

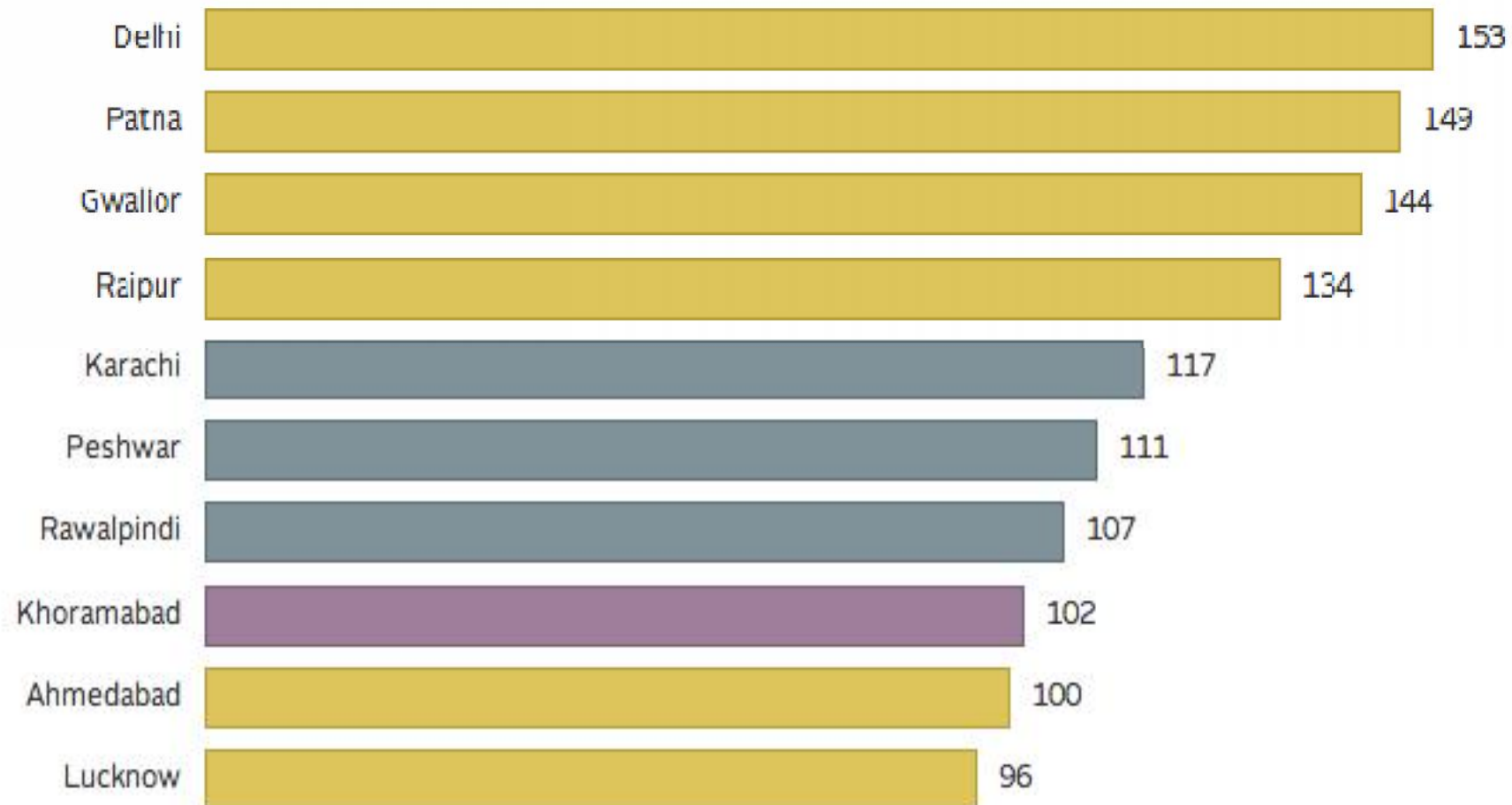
**PM 2.5**



15      30      60      90      120      150

Source: World Health Organization

# The ten cities worldwide with highest levels of air pollution



Source: World Health Organization



# **EFFECTS OF AIR POLLUTION, PREVENTION AND CONTROL**

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# Our cities....



©Reuters

Our factories even in villages....



# Air Pollution

Air pollution signifies the presence in the ambient atmosphere of substances like gases, mixture of gases and particulate matter generated by the activities of man in concentrations that interfere with human health, safety or comfort or injurious to vegetation and animals and other environmental media resulting in **chemicals entering the food chain or being present in drinking water** and thereby constituting additional source of human exposure

# Direct effect of air pollutants

- On Plants
- On Animals
- On Soil
- Influences the structure and function of ecosystems, including self regulation ability.
- In the past air pollution meant smoke!

