

Malé Declaration stakeholders meeting

Kathmandu, 4th March 2008

The air pollution problem and the need for emissions inventories

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**Malé Declaration on Control and Prevention of Air Pollution
and Its Likely Transboundary Effects for South Asia**

Presentation overview

The air pollution problem

- ❖ Driving forces
- ❖ Impacts

What is an emission inventory?

- ❖ Definition
- ❖ Major emission source types
- ❖ General steps in inventory development

The Malé Declaration emission inventory preparation manual and workbook

Why do we need emission inventories?

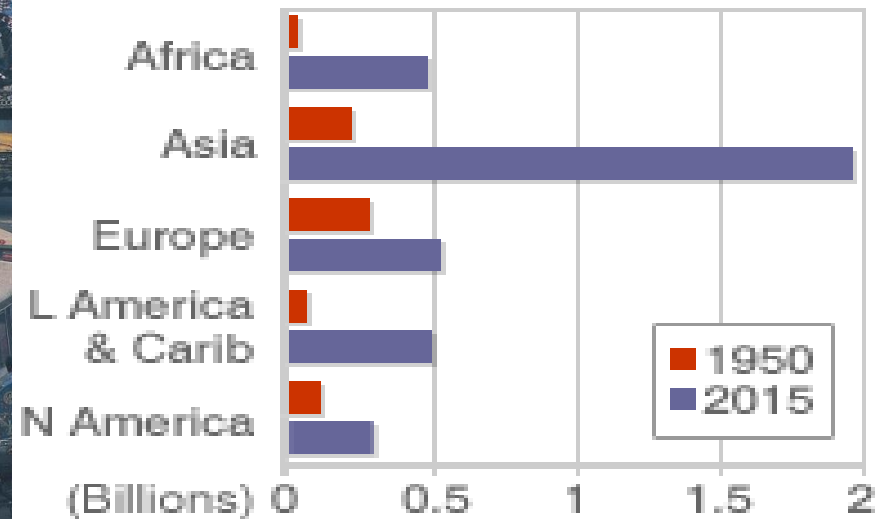
The problem

Driving Forces:

- ❖ Economic growth
- ❖ Urbanisation
- ❖ Motorisation
- ❖ Population growth
- ❖ Industrialisation
- ❖ Increasing energy demand



REGIONAL URBAN POPULATIONS



The problem:- Damage to human health

**Household
scale impact -
mainly women
and children**



The problem:- Damage to human health

**Urban
scale impact**



The WHO estimates that in Asia, 500,000 advanced deaths per year are being caused by outdoor air pollution.



The problem:- Damage to human health

Regional
scale impact



More than 8,000 people were admitted to hospital in Malaysia due to the Indonesian fires in September 1997



