Policy Advisory

No. 2004-03

# ADDRESSING URBAN TRANSPORT AIR POLLUTION

**Congressional Planning and Budget Department**
**House of Representatives**

## Introduction

*Transport plays a crucial role in the proper and efficient functioning of cities. It facilitates movement of people, goods and services within and outside cities. The transport industry provides income to the government in taxes and fees. Likewise, its income multiplier effect extends to the insurance companies, accessory manufacturers and maintenance service providers.*

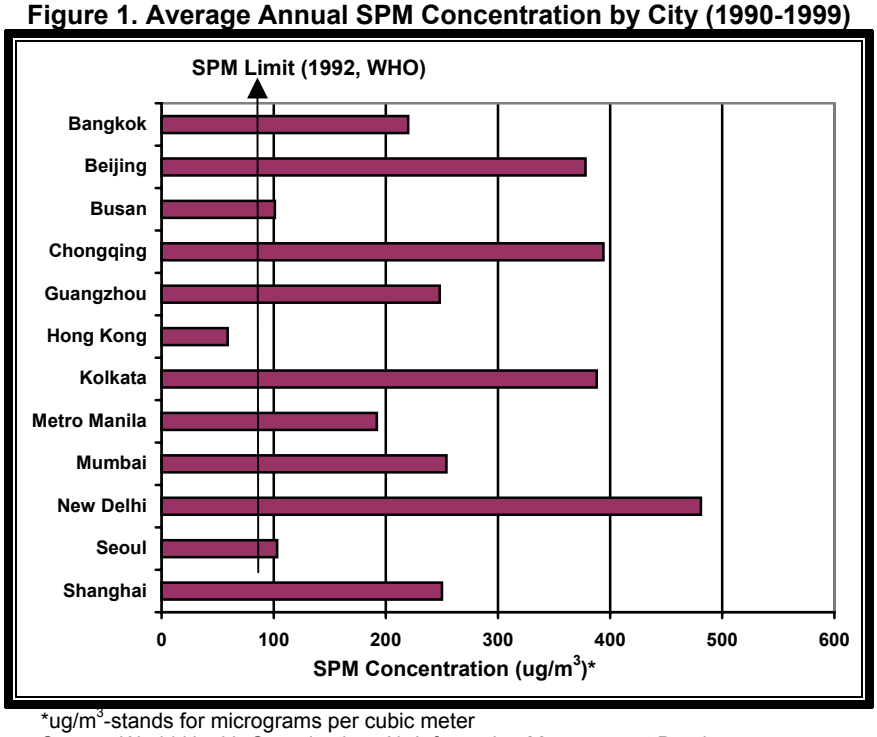
*However, transport is also responsible for some of the ills of cities, chief of which is air pollution. Recent studies have shown that vehicle emissions remain a serious issue in urban areas of the Philippines especially Metro Manila. Although there have been efforts to address this problem, these proved weak and inadequate.*

*This paper looks into urban transport air pollution in the context of Metro Manila, discusses its major causes and aggravating policies, and recommends mitigating measures.*

## I. PROBLEM

In 1992, Metro Manila had been identified one of the world's most polluted cities. Today, it still is. In the recent Asian Development Bank report (*Reducing Vehicle Emissions in Asia, 2003*), Metro Manila emerged among the Asian megacities with serious air quality problem. Its level of suspended particulate matter (SPM) exceeded more than twice the World Health Organization standard (Figure 1). The Department of Environment and Natural Resources (DENR) shares similar disturbing observation, to quote "Despite the numerous interventions implemented and enforced, air quality in the Philippines today remains threatened, especially in key urban centers."