# Primary Air pollutants

- They are emitted in to the atmosphere from a source such as a factory chimney or exhaust pipe or through suspension of contaminates dusts by the wind. In principle, there fore, it is possible to measure the amounts emitted at the source itself



# Secondary air pollutants

- They are formed within the atmosphere itself. They arise from chemical reactions of primary pollutants, possibly involving the natural components of the atmosphere, especially oxygen and water.
- The most familiar example is ozone, which arises almost entirely from chemical reactions that differ with altitude within the atmosphere. Because of this mode of formation, secondary pollutants cannot readily be included in emissions inventories, although it is possible to estimate formation rates per unit volume of atmosphere per unit time.

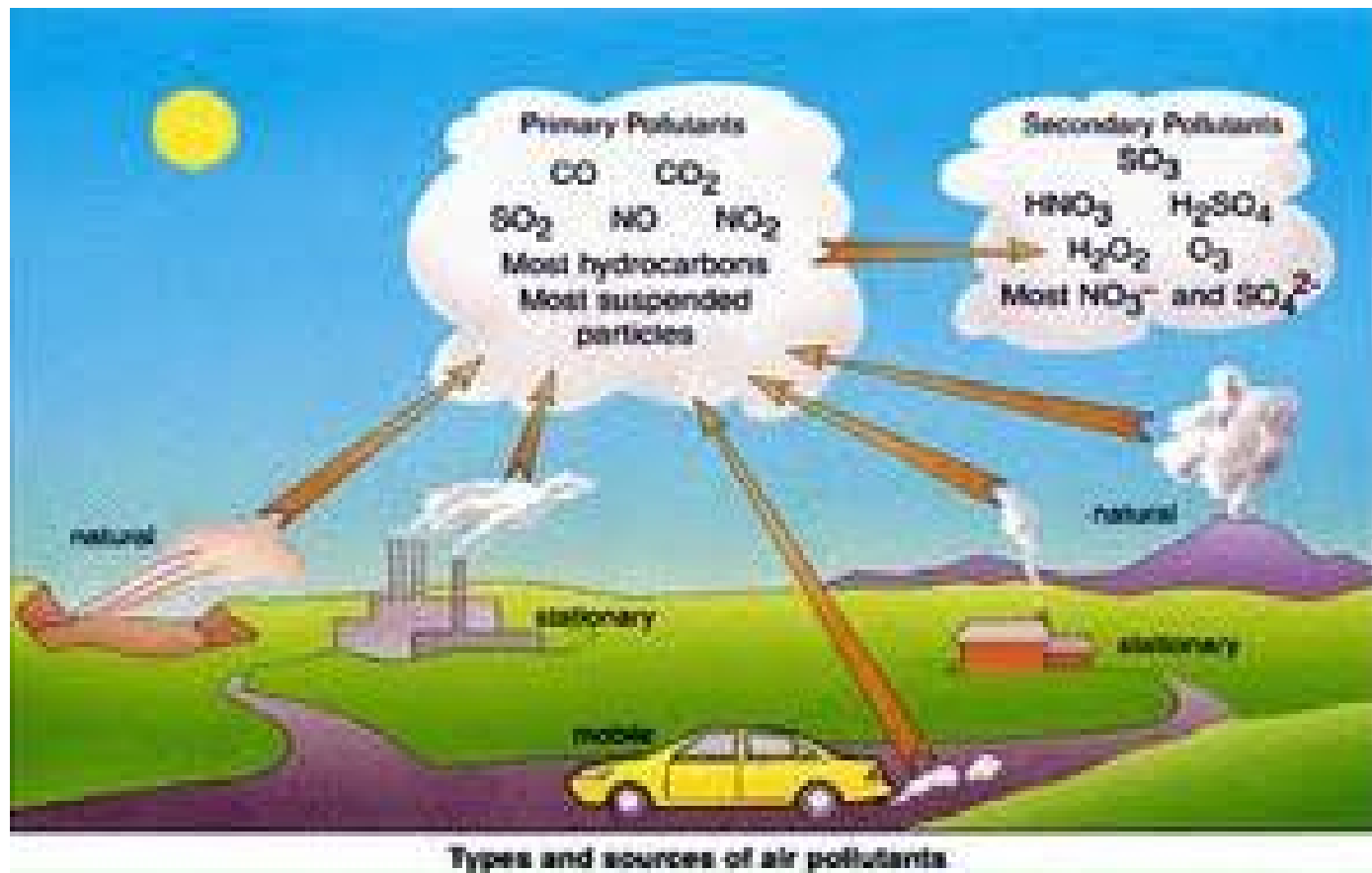
# Gaseous air pollutants

- They are present as gases or vapors, that is as individual small molecules capable for passing through filters, provided they do not absorb to or chemically react with the filter medium.
- They are readily taken into the human respiratory system, although water – soluble, they may very quickly be deposited in the upper respiratory tract and not penetrate to the deep lung.

