STRATEGIES TO REDUCE AIR POLLUTION IN INDIA

Dr. B. Sengupta
Former Member Secretary
Central Pollution Control Board
Ministry of Environment & Forests
Govt. of India, Delhi

Email: bsg161@gmail.com,

Paper presented at Indo-Japanese Conference on Fuel Quality and Vehicular Emissions
On 18 March , 2009

Contents

- Air Quality Concerns
- Current Status of AQM
- Air Quality trends
- Thrust Areas
- Way Forward

Air Quality Concerns

- **METROS CITIES/URBAN AREAS**
  - 65 non-attainment cities
  - Dominant Sources: Vehicular Emissions, Small/Medium Scale Industries, Gensets, Biomass burning, etc.
  - Pollutants: NO_x, SPM/RSPM & CO
- **CRITICALLY POLLUTED AREAS**
  - 24 critically polluted areas
  - Dominant Sources: Industries-Power Plants, Refineries, Chemical Plants, etc.)
  - Pollutants: NO_x ,SPM/RSPM, SO_2 VOCs, PAHs, etc.
- **RURAL AREAS**
  - Indoor air pollution: Use of Biomass, Coal, kerosene, etc.
  - Outdoor air pollution: Unpaved roads, Biomass burning, Gen-sets etc.
  - Pollutants: SPM/RSPM, CO, etc.

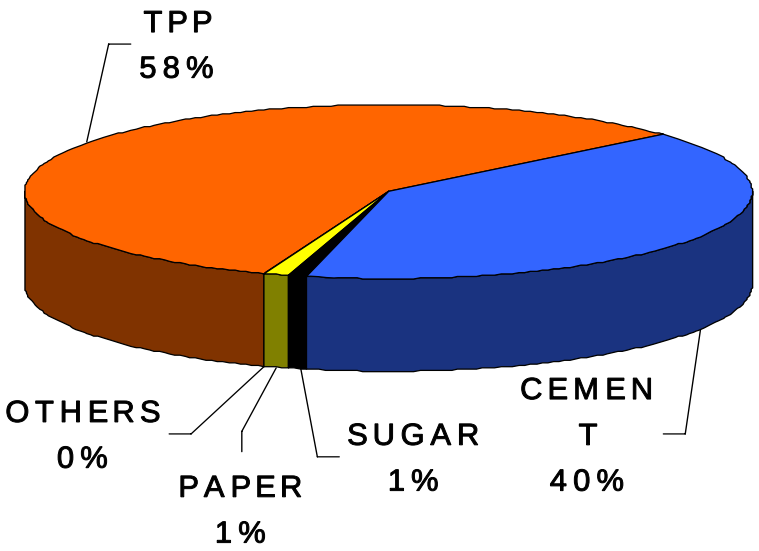
Current Status of AQM

- Institutional Mechanism
- Assessment of Air Quality
  - Monitoring
  - Emission Inventory
  - Source Apportionment
  - Air Pollution Exposure & Health Impacts
- Control Strategies
- City Specific AQM Action Plans

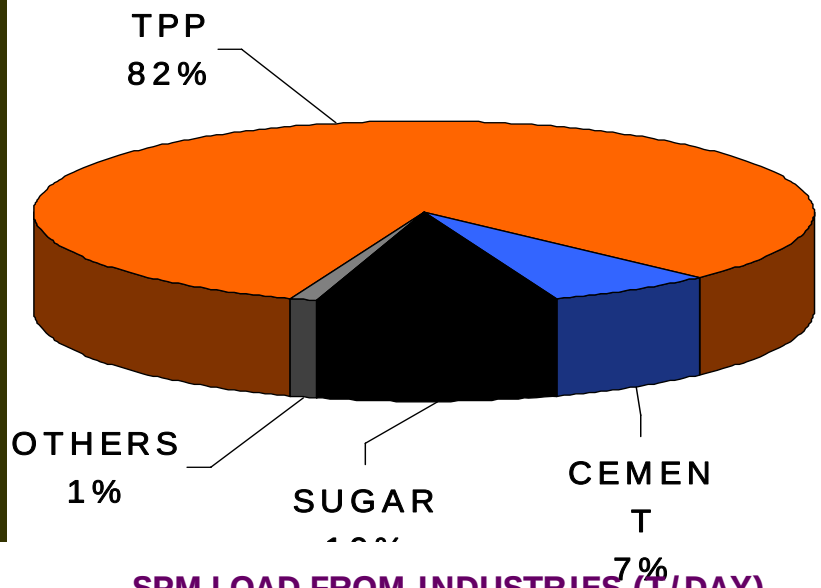
Institutional Mechanism

- **Central Level**
  - Ministry of Environment & Forests
  - Central Pollution Control Board
  - Environment Pollution Control Authority
  - Ministry of Petroleum & Natural Gas
  - Ministry of Road Transport & Highways
  - Other Central Ministries/Agencies
  - R&D Centers & other Institutions
- **State Level**
  - Department of Environment
  - Pollution Control Board/Committees
  - Local Bodies/Authorities

Emission Inventory

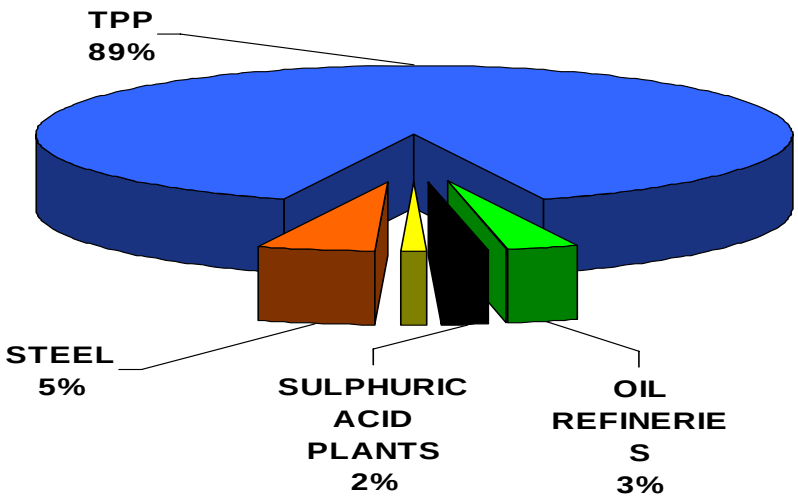


SPM LOAD FROM INDUSTRIES (T/DAY)
[Without Control Device]



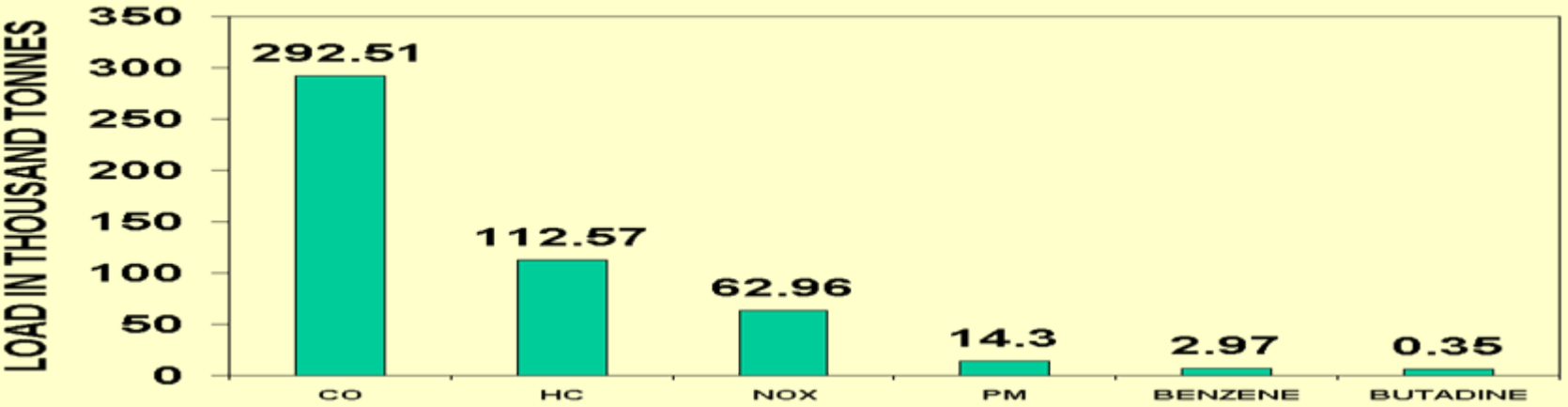
SPM LOAD FROM INDUSTRIES (T/DAY)
[With Control Device]

SO_2 LOAD FROM INDUSTRIES (T/DAY)

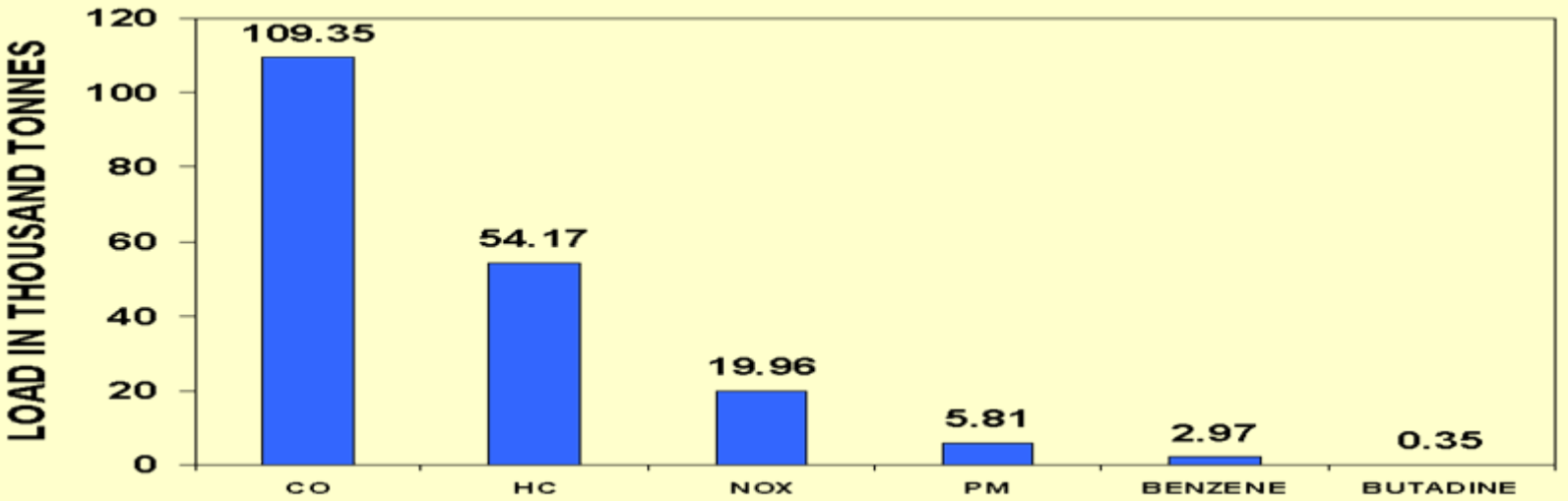


Emission Inventory (Contd..)