**Figure 1. Average Annual SPM Concentration by City (1990-1999)**




*ug/$m^3$-stands for micrograms per cubic meter
Source: World Health Organization, Air Information Management Database

**The Culprit.** Studies show that 70 percent of air pollution in Metro Manila comes from mobile sources or motor vehicles (DENR, 2004). Motor vehicles emit large quantities of total organic gases (TOG, which includes hydrocarbon or HC), carbon monoxide (CO), fine particulate matter (PM), nitrogen oxides ($NO_x$) and sulfur oxides ($SO_x$). These pollutants are proven to have adverse health and environmental effects (ADB, 2003). The PM, for one, is associated with premature death, aggravation of respiratory and cardiovascular disease, and decrease in lung function (Table 1). Environmental effects, on the other hand, include acid rain, eutrophication[1], visibility impairment and climate change.[2]

**Table 1. Estimates of health impact and costs by $PM_{10}$ in four key cities of the Philippines in 2001**

| City | $PM_{10}$ Annual Average ($\mu g/m^3$) | Population (in million) | Excess deaths | Chronic bronchitis | Respiratory symptoms (in million) | Cost (million US$) |
|---|---|---|---|---|---|---|
| Metro Manila | 65.8 | 10.04 | 1,915 | 8,439 | 50.5 | 392 |
| Davao | 39.8 | 1.018 | 83 | 429 | 2.6 | 15 |
| Cebu | 45.0 | 0.73 | 170 | 336 | 2.0 | 16 |
| Baguio | 75.2 | 0.26 | 49 | 262 | 1.6 | 9 |
| Total | -- | 12.11 | 2,217 | 9,466 | 56.7 | 432 |

Source: World Bank, 2002
Note: $PM_{10}$ refers to particulate matter of 10 microns in diameter. It belongs to the class of total suspended particulates (TSP), pollutant that currently receives the DENR's highest monitoring priority because of its prevalence and the danger it poses to health.

**Vehicle Emissions**. Metro Manila accounts for more than a third of the total vehicle emissions in the Philippines (Table 2). Of all the pollutants, CO registered the highest at 948,192 tons or 72.24% of Metro Manila's total vehicle emissions. A distant second was TOG with 190,531 tons (14.52%). $NO_x$, $SO_x$, and PM also contributed to the total vehicle emissions with 109,760 tons, 15,692 tons, and 48,465 tons, respectively.

**Table 2. Summary of Vehicle Emissions, 2001 (in tons)**

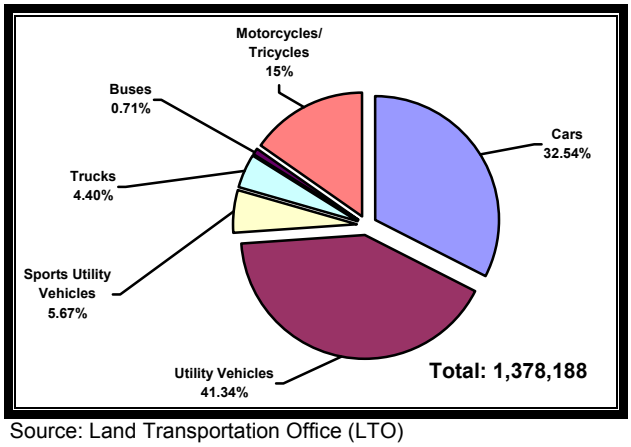
| | TOG | CO | $NO_x$ | $SO_x$ | PM | Total |
|---|---|---|---|---|---|---|
| Philippines | 707,057 | 2,512,228 | 328,800 | NA | 177,928 | 3,726,013 |
| Metro Manila | 190,531 | 948,192 | 109,760 | 15,692 | 48,465 | 1,312,640 |
| % | 26.95 | 37.74 | 33.38 | NA | 27.24 | 35.22 |

Source: DENR

**Vehicle Composition.** Motor vehicles in Metro Manila comprise of cars, utility vehicles[3] (UVs), sports utility vehicles (SUVs), trucks, buses and motorcycles/tricycles (MC/TC). Figure 2 shows that in 2003, UVs dominated the transport sector with 569,686 registered units (41.34%). Cars followed closely with 448,494 registered units (32.54%). Motorcycles/tricycles ranked third in terms of number with 211,450 units (15%). Buses had the least share in the vehicle category with 9,719 registered units (below 1%).