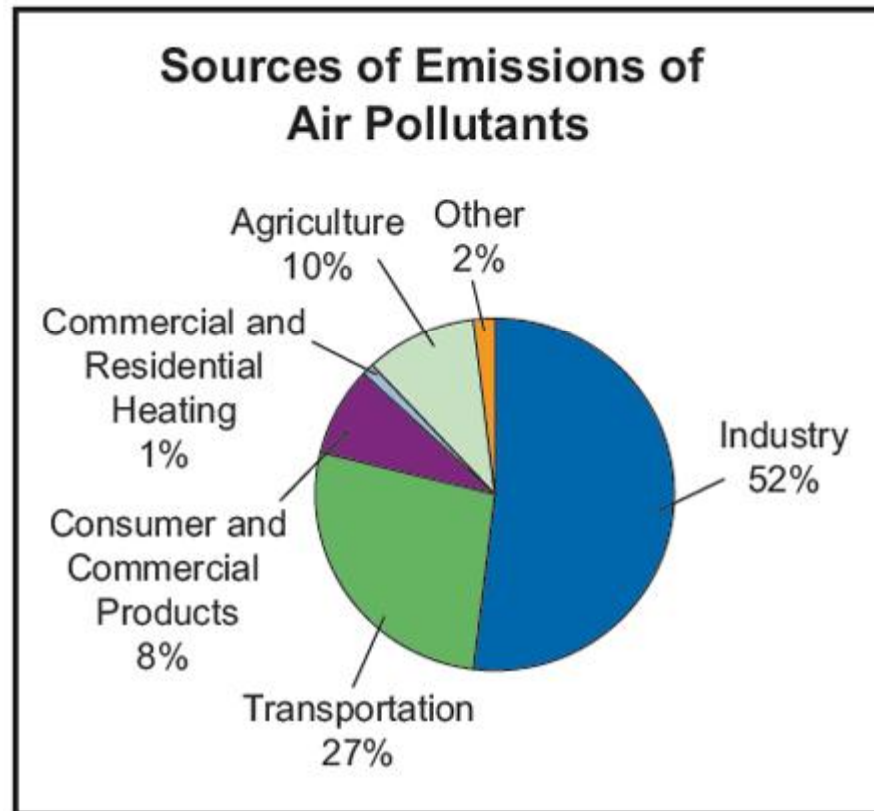
# Particulate air pollutants

- They comprise of material in solid or liquid phase suspended in the atmosphere. Such particles can be either primary or secondary and cover a wide range of sizes.
- Newly formed secondary particles can be as small as 1 – 2  $\mu\text{m}$  in diameter, while coarse dust and sea salt particles can be as large as 100  $\mu\text{m}$  in diameter.

# Primary and secondary pollutants



# Sources of emissions



## Local scale

- Some pollutants by virtue of their source or of having a very short atmospheric life time, are only encountered in appreciable concentrations close to where they are emitted.
- For example in less developed countries, poorly controlled house hold and neighborhood sources, often involving the burning of biomass fuels cause serious local pollution.

## Urban scale

- Pollutants from urban sources, such as nitrogen oxides and carbon monoxide generated by road traffic, tend to be present at high concentrations throughout the city and at significantly reduced concentrations in adjacent rural areas.
- Their atmospheric life times are not long and therefore, concentrations in the remote background atmosphere tend to be very low.

# Regional scale

- Pollutants in the form of fine particles ( $< 2.5 \mu\text{m}$  diameter but not ultrafine particles) and some gas – phase pollutants such as ozone has atmospheric life times of days or even weeks, which permit them to be transported on a regional scale.
- Pollutants such as sulphate particles and ozone readily travel thousands of kilometers in a process known as long – range transport, crossing national boundaries in doing so.



# Hemispheric and global scales

- Some pollutants and especially those associated with greenhouse warming effects (CO<sub>2</sub>, N<sub>2</sub>O, Methane) have atmospheric lifetimes of years and are therefore, capable of distribution throughout a hemisphere and ultimately globally.