Air pollution from vehicles in Delhi



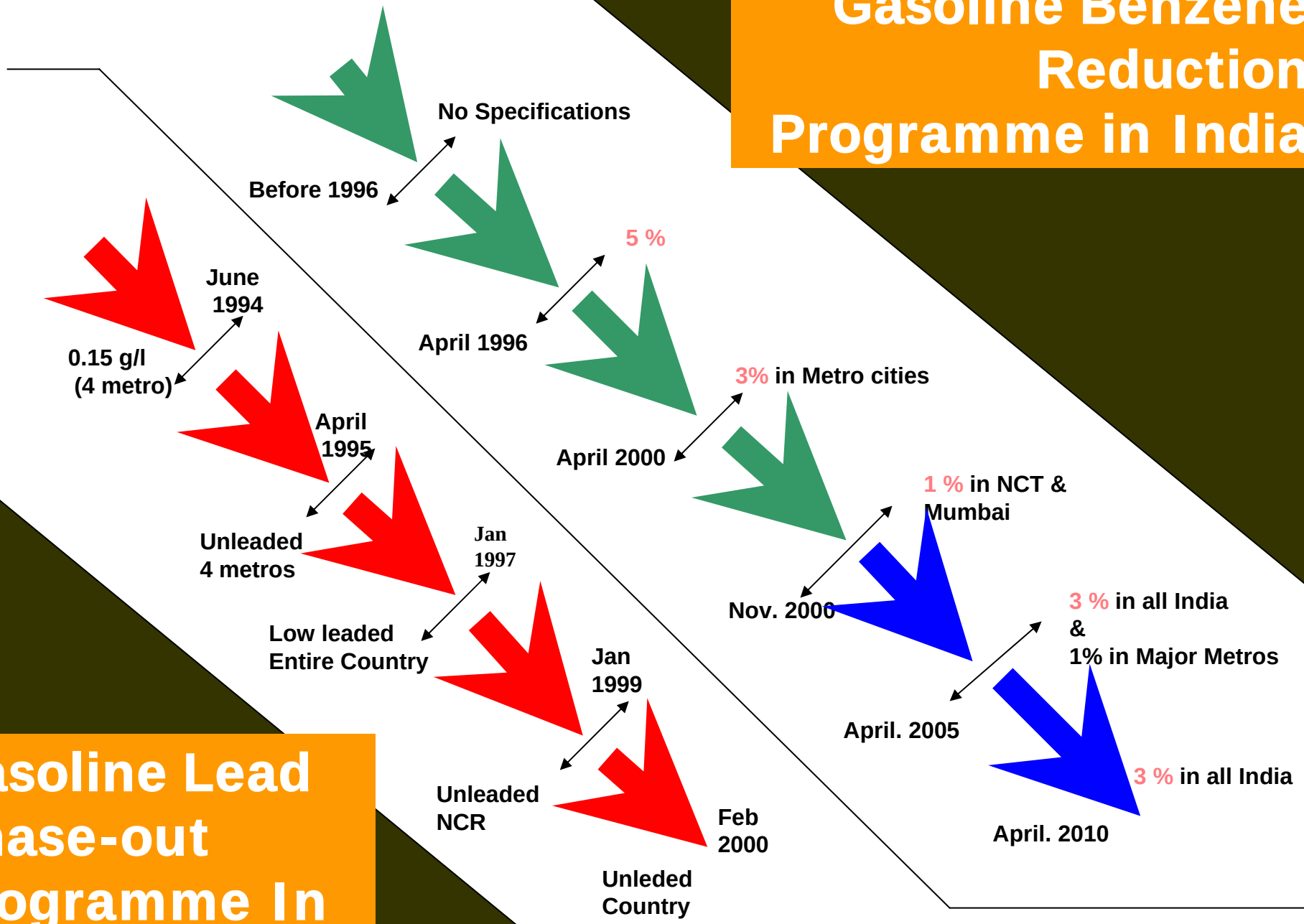
Air pollution from vehicles in Mumbai



Control Strategies Adopted

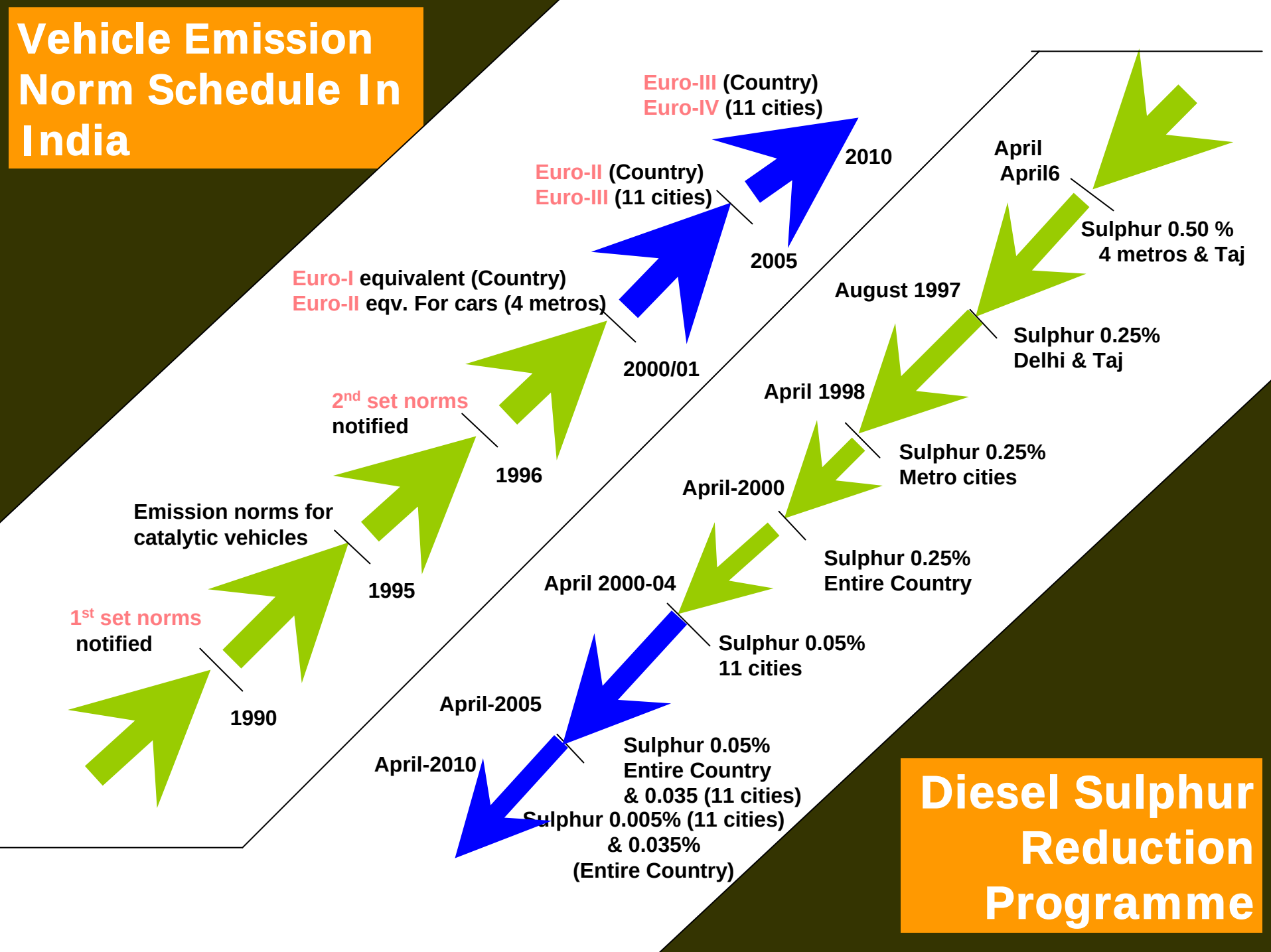
- Air Quality Standards notified (1982 & 1994) and Air Pollution Control areas declared
- Emission Standards notified for Industries Vehicles (in-use & new), Gensets, etc.
- Fuel quality improvements. (Coal, gasoline & diesel).
- Relocation of polluting industries, phasing out older polluting vehicles, introduction of mass rapid transportation, etc.
- Road map for control of emissions from new and in-use vehicles developed up to year 2010
- Use of Alternate fuel (CNG,LPG,Ethanol petrol, Bio-diesel, Hydrogen,etc.)

Gasoline Benzene Reduction Programme in India

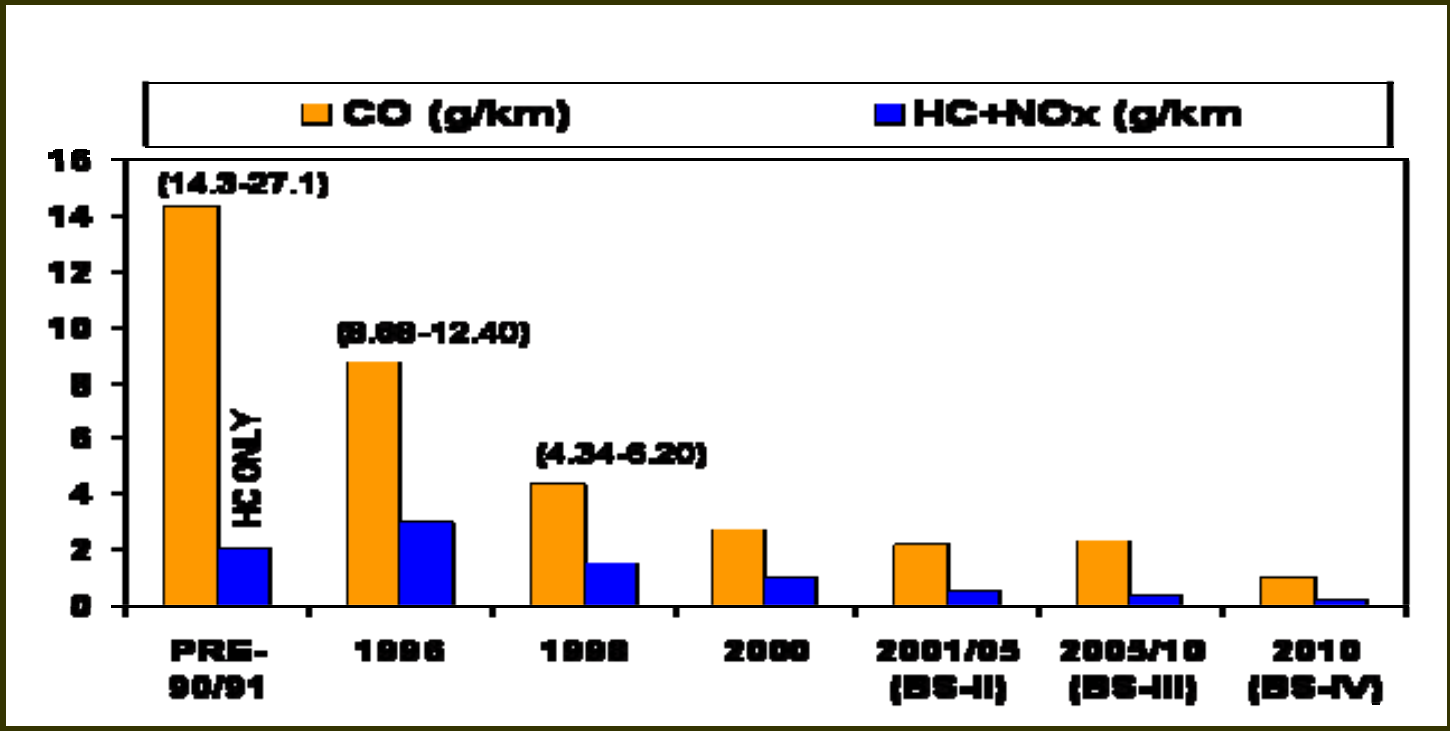


Gasoline Lead Phase-out Programme In India

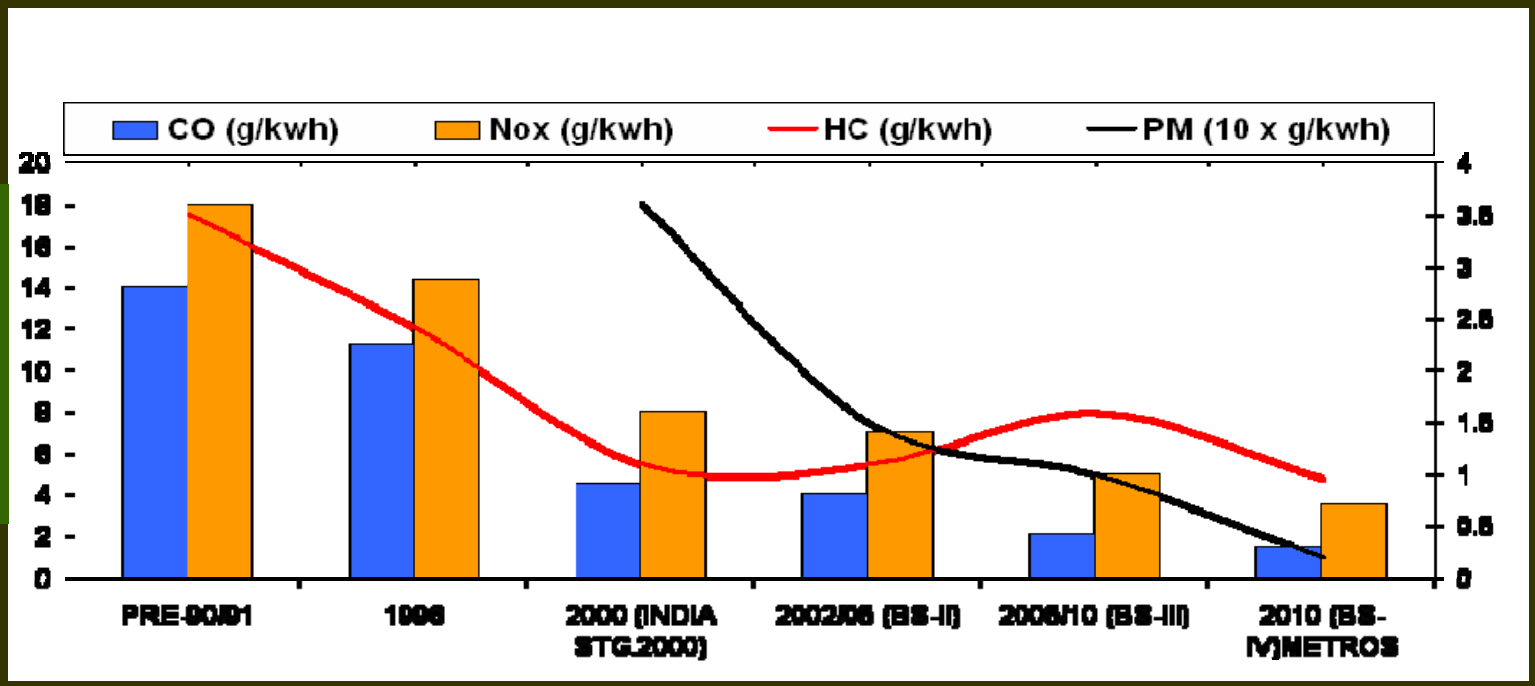
Vehicle Emission Norm Schedule In India



Diesel Sulphur Reduction Programme



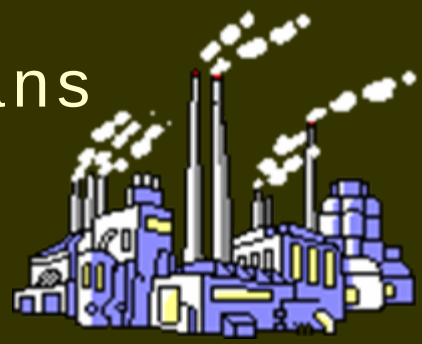
EMISSION REDUCTIONS ROAD MAP FOR NEW PASSENGER CARS



EMISSION REDUCTIONS ROAD MAP FOR NEW (HDV)

Control Strategies Adopted (contd..)

