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ATMOSPHERE IS EMBEDDED WITH PARTICULATE MATTER TO PRODUCE AIR QUALITY

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ABSTRACT

The real-time Air Quality Index (AQI) in Kolkata is 178 (Unhealthy) as of November 6, 2026, driven primarily by elevated levels of $PM_{2.5}$ and PM_{10}. You can check live regional updates and monitor hourly changes via the Kolkata AQI Dashboard on AQI.in.

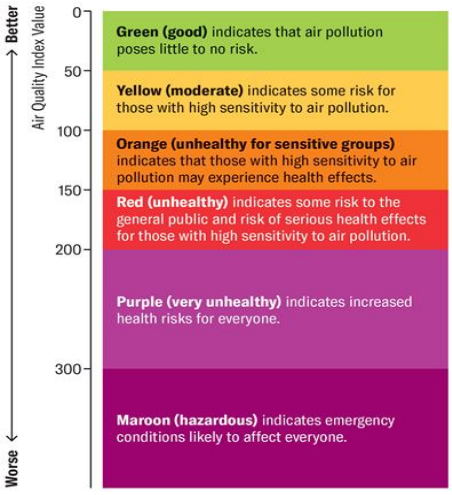
Current Pollutant Breakdown and Status

• AQI Value: 178 (Unhealthy)

• Main Concerns: Particulate matter $PM_{2.5}$ and PM_{10})

• Health Advisory: Sensitive groups (children, elderly individuals, and people with asthma or heart/lung conditions) should limit prolonged or heavy outdoor exertion.

How to Read the Air Quality Index



Air Quality Index

AQI Category and Color	Index Value	Description of Air Quality
Good Green	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Moderate Yellow	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups Orange	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Unhealthy Red	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy Purple	201 to 300	Health alert: The risk of health effects is increased for everyone.
Hazardous Maroon	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

General AQI Reference Scale

• 0 – 50: Good (Green)

• 51 – 100: Moderate (Yellow)

• 101 – 150: Unhealthy for Sensitive Groups (Orange)

• 151 – 200: Unhealthy (Red)

• 201 – 300: Very Unhealthy (Purple)

• 301+: Hazardous (Maroon)

KEYWORDS: AQI, PM, Pollutants, High Risk, Moderate Risk, Very High Risk, Lethal, Volatile Organic Chemical, Biomass, Temperature, Humidity, Graded Response Action Plan, WHO.

Overview: Air quality index (AQI) is an approximation of how polluted the air currently is or how polluted it is forecast to become. As air pollution levels rise, so does the AQI, along with the associated public health risks. Different countries have their own air quality indices, corresponding to different national air quality standards. These include Canada's Air Quality Health Index, Malaysia's Air Pollution Index, and Singapore's Pollutant Standards Index. The World Health Organization has an Air quality guideline. Pollutants that are commonly monitored include ground-level ozone, particulates, sulphur dioxide, carbon monoxide, and nitrogen dioxide.

AQI	Category	Health advice
0–33	Very Good	Enjoy activities
34–66	Good	Enjoy activities
67–99	Fair	People unusually sensitive to air pollution: Plan strenuous outdoor activities when air quality is better
100–149	Poor	Sensitive groups: Cut back or reschedule strenuous outdoor activities
150–200	Very Poor	Sensitive groups: Avoid strenuous outdoor activities Everyone: Cut back or reschedule strenuous outdoor activities
200+	Hazardous/Lethal	Sensitive groups: Avoid all outdoor physical activities Everyone: Significantly cut back on outdoor physical activities

Kolkata currently has an Air Quality Index (AQI) of roughly 173 to 249 (Unhealthy), with fine particulate matter (PM2.5) serving as the primary pollutant.