Impacts of Air Pollution at Different Scales



Household

Urban

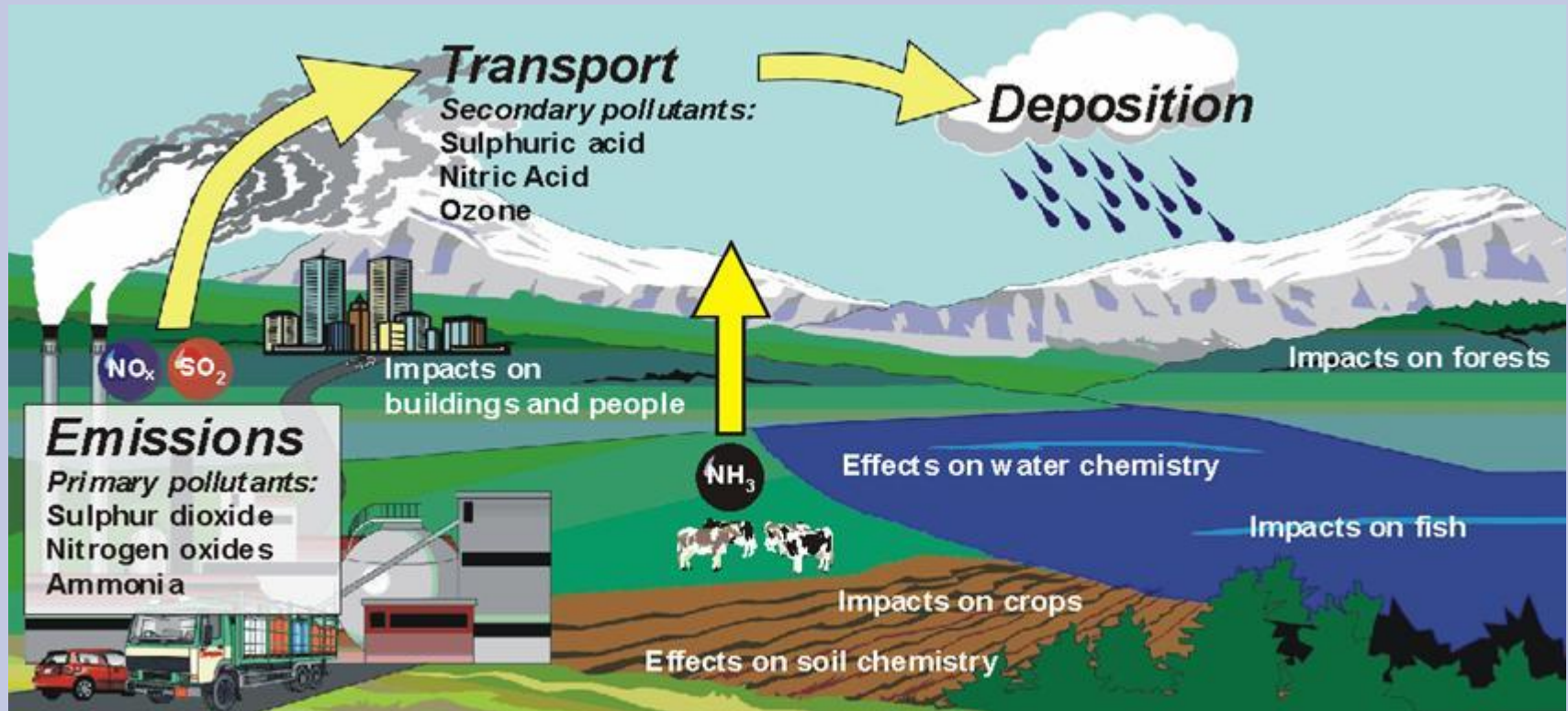
Peri-urban

Regional

Global

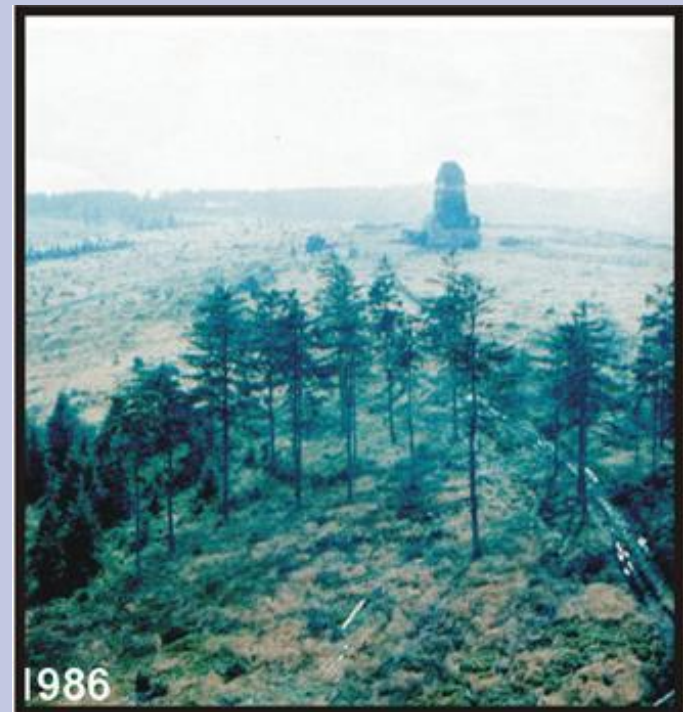
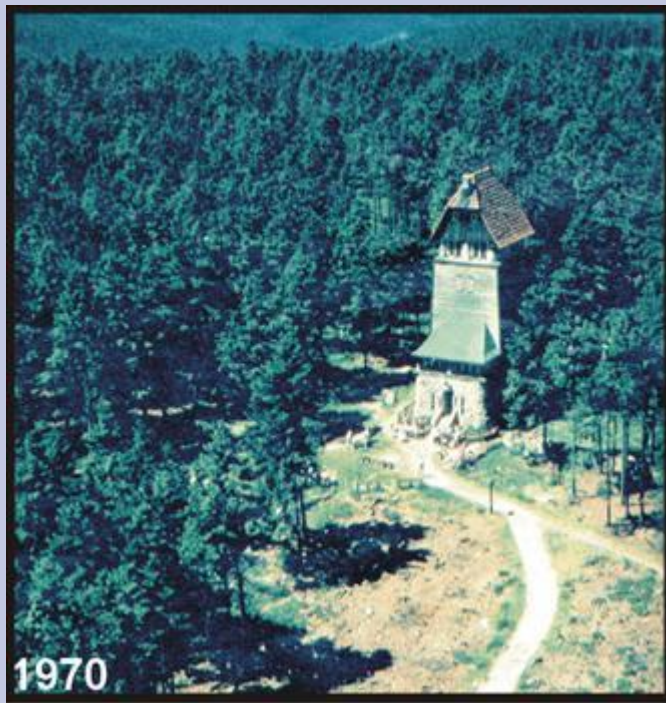