- CREP developed for 17 categories of industries
- Specific control strategies for major industries
- Initiatives for small scale sector
- City specific AQM action plans



Industry Specific Control Strategies

- THERMAL POWER PLANT:
  - Ash utilization time frame laid down (26% utilization)
  - Enforcement of PM Emission Standards (70% compliant)
  - Mandatory use of beneficiated coal
  - Promotion of clean coal technologies. (FBC, PFBC, IGCC, etc.)
  - Tall stack dispersion

Air Pollution Due to Use of Coal in Thermal Power Plants

ITEMS	EXISTING SCENARIO	2050 SCENARIO
Coal based Electricity Production (MW)	67600	900000
Coal Consumption (million tonnes)	258	3434
Particulate Matter Emission (million tonnes)	1.62	21.9
Sulphur Dioxide (million tonnes) Emission	2.451	32.6
Oxide of Nitrogen (million tonnes)	2.3	30.9

Source: CEA / NTPC

Use of clean coal technologies (Super Critical ,IGCC, PFBC, CFBC, etc.) to be promoted based on location specific requirements.

Control Strategies And Policies Adopted

- **Oil Refineries**
  - Control of SO_2 emissions by using high efficiency SRU, adequate stack height & low sulphur fuels. (Mathura refinery emissions restricted to 10.8 MT/day; Total SO_2 emission 175 MT/Day from 123 MMTPA capacity)
  - SO_2 emission standards being revised & NOx & VOC standards to be introduced
  - Leak Detection & Repair Programme to reduce fugitive emissions

Initiatives Taken to Control Air Pollution From SSI Sector

- **Brick Kiln**

1. **Replacement of movable chimney by fixed chimney. (saving of coal by 10%)**

2. **Better firing and feeding practices. (saving of coal by 10%)**

3. **Use of vertical shaft brick kiln (saving of coal by 10-16% over BTK)**

Initiatives Taken To Control Air Pollution From SSI Sector

- **Cupola Furnace (Foundry)**

  1. Use of divided cold blast
  2. Improving metal coke ratio from 5:1 to 9:1 (resulting in saving of 2.5 tonne of coke in 8 hours operation
  3. Development of low pressure scrubbing system

- **Hot Mix Plant**

  1. Indirect heating of bitumen using thermic fluid to replace direct heating

- **STONE CRUSHER**

  1. Developing enclosure and water mist spraying system to control air pollution
  2. Siting guidelines for stone crushers

STEPS TAKEN TO IMPROVE AIR QUALITY IN NCR-DELHI

Industrial Pollution Control

- Use of beneficiated coal (having ash 34%) made mandatory in Thermal Power Plant.
- Closure of hazardous air polluting industries.
- Shifting of highly polluting industries from non-conforming areas (residential area) to conforming area (approved industrial area).
- Emission standard for DG Sets (Portable and Stationery sets)
- Notification and approved fuel for UT of Delhi
- Upgradation of ESP's in three coal based power station in Delhi.
- Use of LDO instead of coal in small boilers.

Emission Reduction from Vehicles by Introducing Stricter Norms

Norms	Year of Implementation
1996	1996
1998 (Cat. Convertor Norms)	1998
Bharat Stage I (Euro I)	1999
Bharat Stage II (Euro II)	2000/2001
Bharat Stage III (Euro III)	April, 2005
Bharat Stage IV (Euro IV)	April, 2010

Vehicular Pollution Control

Road Map for Fuel Quality Improvement

Norms	Year of Implementation
0.5% S – Diesel	1996
0.25% S – Diesel	2000
0.05% S – Diesel	2003
0.035% S – Diesel	2005
Unleaded Petrol	2000
Low Smokes 2 T oil	1998

Approved Fuel for U.T. of Delhi

- Coal with low sulphur (S - 0.4%)
- Fuel oil / LDO/ LSHS / with low sulphur (S – 1.8%)
- Motor gasoline (as per specifications given in the notification dated 2-4-96 of the Ministry of Environment and Forests, annexed hereto)
- Diesel (as per specifications given in the notification dated 2-4-96 of the Ministry of Environment and Forests, annexed hereto)
- Liquid petroleum Gas (LPG)
- Compressed Natural Gas(CNG)
- Kerosene
- Naphtha (for power station)
- Aviation turbine fuel (for aircraft)
- Fire wood (only for domestic use in rural areas and crematorium)
- Bio - Gas

Source: Gazette Notification of Delhi Govt.

Alternate Fuel Use in NCR Delhi

- CNG – Norms notified and more than 80,000 CNG vehicles plying in Delhi
- LPG – Norms notified, LPG kits approved
- Gasoline with 5% ethanol from 2003 in sugar producing states & UT to be extended to other states and Union Territories. 10% to be introduced by 2007
- Bio – diesel (5%) by 2005 & Bio – diesel (10%) by 2011

Restriction on Grossly Polluted Vehicles in India

- 15 Years old Commercial Vehiclesphased out in Delhi
- City Diesel Buses phased out in Delhi and introduced clean fuel (CNG) Buses

ROAD MAP FOR VEHICULAR EMISSION

NORMS FOR IN-USE VEHICLES

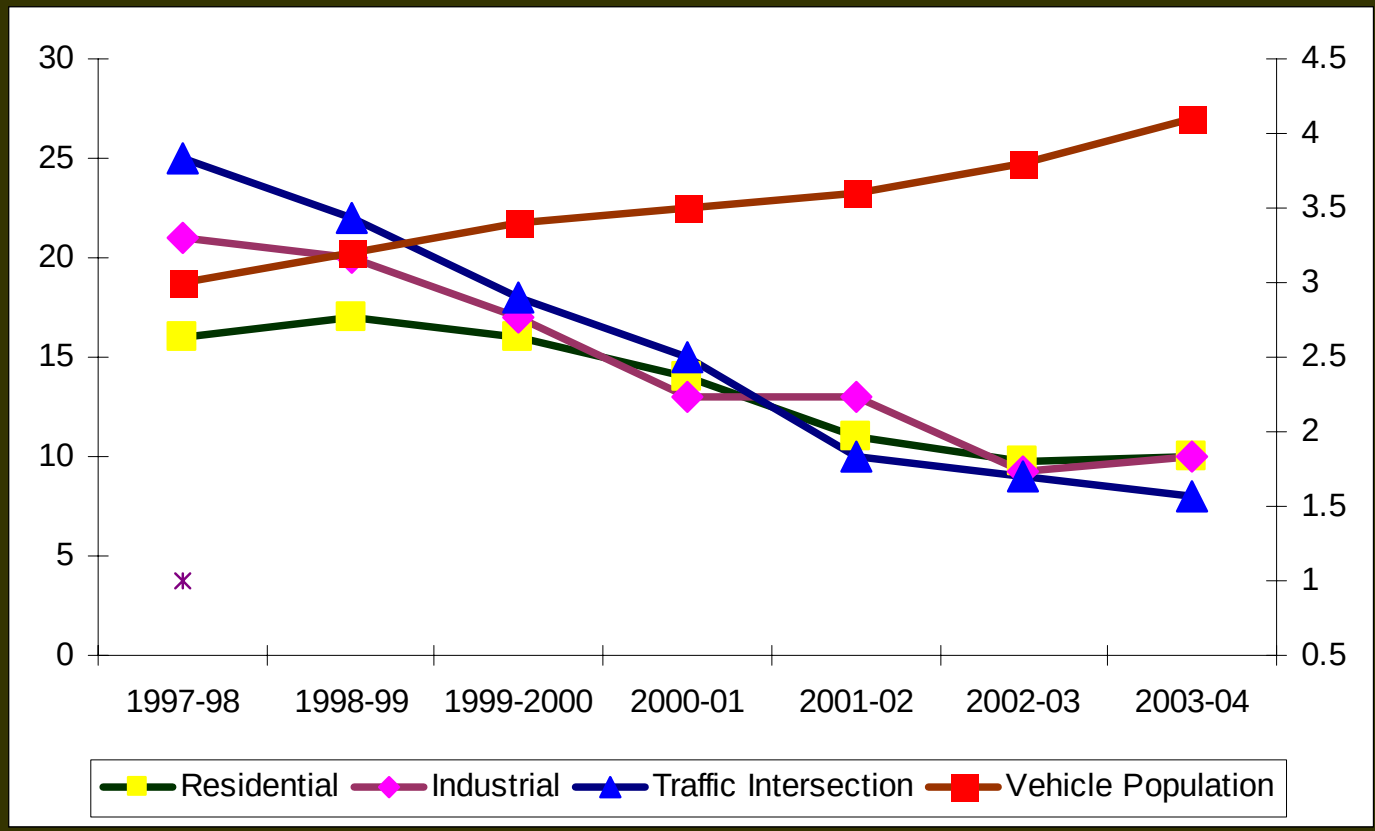
Activities	Applicable for Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Ahmedabad, Kanpur, Pune
New PUC Checking System for all categories of vehicles	1 April 2004
Inspection & Maintenance system for all categories of vehicles	1 April 2006
Performance Checking of catalytic converters and converstion kits installed in vehicles	1 April 2005
Augmentation of city public transport system	Not later than 1 April 2004
Emission norms for city public service vehicles	**City Buses and Taxis** **From 1 April 2004** Registered after 1 April 1996 : Applicable norms on date registration. Before 1 April 1996 : 1996 emission Norms. **From 1 April 2008** Registered after Introduction of Bharat_II norms : Applicable norms on date registration. Registered before Introduction of Bharat_II norms : India 2000 norms **3 wheelers** **From 1 April 2004** Registered after 1 April 2000 : Applicable norms on date of registration. Before 1 April 2000 : 1996 emission norms. **From 1 April 2008** Registered after 1 April 2000 : Applicable norms on date of registration before 1 April 2005 : Minimum India 2000 emission norms.
Emission norms for all inter state buses. Minimum India 2000 Minimum Bharat Stage II	**From 1 April 2004** Registered after 1 April 2000 : India 2000 Before 1 April 2000 : 1996 emission norms. **From 1 April 2008** Registered after 1 April 2005 : Bharat Stage – II Before 1 April 2005 : Minimum India 2000 emission norms.