[1] Occurs when NOx deposited in nitrogen-saturated coastal estuaries and ecosystems result in algal and plankton growth. In time, these organisms sink into water bodies, decay there and use up all or most of the available dissolved oxygen, thus eliminating fish and shellfish population.
[2] The transportation sector is responsible for approximately 17% of global carbon dioxide emissions and these emissions are increasing in virtually every part of the world.
[3] include taxis, jeepneys and vans

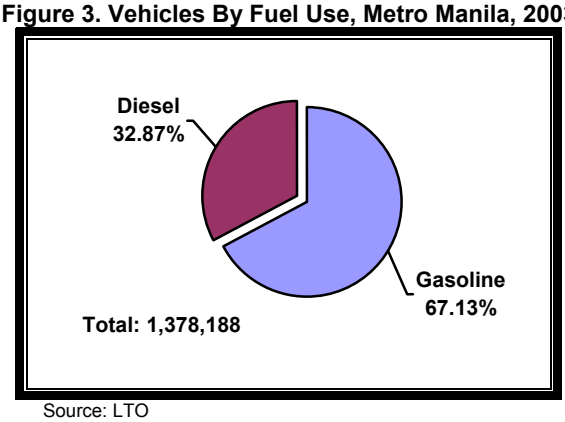
**Figure 2. Motor Vehicle Composition, Metro Manila, 2003**




Source: Land Transportation Office (LTO)

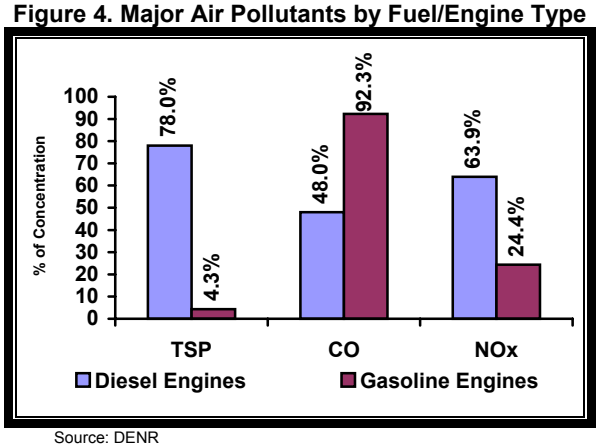
**Fuel Use.** Figure 3 shows that of the 1.3 million registered vehicles in 2003, some 925,234 are gasoline-fuelled (67.13%) and 452,954 diesel-fuelled (32.87%). Major pollutants from diesel engines comprise of total suspended particulates (TSP) from carbon particles, condensed heavy HC and sulfate, and other by-products of combustion. Gasoline engines, on the other hand, emit CO, $NO_x$, lead and volatile organic compounds. Figure 4 shows that diesel engines account for the bulk of air pollutants, thus making them dirtier than gasoline engines. Most UVs, trucks and buses plying the NCR roads are equipped with diesel engines.

**Figure 3. Vehicles By Fuel Use, Metro Manila, 2003**




Source: LTO

**Figure 4. Major Air Pollutants by Fuel/Engine Type**




Source: DENR

## II. CAUSES

There are several reasons to Metro Manila's transport air pollution. The major and most immediate ones are the growing human and vehicle population, and a host of aggravating factors.

### MAJOR CAUSES

***Burgeoning urban population*.** With a density of 255 persons per square kilometer, Philippines is not a crowded country. But in Metro Manila, the ratio jumps to 16,091 making it one of the most crowded places on earth. In 1992, Metro Manila ranked 16th among world's largest urban agglomerations[4]. By the year 2010, it will be home to 16.1 million people, pushing Metro Manila to 10th largest urban agglomeration in the world (Table 3). Rapid urban growth creates greater demand for mobility, thus rising levels of air pollution.

**Table 3. Projected Largest Urban Agglomerations in the World**

| Rank | Agglomeration | Population by 2010 (in millions) | Annual Growth Rate 2005-2010 (in %) |
|---|---|---|---|
| 1 | Tokyo | 28.9 | 0.2 |
| 2 | Sao Paulo | 25.0 | 0.8 |
| 3 | Bombay | 24.4 | 2.7 |
| 4 | Shanghai | 21.7 | 1.9 |
| 5 | Lagos | 21.1 | 4.1 |
| 6 | Beijing<br>Mexico City | 18.0<br>18.0 | 2.0<br>1.0 |
| 7 | Dacca | 17.6 | 3.9 |
| 8 | Jakarta<br>New York | 17.2<br>17.2 | 2.2<br>0.3 |
| 9 | Karachi | 17.0 | 3.4 |
| 10 | Metro Manila | 16.1 | 2.2 |
| 11 | Tianjin<br>Calcutta | 15.7<br>15.7 | 2.0<br>2.3 |
| 12 | Delhi | 15.6 | 2.7 |
| 13 | Los Angeles | 13.9 | 0.4 |
| 14 | Seoul | 13.8 | 0.5 |
| 15 | Rio de Janeiro | 13.3 | 0.8 |