The problem: Damage to crops, animals and ecosystems





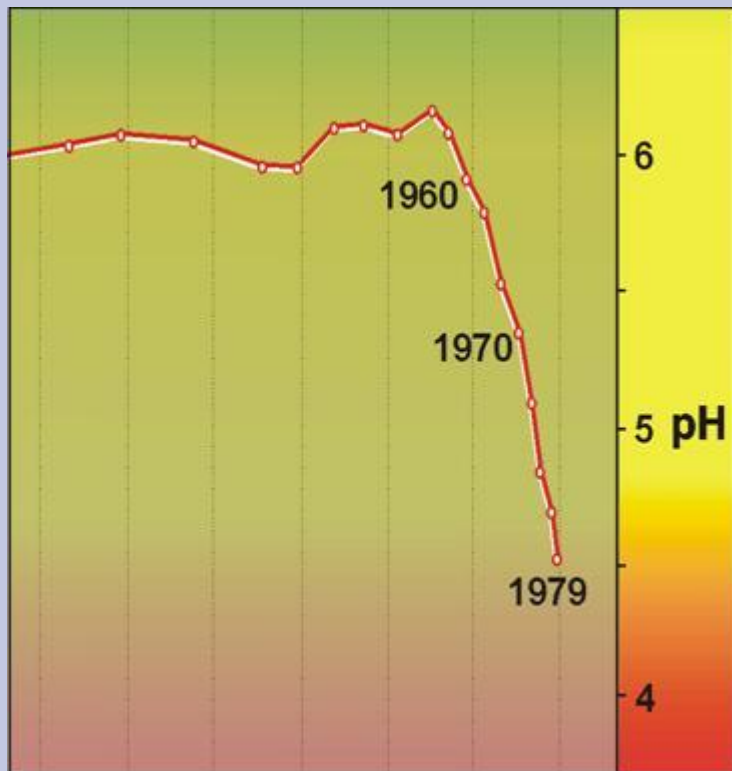
Widespread forest decline in C Europe



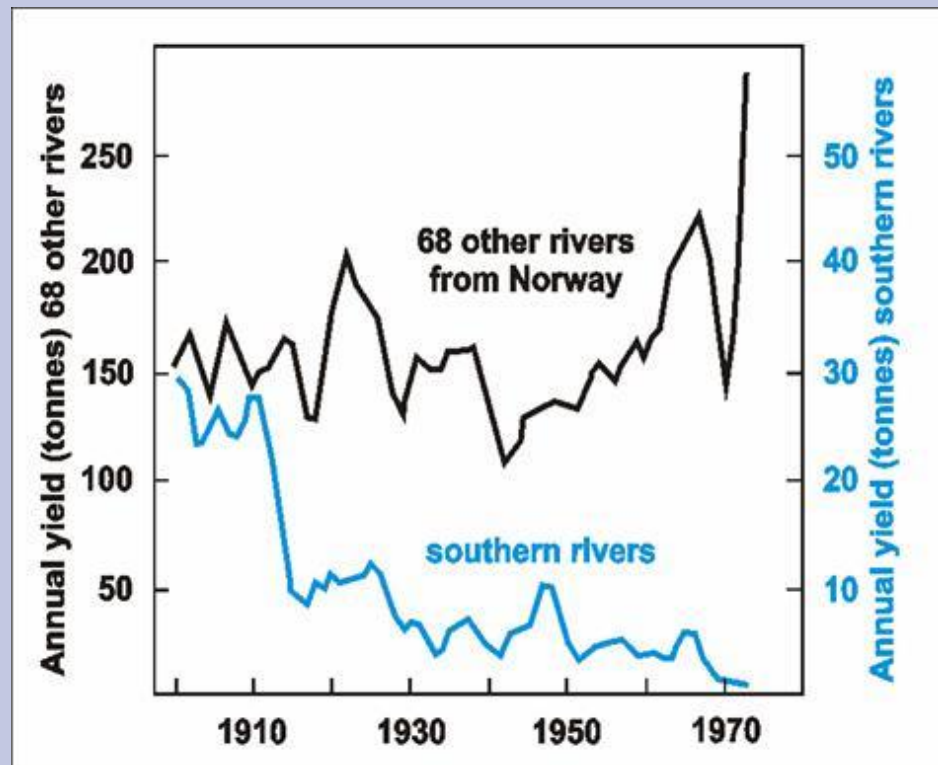
Forest damage in Germany



Effects of 'Acid Rain' in Europe



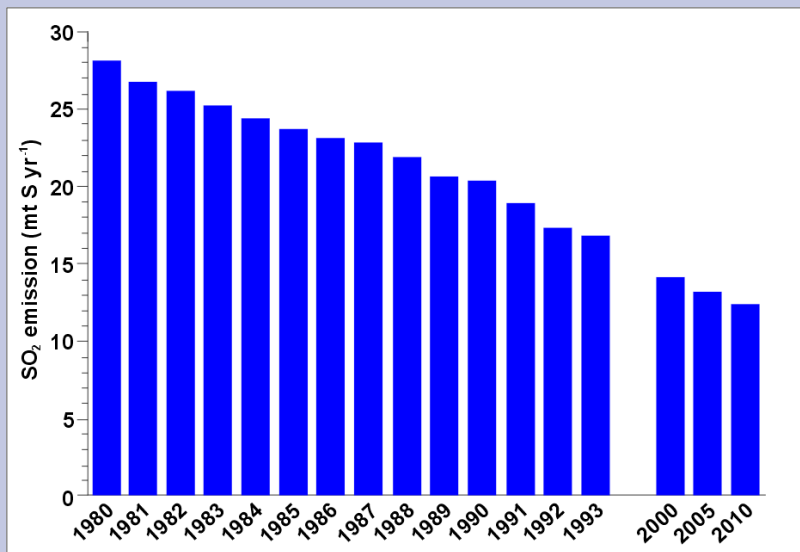
The pH of lake Gårdsjön, SW Sweden



Salmon decline in the acidified waters of southern Norway

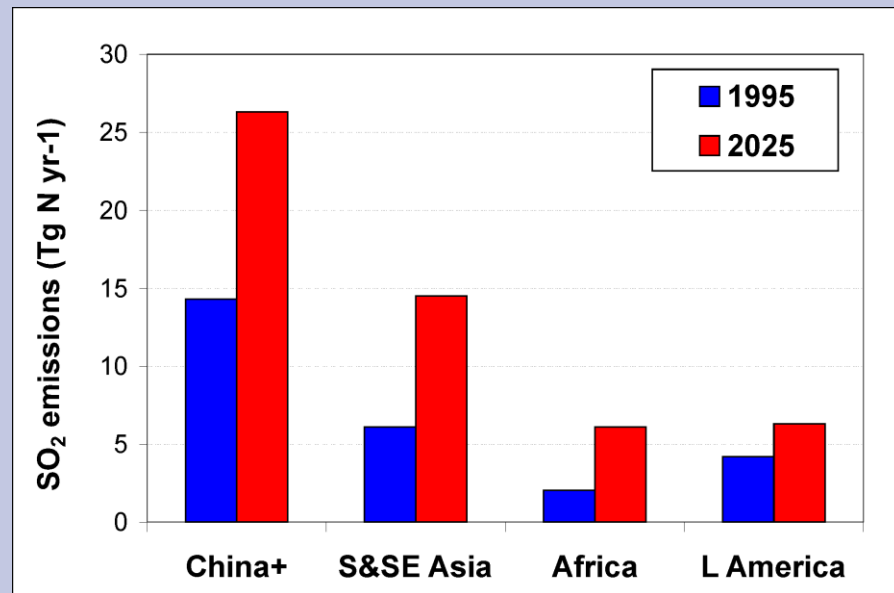


The Progression of Sulphur Emissions in Different Regions



UNECE Europe

Convention on Long-range Transboundary Air Pollution (LRTAP) has successfully addressed sulphur emissions at the regional level





Eutrophication

Nitrogen oxide gases (NO, NO₂) and ammonia (NH₃), can undergo chemical reactions making secondary particulates such as nitric acid and nitrate salts. When deposited onto ecosystems these can cause 'over-fertilization' effects.