Agencies Involved

- Central Pollution Control Board
- Ministry of Environment & Forests
- Environmental Pollution Control Authority
- Ministry of Petroleum & Natural Gas
- Ministry of Road Transport & Highways
- Ministry of Industries

Impacts of Interventions on the Air Pollutants

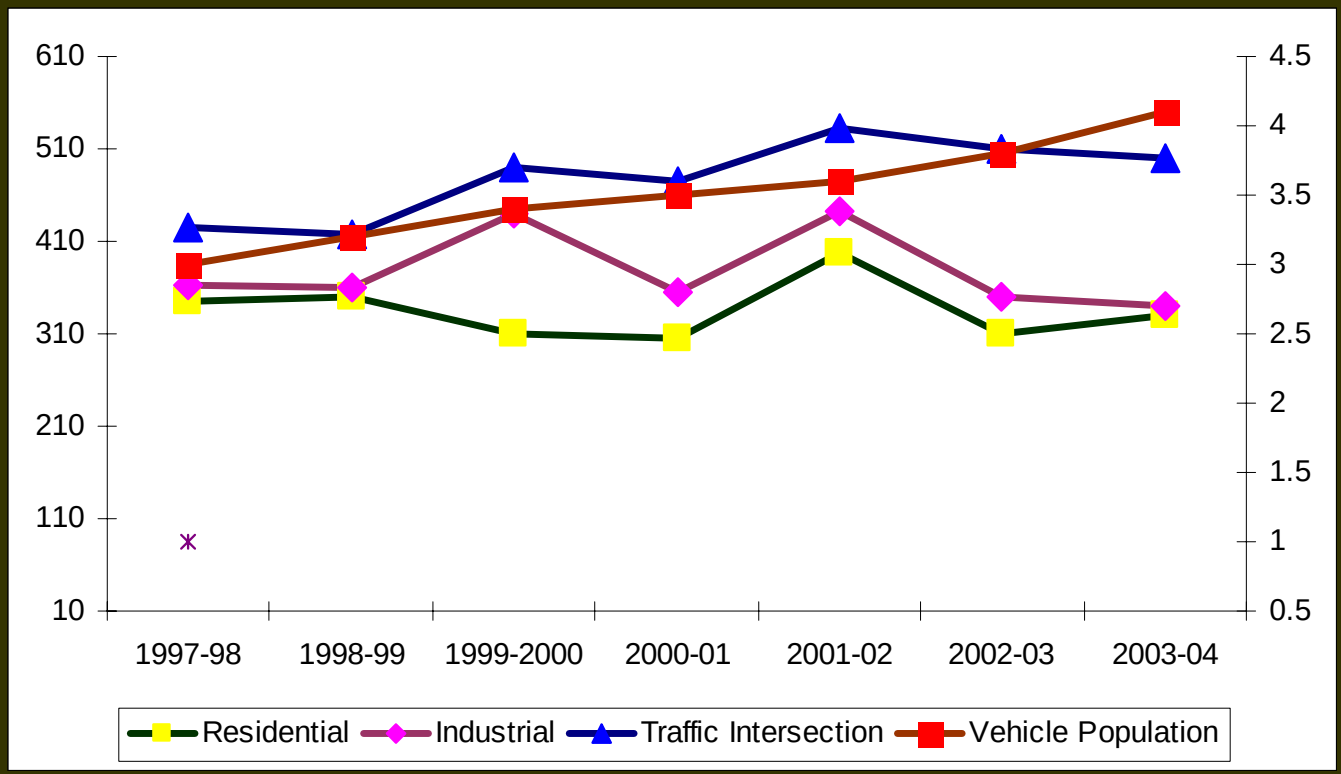
Sulphur Dioxide(SO_2) levels in Ambient Air



Year	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04
Year	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04
Year	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04
Year	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04
Year	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04

Impacts of Interventions on the Air Pollutants

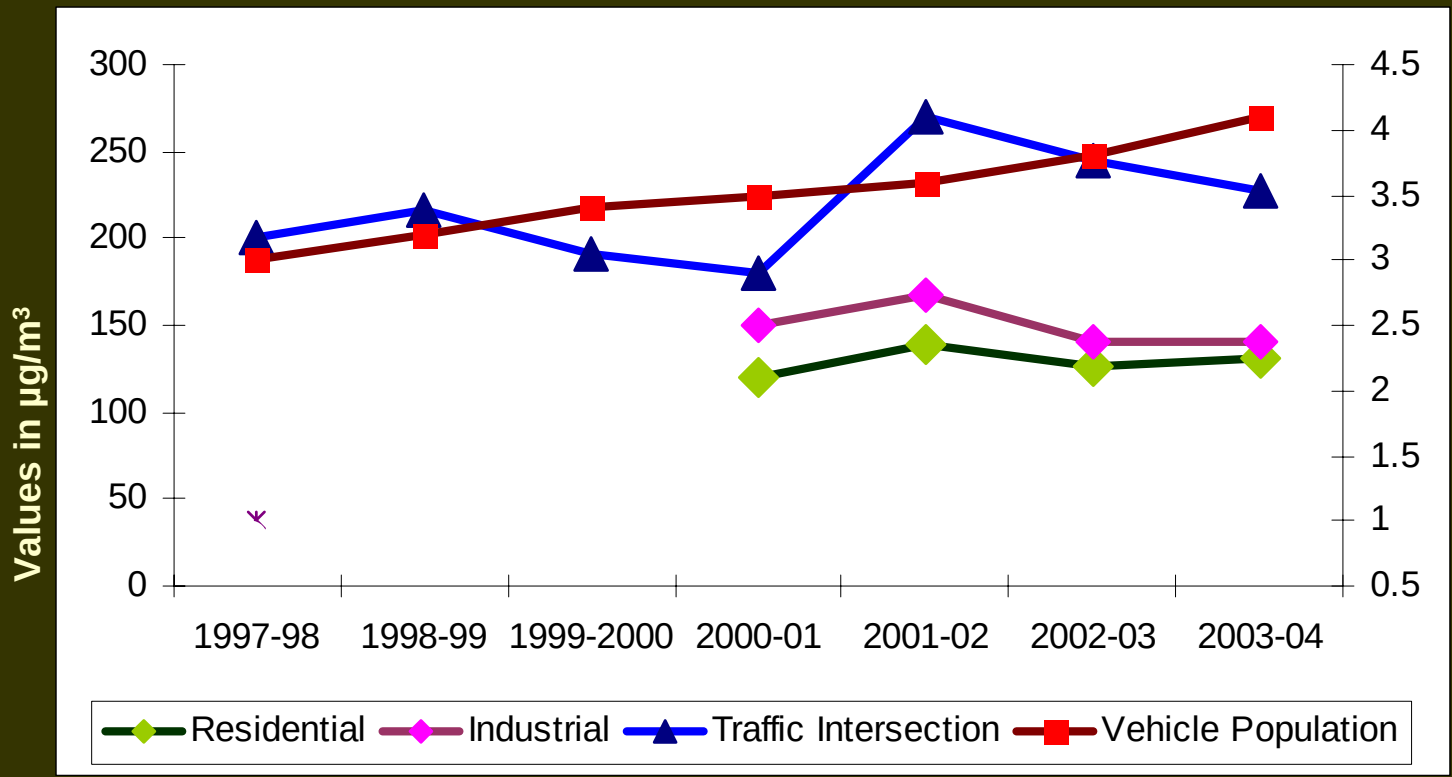
Suspended Particulate Matter (SPM) levels in Ambient Air



Year	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04
Residential	345	349	311	304	397	311	330
Industrial	363	361	439	354	442	349	339
Traffic Intersection	426	418	490	476	533	509	500
Vehicle Population	3	3.2	3.4	3.5	3.6	3.8	4.1

Impacts of Interventions on the Air Pollutants

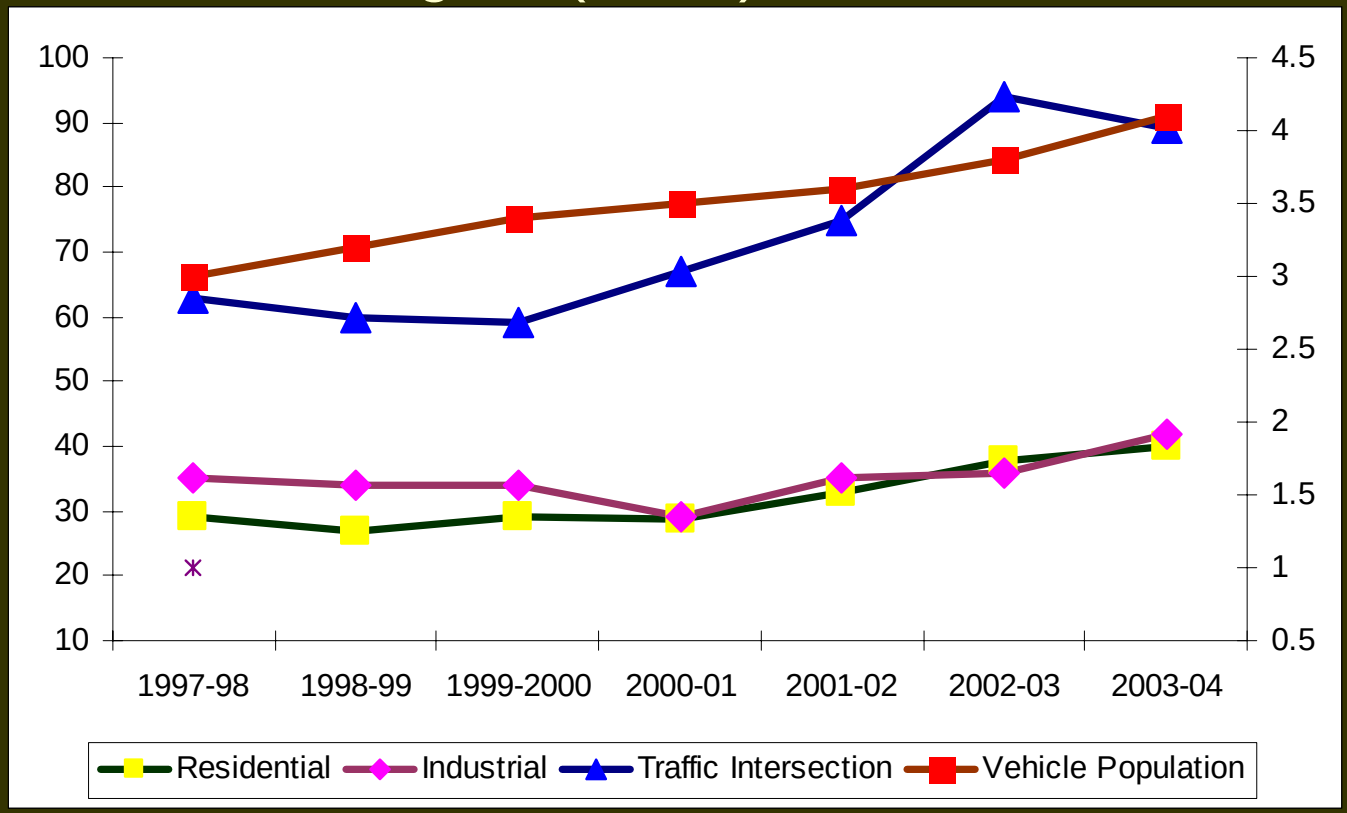
Respirable Suspended Particulate Matter (RSPM) levels in Ambient Air



Year	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04
Residential	NA	NA	NA	120	139	127	131
Industrial	NA	NA	NA	150	167	140	140
Traffic Intersection	200	216	191	180	270	244	228
Vehicle Population	3	3.2	3.4	3.5	3.6	3.8	4.1

Impacts of Interventions on the Air Pollutants

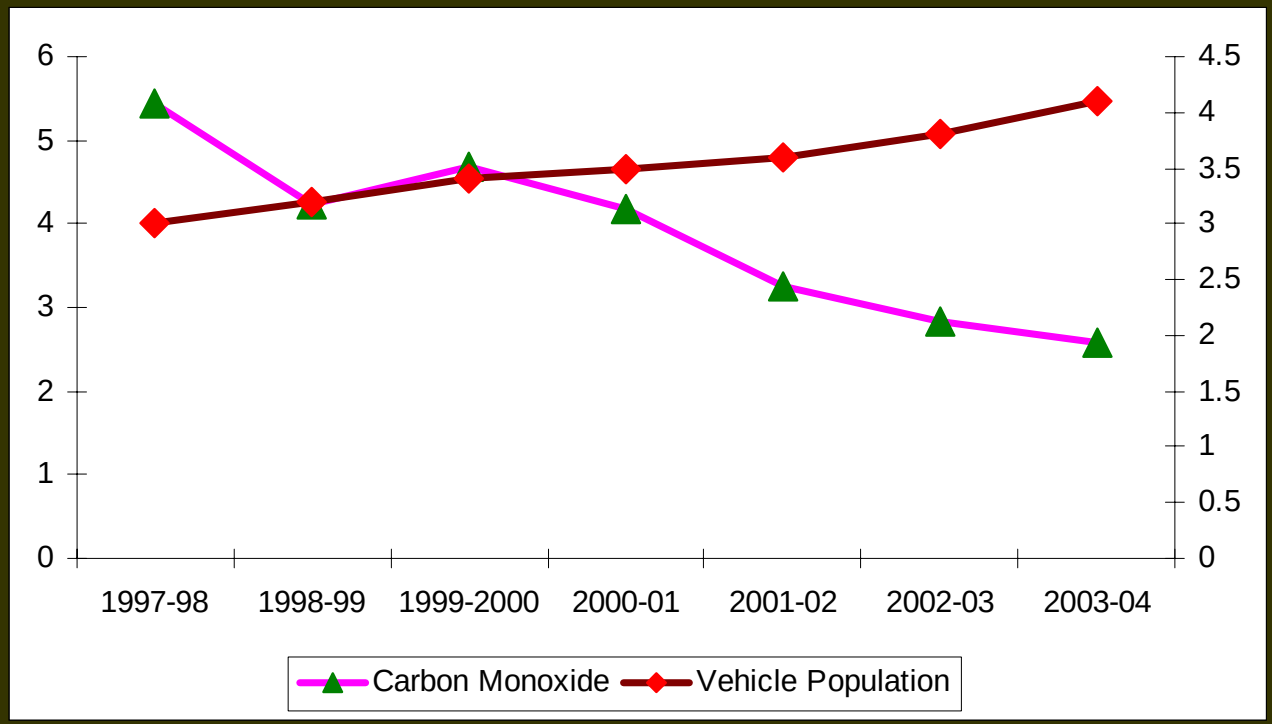
Oxides of Nitrogen (NOx) levels in Ambient Air