Current Kolkata Air Quality Overview

- AQI Range: ~173 – 249 (Unhealthy category on US and local indices)
- Primary Pollutants: $PM_{2.5}$ (ranging around 90–106 µg/m³) and PM_{10} (100–120 µg/m³)
- Temperature & Humidity: ~30°C and 49% humidity
- Local Neighbourhood Readings:
- Ballygunge / Bosepukur: ~178 AQI (Unhealthy)
- Dhakuria: ~183 AQI (Unhealthy)
- Government Colony: ~191 AQI (Unhealthy)
- Bidhannagar: ~164 AQI (Unhealthy)

Real-time neighbourhood tracking and data can be checked via the Kolkata Air Quality Index Dashboard or IQAir Kolkata.

Health Recommendations

- Sensitive Groups: Children, elderly individuals, and people with asthma or heart/lung conditions should avoid outdoor exertion and keep windows closed.
- General Public: Limit prolonged or heavy physical exertion outdoors. Consider using a tight-fitting N95 mask if commuting in heavy traffic areas.

The real-time Air Quality Index (AQI) in Kolkata is 173 to 184 (Unhealthy) as of November 5, 2026, with $PM_{2.5}$ and PM_{10} as the primary pollutants.

Table 1: Air quality and health messages.

Health risk	Air quality	Health messages	
		At risk population	General population
Low Risk	1-3	Enjoy your usual outdoor activities	Ideal air quality for outdoor activities
Moderate Risk	4-6	Consider reducing or rescheduling strenuous activities outdoors if you are experiencing symptoms.	No need to modify your usual outdoor activities unless you experience symptoms such as coughing and throat irritation.
High Risk	7-10	Reduce or reschedule strenuous activities outdoors. Children and the elderly should also take it easy.	Consider reducing or rescheduling strenuous activities outdoors if you experience symptoms such as coughing and throat irritation.
Very High Risk	10+	Avoid strenuous activities outdoors. Children and the elderly should also avoid outdoor physical exertion.	Reduce or reschedule strenuous activities outdoors, especially if you experience symptoms such as coughing and throat irritation.

Current Air Quality Breakdown in Kolkata

- AQI Range: ~173–184 (US AQI) / Unhealthy
- Primary Pollutants:
- $PM_{2.5}$: ~89–102 µg/m³
- PM_{10}: ~99–120 µg/m³
- Temperature & Humidity: ~30°C and 49% humidity.

Neighbourhood Readings (US AQI)

- Dhakuria: 183 (Unhealthy)
- Ballygunge & Bosepukur: 178 (Unhealthy)
- Bagan Bari & Cossipore: 175 (Unhealthy)
- Bidhannagar: 164 (Unhealthy)
- Bhowanipore: 168 (Unhealthy)

Health Recommendations

- Sensitive Groups (children, elderly, and people with asthma or heart/lung conditions) should avoid outdoor exertion and stay indoors.
- General Public may begin to experience minor

throat irritation or breathing discomfort during extended outdoor activities.
- Consider wearing an N95 mask if you need to spend time outside in heavy traffic areas.

Most Polluted Major Cities In Country (Real-Time AQI)

According to live global air quality rankings from the IQAir World Air Quality Ranking and AQI.in Live Rankings, cities recording the highest US AQI levels include:

- Bathinda, Punjab, India: 772 (Hazardous)
- Rewari, Haryana, India: 684 (Hazardous)
- Rohtak, Haryana, India: 613 (Hazardous)
- Bhiwani, Haryana, India: 577 (Hazardous)
- Aligarh, Uttar Pradesh, India: 571 (Hazardous)
- Lahore, Pakistan: ~230–238 (Very Unhealthy)
- New Delhi, India: ~445 (Hazardous)