# Sources of air pollution

- Automobiles: Hydrocarbons, CO, Lead, Nitrogen oxides and particulate matter.
- Industries: Smoke, SO<sub>2</sub>, NO<sub>2</sub>, Fly ash, HF, HCL, Organic Halides, CO, CO<sub>2</sub>, H<sub>2</sub>S
- Domestic sources: coal/ wood /oil combustion create smoke, dust, SO<sub>2</sub>, NO<sub>2</sub>, passive smoking
- Miscellaneous: Burning refuse, incinerators, pesticide spraying, natural sources (wind borne dust, fungi, bacteria) and nuclear energy programmes

# Meteorological factors

- Most of the gases are within the first 30 Km of atmosphere. Man is in contact with 8-10 Km.
- Topography, air movement and climate influences air pollution. Wind helps in dispersal and dilution of pollutants. If the topography is dominated by mountains or big buildings, the wind becomes weak and calm and pollutants tend to concentrate in the breathing zone.
- Temperature gradient is also important. When there is a rapid cooling of lower layers of air, there is no vertical motion. Pollutants and water vapor get trapped resulting in smog. (Temperature inversion). It affects health

# Air pollutants

- Carbon monoxide
- Sulphur dioxide
- Lead
- Carbon dioxide
- Hydrocarbons
- Cadmium
- Hydrogen sulphide
- Ozone
- Oxides of nitrogen
- Poly cyclic aromatic hydrocarbons
- Particulate matter

# Carbon monoxide

- Product of incomplete combustion of carbon containing materials such as automobiles, industrial process, heating facilities and incinerators. (350 – 600 million tones per annum). Heavy during morning and evening rush hours. Topography is another factor.

# Sulphur dioxide

- Colorless gas with a sharp odor that results from the combustion of sulphur containing fossil fuel, the smelting of sulphur containing ores and other industrial processes. Domestic fires, power generation and motor vehicles also produce SO<sub>2</sub>
- SO<sub>2</sub> affects respiratory system and the function of the lungs and causes irritation of the eyes. Inflammation of the respiratory tract causes coughing, mucus secretion, aggravation of asthma and chronic bronchitis and makes people more prone to respiratory infections.

# Lead

- The combustion of alkyl lead additives in motor fuels accounts for major part of all lead emissions in to the atmosphere.
- Children up to 6 years and pregnant women are at increased risk
- BBB or placenta are not effect barriers against lead.

# Hydrocarbons

- Incineration
- Combustion of coal
- Wood
- Petroleum processing and use
- Hydrocarbons exert their pollutant action by taking part in chemical reactions that cause photochemical smog.



# Cadmium

- Steel industry
- Waste incineration
- Volcanic action
- Zinc production
- Tobacco smoking

# Hydrogen Sulphide

- $\text{H}_2\text{S}$  is formed whenever sulphur or sulphur compounds come in contact with organic material at high temperature.
- Coke production, viscose rayon production, waste water treatment plants, wood pulp production using sulphate process, Sulphur extraction process, oil refining, and tanning industry cause  $\text{H}_2\text{S}$  production.

# Ozone

- Ozone at ground level is one among the constituents of photochemical smog
- Formed by the photochemical reaction of sun light with pollutants such Oxides of  $N_2$  from vehicles, industry emissions and volatile compounds emitted by vehicles, solvents and industry. High during sunny days
- Causes breathing problems, trigger asthma, reduce lung function and cause lung diseases.

# Oxides of Nitrogen

- Predominantly Nitric oxide. Commonly from coal combustion. Also from road traffic and electricity generation.
- $\text{NO}_2$  causes incidence of Bronchitis and Asthma
- Reduced lung function and growth.

# Polycyclic aromatic hydrocarbons (PAH)

- A group of 10,000 compounds
- Formed from incomplete burning of firewood, garbage, coal and oil.
- Also automobile exhaust, industrial emission, charcoal and tobacco.
- Toxic when ingested or in contact with skin.
- Carcinogenic, mutagen and reproductive toxin

# Particulate Matter

- Complex mixture of organic and inorganic substances.
- $<2.5 \mu\text{m}$  are more dangerous. They travel deep into bronchioles and interfere with gas exchange in the lungs.
- Can cause respiratory and cardiac diseases and even lung cancer.