- ❖ Aquatic ecosystems: excess algae growth depletes the oxygen levels in the water, killing fish and other animal life.**
- ❖ Terrestrial ecosystems: nutrient-poor but species-rich habitats can suffer loss of species diversity as more common, 'hungrier' species take over.**



Ozone impacts on Crops and Forests

While ozone (O_3) in the stratosphere protects us from harmful UV radiation, tropospheric (or low level) ozone is known to damage plants and crops.



Invisible Injury: as shown by filtration experiments



**O₃ injury to wheat whole plant growth, Pakistan
(courtesy of A. Wahid)**

Air Pollution and Corrosion in Europe



Impacts in Central Germany

What is an emissions inventory?

Definition:

“An air pollutant emissions inventory details the amounts and types of air pollutants released into the air by source category for a specific geographic area over a specific time period.”

Emissions may be either:

- ❖ **Natural or**
- ❖ **Anthropogenic (man-made)**

Natural emissions include:

- ❖ Volcanic emissions (SO_2 & PM)
- ❖ Biogenic emissions from trees and other vegetation (VOCs & NH_3)
- ❖ Wild animals (NH_3 , CH_4)
- ❖ Biogenic emissions from natural soils (NO_x)
- ❖ Wind-blown dust from deserts and disturbed areas
- ❖ Marine and Sea - Sea salt particles
- ❖ Lightning (NO_x)



Anthropogenic (man-made) emissions

Large point sources (LPS) - large emitters that can be identified at a specific location:

- ❖ electrical power plants
- ❖ metal smelters
- ❖ large factories
- ❖ oil refineries



Air Pollution from stationary sources, Azerbaijan
Source: HDR, Azerbaijan, 1999



Anthropogenic (man-made) emissions

Other source categories are made up of many small, or diffuse sources:

- ❖ domestic households
- ❖ small factories
- ❖ offices and public buildings
- ❖ cars and other mobile sources (line sources)
- ❖ vegetation fires
- ❖ crop residue burning
- ❖ application of fertilizers



General approach for calculation of emissions

$$\text{Emission} = (\text{emission factor}) \times (\text{activity rate})$$

Emission factors are the rate of emission of a pollutant per unit of activity

Examples:

- ❖ In power stations - kg NO_x per tonne coal burnt
- ❖ In copper smelters - kg SO₂ per tonne blister copper produced

General approach for calculation of emissions

$$\text{Emission} = (\text{emission factor}) \times (\text{activity rate})$$

The **activity rate** is some measure of the annual level of the relevant activity e.g. :

- ❖ For *fuel combustion* - the annual rate of consumption of a fuel (e.g. kilotonnes coal burnt per year in power stations)
- ❖ For *industrial process emissions* - the annual rate of production of the commodity (e.g. kilotonnes copper blister produced per year at copper smelters)



**Malé Declaration on Control and Prevention of Air Pollution
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The Malé Declaration Air Pollutant Emissions Inventory Manual

Draft Version 2.3
May, 2007



Air pollutants included in the Malé Declaration emission inventory manual

- ❖ Sulphur dioxide (SO_2)
- ❖ Nitrogen oxides (NO_x)
- ❖ Particulate matter (PM_{10} and $\text{PM}_{2.5}$)
- ❖ Ammonia (NH_3)

The ozone (O_3) precursors (in addition to NO_x , SO_2 and NH_3):

- ❖ Carbon monoxide (CO)
- ❖ Non-methane volatile organic compounds (NMVOCs)

Summary of anthropogenic emission source categories used in the manual

Energy sources:

- 1 Combustion in the Energy Industries
- 2 Combustion in Manufacturing Industries and Construction
- 3 Transport
- 4 Combustion in Other Sectors
- 5 Fugitive emissions from fuels

Summary of anthropogenic emission source categories used in the manual

Other source sectors:












- 6 Industrial Processes
- 7 Solvent and Other Product Use
- 8 Agriculture
- 9 Vegetation Fires & Forestry
- 10 Waste

User must enter inventory details here:

| | |
|-----------------|----------------------|
| Inventory year: | 2000 |
| Region: | South Asia |
| Country: | Someland |
| Province: | Somestate (optional) |

The Malé Declaration emission inventory Excel workbook: main menu

MENU OVERVIEW

| | | |
|-------------------------------------------------------------------------------------|------------|---------------------------------------------------------------------------|
|  | Menu1 | Sectors 1. to 4. Fuel combustion activities |
|  | Menu2 | Sector 5. Fugitive emissions (non-combustion) for fuels |
|  | Menu3 | Sector 3. Fuel combustion activities. Sector: Transport (Detailed method) |
|  | Menu4 | Sector 6. Industrial processes (non-combustion) emissions |
|  | Menu5 | Sector 7. Solvent and other product use |
|  | Menu6 | Sector 8. Agriculture |
|  | Menu7 | Sector 9. Vegetation fires and Forestry. |
|  | Menu8 | Sector 10. Waste |
|  | Menu9 | Large Point sources |
|  | Sheet 9 | Summary sheet - Annual emissions of each pollutant by source sector |
|  | References | |

The Malé Declaration emission inventory Excel workbook: Menu 4

Sector 6. Industrial processes (non-combustion) emissions

[Back to Back
to Main](#)

GO

Sheet: 2.1 Process (non-combustion) emissions from the production of mineral products.

