Clean Air in Sri Lanka:
Summary of progress on improving air quality

Country Network Sri Lanka
Clean Air Sri Lanka
November 2008

CONTENTS

About CAI-Asia

The Clean Air Initiative for Asian Cities (CAI-Asia) was established as a joint initiative by the Asian Development Bank, World Bank, and the United States – Asia Environmental Partnership (a project of USAID) in 2001.

CAI-Asia promotes innovative ways to improve air quality of Asian cities by sharing experiences and building partnerships. This multi-stakeholder initiative has three parts:

- The CAI-Asia Center, a regional, Philippines-based non-profit organization as the implementing arm of CAI-Asia
- The CAI-Asia Partnership, a United Nations Type II partnership, with over 120 member organizations
- CAI-Asia Country Networks in the People's Republic of China, India (2009), Indonesia, Nepal, Pakistan, Philippines, Sri Lanka, and Viet Nam.

FOREWORD

Air quality management (AQM) is still a major challenge in Asia. The fast growing Asian economies and continued urbanization have increased the demand for mobility and energy in the region, resulting in high levels of air pollution in cities from transport, industry and other sources. The World Health Organization estimates that ambient air pollution causes *over half a million* premature deaths per year, leaving the urban poor particularly vulnerable since they live in air pollution hotspots, have low respiratory resistance due to bad nutrition, and lack access to quality health care.

We are, therefore, pleased to present you with an update on the efforts and progress to improving air quality in Sri Lanka, which also focuses on related areas, most importantly health, climate change, transport and energy management. This summary report was prepared by the Clean Air Network of Sri Lanka, also known as Clean Air Sri Lanka (CleanAirSL), which is hosted by the Air Resource Management Center (AirMAC). This report presents

- Trends in air quality and climate change
- The Clean Air Network of Sri Lanka, including main achievements and challenges
- Responses to address air pollution in Sri Lanka including policies, programs/projects, training courses, and several case studies of concrete actions.

You are invited to discuss with us the achievements and challenges of Sri Lanka at the Roundtable of South Asian Countries on Thursday, 13 November, 10:30 – 12:00, at the Better Air Quality (BAQ) workshop 2008 in Bangkok, under the theme “Air Quality and Climate Change: scaling up win-win solutions for Asia.”

You can visit our country webpage on www.cleanairnet.org/cleanairsl for more information, or contact us directly. We welcome your support to help improve air quality in Sri Lanka.

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1. TRENDS IN AIR QUALITY AND CLIMATE CHANGE

This chapter explains the drivers of air pollution and climate change, trends in air pollutant levels and greenhouse gas emissions, and impacts from air pollution.

1.1 Drivers of Air Pollution and Climate Change

Sri Lanka is rapidly urbanizing. By 2050, an estimated 34% of people will be living in cities, compared to 17% in 1990. Bigger cities put more pressure on available resources, including clean air.

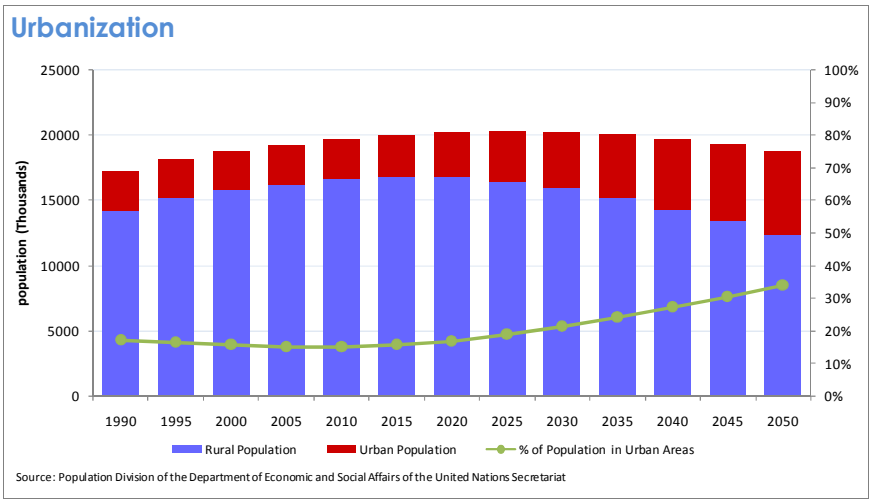

Figure 1. Urbanization increase between 1990 and 2005 and forecast for 2050

As the GDP of Sri Lanka continues to rise, energy consumption is also increasing. Energy consumption increased from 0.106 quadrillion BTU in 1990 to 0.213 quadrillion BTU in 2005.