Source: United Nations

**Growing vehicle population**. More motor vehicles will lead to more emissions. Motor vehicles in Metro Manila have been increasing, albeit at slower pace (Table 4). In 1996, total motor vehicles registered grew by 12.60 percent or from 1,055,692 in 1995 to 1,188,724 a year after. Such increase remained until 1997. However, the number of registered vehicles began to skid by 1.54 percent in 1998 and 13.81 percent in the following year. In 2000, a surprising jump of 20.90 percent was recorded or from 1,063,853 registered vehicles to 1,286,176. A year later, registered vehicles dropped but bounced back the following year. In 2003, a slight decrease was recorded.

**Table 4. Number of Motor Vehicles Registered in Metro Manila, 1995-2003**

| Year | Metro Manila | Growth Rate, % |
|---|---|---|
| 1995 | 1,055,692 | - |
| 1996 | 1,188,724 | 12.60 |
| 1997 | 1,253,669 | 5.46 |
| 1998 | 1,234,372 | (1.54) |
| 1999 | 1,063,853 | (13.81) |
| 2000 | 1,286,176 | 20.90 |
| 2001 | 1,255,140 | (2.41) |
| 2002 | 1,390,579 | 10.79 |
| 2003 | 1,389,808 | (0.06) |

Source: LTO

[4]The United Nations defines urban agglomerations as those with a population of 1 million or more. The concept of agglomeration defines the population contained within the contours of contiguous territory inhabited at urban levels of residential density without regard to administrative boundaries.

## AGGRAVATING FACTORS

**Inadequate Mass Transit Systems.** The overcrowding of high-capacity LRT/MRT lines and public utility buses (PUBs) during peak hours (6 a.m.-9 a.m & 4 p.m.-7 p.m.) speaks well of the current shortage of mass transit systems in Metro Manila, now home to 12 million residents. Buses in the metropolis account for a nil 0.7 percent of the overall vehicle composition. Likewise, only LRT lines 1 & 2 and MRT 3 are presently operating, each rail system accommodating a daily ridership of about 300,000 people. Given the growth rate of population and available mass-based mode of transport, this inadequacy may worsen. Studies show that inadequacy of efficient, convenient and reliable mode of public transport pushes the *can-affords* to own vehicles. Personal vehicle ownership in the Philippines rises as individual incomes increase (WB, 2002). A high growth in vehicle ownership, combined with low turnover, contributes significantly to air pollution.[5]

Still, the development of the Metro Manila Urban Transportation Integration System Master Plan (MMUTIS) reflects the supply deficit of mass-based transport. The Plan, premised on the huge flow of passengers in and outside of Metro Manila and the increasing traffic, envisions by 2015 an integrated rail-based transport in the metropolis and outlying provinces of CALABARZON. It recommends the construction of 197 km elevated railways, extending the north and east ends of the existing LRT and MRT lines that could ferry more than 4 million passengers daily (Figure 5).

**Figure 5. Traffic Modal Distribution, Year 2015 ('000 trips/day)**

| | 1 | 2 | 7 | 5 | 10 | Total |
|---|---|---|---|---|---|---|
| 1 | | 302 | 431 | 105 | 387 | 1,225 |
| 2 | 302 | | 478 | 0 | 69 | 849 |
| 7 | 431 | 478 | | 87 | 143 | 1,139 |
| 5 | 105 | 0 | 87 | | 321 | 513 |
| 10 | 387 | 69 | 143 | 321 | | 920 |
| Total | 1,225 | 849 | 1,139 | 513 | 920 | 4,646 |

Notes: 1 – Core of Metro Manila; 2 – Caloocan within EDSA; 7 – Bulacan;
5 – Makati; 10 – East Calabarzon
Source: Railway Projects in the Philippines Evaluation and Future Direction
(Technical Report of the Japan International Cooperation Agency), March 2002.