GO

Sheet: 2.2 Process (non-combustion) emissions from the production of chemicals.

GO

Sheet: 2.3 Process (non-combustion) emissions from metal production.

GO

Sheet: 2.4 Process (non-combustion) emissions of SO₂, NO_x and NMVOCs from pulp and paper production.

GO

Sheet: 2.5 Process (non-combustion) emissions of NMVOC from alcoholic beverage manufacture.

GO

Sheet: 2.6 Process (non-combustion) emissions of NMVOC, PM₁₀, and PM_{2.5} from food production

GO

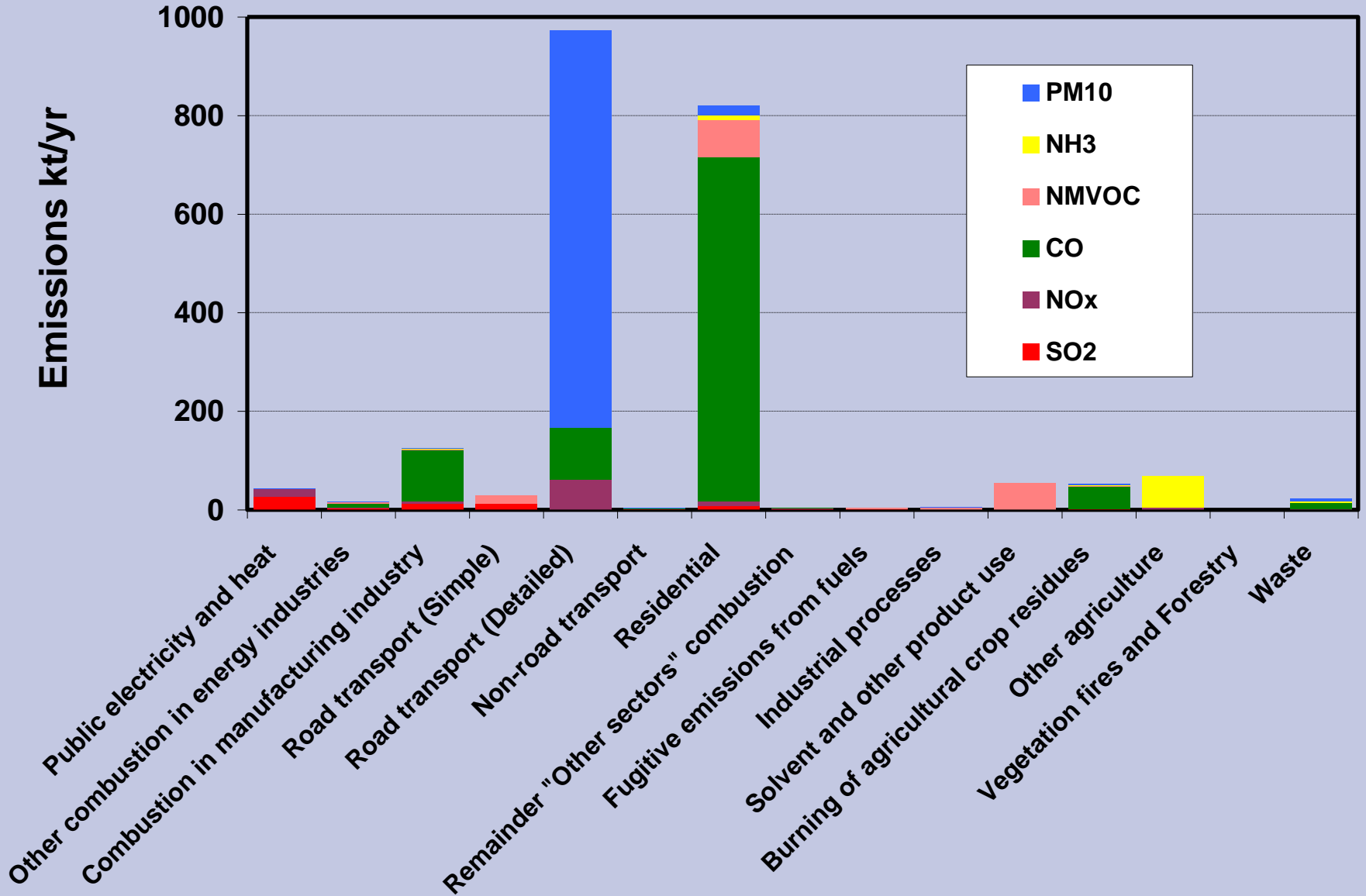
Sheet: 2.7 Fugitive emissions of particulate matter from major building construction activities.