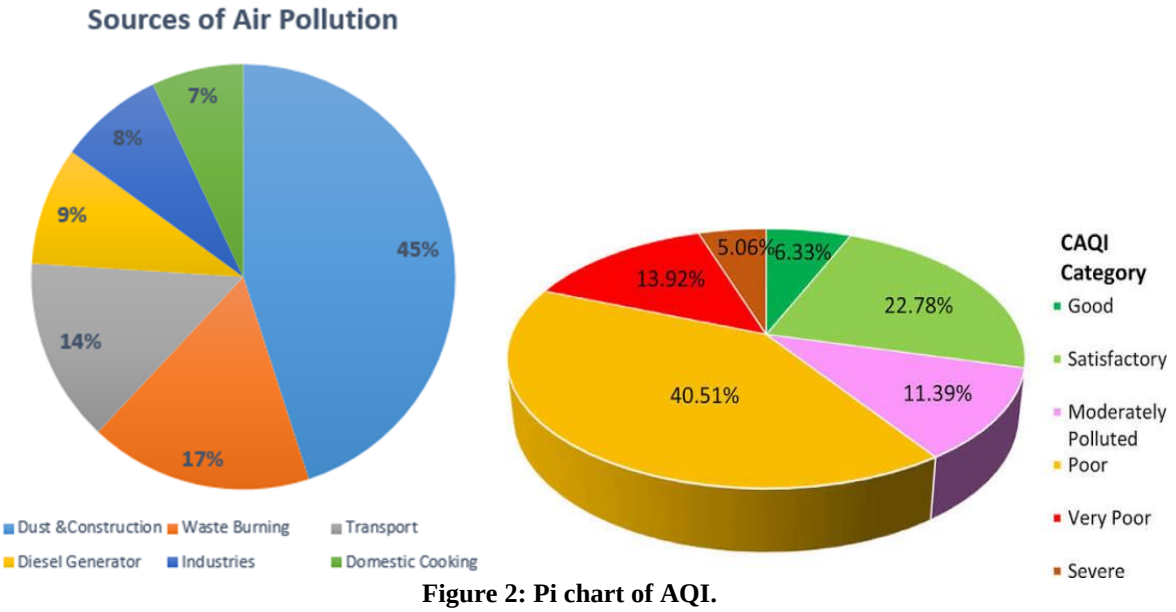


Figure 2: Pi chart of AQI.

Global Overview & Key Pollutants

- Primary Pollutant: Fine particulate matter ($PM_{2.5}$) and PM_{10}) remains the leading.
- Health concern, penetrating deep into the lungs and bloodstream.
- Regional Disparities: South and Central Asia regularly experience the highest regional concentrations, with ambient air pollution exceeding World Health Organization (WHO) safe guidelines for the vast majority of the global population.

According to global environmental and air quality reports (such as IQAir), Iceland and Finland frequently rank at the very top for having the cleanest air in the world.

Countries Meeting Strict WHO Air Quality Standards: Only a small number of countries consistently meet the World Health Organization's (WHO) strict annual guideline for fine particulate matter ($PM_{2.5}$) of 5 μ g/m³ or less:

- Iceland (often recording ($PM_{2.5}$) around 3–4 μ g/m³)
- Finland
- Estonia
- Australia
- New Zealand (around 3.3–4.5 μ g/m³)
- Grenada & Mauritius

