Secondary Pollutants

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Why in news: Recent analysis by the **Centre for Research on Energy and Clean Air (CREA)** shows that **secondary pollutants contribute nearly one-third of Delhi's annual PM2.5 load**, highlighting their growing role in urban air pollution.

What Are Secondary Pollutants?

Definition: Pollutants **not emitted directly** from a source but **formed in the atmosphere** through chemical reactions of **primary pollutants** under the influence of sunlight, humidity, temperature, and stagnation.

Unlike primary pollutants, they **accumulate over time** and often affect regions **downwind** from the emission source, making their control more challenging.

Major Secondary Pollutants

1**Secondary Particulate Matter (PM2.5):** Ammonium sulfate, ammonium nitrate.

2**Ozone (O?):** Formed from **nitrogen oxides (NOx)** and **volatile organic compounds (VOCs)** under sunlight.

3**Acids:** Sulfuric acid (H?SO?) and nitric acid (HNO?) – contributors to **acid rain**.

4**Photochemical smog components:** Peroxyacetyl nitrates (PANs), nitrogen dioxide (NO?).

Formation Mechanism

1**Emission of precursor gases:**

o**SO?:** Coal-fired power plants, refineries.

o**NOx:** Vehicles, power plants.

o**Ammonia (NH?):** Fertiliser use, livestock, sewage.

2**Atmospheric transformation:**

oSO? oxidises ? sulfate ? reacts with NH? ? ammonium sulfate.

oNOx oxidises ? nitric acid ? reacts with NH? ? ammonium nitrate.

3**Favourable meteorological conditions:**

oHigh humidity, fog, low temperatures, low wind speeds (typical in winter) accelerate secondary particle formation, leading to **sudden PM2.5 spikes**.

Implications

Regional and Transboundary Impact: Secondary aerosols can travel **hundreds of kilometres**, so Delhi's air quality is affected by emissions from **coal-dominated states beyond NCR**.

Winter Smog: Stagnant, moist winter conditions cause severe PM2.5 buildup even when local emissions are controlled.

Policy Blind Spots: Controlling **visible PM10 or local sources alone** is insufficient; **precursor gases (SO?, NOx, NH?)** must also be targeted.

Health Risks: Fine secondary particles penetrate deep into lungs, increasing **respiratory, cardiovascular, and chronic health risks**.