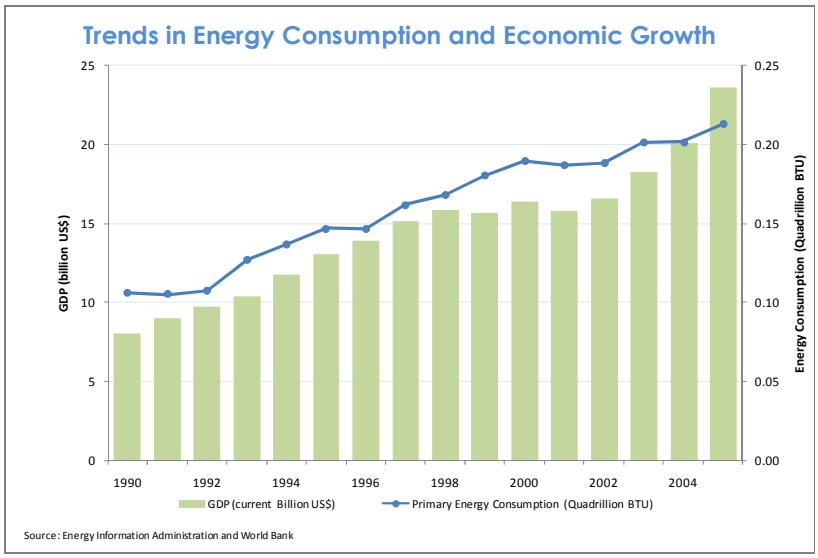

Figure 2. Energy Consumption Increase compared to GDP between 1990 and 2005

Vehicle ownership is also growing rapidly. In 1990, the total number of registered vehicles was 0.9 million, in 2007 this reached 3.1 million. Motor tricycles are growing fastest, while motorcycles are the most dominant in number.

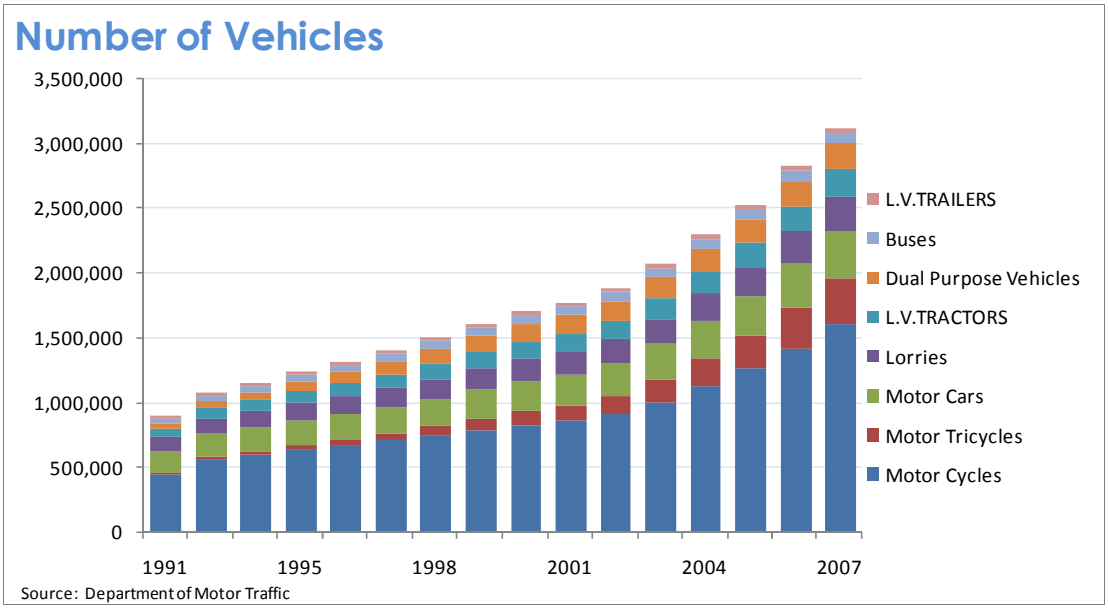

Figure 3. Vehicle growth between 1991 and 2007

1.2 Air Pollutants and Greenhouse Gas Emissions

The main air pollutants in cities are Sulfur dioxide (SO_2), Nitrogen oxides (NO_x), Particulate matter (PM, usually expressed as PM with diameter of 10 microns or smaller, PM_{10}, or 2.5 microns or smaller, $PM_{2.5}$), Carbon monoxide (CO), ozone, volatile organic compounds (VOCs), and lead.