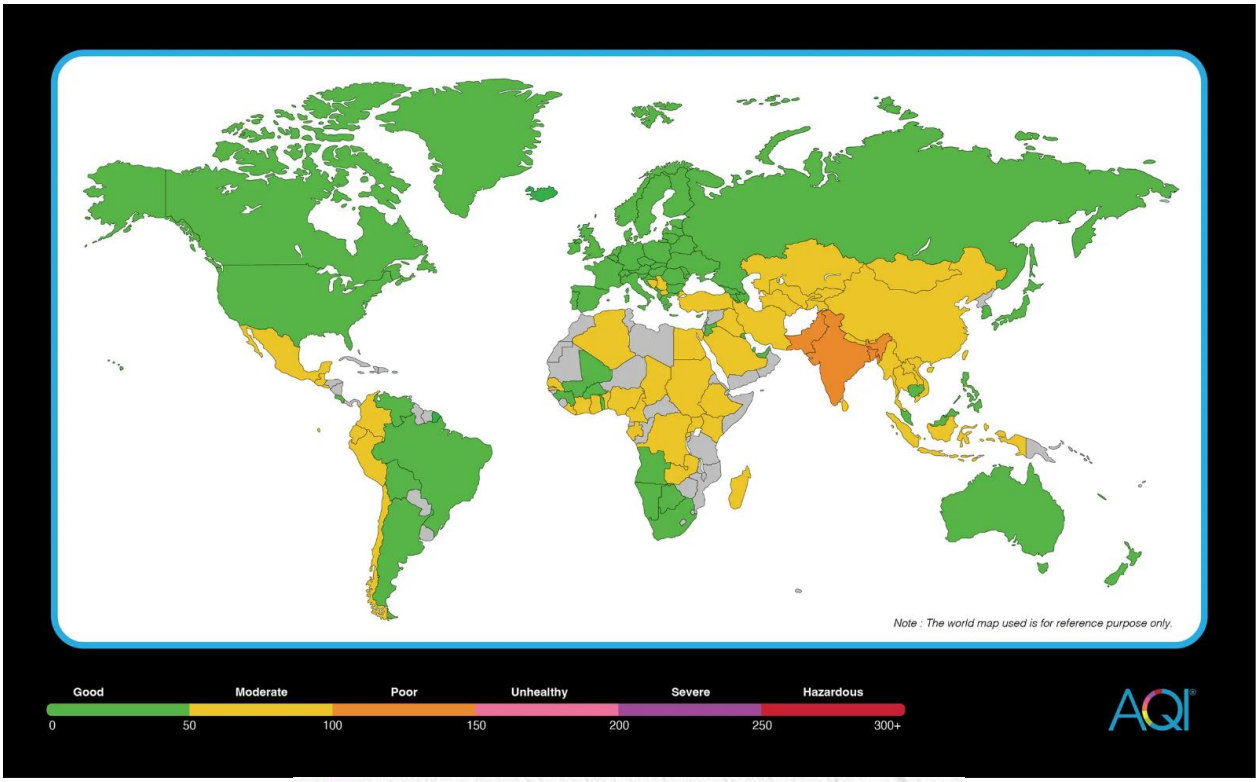
Why These Countries Have the Best Air

- **Low Population & Industrial Density:** Fewer heavy industries and vehicle emissions.
- **Clean & Renewable Energy:** Heavy reliance on geothermal, hydroelectric, and wind power rather than fossil fuels.
- **Geographical Advantages:** Remote locations, strong ocean or coastal winds, and high forest cover that naturally disperse or absorb pollutants.

Pakistan currently ranks as the country with the worst air quality in the world, according to recent global air quality data.

Most Polluted Countries (by Annual Average $PM_{2.5}$ Concentration): According to the latest IQAir World Air Quality Report, the top countries with the highest levels of fine particulate matter $PM_{2.5}$) are:

1. **Pakistan – 67.3 μg/m³ (over 13 times higher than WHO guidelines)**
2. Bangladesh – 66.1 μg/m³
3. Tajikistan – 57.3 μg/m³
4. Chad – 53.6 μg/m³
5. Democratic Republic of the Congo – 50.2 μg/m³
6. India – 48.9 μg/m³ (ranking 6th globally, with major pollution concentrated in northern regions and the Indo-Gangetic Plain)