**Traffic congestion.** Inadequate mass transit system triggers production and acquisition of more low-occupancy, high-polluting vehicles such as UVs and cars. Some sections of Metro Manila (Table 5) are literally turning into a sea of UVs and cars at certain day and time. Traffic delays contribute greatly to air pollution because the emission rates (for all pollutants except $NO_x$, which tend to increase with vehicle speed) of idling vehicles are much higher than at free flow.[7] As to cause and effect of traffic congestion**,** a master urban planner has this to say:

> *Metro Manila's traffic problems are a product of a car-oriented society. Motorists and commuters spend an average of 1,000 hours a year in traffic, and that's a lot of time wasted instead of time devoted to the family and to the enhancement of work productivity. And by 2010, the speed of road traffic in Metro Manila is projected to be three kilometers per hour.*
>
> -Architect Felino Palafox Jr.

[5] World Bank, "Philippines Environment Monitor, 2002."
[7] Asian Development Bank, "Transport Planning and Traffic Management for Better Air Quality*,"* 2003.

**Table 5. Ten Most Traffic-Congested Areas in Metro Manila**
**Annual Average Daily Traffic 2000**

| Section | Cars | PUJs | Bus | Trucks | TOTAL |
|---|---|---|---|---|---|
| EDSA | | | | | |
| Kamias-Aurora Blvd. | 107,537 | 15,415 | | 661 | 123,613 |
| Santolan-Ortigas Ave. | 146,361 | 19,155 | | 1,019 | 166,535 |
| Shaw-Guadalupe | 127,747 | 20,941 | 149 | 695 | 149,532 |
| Guadalupe-Buendia | 154,383 | 17,656 | 408 | 2,571 | 175,018 |
| Buendia-Pasay Road | 110,289 | 3,106 | 2,838 | 2,214 | 118,447 |
| Pasay Road-SSH | 93,189 | 15,338 | 8,066 | 1,528 | 118,121 |
| Katipunan-E. Rodriguez | | | | | |
| Kalayaan-Ortigas | 101,052 | 1,169 | 147 | 3,305 | 105,673 |
| Roxas Blvd. | | | | | |
| Pedro Gil-Pres. Quirino | 132,064 | 283 | 916 | 427 | 133,690 |
| Roosevelt-G. Araneta | 100,236 | 17,324 | 1,285 | 1,539 | 120,384 |
| MIA Rd.-EDSA | 132,292 | 1,426 | 12,154 | 2,234 | 148,106 |

Source: Today, July 25, 2003

**Continued peddling of used 2T oil.** Loose oil or used 2T oil and other "bottled" petroleum products are still being sold to tricycles and jeepneys in certain parts of Metro Manila in violation of Department Administrative Order 59 (IRR of Republic Act 6969 or the Toxic Wastes and Hazardous Act). The oil contains, among others, heavy metals and fine asphalt materials that increase HC and smoke emissions.

**Weak enforcement of RA 8749 CAA due to non-funding.** The DENR has not received from the Department of Budget and Management (DBM) its share in the P750 million appropriated for the initial implementation of Republic Act 8749 (Clean Air Act). This undermines the capacity of this agency to effectively implement the law. In an interview with staff of the Environmental Management Bureau, it was learned that the agency currently utilizes its own regular budget to implement the CAA. It requested though a special fund from the DBM for the purpose, but no money is released yet.

**Fare restrictions.** PUVs in Metro Manila and in the rest of the country are heavily constrained by the current regulatory system within which they operate. Fare increases, for example, have to be filed, heard and results waited for. In the meantime, drivers and operators have to bear the brunt of successive fuel price increases and other operational expenses. According to the Asian Development Bank (2003), unnecessary regulations discourage innovation, thus limiting the range and quality of transport services provided. They weaken the financial position of public transport operators, therefore preventing proper maintenance of vehicles.