Worksheet for *Process (non-combustion) emissions from metal production*

| Process | A Activity rate (kt product/ year) | B SO ₂ emission factor (kg SO ₂ /t) | | C SO ₂ emissions (Tonnes) (A x B) | D NO _x emission factor (kg NO _x /t) | | E NO _x emissions (Tonnes) (A x D) |
|---------------------------|---------------------------------------------|--------------------------------------------------------------------|-------------------|--------------------------------------------------------------|--------------------------------------------------------------------|--------------------|--------------------------------------------------------------|
| | | | Default | | | Default | |
| Pig iron production | | | 3 ^a | 0 | | 0.076 ^d | 0 |
| Aluminium production | | | 15.1 ^e | 0 | | 2.15 ^e | 0 |
| Copper smelting (primary) | | | 2120 ^f | 0 | | | |
| Lead smelting (primary) | | | 320 ^g | 0 | | | |
| (secondary) | | | 40 ^h | 0 | | | |
| Zinc smelting (primary) | | | 1000 ^g | 0 | | | |
| Other (please specify) | | | | 0 | | | 0 |
| Total emissions | | | | 0 | | | 0 |

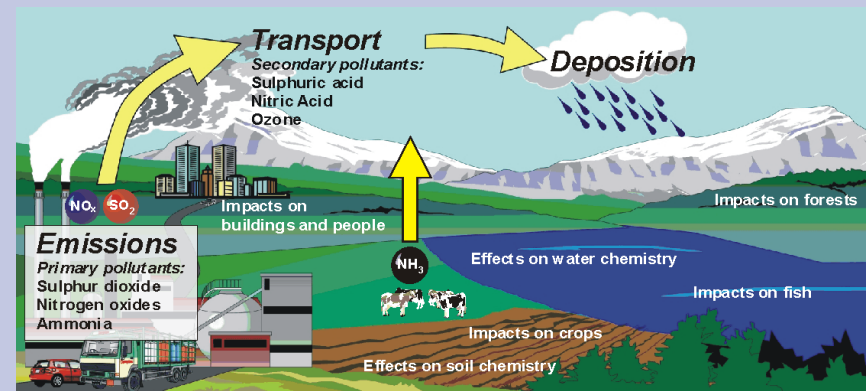
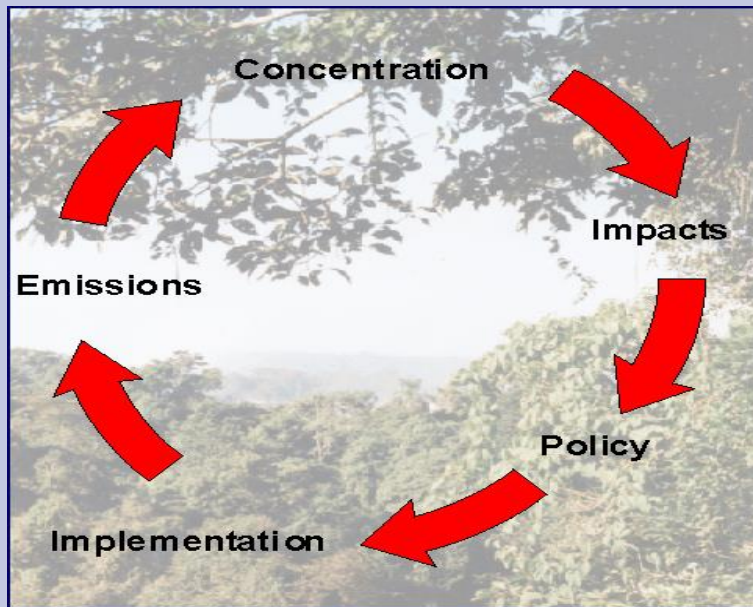


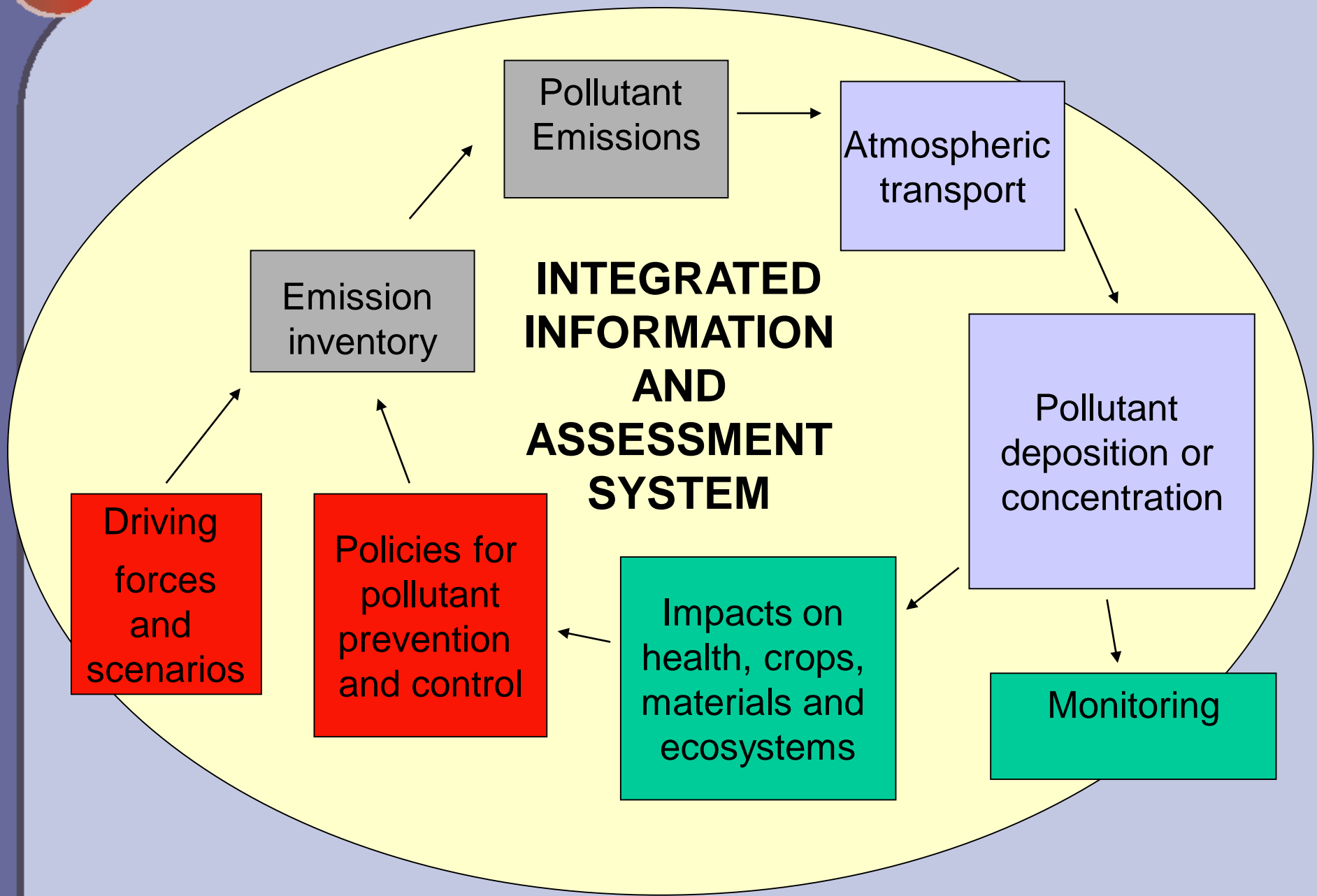
Sri Lanka's draft emission inventory for 2000