As shown in the figures below, average national levels of PM_{10} in Sri Lankan cities have been fairly stable since 1998. SO_2 levels increased from 1997 to 2001 and decreased in 2004 and has remained stable since. NO_2 levels dropped dramatically from 1997 to 1998 and remained mostly in the 30 to 40 microgram per cubic meter level until 2006. It is important to note that in 2007 the average NO_2 levels are now within World Health Organization (WHO) guideline values, but that PM_{10} levels continue to exceed WHO guideline values.

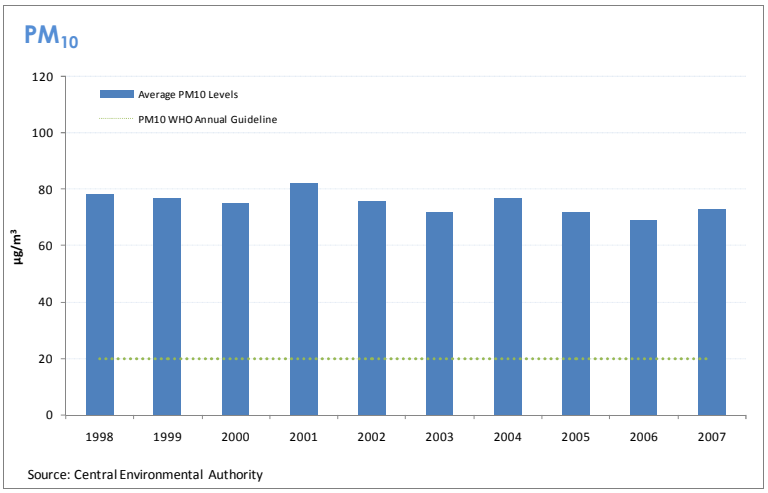

Figure 4. Trends in PM_{10} levels in Colombo between 1998 and 2007

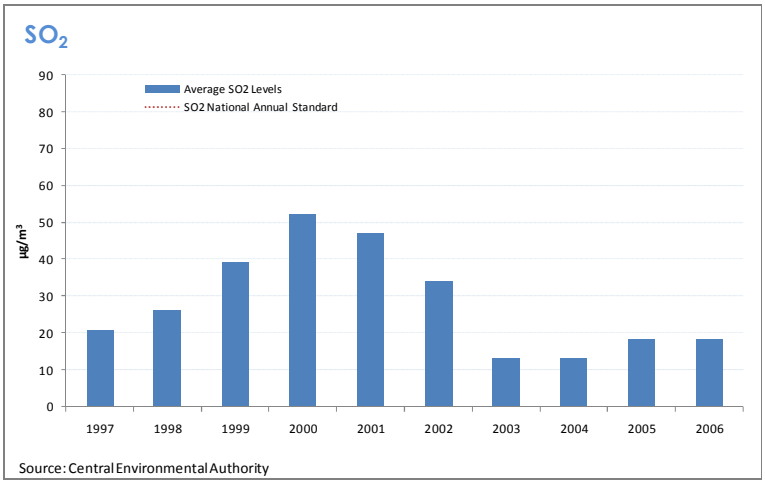

Figure 5. Trends in SO_2 levels in Colombo between 1997 and 2006

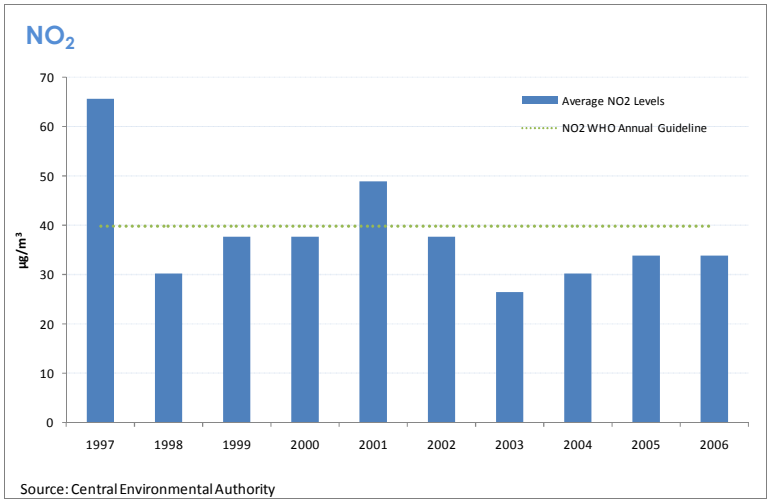

Figure 6. Trends in NO_2 levels in Colombo between 1997 and 2006

Greenhouse gas emissions, expressed as Carbon dioxide (CO2)-equivalents, are rapidly increasing. In 1990, GHG emissions from fossil fuel combustion were 3762 thousand metric tons, in 2004 this was 11,534 thousand metric tons. Increased energy consumption is the main reason for this steep increase.

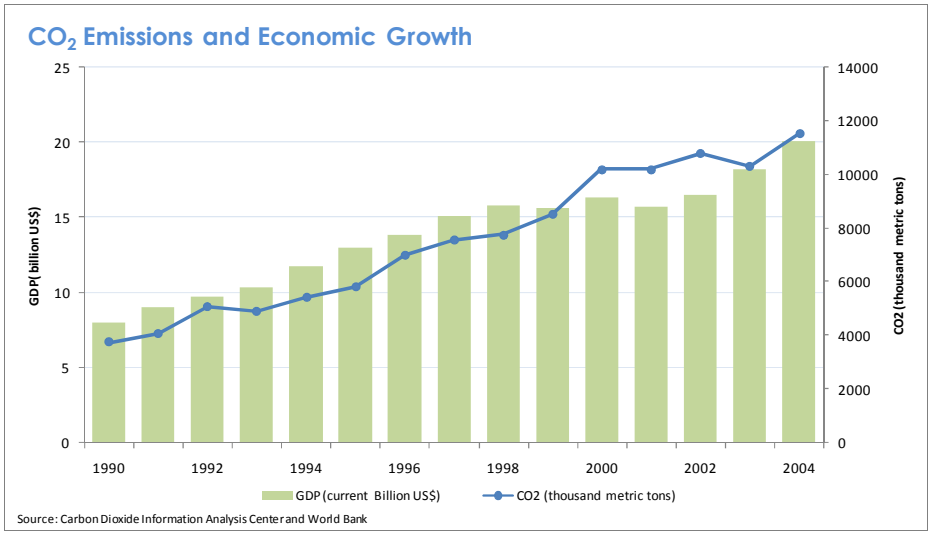

Figure 7. Trends in greenhouse gas emissions (CO_2-equivalents) from fossil fuel combustion for Sri Lanka between 1993 and 2004

1.3 Impacts of Air Pollution

Several studies conducted in Sri Lankan cities show that air pollution leads to reduced health and quality of life, damage to property, and economic losses.