**Imported second hand and rebuilt vehicles.** The IRR of the CAA allows registration of rebuilt and imported second hand vehicles provided they meet emission standards. This does not augur well in the fight to reduce vehicular pollution. Every year, there is a substantial number of vehicles added to the fleet—the ubiquitous SUVs that are currently auctioned in Subic and certain parts of Metro Manila and buses and other PUVs. The buses and other PUVs are built around second hand engines imported from either Japan or other places where stringent in-use emissions and safety requirements have made these engines obsolete.[8] These are typically vehicles used intensively and not maintained very well.[9]

[8] Asian Development Bank, "Reducing Vehicle Emissions In Asia", 2003.
[9] Ibid.

**Tax structure of petroleum products.** Current tax structure of petroleum products does not favor cleaner fuel, that is between unleaded gasoline and diesel, the former is taxed heavily (P4.35/liter) and the latter a low P1.63/liter (Table 6). While this configuration is reflective of the so-called "social sensitivity" of the product, it fails to take into account the true environmental cost of the dirtier fuel, which is diesel. Between diesel and gasoline, the former is found to be the greater source of PM, pollutant that is partly responsible for the US$392 million health bill of Metro Manila residents.

**Table 6. Tax Structure of Petroleum Products in the Philippines (in ₱/Liter)**

| Petroleum Products | Specific Taxes |
|---|---|
| **Unleaded Premium Gasoline** | **4.35** |
| Aviation Turbo | 3.67 |
| Kerosene | 0.60 |
| **Diesel** | **1.63** |
| Fuel Oil | 0.30 |
| Liquefied Petroleum Gas | 0.00 |

Source: Republic Act 8184

## III. WHAT HAVE BEEN DONE

The Executive Department and its various offices (MMDA, DENR DOTC, LTO, and DOE) have undertaken measures to reduce vehicle pollution, to wit:

Malacanang has:

- Issued on Jan. 10, 2003 Executive Order 164 reducing import duties on Natural Gas Vehicles (NGVs), NGV engines and NGV industry-related facilities, equipment, parts and components to one (1) percent;
- Issued on Feb. 24, 2004 Executive Order 290 implementing the Natural Gas Vehicle Program for Public Transport (NGVPPT); and
- Signed on Feb. 9, 2004 Memorandum Circular No. 55 requiring all government agencies to use one-percent coconut methyl ester (CME)-diesel blend in their vehicles.

MMDA has, among others:

- Restricted the use of private vehicles via the ODD/EVEN Scheme;
- Launched campaign against *colorum* PUVs; and
- Closed major intersections considered chokepoints.

DENR has (insofar as implementing the CAA is concerned):

- Developed the Air Quality Framework
- Brought to 10 the number of designated interim airsheds throughout the Philippines
- Set up Ambient Air Quality Monitoring Network, including 10 electronic stations
- Conducted emissions inventory at stationary, mobile and area sources of air pollution
- Set emission standards for motor vehicles
- Conducted emission testing of motor vehicles prior to registration
- Improved fuel quality (lowered sulfur content in diesel and lowered benzene and aromatics in gasoline)
- Expanded promotion of use of alternative cleaner fuels (biodiesel, liquefied petroleum gas (LPG) and compressed natural gas (CNG)

It may take a while before urban residents can breathe in clean air. On the one hand, some of the foregoing measures are obviously in their infancy stage like the reduced NGV import duties and the NGVPPT, thus have to be accorded with necessary support mechanisms. The NGVPPT, for instance, cannot be enjoyed at the downstream or market level unless vital structural and policy infrastructure are put in place. It will require the establishment of CNG refilling stations along major thoroughfares and creation of a "pricing environment" that would make CNG cheaper than diesel.

On the other hand, some other measures suffer from slow implementation due to limited agency budgets. The DENR, for example, has only about 13 staff manning its Air Quality Management Section. Only a handful of these have technical background to undertake air quality monitoring and analyze pollutants sampling results. Likewise, the LTO grapples with limited funds to efficiently manage sustained drive against smoke-belchers. It has only about 20 people doing the job. It needs at least 40 more staff, additional vehicles that will bring the smoke emission testers to roadside inspection destinations, and money to finance its staff training and public information campaign. The LTO relayed through an interview that it does not receive from the DENR any centavo of its share from the fines and penalties collected from smoke belchers, which amounts to about P43 million.[10] Altogether, this reflects the existing institutional gaps. Addressing transport pollution behooves that all concerned agencies, be it lead or support, harmonize and integrate all their efforts. No one agency should be restrained by the failure of another. Thus, cooperation and resource-sharing should be the norm, and ingenuity too to raise the needed funds to implement the CAA.