# Indoor air pollutants

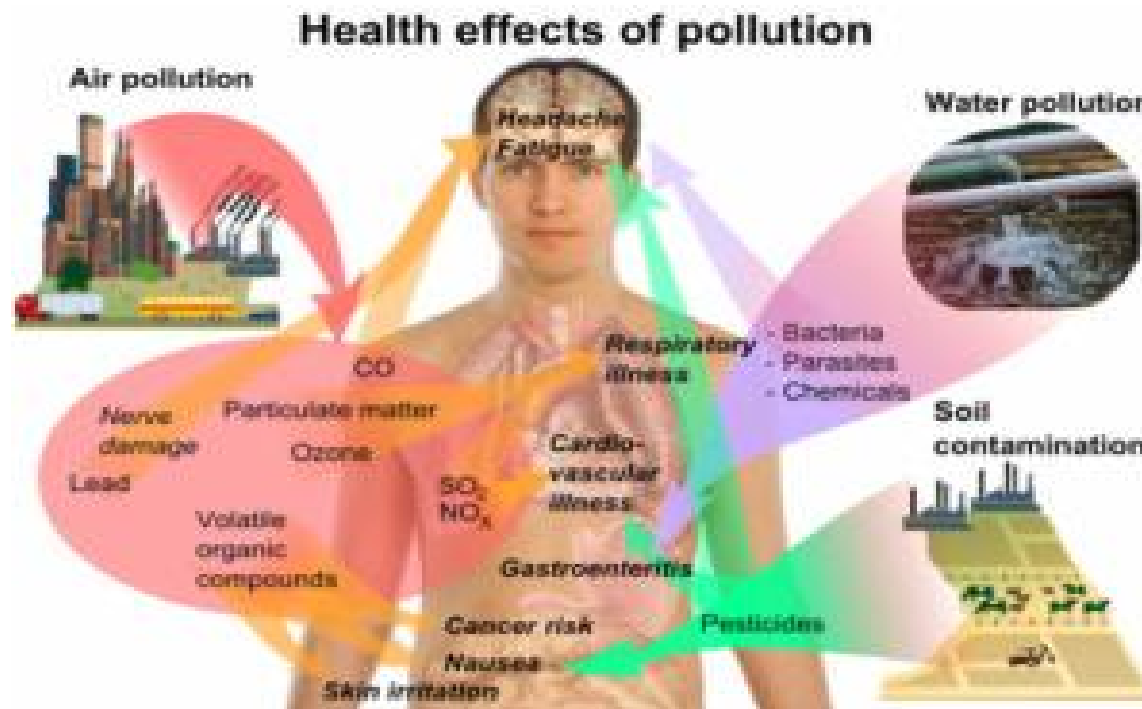
Pollutant	Sources
Respirable Particles	Tobacco smoke, Stove, Aerosol sprays
Carbon Monoxide	Combustion equipment, Stove, Gas heaters
Nitrogen Dioxide	Gas cookers, Cigarettes
Sulphur Dioxide	Coal combustion
Carbon Dioxide	Combustion, Respiration
Formaldehyde	Particle board, Carpet adhesives, insulation
Other organic vapors (benzene, toluene etc)	Solvents, Adhesives, Resin products, aerosol sprays
Ozone	Electric arcing, UV light sources
Radon and daughters	Building material
Asbestos	Insulation, Fireproofing
Mineral fibers	Appliances

# Indoor Air Pollution - effects

- Acute respiratory infections in young children
- Chronic lung disease and cancer in adults
- Adverse pregnancy outcomes like stillbirths



# Effects of Air Pollution on health



# Monitoring Air Pollution

- Best indicators –  $\text{SO}_2$ , Smoke and Suspended particles
- $\text{SO}_2$  concentration
- Smoke or Soiling Index
- Grit and Dust measurement
- Coefficient of Haze
- Air Pollution index:  $10 \text{SO}_2 + 2 \text{CO}_2 + 2 \text{CoH}$

# Effects of Air Pollution

- Health aspects

Immediate – a/c bronchitis, suffocation, death

Delayed - c/c bronchitis, Lung cancer, bronchial asthma, emphysema and respiratory allergies

Lead poisons many systems.

- Social and Economic aspects

- Destruction of plant and animal life, corrosion of metals, damage to buildings, cost of cleaning and maintenance, aesthetic nuisance.