Year	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04
Residential	29	27	29	28.7	33	37.9	40
Industrial	35	34	34	29	35	36	42
Traffic Intersection	63	60	59	67	75	94	89
Vehicle Population	3	3.2	3.4	3.5	3.6	3.8	4.1

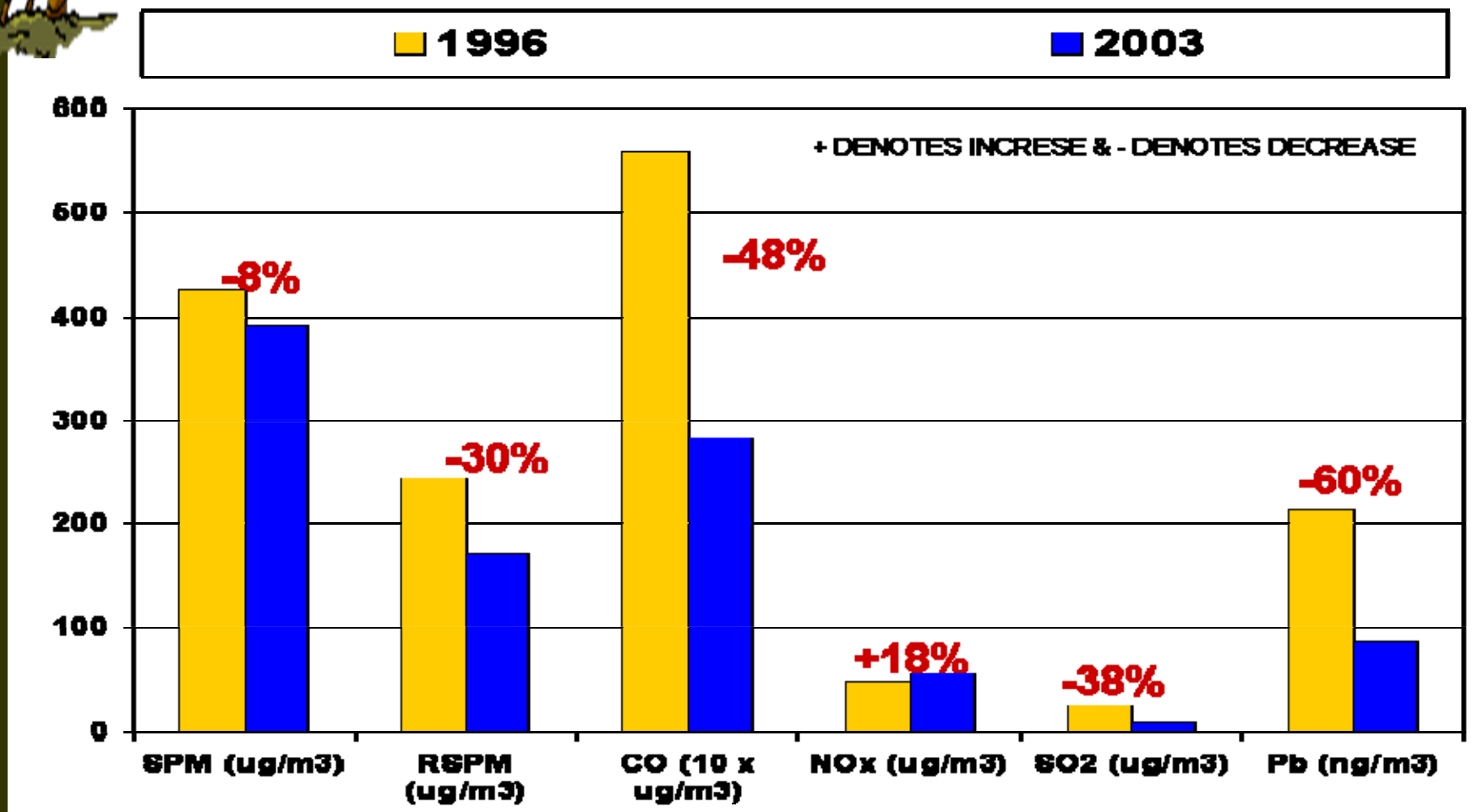
Impacts of Interventions on the Air Pollutants

Carbon Monoxide (CO) levels in Ambient Air



Year	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04
Carbon Monoxide	5.45	4.241	4.686	4.183	3.258	2.831	2.581
Vehicle Population	3	3.2	3.4	3.5	3.6	3.8	4.1

IMPACT OF INTERVENTIONS ON AIR QUALITY OF DELHI (1996 Vs. 2003)



CONTINUOUS AIR QUALITY MONITORING STATION IN INDIA

PM_{10} & $_{2.5}$ CONTINUOUS MONITOR AT BHADUR SHAH ZAFAR MARG (ITO), NEW DELHI

Inside View of the CPCB Continuous Monitoring Station at Sirifort, New Delhi

Parameter Monitored:

Sulphur Dioxide, Carbon Monoxide, Oxides of Nitrogen, Ozone, THC, BTX and Meteorological parameters, Wind Speed, Wind Direction, Temperature & Relative Humidity

Inside View of the CPCB Continuous Monitoring Station at DCE, Delhi

Parameter Monitored:

Sulphur Dioxide, Carbon Monoxide, Oxides of Nitrogen, Ozone, PM_{10} and Meteorological parameters, Wind Speed, Wind Direction, Temperature and Relative Humidity

CPCB Mobile Monitoring Van

Schematic Description of Air Quality Monitoring System

Sulphur Dioxide (SO2)

Nitrogen Oxides (NOx)

Carbon monoxide (CO)

Ozone (O3)

ZERO GAS

Calibration

SPAN GAS

CALIBRATIO N GAS

ANALYSERS

Intercom 6

Measuring Signal

METEOROLOGIC AL DATA

- TEMPERAURE
- HUMIDITY
- WIND SPEED
- WIND DIRECTION

Central Computer

Station Computer

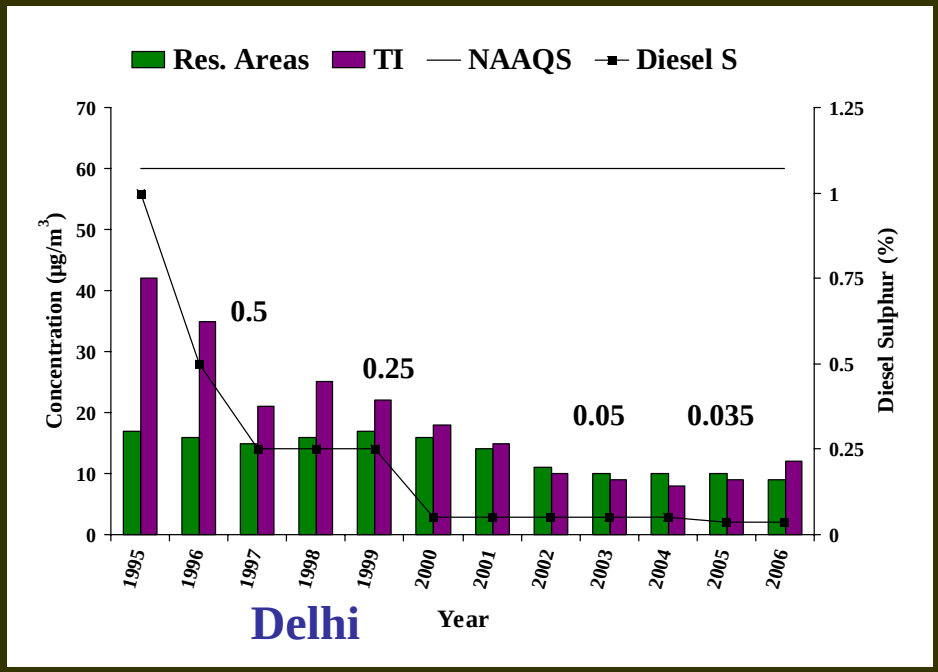
MODEM

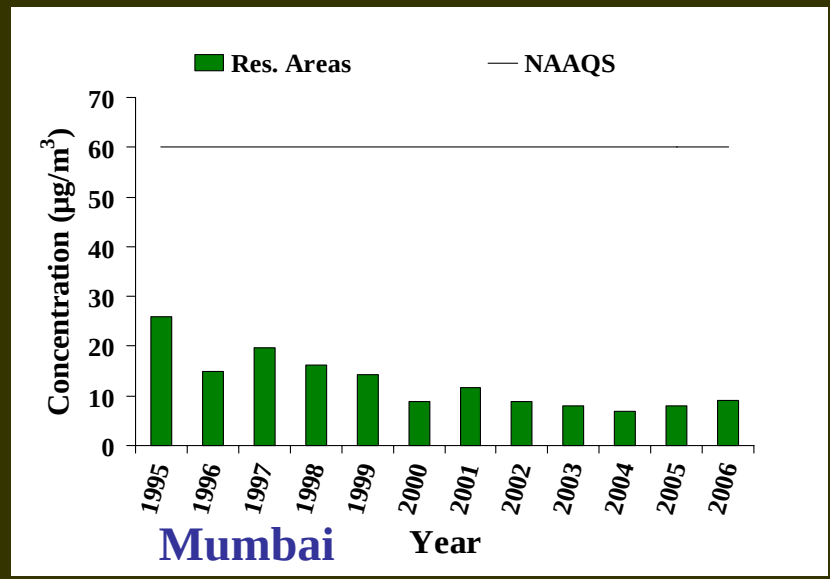
Air Quality Trends

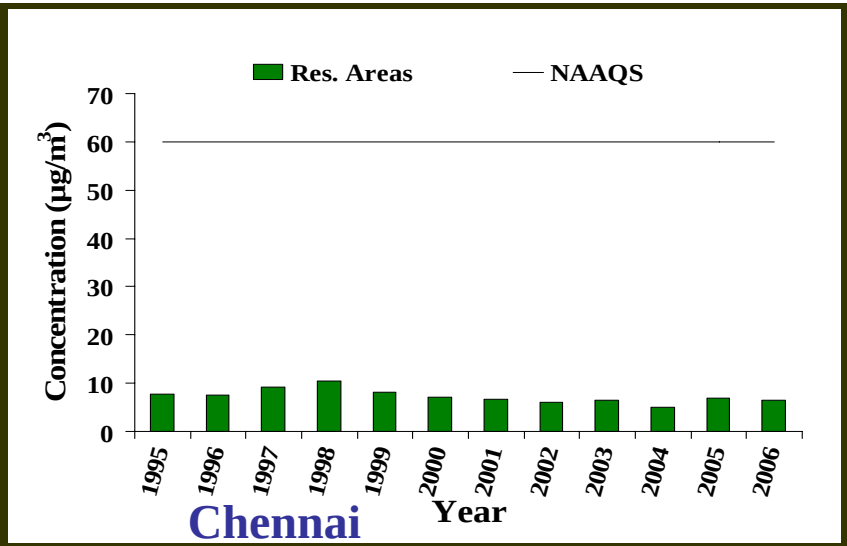
SO_2	Within standard in most of metro cities and showing decreasing trend
NO_2	Exceeding standard in few metros and showing increasing trend in some metros
RSPM	Exceeding standard in most metro cities but decreasing trends in most metros
SPM	Exceeding standard in most metros but with no definite trends
CO	Decreasing trend in Delhi

