

## Air Pollution in India

### **Summary of Problem:**

- India's high air pollution is affecting the lifespan of people, reducing most Indian lives by over three years, and is ranked among the worst in the world.
- More than half of the country's population live in places where particulate matter (PM) pollution is above India's standards.
- Thirteen of the world's top twenty polluted cities are in India (China has three of the top twenty).
- Delhi ranks 11th in the World Health Organization's (WHO) list of most polluted cities

### **Main Pollutants:**

- PM<sub>10</sub> and PM<sub>2.5</sub>
  - \*Reminder\* an aerosol is another term for PM, defined as particles suspended in gas
  - PM<sub>2.5</sub> emissions exceed Indian standard of 40 mg/m<sup>3</sup> at population exposure of 30-145 mg/m<sup>3</sup>
- Smog Generation
  - Mixture of reactive gases and particles (photochemical smog)

### **Sources:**

- Emissions from vehicles
- Coal-fired power plants
- Cement and steel industries
- Dust storms (November 2017 storm in western Asia amplified smog)
- Household air pollution from the use of solid fuels for cooking
- Ammonia reacts with acids from SO<sub>2</sub> and NO<sub>x</sub> to form PM<sub>2.5</sub>
  - SO<sub>2</sub> + particles → H<sub>2</sub>SO<sub>4</sub>
  - NO<sub>2</sub> + OH + M → HNO<sub>3</sub> + M
    - HNO<sub>3</sub>(g) → HNO<sub>3</sub>(aq)

### **Health and Environmental Impacts:**

- PM<sub>2.5</sub> can be inhaled and remain in lung tissue and deposit toxic material
- Eye, nose, throat and lung irritation
  - Coughing, sneezing, shortness of breath
  - Children and elderly at greater risk

- 2015 statistics claim that 1.1 million deaths or 10.6% of total number of deaths in India attributed to PM emissions from mobile and stationary sources
  - If no action is taken for emissions control, expected exposure increase of 40% by 2050
- Visibility Impacts
  - Visibility Length (km) =  $1000/TSP$  where TSP is total suspended particulates in  $\mu\text{g}/\text{m}^3$

**Suggestions for Control:**

- Replace existing cook stoves with clean cooking stoves.
  - “India could cut its total air pollution by one third by giving clean cooking stoves to all its villagers”
- Reduce pollution from diesel transport
- Restrict open burning of biomass and fossil fuels
- Add or improve efficiency of cyclones, baghouses, or electrostatic precipitators to industrial facilities
- Recent measures in the capital include tighter vehicle emissions norms, higher penalties for burning rubbish and better control of road dust.
- While Delhi’s air quality has slightly improved recently, air quality levels in smaller cities have become worse in smaller cities

**Sources:**

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