EXECUTIVE SUMMARY

URBAIR – Greater Mumbai (Bombay) : Larger and more diverse cities are a sign of Asia's increasingly dynamic economies. Yet this growth has comes at a cost. Swelling urban populations and increased concentration of industry and automotive traffic in cities has resulted in server air pollution. Emissions from automobiles and factories, domestic heating, cooking and refuse burning are threatening the well being of city dwellers, imposing not just a direct economic cost on human health but threatening long-term productivity. Governments, businesses and communities face the daunting yet urgent task of improving their environment and preventing further air quality deterioration.

Urbain Air Quality Management Strategy or URBAIR aims to assist in the design and implementation of polices, monitoring and management tools to restore air quality in the major Asian metropolitan areas. At several workshops and working group meetings, government, industry, local researchers, non-governmental organizations, international and local experts reviewed air quality data and designed action plans. These plans take into account economic costs and benefits of air pollution abatement measures. This report focuses on the development of an air quality management system for Greater Mumbai (Bombay) and the resulting action plan.

THE DEVELOPMENT OF GREATER BOMBAY AND ITS POLLUTION PROBLEM

Greater Bombay's population grew by 38 percent from 1971 to 1981 and another 20 percent between 1981 and 1991 to reach 9.9 million. This growth was accompanied by an increase in the per capita gross domestic product. Expansion of industries, increased foundry production and a 103 percent increase in vehicles has led to a severe air pollution problem in the city.

Annual average total suspended particles (TSP) concentration has increased from about 180 $\mu g/m^3$ (particles per cubic meter) to approximately 270 $\mu g/m^3$ between 1981 and 1990 – an increase of almost 50 percent. Nitrous Oxide (NOx) increased by about 25 percent while sulfur dioxide (SO_2) concentrations declined due to increased use of natural gas and low-sulfur coal. The average lead (Pb) concentrations doubled from 1980 to 1987. In general, SO_2 and NO_2 pollution is not as serious an issue as TSP and PM_{10} concentrations. The total annual emissions of TSP and PM_{10} are estimated at 32,000 and 16,000 tons/year. The resulting annual average ambient concentration varies from 118 to 313 $\mu g/m^3$ at various locations. World Health Organization's Air Quality Guideline (WHO AQG) as well as the National guideline for PM_{10} are frequently and substantially exceeded in Bombay, 97 percent of the population lives in areas where WHO AQG is exceeded. TSP exposure is mainly due to resuspension from roads caused by vehicles (40%), emissions form diesel and gasoline vehicles (14%) domestic wood and refuse burning (31%) and others (15%). Drives, roadside residents and those who live near large sources are most severely affected.

Studies conducted between 1976 and 1990 conclude that growing concentrations of air pollutants have led to increased cases of chronic bronchitis, colds and general decline in lung functions. A 1990 study observed that incidence of different respiratory symptoms and cardiac diseases, respiratory tract infections and skin allergies was 5 to 10 percent higher in communities near factories in Chembur. Similarly, a study of two high density traffic areas in Bombay found a significant correlation between concentrations of air pollutants and frequency of colds and attacks of breathlessness. Past studies, as well as anecdotal evidence, suggest that Greater Bombay resident's health, especially in high density traffic areas or near industries, is under assault. The health impact is estimated at 2,800 cases of excess mortality, 60 million respiratory symptom days and 19 million restricted activity days, with an estimated health damage cost of Rs. 18 billion, per day.

CONCEPT OF AN AIR QUALITY MANAGEMENT SYSTEM

Assessment of pollution and its control form two prongs of an Air Quality Management System (AQMS). These components are inputs into a cost-benefit analysis. Air quality guidelines or standards and economic objectives and constraints also guide the cost benefit calculation. An Action Plan contains the optimum set of abatement and control measures for short, medium and long term enactment.

Successful AQMS requires the establishment of an integrated system for continual air quality monitoring. Such as a system involves :

- An inventory of air pollution activities and emission
- Monitoring of air pollution and dispersion parameters
- Calculation of air pollution concentrations by dispersion models
- Inventory of population, building materials and planned urban development.
- Calculation of the effect if abatement / control measures and
- Establishment / improvement of air pollution regulations

In order to ensure that an AQMS is having the desired impact, it is necessary to carry out surveillance or monitoring. This requires the establishment of an air quality information system (AQIS) to inform authorities and the general public about air quality and assess results of abatement measures. AQIS should also provide continuous feedback to the abatement process.