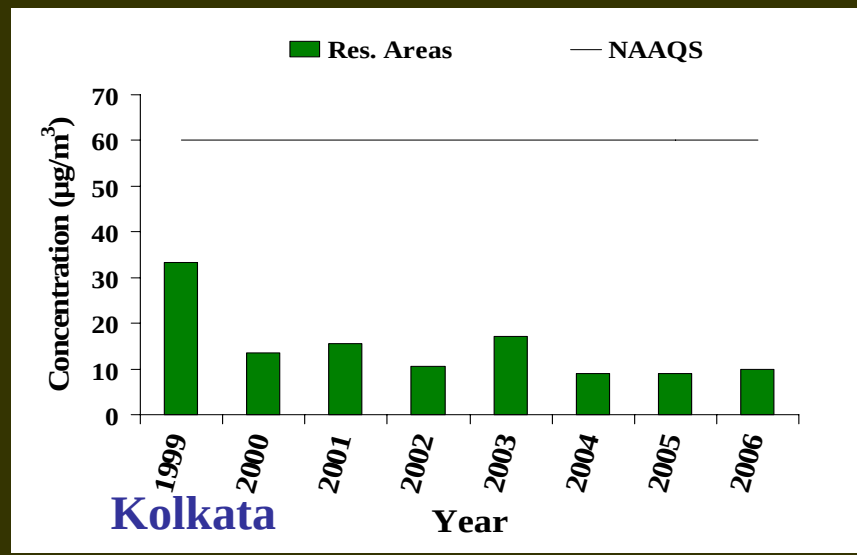
Air Quality Trends in Major Cities in India

Trends of SO_2

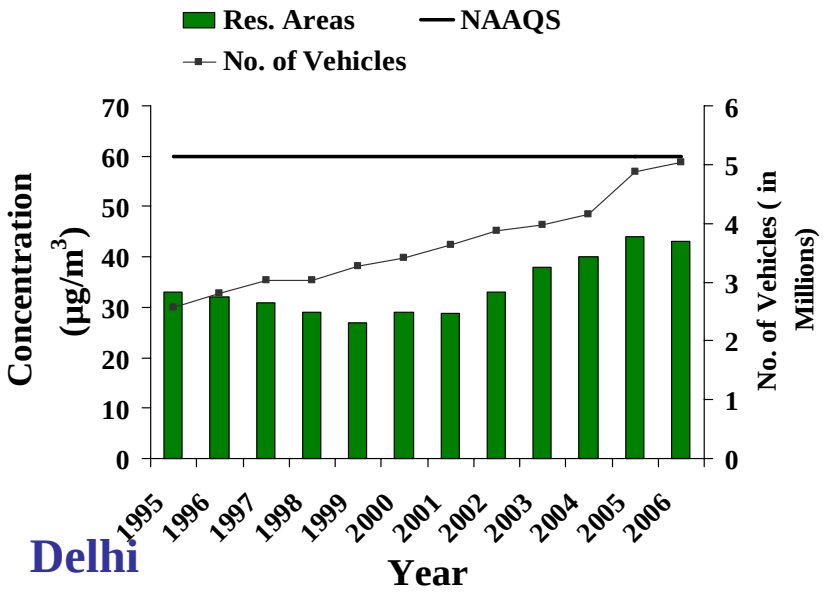




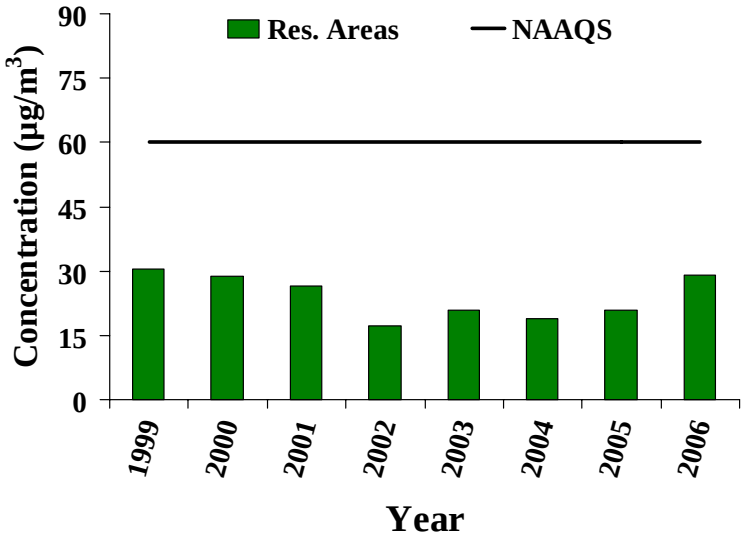




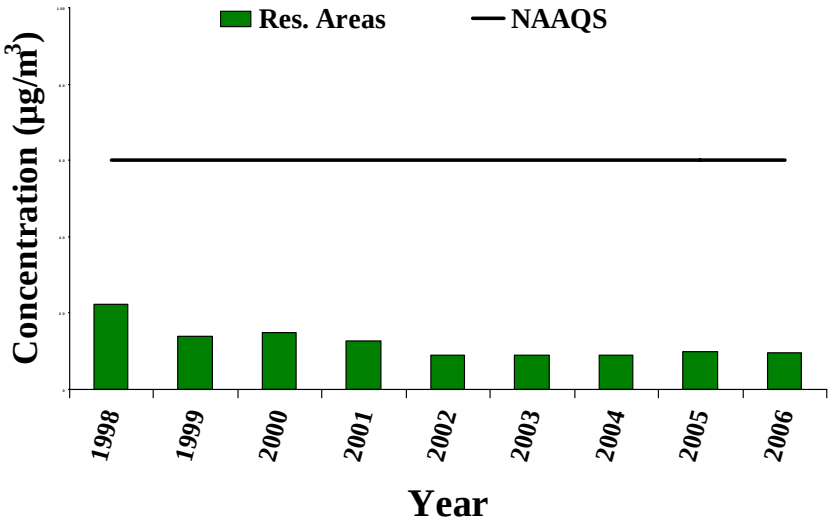
Trends of NO_2



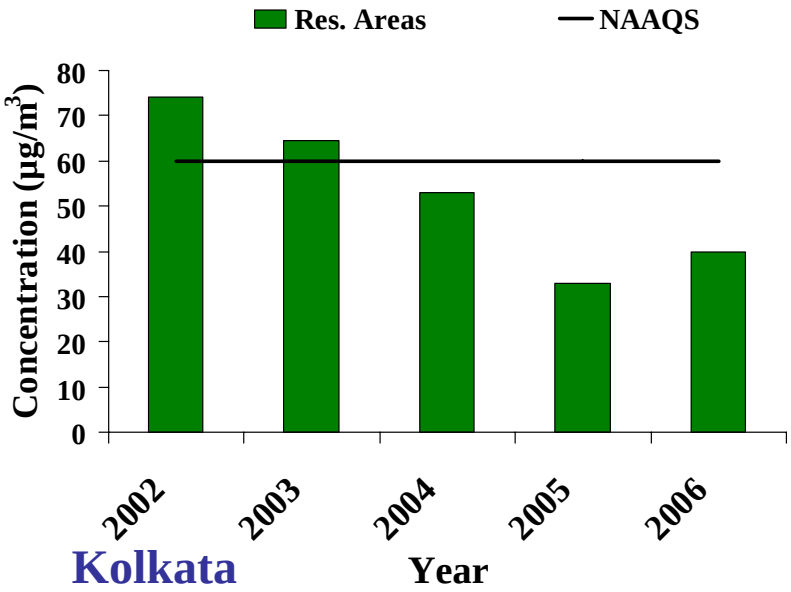
Delhi



Mumbai

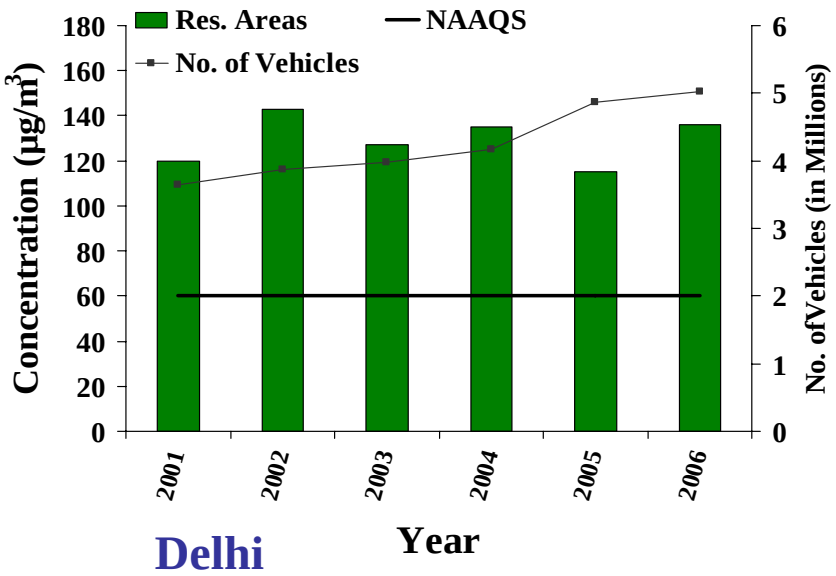


Chennai

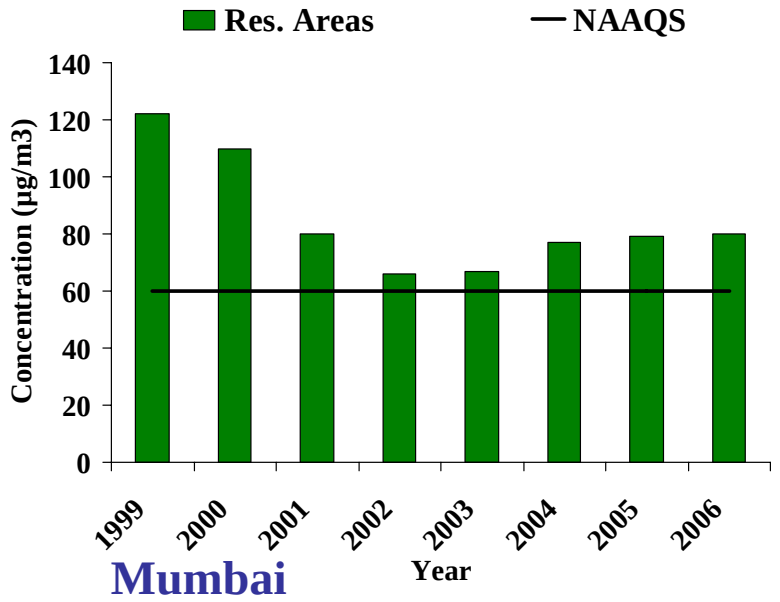


Kolkata

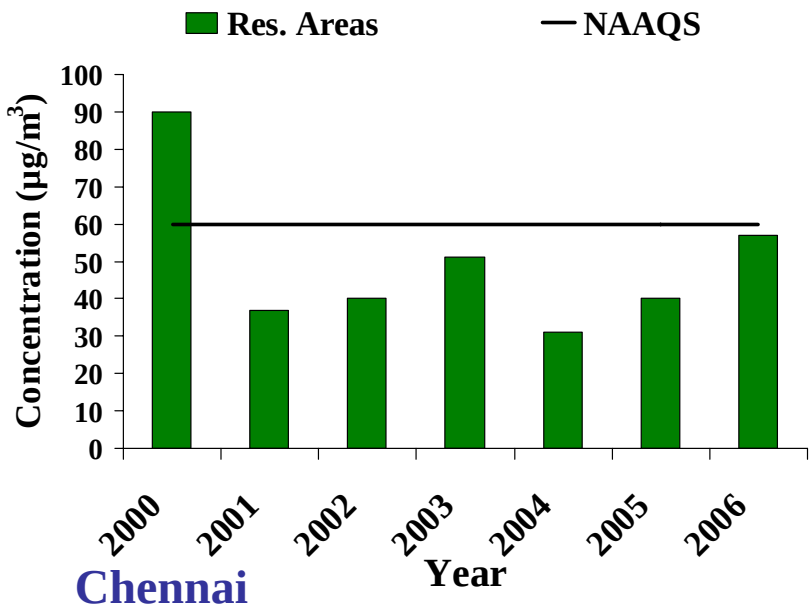
Trends of RSPM



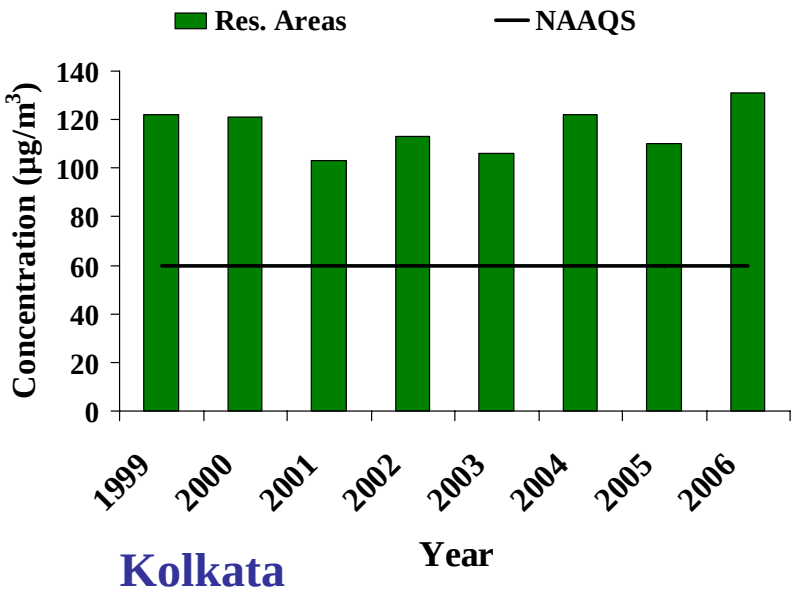
Delhi



Mumbai



Chennai



Kolkata

Environmental Data Bank

Information/data on various environmental parameters are quite often required by various user groups-Pollution Control Board, Researchers, Students and general public. In order to facilitate quick and easy retrieval of these information, Central Pollution Control Board (CPCB) has taken up the task of developing a user friendly database-Environmental DataBank(EDB). The EDB comprises various modules viz. air quality, water quality, urban pollution, industrial pollution, hazardous waste, etc. Data structures for each of the modules are designed considering the requirements of various target user groups. Data/information are gathered from different sources including the Central/State Pollution Control Boards. The state Pollution Control Boards/Pollution Control Committees has been requested to periodically update the information pertaining to their State/Union Territories.