PM_{10}-related health damage in the City of Colombo is about Rs. 26.0 billion per annum; and in the case of $PM_{2.5}$ it is about Rs. 774 million per annum. This is according to a study by Chandrasiri,S. *et. al.* (2004) which quantified the health effects of $PM_{2.5}$ from auto-diesel emissions.

Table 1. Health damage due to PM_{10} and $PM_{2.5}$ (Rs. Millions/year) - 2003

Pollutant	Total vehicle population	Diesel vehicles only
	Rs. Millions/year	Rs. Millions/year
PM_{10}	30,130	26,312.5
$PM_{2.5}$	886	773.7

Based on the above estimates, the researchers calculated the cost per ton of auto diesel emissions in Colombo and the estimated figures are given Table 2.

Table 2. Health Damage due to PM_{10} and $PM_{2.5}$ (Value/ton) - 2003

Pollutant	Rs. Millions /ton	US$ /ton
PM_{10}	1.88	18,341
$PM_{2.5}$	0.09	883

These estimates of the health damage values for PM_{10} in Colombo come quite close to previous estimates in these studies:

- ESMAP (2003) study stated it was in the region of US$18,000/ton for 2000
- Lovovsky *et. al.*, (2000) covering six cities came up with a low value estimate of US$17,790 to 14,232/ton

Another study on the "Exposure to Aerosol Pollution and Reported Respiratory Symptoms Among City Dwellers" by Perera, G.B.S., Emmanuel, R., Premasiri, H.D.S., (2006) shows that urban dwellers report higher prevalence of respiratory illnesses since they spend more on the roadsides, have higher exposure and also have all the common respiratory symptoms. Comparison of most common causes of mortality and morbidity data shows that although non-air pollution-related causes remain the primary cause for mortality, air pollution is a significant contributor to morbidity.