Why produce an emissions inventory?

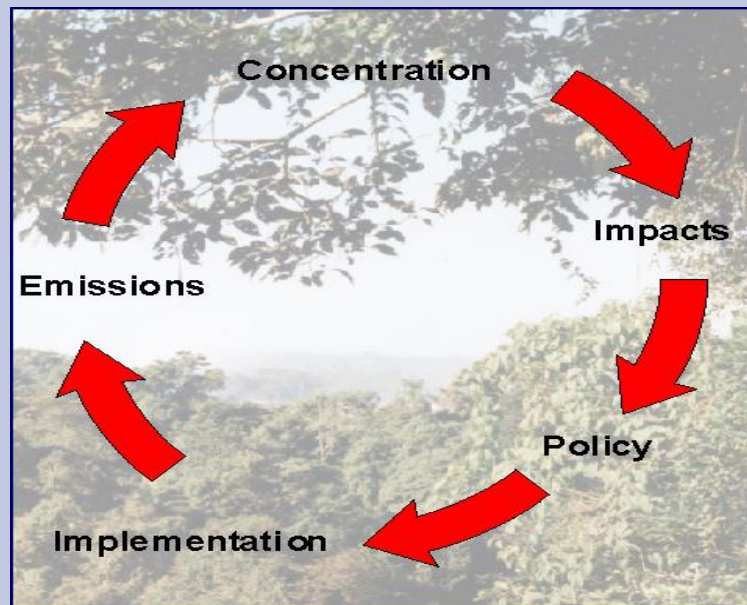
- ❖ to provide input data for modelling the movement, concentrations, deposition and effects of air pollutants





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- ❖ help inform the policy makers and the public

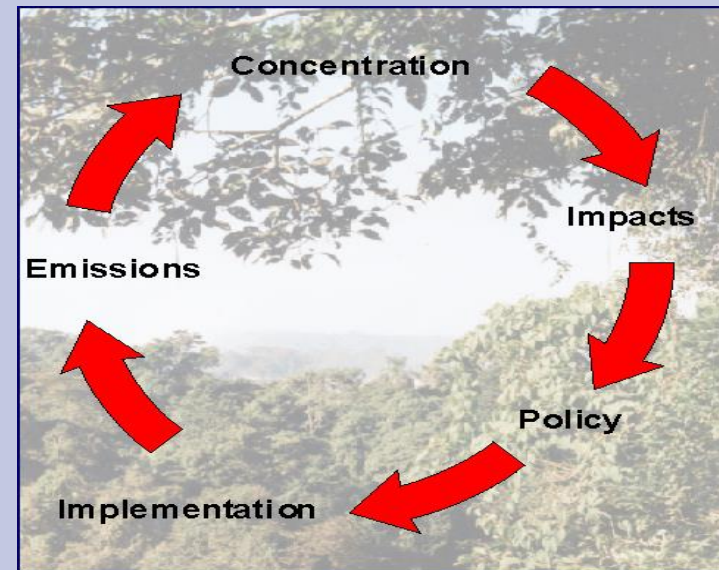


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- ❖ **assess the potential impacts of different reduction strategies on current levels of emissions**

