Aerosol Pollution and Solar Power Generation

Prelims: *GS III – Energy| Environment*

Why in News?

Recently, a study found that the aerosol pollution reduces the solar power generation capacity.

Findings of the study

- **Analysis published in** – Nature Sustainability.
- **Reduced solar power generation** – Aerosols in the air reduced the amount of solar power generated in India by *9.6% in 2023*, equivalent to around 15 terawatt-hours (TWh).
- **Global average loss** – It was 5.8%.
- **Role of smog** – It directly reduces the amount of sunlight reaching solar panels, thus undermining an important source of power meant to replace coal in India.

Smog *is a mixture of aerosols and gases*

- **Aerosols** – They are tiny solid particles or liquid droplets suspended in the atmosphere, ranging in size from a few nanometres to several micrometres.
- **Aerosol pollution** – It refers to excessive concentration of these particles in the air, adversely affecting human health, visibility, weather, and climate.

Types

- **Natural Aerosols** – Dust storms, sea salt, volcanic ash, pollen, forest-fire smoke.
- **Anthropogenic (Human-made) Aerosols** – Sulfates, nitrates, black carbon (soot), fly ash, industrial emissions, vehicular exhaust, biomass burning.

- **Major Sources**
- Fossil fuel combustion in power plants and industries.
- Vehicular emissions.
- Crop residue burning and biomass combustion.
- Construction activities and road dust.
- Mining and quarrying operations.
- Natural events such as volcanic eruptions and dust storms.
- Environmental and Health Impacts:
- Cause respiratory and cardiovascular diseases.
- Reduce visibility, leading to smog formation.
- Influence cloud formation and precipitation patterns.
- Alter Earth's radiation balance.

India vs China analysis –

- **Absolute Energy Loss (2023) -** China experienced the highest absolute loss globally at 61.3 TWh due to its massive overall solar capacity, while India lost approximately 15 TWh
- **Fractional loss -** India faced a higher efficiency impact with a 9.6% reduction in its total solar generation potential, compared to China's lower fractional loss of 7.7%.
- **Share of loss -** China alone accounted for 54.9% of all aerosol-related solar energy losses worldwide, whereas India's share remained highly significant but smaller in absolute volume.
- **2013 -2023 Pollution data-** India’s aerosol-induced solar production losses remained stagnant and flat with no reduction. In contrast, China successfully decreased its losses by roughly 1.4% annually through aggressive power plant retrofits.

Reference

[The Hindu| Air pollution and Solar Power Generation]