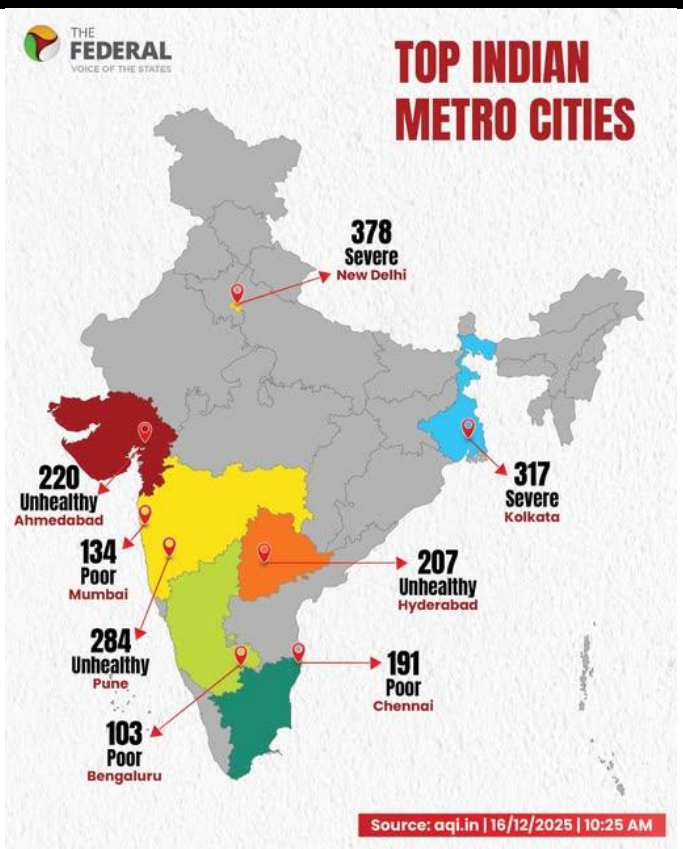


Figure 3: AQI Global View & Country View.

Key Causes of Severe Air Pollution

- **South Asia (Pakistan, Bangladesh, India):** Stubble and crop burning, heavy vehicle emissions, industrial output, brick kilns, and seasonal weather patterns like temperature inversions that trap smog close to the ground.
- **Central and Central-West Africa / Central Asia:** Biomass burning, wood-and-coal-based domestic heating and cooking, and unmonitored industrial extraction. India's poor air quality index (AQI) is driven by a combination of heavy year round human emissions, industrial activity, and seasonal weather

patterns that trap pollution near the ground.

Main Sources of Pollution

1. **Vehicular Emissions:** Growing traffic congestion, older diesel engines, and high volumes of cars and trucks are major contributors to fine particulate matter ($PM_{2.5}$).
2. **Industrial & Power Plants:** Coal-fired thermal power plants, brick kilns, and general industrial manufacturing release massive amounts of sulphur dioxide, nitrogen oxides, and dust.
3. **Dust & Construction:** Unpaved roads and widespread, often unregulated construction and demolition sites generate heavy airborne dust.
4. **Biomass & Household Burning:** In rural and semi-urban areas—and among impoverished urban communities—burning wood, agricultural waste, cow dung, and kerosene for cooking and heating contributes a large share of year-round background pollution.

The Graded Response Action Plan (GRAP) is a set of emergency anti-air pollution measures implemented in the Delhi-NCR region when the Air Quality Index (AQI) crosses specific threshold levels. It is managed by the Commission for Air Quality Management (CAQM).

Stages of GRAP and AQI Thresholds

- Stage I – Poor (AQI 201–300): Focuses on road dust management, mechanical sweeping, water sprinkling, strict enforcement of PUC (Pollution Under Control) certificates, and banning open waste burning.
- Stage II – Very Poor (AQI 301–400): Adds restrictions on diesel generators, increases parking fees to discourage private vehicle use, intensifies anti-smog gun deployment, and restricts non-BS6 vehicle operations.
- Stage III – Severe (AQI 401–450): Imposes strict bans on non-essential construction and demolition activities, halts mining, and may discontinue physical classes for primary school students.
- Stage IV – Severe + (AQI > 450): Enforces a ban on the entry of truck traffic and LCVs registered outside Delhi (except for essential goods/services), allows work-from-home provisions, and may order the closure of schools and non-emergency commercial operations.

4 Nov 2026 — As Delhi's average Air Quality Index (AQI) deteriorated to “very poor” category (reaching 324), the Commission for Air Quality Management.

GRAP Stage-I Implemented in Delhi

GRAP stage-I implemented in Delhi-NCR (Oct 2026) GRAP Stage-I Implemented in Delhi-NCR with Immediate Effect Due to worsening air.