As the data/information are gathered/supplied by various agencies and interpretation of data on various environmental components may depends on several factors, it is advised that the data/information may be used as indicator/estimation and not as absolute values. The user may like to contact the data provider for further clarification, if required.

Disclaimer

CPCB will not be responsible for any loss to any one, in what-so-ever form arising due to use of this information. Discrepancy found, if any may be communicated to CPCB.

TO VIEW DATA (Click here)

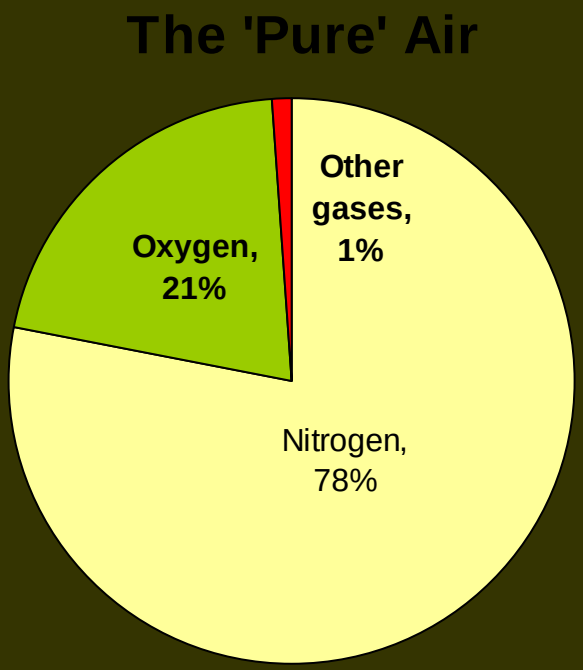
Admin

Help Desk | Contact Us

Real Time Continuous Ambient Air Quality Data of Delhi on CPCB website

AIR POLLUTION AND HEALTH EFFECTS

POLLUTION CAUSES, POLLUTANTS & EFFECTS



MAJOR CAUSES

Automobile exhausts, Industrial emission, Domestic cooking, Thermal power plants

MAJOR POLLUTANTS

Heavy metals: Pb, Fe, Cd, Zn, Ni

Gases: CO, NOx, SO2 VOC: Benzene, Toluene

PAH: Benzo-a-pyrene, Benz anthracene

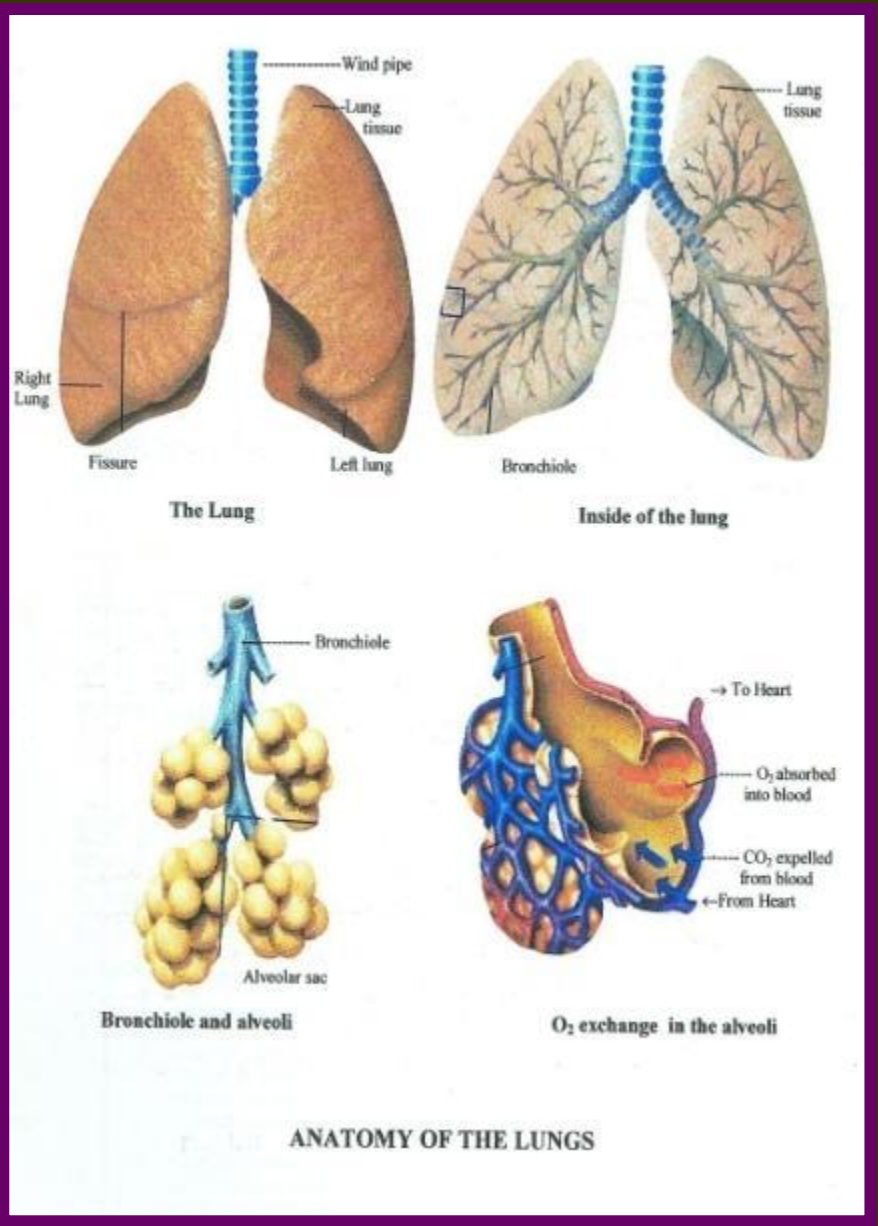
Particulate matter: 0.01-100μm

Health effects of pollutants

- Induction or revival of diseases
- Respiratory illness / disorder
- Genotoxicity leading to cancer
- Systemic & Immune alterations
- Cardiovascular problems
- Brain damage
- Retardation of fetal growth

Health effects are the impact of a complex mixture rather than a particular pollutant

LUNG – THE ENTRY POINT OF POLLUTANTS



Route of Invasion

- Lung - the main entry point of air pollutants, and the target organ is the alveolus. (There are 300 million alveoli in human lungs)
- 10,000 – 15,000 litres air enters every day in an adult lung.
- Increase in the concentration of pollutants cause parallel increase in the toxic insult to the lungs
- From the alveolus, pollutants travel via lymph or blood to different organs.

What are the health impacts of changes in air quality ?

Air Quality Data Required for Epidemiological Studies

- **CPCB is monitoring ambient air quality under National Air Quality Monitoring Programme (NAMP)**
- **Monitoring is carried out at 341 monitoring stations in 126 cities/towns in 25 states and 4 UTs**
- **Data is available online in Environmental Data on a daily basis**
- **Data of 3 continuous stations and 1 mobile van in Delhi is available on a real time basis on CPCB website (After a time lag of 15 minutes).**
- **Data available in 1-hourly, 8-hourly, 24-hourly average and annual average basis.**
- **Parameters include SO_2, NO, NO_2, NOx, $PM_{2.5}$, PM_{10}, BTX, CO, Ozone**
- **Many SPCBs are carrying out continuous monitoring and data is available on their website.**

Epidemiological Studies Initiated by CPCB in India

- **Epidemiological Study to find the Effect of Air Pollutants especially Respirable Suspended Particulate Matter (RSPM) and other carcinogens on Human Health in Delhi – CNCI, Kolkata**
- **Study on Ambient Air Quality, Respiratory Symptoms and Lung Function of Children in Delhi – CNCI, Kolkata**
- **Health Effect of Chronic Exposure to Smoke from Biomass Fuel burning in Rural Households: A Study in Northern and Eastern India - CNCI, Kolkata**
- **Effects of Environmental Pollution on the Status of Human Health of Delhi Residents – AIIMS, New Delhi**
- **Human Risk Assessment Studies in Asbestos Industries in India - ITRC, Lucknow**

Epidemiological Study on Effect of Air Pollution on Human Health in Delhi (Adults)

STUDY PROTOCOL

Study Population:

- **6005 adults residing in Delhi for past 10 years or more**
- **1046 subjects from rural areas of West Bengal as control**
- **1438 individuals have been clinically examined in Health Camps.**
- **Age - 21 - 66 years**

Questionnaire survey

Information obtained regarding

- **Age, sex, smoking habit, occupation, socio-economic status etc.**
- **Upper respiratory symptoms (URS)**
- **Lower respiratory symptoms (LRS)**
- **Asthma, headache, eye irritation, respiratory allergy**
- **Neurobehavioral symptoms**

Clinical examination

Contd..

Study Protocol

LUNG FUNCTION TEST BY SPIROMETRY

Sampling & lab investigation:

- Sputum: cytopathology
- Blood: hematology, immunology, biochemistry, enzymology
- Buccal mucosa: genotoxicity
- Urine: t,t-MA

Statistical Analysis:

- Epi Info6, SYSTAT 9.0 Software system (SPSS INC. Chicago, USA)

FINDINGS

(These findings are under review by AIIMS)

- High level of air pollution in Delhi was associated with higher incidence of upper and lower respiratory symptoms
- Residents of Delhi showed statistically significant increased prevalence of restrictive, obstructive, as well as combined (both obstructive and restrictive) type of lung functions deficits as compared with controls.
- Lung function reduction was more prevalent in women than in men both in rural and urban settings
- Besides gender, smoking habit, Body mass index (BMI) and Socio economic status (SES), particulate air pollution was positively associated with lung function deficits
- Very high alveolar macrophage (AM) count in sputum suggesting higher particle load

Study on Ambient Air Quality, Respiratory Symptoms and Lung Function of Children in Delhi

STUDY PROTOCOL

Study Population:

11,628 school children of Delhi

Control: 4536 children from Uttaranchal& rural West Bengal

Questionnaires: personal & family history; socioeconomic status; exposure & respiratory symptoms assessed. The following symptoms were analyzed

- **URS – running/stuffy nose, sinusitis, sore throat, common cold & fever**
- **LRS – dry cough, cough with phlegm, wheezing, chest discomfort, breathlessness**
- **Other symptoms – asthma, allergy, headache, nausea, eye irritation, palpitation**

Clinical examination

Air quality data - obtained from CPCB and Laser operated Dust Trak Monitor

Contd..

STUDY PROTOCOL

Pulmonary function test - Assessed by spirometry using portable spirometer (Spirovit SP1, Schiller, Switzerland) Parameters assessed:FVC, FEV_1, PEFR, $FEF_{25-75\%}$. Lung function impairment categorized as restrictive, obstructive and combined defects & degree of impairment was ascertained

Laboratory investigation :

Sputum: **AM responses, sputum cytology & infiltrating leukocytes (NSE, PPB, PAP)**

Blood: **TC, DC, and cell morphology**

Statistical Analysis : **Data were analyzed in the Dept. of Medical Statistics using the software EPI6 & SYSTAT 9.0 (SPSS INC Chicago, USA)**

Statistical tests like bivariate correlation, logistic regression, multiple regression were used as per requirements taking into account various confounding variables

FINDINGS

(These findings are under review by AIIMS)

- Upper respiratory symptoms (URS) like sinusitis, running or stuffy nose, sneezing, sore throat and common cold with fever were more prevalent in Delhi than in controls, and the girls suffered more than the boys.
- Children in Delhi had more lower respiratory symptoms (LRS) such as frequent dry cough, sputum-producing cough, wheezing breath, breathlessness on exertion, chest pain or tightness and disturbed sleep due to breathing problems.
- Respiratory and associated symptoms were most prevalent in children from low socio-economic status, and least in children from families with high socio-economic background.
- The symptoms were more prevalent in children during winter when PM_{10} level in air is highest in a year, and lowest during monsoon when particulate air pollution level is lowest, suggesting a positive association with particulate air pollution.