The average property damage due to urban air pollution in Colombo is estimated at Rs. 12677 (US$ 126) per household per year. The average willingness to pay to avoid property damage from urban air pollution is at Rs. 520 (US$ 52) per household per year. If an Air Quality Improvement Fund were to be established, the public would be willing to pay Rs.1546 (US$ 154) per household per year. These were the findings of a study on the "Valuation of Property Damages from Urban Air Pollution: A Case Study of Colombo, Sri Lanka" by Batagoda B.M.S. & Parameshwaran,G., (2004).

2. CLEAN AIR NETWORK SRI LANKA

2.1 Introducing the Clean Air Network Sri Lanka

The Clean Air Sri Lanka (CleanAirSL) was established in 2004 as a non-stock, nonprofit organization to work on combating air pollution. In addition, it was expected to assist all government agencies in implementing air quality management programs and climate change mitigation programs.

The objectives of CleanAirSL are to

- Assist all government agencies in implementing their mandated activities in air quality management programs and climate change mitigation/ adaptation programs
- Strengthen and build the capacity for air quality management
- Develop policies and programs for air quality management
- Promote and facilitate air quality research
- Provide advisory services for air quality management related activities

The CleanAirSL keeps track of air quality drivers, trends, impacts and responses. In doing so, it works together with a wide range of stakeholders with an interest in better air quality in Sri Lanka and who have a role to play in achieving this: government agencies, development partners (including donors, foundations, development agencies), civil society (including non-governmental organizations or NGOs, academia, research institutes) and the private sector. Stakeholder groups are shown on the next page.

2.2 Main Achievements and Challenges

The main achievements in improving air quality in Sri Lanka since 2006 are

- **Banning of importation of two-stroke engine three- wheelers:** The Government of Sri Lanka banned the importation of two-stroke petrol three-wheelers from 1 January 2008 and prohibited the import of full engine, engine blocks and cylinder heads after 2011 in order to avoid the local assembly of two-stroke engines.
- **Implementation of vehicle emission testing program:** Sri Lanka is in the process of implementing the Vehicle Emission Testing program. The Program was launched on 15 July 2008. Several agencies play an important part in its implementation. The Ministry of Environment and Natural Resources developed the emission standards; the Department of Motor Traffic is the designated implementing agency of the program. This program is designed as a public-private partnership and is a centralized system with two large private sector companies contracted to conduct the vehicle emission tests. Two private sector companies have been selected to establish testing centers in all of Sri Lanka. The testing centers in the major cities are already in place.

  Under the Program, vehicle owners must secure an emission certificate because it is a requirement to obtain the annual revenue license in Sri Lanka. After the vehicle is tested, the owner gets an emission certificate which states the emission levels of the vehicle. If the vehicle meets the

standards, the owner gets a pass certificate; if he fails, he has to repair the vehicle and go back to the testing center for a re-test.

- **Amendment of National Ambient Air Quality Standards:** Considering the latest revised WHO guideline values, Sri Lanka reviewed the National Ambient Air Quality Standards and incorporated PM_{10} and $PM_{2.5}$. Sri Lanka set the interim targets 2 as given in the Global update of WHO Air Quality Guideline in 2005.

Gazette No. 1562/22, 15th Friday 2008

National Environmental (Ambient Air Quality) Regulations – Sri Lanka

SCHEDULE

Pollutant	Averaging Time	Maximum Permissible Level		Methods of Measurement
		μgm^{-3}	ppm	
Particulate Matter Aerodynamic diameter is less than 10 µm in size (PM_{10})	Annual	50	--	Hi-Volume sampling and gravimetric or Beta Attenuation
	24 hr	100	--	
Particulate Matter Aerodynamic diameter is less than 2.5 µm in size ($PM_{2.5}$)	Annual	25	--	Hi-Volume sampling and gravimetric or Beta Attenuation
	24 hr	50	--	
Nitrogen dioxide (NO_2)	24 hr	100	0.05	Colorimetric using Saltzman Method or equivalent Gas phase Chemiluminescence
	8 hr	150	0.08	
	1 hr	250	0.13	
Sulfur dioxide (SO_2)	24 hr	80	0.03	Pararosaniliene Method or equivalent Pulse Fluorescent
	8 hr	120	0.05	
	1 hr	200	0.08	
Ozone (O_3)	1 hr	200	0.10	Chemiluminescence Method or equivalent Ultraviolet photometric
Carbon monoxide (CO)	8 hr	10000	9.00	Non Dispersive Infrared Spectroscopy
	1 hr	30000	26.00	
	Any Time	58000	50.00	