# Major Air Pollutants, sources and adverse effects

Noxious Agent	Sources	Adverse Effects
Oxides of Nitrogen	Automobile exhaust, gas stove and heaters, wood burning stoves, kerosene space heaters	Respiratory Tract irritation, bronchial hyperactivity, impaired lung defenses
Hydrocarbons	Automobile exhaust Cigarette smoke	Lung Cancer
Ozone discomfort	Automobile exhaust	Cough Substernal
Sulphur Dioxide	Power plants, Smelters, Oil refineries, kerosene space heaters.	Exacerbation of Asthma and COPD, respiratory tract irritation, hospitalization may be necessary, death in severe exposure
Lead	Automobile exhaust using leaded gasoline	Impaired neuropsychological development in children

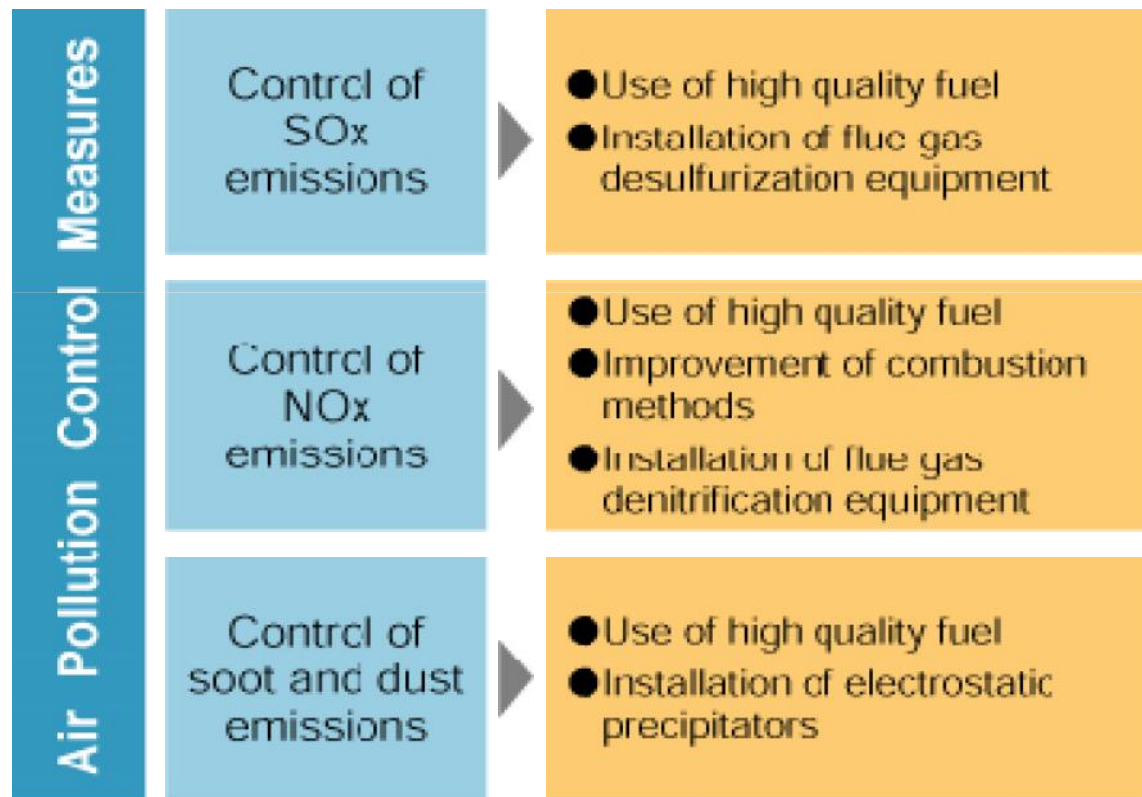
# Prevention and Control of Air Pollution