## IV. ANTI-VEHICLE POLLUTION EFFORTS ACROSS COUNTRIES

Vehicle pollution is a worldwide urban experience, thus the Philippines have a lot to learn peeking at how others dealt with the problem. Following are the different countries and their strategies employed:

- Singapore, Seoul, Taipei, China and Hong Kong, China have integrated their rail transit systems, thereby giving attention to linking rail systems with other 'feeder" public transport services, good quality waiting and transfer facilities, common ticketing and information systems that support seamless connections between rail and bus-way systems and the overall public transport system;
- In Hong Kong, China, the tax differential on low-sulfur diesel led to a widespread early adoption of the lower sulfur levels in diesel;
- In Taipei, China, the use of financial incentives convinced many people to trade in their dirty 2-stroke scooter for a cleaner electrical one;
- Several countries in Europe have good experiences with lower taxes for cars which meet more stringent emission standards than required;
- In Bangkok and India, conversions of three-wheeled vehicles to both LPG and CNG have been well established. Thus, Tuk-tuks in Bangkok have been operating on LPG while India's version of tricycle run on CNG.

[10]Telephone interview with LTO Road Safety Head Ms. Daisy Jacobo, 11 March 2004.

## V. CONCLUSION AND RECOMMENDATIONS

Mobile sources or motor vehicles account for 70 percent of air pollution in Metro Manila. They emit large quantities of TOG, CO and PM. Diesel fuel generates more pollutants like PM, which causes more health damage to urban residents.

Metro Manila's vehicle pollution has both major causes and aggravating factors. Major causes are the growing human and vehicle population. Aggravating factors include the inadequate mass transit systems, traffic congestion, fare restrictions and the importation of second hand and rebuilt vehicles.

Addressing urban transport pollution requires harmonizing agency relations, and exploring cross-countries' experiences with transport pollution. More importantly, it calls for consideration of some or all of the following measures:

***On the burgeoning urban population***

- Institute a mechanism that will regulate urban in-migration. This will reduce pressure on urban transport provision/infrastructure;

***On the growing vehicle population***

- Tighten in-use motor vehicle emission standards to force retirement of older, high-polluting vehicles or to move them away from pollution hotspots;
- Adopt a *Scrappage Scheme* or impose age limit to all motor vehicles to discard of highly pollutive/poorly maintained vehicles;
- Introduce *differential vehicle registration taxes* to favor cleaner technologies/engines, thus higher registration/renewal fee for diesel vehicles and lesser for low-polluting ones;

***On the mass transit systems***

- Pursue the MMUTIS recommendation of constructing more elevated railways and integrating existing LRT and MRT lines. This will partly restrain car ownership, address surging Metro Manila commuters and decongest the metropolis.

***On traffic congestion***

- Refile House Bill 972 or the proposed Pedestrian Safety Law**.** The bill partly aims to address the worsening traffic conditions in Philippine cities through clearance of public roads and sidewalks from all forms of obstruction.

***On weak enforcement of RA 8749 due to non-funding***

- Earmark portion of fees and penalties collected from smoke-belching, traffic violation, car registration, accreditation of private emission testing centers towards reducing urban transport pollution. Set up *Vehicle Pollution Reduction Fund* for this purpose, to be administered by representatives from DENR, DOTC/LTO, DOE, DOH and MMDA

***On PUV fare restrictions***

- Deregulate PUV fares to strengthen financial position of drivers/operators, thus allowing for proper maintenance of the vehicles.

***On importation of second hand and rebuilt vehicles***

- Amend RA 8749 to prohibit/ban importation of second hand and rebuilt motor vehicles including engines.

***On petroleum products and related tax structure***

- Introduce tax/pricing differential mechanism such that cleaner fuels like unleaded gasoline, and later coco-diesel, CNG and LPG are preferred to diesel and other dirtier fuel products. This would positively alter customer behavior;
- Promote commercialization/expand market availability of coco diesel or coconut methyl ester and other cleaner fuel alternatives to benefit the public transport sector.