DEVELOPMENT OF NEW AIR QUALITY STANDARD FOR IMPROVEMENT OF AIR QUALITY

CURRENT NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

Pollutant	Time Weighted Average	Concentration in Ambient Air			Method of Measurement
Sulphur Dioxide (SO_2)	Annual Average*	80 µg/m^3	60 µg/m^3	15 µg/m^3	• Improved West and Gaeke Method • Ultraviolet Fluorescence
	24 Hours Average**	120 µg/m^3	80 µg/m^3	30 µg/m^3	
Oxides of Nitrogen as NO2	Annual Average*	80 µg/m^3	60 µg/m^3	15 µg/m^3	• Jacob & Hochheiser modified (NaOH-NaAsO2) Method • Gas Phase Chemiluminiscence
	24 Hours Average**	120 µg/m^3	80 µg/m^3	30 µg/m^3	
Suspended Particulate Matter (SPM)	Annual Average*	360 µg/m^3	140 µg/m^3	70 µg/m^3	• High Volume Sampling (Average flow rate not less than 1.1m3/minute)
	24 Hours Average**	500 µg/m^3	200 µg/m^3	100 µg/m^3	
Respirable Particulate Matter (Size less than 10µm)(RPM)	Annual Average*	120 µg/m^3	60 µg/m^3	50 µg/m^3	• Respirable Particulate Matter Sampler
	24 Hours Average**	150 µg/m3	100 µg/m3	75 µg/m3	

Contd..

Pollutant	Time Weighted Average	Concentration in Ambient Air			Method of Measurement
Lead (Pb)	Annual Average*	1.0 µg/m^3	0.75 µg/m^3	0.50 µg/m^3	AAS Method after sampling using EPM 2000 or equivalent filter paper
	24 Hours Average**	1.5 µg/m^3	1.0 µg/m^3	0.75 µg/m^3	
Carbon Monoxide (CO)	8 Hours Average**	5.0 mg/m^3	2.0 mg/m^3	1.0 mg/m^3	Non dispersive Infrared Spectroscopy
	1 Hour Average	10.0mg/m^3	4.0 mg/m^3	2.0 mg/m^3	
Ammonia (NH3)	Annual Average*	0.1 mg/m^3			
	24 Hour Average**	0.4 mg/m^3			

* Annual Arithmetic mean of minimum 104 measurements in a year twice a week 24 hourly at uniform interval.

** 24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.

NOTE

1. National Ambient Air Quality Standard : The levels of air quality necessary with an adequate margin of safety, to protect the public health, vegetation and property.
2. Whenever and wherever two consecutive values exceed the limit specified above for the respective category, it would be considered adequate reason to institute regular/continuous monitoring and further investigations.
3. The State Government / State Board shall notify the sensitive and other areas in the respective states within a period of six months from the date of notification of National Ambient Air Quality Standards

PROPOSED AMBIENT AIR QUALITY STANDARDS

S. No.	Parameter, units	Averaging time				Analysis Method
		1-hr	8-hr	24-hr	Annual	
1.	Benzene (C_6H_6), $\mu g/m^3$	-	-	15	5	• Online gas chromatography • Activated carbon/tenex adsorption and GC analysis
2.	Carbon Monoxide (CO) $\mu g/m^3$	4000	6000	-	-	• Non Dispersive Infra Red (NDIR), Spectroscopy
3.	Formaldehyde (HCHO), $\mu g/m^3$	80	45	-	-	• Absorption in MBTH and spectrophotometer analysis
4.	Polyaromatic Hydrocarbons (BaP) (particulate phase only), ng/m^3	-	-	5	1	• Solvent extraction followed by analysis of GC/HPLC/GCMS

Contd..

5.	Arsenic, ng/m^3	-	-	20	6	• AAS/ICP method after sampling on EPM or equivalent Filter Paper
6.	Lead, µg/m^3	-	-	1	0.5	
7.	Mercury(1) (total), ng/m^3	-	-	15	-	• Particulate : same as for lead above. • Vapour – Activated Carbon or goal coated sand adsorption followed by analysis on AAS/ICP
	Particulate phase, ng/m^3	-	-	3	-	
	Vapour phase, ng/m^3	-	-	12	-	
8.	Nickel, ng/m^3	-	-	25	-	• AAS/ICP Method after sampling on EPM or equivalent Filter Paper
9.	Vanadium, ng/m^3	-	-	200	-	
10.	Nitrogen Dioxide (NO_2) General Area, µg/m^3	200		80	40	• Jacob & Hochhelser Modified Method • Chemiluminescences
	Nitrogen Dioxide (NO_2) Sensitive Area(2), µg/m^3				30) 3-month Avg)	
11.	Ozone (O_3), µg/m^3	180	90	-	-	• UV Photometric technology • Chemiluminescences

Contd..

12.	Particulate Matter (PM_{10}), $\mu g/m^3$	-	-	100	60	• Approved Particle size cutoff sampler • Gravimetric analysis
	Particulate Matter ($PM_{2.5}$), $\mu g/m^3$	-	-	60	40	
13.	BSF/TSF (Benzene / toluene soluble fraction), $\mu g/m^3$	-	-	20	-	• ASTM D4600-87, 1990
14.	Sulphur dioxide (SO_2) General Area, $\mu g/m^3$	260	-	80	50	• Improved West and Geake • Ultraviolet Fluorescence
	Sulphur dioxide (SO_2) Sensitive Area, $\mu g/m^3$	-	-	-	20 (3-month avg.)	
15.	Ammonia (NH_3), $\mu g/m^3$	-	-	400	100	• Chemiluminescence, • Indophenol – blue method

(1) Whenever measurement of vapour mercury cannot be done, standard for particulate mercury only is applicable.

(2) For sensitive area, more stringent standards will be applicable for NO_2 and SO_2 standards for other parameters remain unchanged Notes.

Notes :

(a) Annual arithmetic mean of minimum 104 measurements taken twice a week 24 hourly at a uniform interval should not exceed the annual standards.

(b) 1-hour/24-hour/8-hour values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.

Thrust Areas for Air Pollution Control

The major programme areas identified for air pollution control during 11th Five Year Plan will include :

- Strengthening the monitoring and enforcement of emission standards for both point and non-point sources
- Prepare and implement action plans for major cities for addressing air pollution for both point and non-point sources.
- Strengthening efforts for partial substitution of fossil fuels by bio-fuels.
- Toxic / hazardous air pollution monitoring and control in chemical industrial zones and critically polluted areas.
- Monitoring of hazardous air pollutants (HAP) in major industrial sectors like pesticides, pharmaceuticals, dyes and dye intermediates, etc.

Contd..

- Promotion of clean transportation fuel like bio-diesel, etc.
- Shifting from manual air quality monitoring to continuous air quality monitoring systems.
- Source apportionment studies for RSPM and NOx for all major non-attainment cities.
- Introduction of clean process technology for highly air polluting industrial sectors like Coke oven plants, Aluminium industry, Thermal power plants, Sponge Iron Plants.
- Networking of existing manual and continuous air quality monitoring stations and data transmission from all automatic and manual stations through environmental data bank on daily basis on CPCB website.

Contd..

- Undertaking of monitoring of Fine Particulate Matter PM2.5 from urban areas.
- Extending network of National Air Quality Monitoring Programme (NAMP) to Class-I cities, metro cities and State Capitals.
- Undertaking health related studies and evolving air pollution control plans.
- Preventing burning of low-grade fuel / unapproved fuel in urban areas to prevent air pollution
- Review of existing air quality standards & development for Hazardous Air Pollutants (HAPs) & for PM2.5.
- Air Pollution Control from 17 categories of highly polluting Industries as per CREP agreement

Contd..

- Fuel Quality monitoring/surveillance
- Introduction of I&M System for in-use vehicles
- Setting up Regional Calibration Laboratories
- Air pollution Control from Small Scale Air polluting Industries (Brick Kiln, Foundry, Sponge Iron Plants, Lime Kilns, Ceramic Industries etc.)
- Comprehensive apportionment studies for RSPM and NOx in 16 highly air polluting cities
- Promotion of clean coal technologies.
- Promotion of public private partnership in Air Quality Monitoring.

Contd..

CHALLENGES IN THE FIELD OF AIR POLLUTION CONTRO

1. **Air Quality Monitoring Station to be increased from 342 to 700 during 11th Five Year Plan and quality of data to be improved by proper calibration of samplers, QA/QC, training of personnels, etc. Also all data to be posted in website of CPCB / SPCBs for public information.**
2. **More Continuous Air Quality Monitoring Station (CAAQMS) to be set-up and real time data to be posted in Website for public information.**
3. **Health Impact Studies to be initiated to give Scientific Input to Ambient Air Quality Standard.**
4. **Action Plan for 65 Non Attainment cities to be prepared and implemented.**

Contd..

5. Effective enforcement of standard in Thermal Power Plants, Sponge Iron Plants, Stone Crusher, Brick Kiln, Coke Oven Plants, Ferro Alloy Plant, etc which are causing serious air pollution problem.

6. CREP recommendations to be implemented in 17 categories of industries for air pollution control.

7. Effective implementation of Action Plan in identified 24 critically polluted area (Singrauli, Korba, Vapi, Ankleshwar, Manali, Pattancheru, Cochin, Dhanbad, Haldia, Tarapur, etc), specially Hazardous Air Pollutant (HAP) control.

8. Inspection and maintenance programme to be strengthened for in-use vehicle emission control through transport Department.

9. Enforcement of standard in small scale air polluting industries (stone crusher, hot mix plants, brick kiln, re-rolling mills, etc.)

Contd..

10. National / State Task Force to be set-up for management of air pollution from Sponge Iron Plants as problem is very serious.
11. Source Apportionment Studies for RSPM/PM_{10} for non attainment cities on priority to be initiated.
12. Hazardous Air Pollutants (HAP) assessment / monitoring and control in chemical industry zone like Vapi, Anklehswar, Cuddalore, Manali, Mahad, Trans Thane Area, Mahad, Tarapur, Durgapur, Dhanbad, etc.)
13. Air / Noise Pollution from DG Sets to be effectively controlled as >50000 DG Sets are installed by Cellular Tower only.
14. Serious attention to be given to Management of Fly Ash generated from coal based Thermal Power Plants (present generation is 112 Million Tonnes per Annum)
15. Issue regarding fuel adulteration to be addressed with appropriate authorities in Government.

Recommendation for Urban air quality improvement

- Bharat Stage (IV) norms to be implemented immediately.
- In use vehicular emission control to be strengthened especially city specific I/M programme.
- BS(V) and BS (VI) norm to be formulated considering air quality and health impact data.
- Clean fuel like CNG, LPG, Bio-fuel and Bio-diesel to be promoted in a big way.
- Future fuel (such as hydrogen) and vehicle technology (such as hybrid vehicle) to be promoted.
- Continuous air quality monitoring to be further strengthened and data to be posted in CPCB/MOEF website for public information.
- Major thrust to be given for transportation planning(dedicated bus corridor, Metro services, Metro connectivity, Flyover etc)
- New ambient air quality standard finalized and recommended by CPCB based upon health impact should be notified quickly
- Fuel adulteration to be checked.
- Policy on SO2/NOX control from industrial sources to be finalized

Recommendation for Industrial area air quality improvement

- Clean coal technology to be promoted in a bigger way.
- Fly ash management specially from thermal power plant to be given priority.
- Carrying capacity based development to be started specially in area like Paradeep, Jharsuguda, Kutchch, Raipur-Siltara, Raigarah, Dhanbad-Asansol, Durgapur, Haldia, Cochin, Vizag, Chandrapur etc.
- Policy on So2/NOX control in industrial area to be finalized.
- Hazardous air pollution assessment and control to be promoted in chemical industrial zones.
- Major thrust to be given to control air pollution from SSI units like stone crushers, brick klin , sponge iron plants, lime kiln, foundry etc.
- CREP recommendation as finalized by CPCB to be implemented for 17 categories of highly polluting industries.
- Action plan to be implemented in 24 critically polluted areas as identified by CPCB.

THANKS ALOT.

By

DR. B. SENGUPTA

Former Member Secretary

Central Pollution Control Board

DELHI (INDIA)

Email : bsg1951@yahoo.com

Website : http://www.cpcb.nic.in