- Containment
- Replacement
- Dilution
- Legislation
- International action

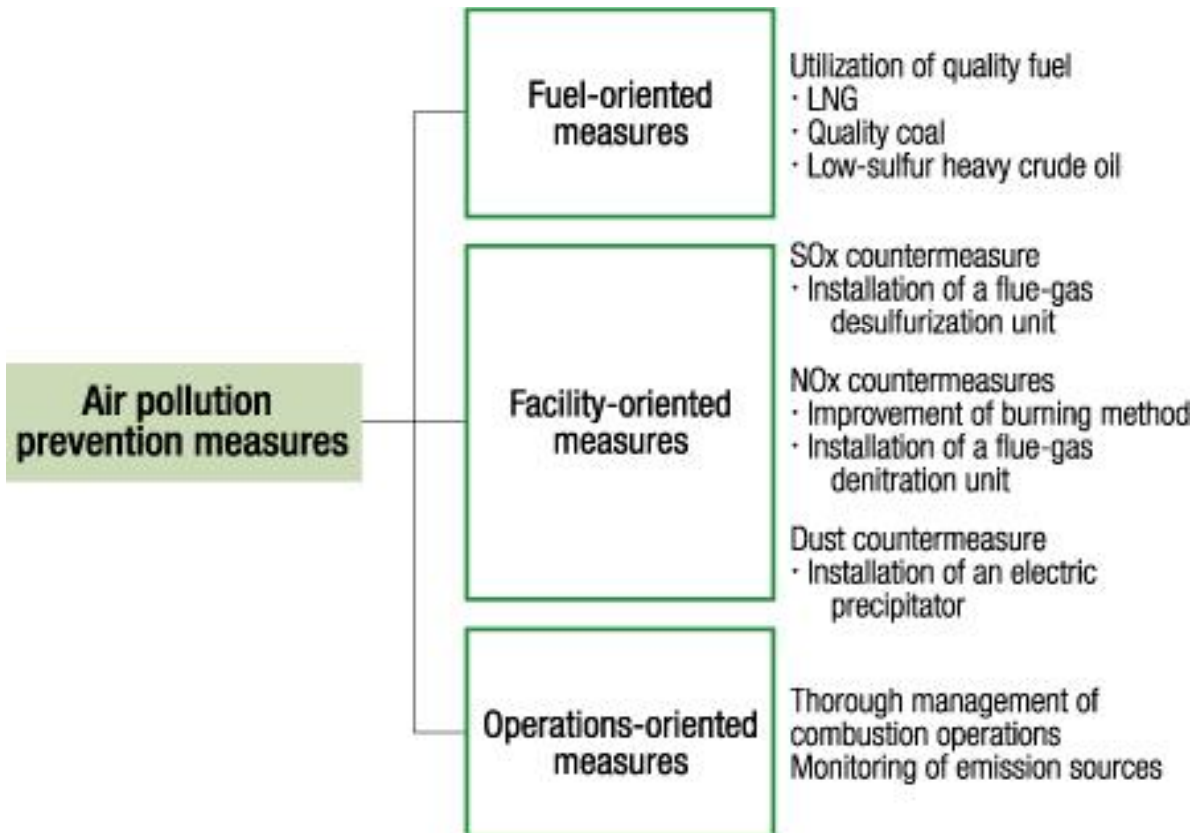
# Disinfection of Air

- Mechanical ventilation
- Ultraviolet Radiation
- Chemical mists
- Dust control

# Prevention and Control of Air Pollution



# Prevention and Control of Air Pollution





# What does Ayurveda say?



# Signs of Vitiated Vayu

“तत्र वातमेवं विधं अनारोग्य करं विद्यात् ; तद्यथा -  
यथात्तु विषमं अतिस्तिमितं अतिचलं अतिपरुषं  
अतिशीतं अत्युष्णं अतिरूक्षं अत्यभिष्यन्दिनं  
अतिभैरवारावं अतिप्रतिहता परस्परगतिं  
अति कुण्डलिनं असात्म्य गंधा बाष्प सिकता  
पांसु धूमोपहर्तमिति ”

## Air having the following characteristics is injurious to health

- Absence of characteristic features in conformity with the season
- Excessive calmness or violent blow
- Excessive dryness, cold, heat, roughness or humidity
- Excessive clashes among each other
- Excessively cyclonic in nature
- Association with unwholesome smell, gases, sand, ashes and smoke

# Methods of Air Purification

- Fumigation
- Sprinkling
- Spraying
- Medicated Flags
- Medicated Drums

# Dhupanam

लाक्षा हरिद्रातिविषाभयाब्द  
हरेणुकैला दलवाकरकुण्ठं  
प्रियंगुकां चाप्यनले निधाय  
धूर्मानिलौ चापि विशोधयेत्

(Su. Jamgamavishavijnaniyam - 17)

Aparajita

पुराध्यम वचा सज निम्बाकागारुदारुभीः  
धूपो ज्वरेषु सवषु प्रयोक्तव्यो अपराजितः(AH Jwara chi)



# Sprinkling

देवदारु नतानन्ता मधुकाजुन गैरिकम्  
वज्रकन्द लत्तां लोध्रं वीकिरेचछलक्षण चूर्णतम्  
वृक्षाग्रेषु पताकासु दुष्येषु सुमहत्स्वर्वाप  
सर्वतश्चूण संपकात निविशो जायतेनीलः



# Spraying

विल्वाढको यवक्षार पाटलो बाल्हिकोषणाः  
श्रीपर्णा सल्लकोयुक्ता निष्क्वाथः प्रोक्षणः परं  
सर्विषं प्रोक्षितं तेन सदयो भवति निर्विषम्



