Urban Air Quality Monitoring and Management – Singapore's Experience

2nd High Level Seminar on Environmentally Sustainable Cities
Kitakyushu Japan, 15 – 16 Mar 2011

Indrani C Rajaram
Pollution Control Department
National Environment Agency

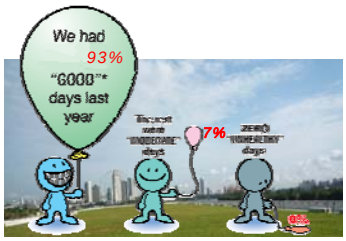
- In the 1950s and 60s, poverty and unemployment were more immediate concerns

- An intensive industrialisation programme was implemented to provide employment after Singapore's independence in 1965

- There were also parallel developments in the housing, commercial and service sectors

- All these developments generated pollution

- Pollution from industrialisation, breakneck growth, rapid urbanisation could have caused severe and possibly permanent degradation to the environment
- However, Singapore did not compromise the environment for economic development
- We recognise that society will eventually pay the price, at a higher cost, if the pursuit of economic development is done without due consideration for the environment
- Living environment was improved so that the present and next generation enjoy a clean and green environment with a high standard of public health



- ***Political Vision*** and ***Leadership*** are key to balancing economic development, social progress & environmental goals
- The government recognised in the early years the importance of a good environment:
  - Support good quality of life for present and future generations.
  - Attract investments, attract/retain talents thereby supporting further growth

Fundamental Principles of Environmental Management

1) Control pollution at source
2) "Polluter Pays" Principle
3) Pre-empt pollution and take early action

Environmental Management Strategy

- The present state of the environment in Singapore is achieved through adopting a forward-looking and an integrated approach to environmental protection and management as follows:
  - Prevention
  - Enforcement
  - Monitoring
  - Education & Partnership

Environmental Management Strategy

- Prevention
- Enforcement
- Monitoring
- Education / Partnership

- Key thrusts of pollution prevention strategy adopted in Singapore:
  - Proper land use planning
  - Judicious siting of industries
  - Development and building plan control
  - Provision of environmental infrastructure
  - Regulatory Controls and Policies

Pollution Prevention

- Major pollutive uses grouped together and sited away from residential areas and population centres
- Interagency consultation for new industrial development before land allocation. Project has to satisfy planners of its environmental impact and compatibility with surrounding land use.
- Highly pollutive industries and major developments with likely environmental impacts are required to carry out environmental impact assessment
- Environmental pollution control requirements have to be incorporated into the design of the development
- One-stop service centre (Central Building Plan Unit) for developers, architects and engineers to ensure compliance of their projects with the various environmental requirements.

Environmental Management Strategy

- Prevention
- Enforcement
- Monitoring
- Education / Partnership

- Legislation enacted to control pollution by stipulating the limit of pollutant emission allowed
- Legislation is supported by close monitoring and strict enforcement
- Regular inspections
- Investigation of complaints/feedback

Controlling Industrial Emissions

- **Fuel Quality**
  - Max sulphur content in diesel: 0.005% since Dec 2005
  - Industries: 1% or less S fuel oil
  - Industries near residential area: natural gas or diesel with ≤ 0.005% S
  - Industries and power stations encouraged to use natural gas (about 90% of electricity generated using natural gas)
- **SO2 Cap**
  - SO2 emission from power plants and refineries are capped
- **Emission limits**
  - Environmental Protection and Management (Air Impurities) Regulations
  - Standards progressively tightened in tandem with developments in technology and international standards
- **Self Monitoring**
  - Operate instruments to continuously monitor emissions
  - Regular source emission tests
  - Keep proper records of monitoring results, quantity of fuel used, etc for inspection

Controlling Vehicular Emissions

- **Fuel Quality**
  - Leaded petrol phased out in Jul 98
  - Ultra Low Sulphur Diesel (≤ 0.005% S) since Dec 05
- **Mandatory Inspection and Enforcement**
  - Mandatory periodic inspection for in-use vehicles
  - Chassis Dynamometer Smoke Test for diesel vehicles
  - Video cameras for smoky vehicles
- **Emission Standards**
  - Euro IV standard for diesel vehicles since Oct 06
  - Euro II standard for petrol vehicles since 2001
- **Promotion of Green Vehicles**
  - Tax rebates for hybrid, electric and CNG vehicles
- **Measures to restrain car-ownership and usage**
  - Certificate of Entitlement (COE) for car ownership
  - Electronic Road Pricing for road usage
  - Efficient public transport system (MRT, LRT, buses)

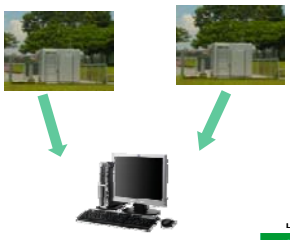
Environmental Management Strategy

- Prevention
- Enforcement
- Monitoring
- Education / Partnership

- Continuous monitoring of ambient air quality to :
  - Monitor trends to provide early warning of impending air pollution problems
  - Assess nature and magnitude of air pollution problems to assist in the formulation of effective air pollution control programmes
  - Assess effectiveness of pollution control measures implemented to improve air quality

Ambient Air Quality Monitoring System

Air Monitoring Stations



Central Control Station (CCS)

- Telemetric Air Quality Monitoring and Management System with15 air monitoring stations
- Continuous monitoring of SO2, PM10 ,PM2.5, CO, NOx and Ozone
- Data transmission from air monitoring stations to CCS through telephone network and wireless modems

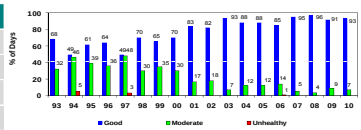
LOCATION OF AIR QUALITY MONITORING STATIONS

Ambient Air Quality

- Pollutant Standards Index (PSI) for reporting daily air quality levels
- PSI is based on Sulphur Dioxide, PM10, Ozone, Carbon Monoxide and Nitrogen Dioxide

PSI Value	Air Quality Descriptor
0 to 50	Good
51 to 100	Moderate
101 to 200	Unhealthy
201 to 300	Very Unhealthy
Above 300	Hazardous

AIR QUALITY IN TERMS OF PSI
(1993 TO 2010)



Air quality in 1994, 1997 and 2006 went into the unhealthy range on some days due to the impact of smoke haze from the land and forest fires in Indonesia.

Environmental Management Strategy

- Prevention
- Enforcement
- Monitoring
- Education / Partnership

- Public campaigns, e.g. Clean and Green Singapore
- Training courses for professionals, industries, etc
- Seminars, workshops for industries, businesses, etc
- Dialogues with industries, professional institutions, etc

Community Involvement & Ownership


Clean and Green Singapore 2009


Dialogue with Stakeholders

Future Plans for Controlling Air Pollution in Singapore

- Extension of in-stack monitoring to more chimneys
- Greater use of remote sensing technology

- Enhance emission standards for motor vehicles
- Cleaner automotive fuels

Thank you