Region 5

The local government of Legazpi City has passed an ordinance banning smoking in public places and

conveyances. Also, Naga City and Iriga City have intensified their campaign against smoke belchers by creating Anti-Smoke Belching Units which will provide assistance to LTO and EMB Region 5 deputized agents in the conduct of random roadside vehicle emission testing. The issuance of ordinance by other LGUs regarding ban on open burning also helps in improving air quality in the region.

Region 6

Iloilo City has undertaken activities against open burning. The city has likewise actively participated in DENR's Green Philippine Highways Program and continues to implement other urban greening activities.

Region 7

Cebu City takes pride of its comprehensive planning for transport and land use. The city has embarked on a variety of initiatives in traffic management. It has already installed a computerized traffic signal system called SCATS (Sydney Coordinated Adaptive Traffic System) in 1993, the first in the country. In recent years. The city government has been active in its anti-smoke belching efforts and the promotion of the Bus Rapid Transit (BRT) as a mass transit system for the city.

Region 8

EMB Region 8 tied up with industries having initiatives on environmental education and public awareness programs for Air Quality Management and Clear Air. An example is the creation of the Leyte Geothermal Airshed in Ormoc City and Kananga, Leyte thru the initiative of the PNOC-EDC. Since the establishment of Geothermal Areas as Airsheds in 2002, and the organization of the Leyte Geothermal Airshed Governing Board in 2005, various programs and activities were undertaken thru the chairmanship of EMB Region 8 and logistical support of PNOC-EDC.

Region 9

Efforts of the region were focused more on awareness campaigns and advocacy for various environmental programs.

Region 10

Iligan City

The city of Iligan has been a forerunner in the institution of traffic management at the local government level. Through the help of the Asian Development Bank and AusAID, the construction of the north and south bound terminals for buses, and jeepneys, and road widening was made possible. This greatly enhanced the traffic condition of the city and has significantly reduced emissions from inter-city vehicles.

Cagayan de Oro City

The local government of Cagayan de Oro City has prepared a comprehensive land use plan that is intended to decongest its Central Business District (CBD) and identify growth corridors that integrate both land use and transport development.

Region 11

The local government in Davao City has issued policies in support of the Clean Air Act. For 2007, four city ordinances were issued, namely, city ordinances on anti-smoke belching, anti-smoking in public

places, no vending of cigarettes within 100 meters from school premises and ban on aerial spraying of pesticides.

Region 12

One of the best practices in the region is the promotion of proper maintenance of motor vehicles. It was observed during roadside inspection of vehicles in 2007 that majority of the vehicles inspected passed the opacity standard. Interviews with vehicle owners revealed that they regularly undertake maintenance check for their vehicles, which according to them, resulted in lower emission.

CARAGA Region

The local government of CARAGA has established a strong linkage with other sectors of society to institutionalize the implementation of the ban on open burning as well as an intensified greening program.

6. Challenges

The contribution of the transport sector to the worsening air pollution requires immediate attention inasmuch as mobile sources account for the bigger percentage of the pollutants present in the air particularly in Metro Manila, not to mention its effects to the health of the city dwellers. It is also a reality that there is a direct correlation between the worsening traffic situation and increasing emission of pollutants. Unsustainable urbanization leads to growing traffic congestion necessitating costly transport planning and management.

The aspect of air quality monitoring and assessment still needs improvement as most of the monitoring stations are traffic-exposed. The practice of computing the annual average TSP level of all monitoring stations needs to be reassessed as it is being construed as the air quality of any given region.

7. Recommendations

The government should re-direct its effort of controlling and/or minimizing emissions coming from mobile sources. Programs and activities of DENR aimed at improving the air quality of Metro Manila shall continue to be of minimal effect unless other government agencies implement their respective mandates vigorously as provided in the CAA.

To further improve air quality monitoring and assessment, the following are recommended:

- Strengthen industry self-regulation programs;
- Fast track the nationwide implementation of the MVIS;
- Strengthen monitoring of compliance on fuel specifications by oil companies;
- For LGUs to strengthen their programs in prohibition of open burning of wastes;
- Strengthen air-related researches;
- Intensify public awareness and education on air pollution prevention among all stakeholders;
- Strengthen anti-smoke belching operations by LGUs;
- Results of air quality monitoring should be made known to the LGUs concerned particularly those which frequently exceed the guideline values; and
- Encourage the active participation of civil society in the monitoring of the implementation of the Clean Air Act.

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