Minimum number of observations required to determine the average over the specified period

03 hour average - 03 consecutive hourly average

08 hour average - 06 hourly average

24 hour average - 18 hourly average

Yearly average - 09 monthly average with at least 02 monthly average each quarter

- **Preparation of National Action Plan for Air Quality Management (Clean Air 2015):** Clean Air Sri Lanka and the Air Resource Management Center of the Ministry of Environment and Natural Resources have prepared the Clean Air 2015 action plan to manage the air pollution in Sri Lanka. The main areas under the action plan have been identified as priorities, action plans prepared and work started for each: Monitoring Emissions of Power Plants and High Polluting Industries, Monitoring and Reducing Vehicle Emissions, Provisions of Cleaner Fuels for Motor Vehicles, Prepare and Maintain Emissions Inventory, Monitoring Ambient Air Quality, Enhance Public Awareness and Carry out health impact assessments and Providing an Indoor Air Pollution Management Programme.

- **Strategic Plan for Traffic Management in Greater Colombo Area (2008-2010):** The Supreme Court of Sri Lanka has ordered the preparation and implementation of the Strategic Plan for Traffic Management in Greater Colombo Area. Therefore, the National Transport Commission of the Ministry of Transport has conducted wider discussion with stakeholders and formulated an action plan. This action plan includes several interventions such as the formulation of an urban transport policy, set up of an urban traffic coordinating mechanism, operation of a Bus Rapid Transit (BRT), operation of at least two new multimodal terminals and introduction of the advance traffic control system etc., for completion by 2010.

Despite of progress made, several challenges remain, the most important ones being

- **Lack of financial resources:** Although Sri Lanka wants to implement both the Transport plan and Clean Air 2015 Action plan, the main barrier is the lack of funding. Sri Lanka wants to introduce clean fuel to the market. It has gazzeted the regulations and wants to introduce low sulphur diesel. It is able to reduce the sulphur level from 5000 ppm to 3000 ppm with effect from 1 January 2004, but couldn't reduce up to 500 ppm with effect from January 2007. The main problem was the cost of improving the refinery.
- **Lack of technical capacity:** The Sri Lanka Vehicle Emission Testing program is a good example of the need for technical capacity. This program was launched in July 2008. However, Sri Lanka still has not declared a compulsory date to obtain the vehicle emission testing certificate due to technical problems.

Figure 8. Clean Air Network of Stakeholders in Sri Lanka

3. RESPONSES TO IMPROVE AIR QUALITY

Countries and cities can address air pollution in several ways, such as, policies, programs, training courses, and on-the-ground measures.

3.1 Policies

Sri Lanka has a range of policies relevant to air quality management. Policies can be directly aimed at improving air quality, or policies cover related areas (such as health, climate change, energy management, environment) or sectors (such as transport, industry, construction) that affect air pollution indirectly. The most important ones are:

- Clean Air 2015 Action Plan and the Transport plan which include a number of actions to reduce air pollution.
- Sri Lanka established a Climate Change Secretariat and National Advisory Committee on Climate change in 2008. One of the main objectives is to incorporate air pollution and the climate change component into the local agenda.
- The Government of Sri Lanka established the Sustainable Energy Authority which is finalizing an energy policy and strategy that introduces coal and non-conventional renewable energy.

3.2 Programs/projects and Training Courses

The CAI-Asia Center and CAI-Asia Country Networks compiled a Compendium of air quality management (AQM) organizations, programs/projects, and training courses, which was published in January 2007. For Sri Lanka, 29 programs and projects were identified. In Asia, 28 air quality training courses delivered on a regular basis were identified. For more information see www.cleanairnet.org/compendium.