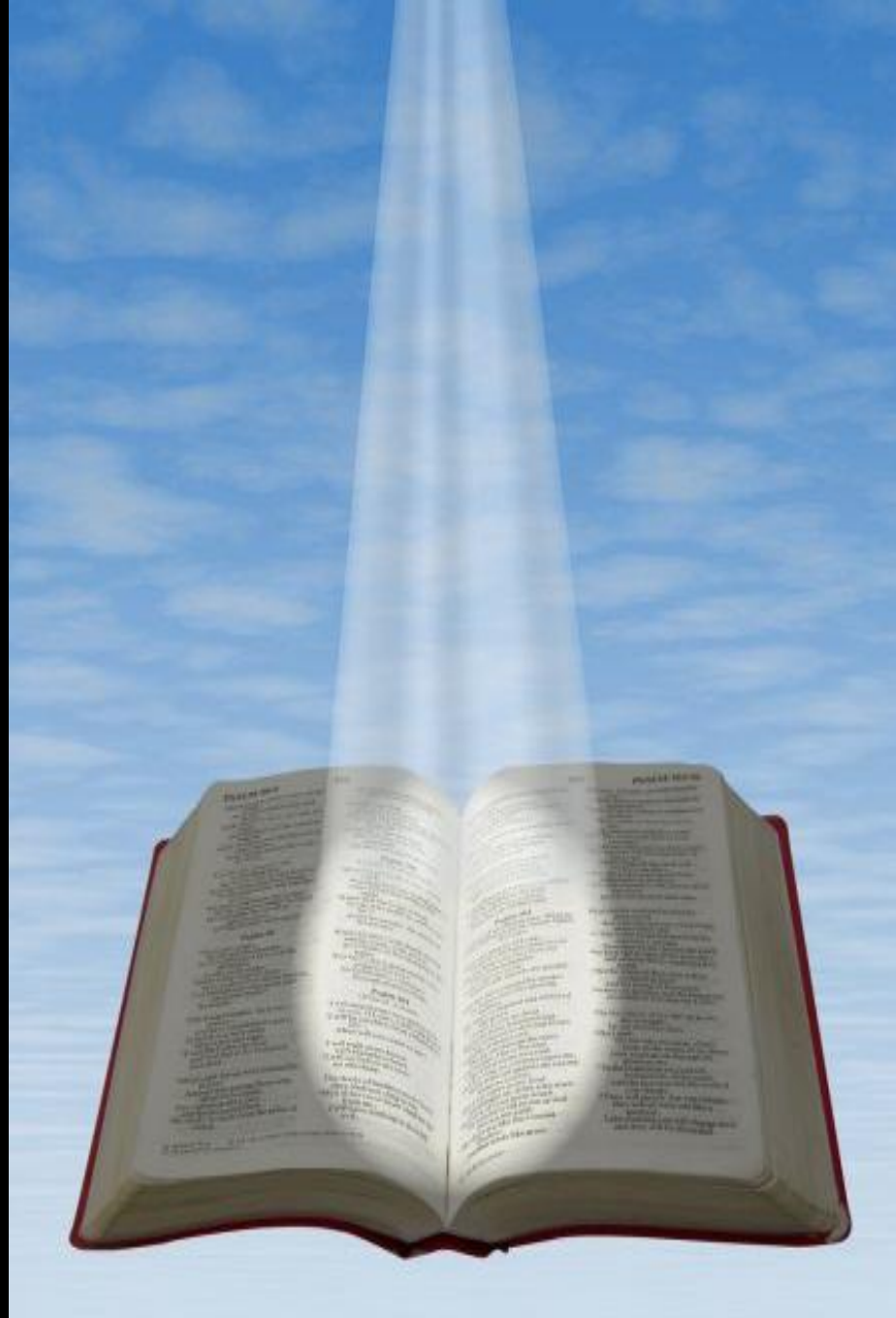
# Spraying

अरेणु मांसी मंजिष्ठा रजनी मधुकं मधु  
अक्षत्वक सुरसं लाक्षा अर्श्वपत्तं पूवन्मणिः  
वादित्राणि पताकाश्च पिष्टैरेपिश्च लेपिताः  
श्रुत्वा दृष्ट्वा समाघ्राय सद्यो भवति निविषम्





आनो भद्रा  
क्रतवो  
यन्तु  
विश्वतः



“ Let  
knowledge  
come from  
all sides  
towards us!  
”



THANKYOU!!!