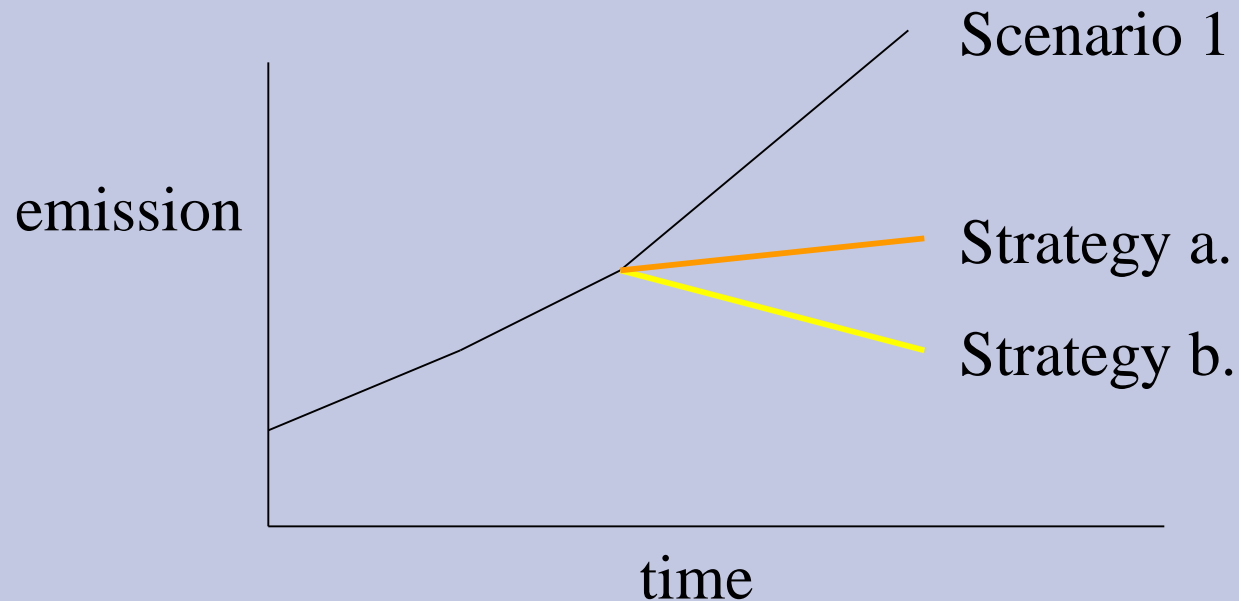


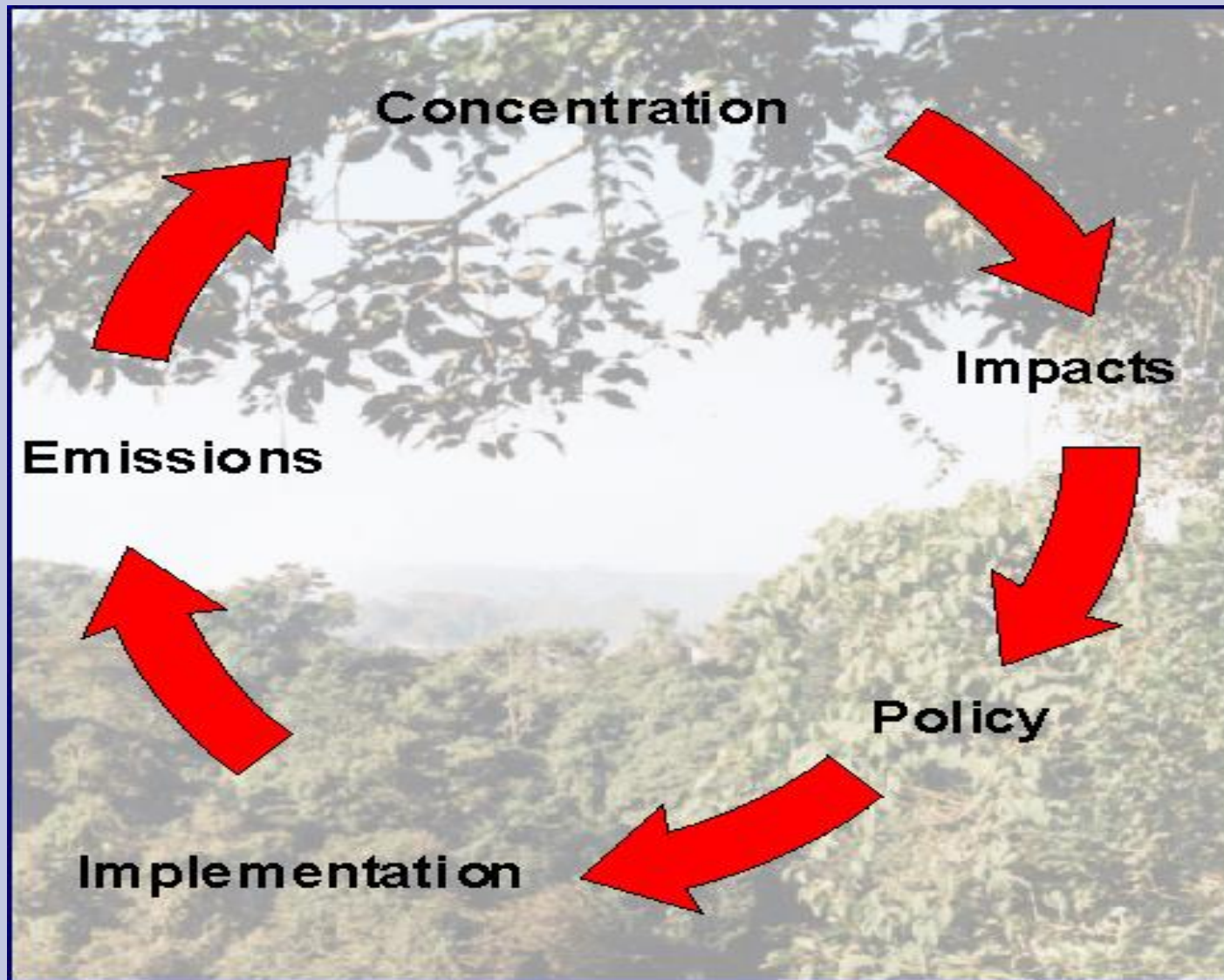
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- ❖ help inform the policy makers and the public
- ❖ help define priorities and set objectives for reducing emissions
- ❖ assess the potential impacts of different reduction strategies on current levels of emissions
- ❖ forecast future emission levels to determine which emission sources might require further controls

Why produce an emissions inventory?

Developing cost-effective strategies to limit air pollution





人无远虑 必有近忧

**“If one takes no thought
about what is distant**

**..... one will find sorrow
near at hand.”**

Confucius (551 BC - 479 BC)

Thank you