ABATEMENT MEASURES AND ACTION PLAN

Measures to reduce air pollution in Bombay focus on traffic. Traffic emissions are a clear and major source of air pollution exposure. Abatement measures which address other important pollutions sources including refuse and wood burning and resuspension of road dust could not be addressed due to lack of data. While pollution control in industrial areas has not been discussed at length, it must also be promoted through enforcement and regulation.

Based on abatement measures, an Action Plan was designed through a consultative process with Bombay URBAIR working groups, the Municipal Council of Greater Bombay, Maharashtra ESI for estimated costs and benefits of these measures. Recommended actions fall under two categories 1) technical and other measures that will reduce exposure to and damage from pollution and 2) improvements in the database and in regulatory and institutional basis required to establish an operative system for air quality management in Greater Bombay.

It is proposed that the following technical and policy measures be given priority :

- Address gross polluters : Existing smoke opacity regulations for diesel vehicles must be strictly enforced. Successful action depends on routine maintenance and adjustment of engines.
- Clean vehicle emission standard : Establish state-of-the-art emission standards for gasoline cars, diesel vehicles, and motorcyclers. Such standards would be better enforced with the assured availability of lead-free gasoline, at prices below that of leaded gasoline.
- Switch to unleaded gasoline : This is an early prerequisite for clear vehicle standards. The health benefits stemming from this action would be substantial.
- Use of low-smoke lubrication oil, 2-stroke : Setting and enforcing a standard for oil quality and is important. Taxes and subsidies can be used to set the price of oil according to its quality.
- Inspection and maintenance of vehicles : More maintenance stations able to carry our annual or biannual inspections are needed for enforcement of clean vehicle standards. Basic legislation is already in place. The greatest potential to reduce emissions lies in diesel vehicles and initially, agencies could concentrate on these vehicles.
- Improving diesel quality : Indian refineries require modification in order to produce low sulfur (less than 0.2 percent) diesel. Economic instruments such as taxes and subsidies can be used to differentiate fuel price according to quality.
- Fuel switching, gasoline to LPG / CNG in vehicles : The tax or subsidy structure must be changed in order to make LPG / CNG the preferred fuel. The establishment of distribution and compression systems for CNG are also a key component of this actions.
- Cleaner fuel oil : A reduction in the sulfur content of furnace oil, initially to less than 2 percent is a prerequisite.
- Awareness raising : Public awareness and participation are key to bringing about policy change. Widespread environmental education promotes understanding of linkages between pollution and health and encourage public involvement. Private sector participation through innovative schemes like accepting delivery only from trucks that meet government emission standards, Adopt-a-street campaigns and air quality monitoring displays should be encouraged. Media can also participate in awareness raising by disseminating air pollution related data.

RECOMMENDATIONS FOR STRENGTHENING AIR QUALITY MONITORING AND INSTITUTIONS

A single coordinating institution with a clear mandate and sufficient resource must be made responsible for air quality management. In order to improve data, it is recommended that there be continuous, long-term monitoring at 5 or more general city sites (or city background sites) 1 to 3 traffic exposed sites, 1 to 5 industrial hot spots. Also, an on-line data retrieval system directly linked to a laboratory database either via modern or fax is recommended for modern surveillance.

The analysis in this report calculates health impacts based on average does effect relations derived from U.S. cities because of a lack of local data. Such epidemiological data for exposure calculations should be improved. It is suggested that dispersion modeling experts be identified in Bombay and their expertise used by the agencies responsible for air quality management.

Current restrictions on the use of coal, the Industrial Location Policy (1984) and the Central Action Plan (1992) to discourage non-compliance have been the most effective regulations. Restrictions on auto-rickshaws (three wheelers) and heavy commercial vehicles have had a positive effect on the air quality. It is important to ensure that institutions dealing with air quality be strengthened through clearer mandates and enforcing powers.

Clearly, environmental risks are escalating. If pollution sources are allowed to grow unchecked the economic costs of productivity lost to health problems and congestion will escalate. While working with sparse and often unreliable data, this report sets out a preliminary plan that has the potential to improve air quality and better manage the AQMS in the future.