3.3 Case Studies of Concrete Actions

Pilot Project on Indoor Air Pollution Management in Sri Lanka

The pilot project monitored the indoor air pollution levels and surveyed the socio-economic and health conditions in selected households in urban and rural residential areas. Results of the project show that

- The mean concentration of suspended particulate matter (SPM) and PM_{10} in dwellings using biomass as cooking fuel was 1.5 times higher than that of those where gas was used as cooking fuel.
- The ambient 24-hour average PM, CO, and volatile organic compounds levels were two times higher in urban areas than in rural areas.
- When compared to urban ambient levels of SO_2 and nitrous oxide with that of rural areas, three times higher levels were recorded in the urban area.
- However, there is no significant difference between urban and rural carbon dioxide levels.

A long term monitoring program involving more households needs to be carried out and national guidelines on indoor air quality need to be developed after such monitoring is conducted.

The Netherlands government environmental programs provided support for the pilot project.

Communicating the importance of emission testing through media

The Vehicle Emission Testing (VET) program is an important endeavor of the Government of Sri Lanka to prevent smoke-belching vehicles from being registered. To create awareness and buy-in of the public on the importance of this program, four television commercials, a one hour television program, three radio commercials and newspaper commercials were prepared. These media efforts formed part of a communication strategy prepared by CleanAirSL which aimed to create public awareness of motor vehicles as a key source of air pollution which needs to be addressed through the VET program. The communication strategy was based on results of a survey which measured the prevailing awareness level of stakeholders (350 respondents from the general public, 350 vehicle owners and drivers, and 250 students).

The Government of Sri Lanka, Asian Development Bank and the Clean Air Initiative for Asian Cities provided support for the project.

Evaluation of Present Status of Vehicle Repair Facilities and Identification of Resource Requirement for Successful Implementation of Vehicle Emission Testing (VET) Program in Sri Lanka

An evaluation of vehicle repair facilities was conducted to assess their preparedness in repairing vehicles that fail the emission tests. The active vehicle fleet in the base year 2004 was calculated based on the total vehicle registrations and assumed survival rate of each vehicle class. The results indicate that the total active vehicle fleet in 2004 was about 1.34 million. Two and three wheelers comprised 61% of the vehicle fleet; in 2001 it was only about 56%. This trend would contribute to the deterioration of air quality in the urban area more severely. The geographical distribution of active vehicle fleet is also predicted and the results show that about 50% of the active vehicle fleet is concentrated in the western province. The forecast of future vehicle fleet was carried out using the present active vehicle fleet and the trends in vehicle ownership, under the three economic scenarios.

A country survey was conducted to obtain basic characteristics / data of vehicle repair facilities (such as type of repairs carried out, number of employees, number of vehicles repaired per month) and also to predict the total number of establishments. Data of more than 4,500 establishments were obtained. The results indicate that majority of the establishments are micro / small level with less than 10 employees and less than 25 vehicles repaired per month. The estimated total number of establishments is about 21,260. The total number of employees in the sector exceeds 115,000.

A survey to obtain the perception of vehicle owners / users on vehicle repair facilities was also conducted, with a sample size of 500 covering the major vehicle categories. Several areas were covered including number of repairs carried out, perception on quality of repairs and resources, awareness on environment and health problems associated with emissions, awareness on the VET program, etc. Results show that the average number of repairs per year per vehicle is approximately four.

Data on the essential resource requirements in terms of technical personnel, equipment and tools and infrastructure were identified. These data, together with information on the present status of vehicle repair industry, were used to estimate the additional resource requirement to upgrade the industry. The funding

requirement to train the technical personnel in the vehicle repair sector is estimated as Rs. 95 million, and that needed to upgrade the emission measurement facilities is estimated as Rs. 1194 million.

A procedure for certification of vehicle repair facilities (VRFs) is proposed, with the objective of upgrading of the entire vehicle repair sector up to an acceptable standard of professional conduct. The proposed certification procedure defines minimum requirement under different areas including staff, equipment, infrastructure, records, and customer information. It is recommended to categorize the VRFs based on the types of vehicles repaired and types of repairs conducted and certification be given for each major category of repairs. Ranking criterion for VRFs based on their performance and effectiveness of the repairs carried out is also introduced, especially with regards to the VET program.

The Asian Development Bank and the Clean Air Initiative for Asian Cities provided support for the project.

Road side testing

VET Awareness Program for Traffic Police Officers

VET Center – Clean Co (Pvt.) Ltd.

VET Center – LAUGFS ECO Sri (Pvt.) Ltd.

Vehicle Emission Testing Program supervised by the Hon. Patali Champika Ranawaka, Minister of Environment and Natural Resources

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