Definition: GRAP is Delhi-NCR's Graded Response Action Plan administered by the CAQM, escalating via forecasts based on CPCB air quality categories.

Graded Response Action Plan (GRAP): The plan was developed by the Environment Pollution (Prevention and Control) Authority (EPCA).

Air pollution is the presence or release of chemical, physical, or biological agents—such as gases, smoke, dust, and tiny particles—into the indoor or outdoor atmosphere that modify its natural characteristics and harm human health, living organisms, or the environment.

Pollution Definition “Air Pollution is the release of pollutants such as gases, particles, biological molecules, etc. into the air that is harmful to human. A Brief Guide to Atmospheric Pollutants - Compound Interest. Air pollutants are any chemical, physical, or biological substances that contaminate the indoor or outdoor atmosphere and cause harm to human health, animals, plants, or the environment.

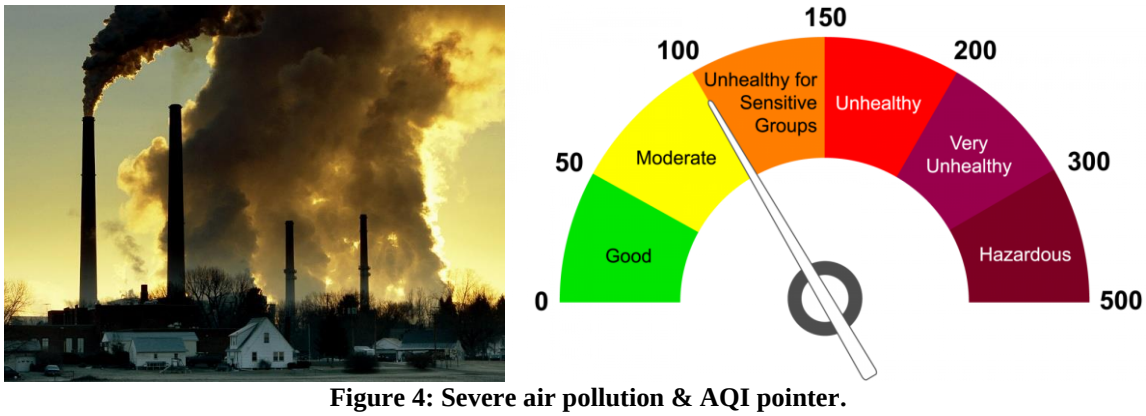


Figure 4: Severe air pollution & AQI pointer.

Key Types of Pollutants

Primary Pollutants: Substances emitted directly into the air from a source, such as carbon monoxide from car exhaust or sulphur dioxide from coal burning. Primary pollutants are emitted directly into the atmosphere from specific sources, such as vehicle exhausts, factory smokestacks, or wildfires.

- ✓ **Particulate Matter ($PM_{2.5}$ & PM_{10}):** Tiny solid or liquid particles like dust, soot, and smoke that can penetrate deep into the lungs. Tiny solid or liquid

droplets suspended in the air that can penetrate deep into the lungs. Tiny solid or liquid particles like dust, soot, and smoke that can penetrate deep into the lungs.

- ✓ **Carbon Monoxide (CO):** A colourless, odourless gas produced by the incomplete combustion of carbon-in-fuel (from cars, trucks, and heaters).
- ✓ **Sulphur Dioxide (SO_2):** A pungent gas released primarily from burning fossil fuels like coal and oil in power plants.
- ✓ **Nitrogen Oxides (NO):** Gases produced from high-temperature fuel combustion in vehicles and industrial machinery.
- ✓ **Organic chemicals (like benzene or toluene)** that vaporize into the air from paints, solvents, and fuels.
- ✓ **Particulate Matter (PM_{10}):** Organic chemicals (like benzene or toluene) that vaporize into the air from paints, solvents, and fuels.

Secondary Pollutants: Harmful substances formed when primary pollutants react with one another or natural components in the atmosphere, such as ground-level ozone. Secondary pollutants are not emitted directly. Instead, they form when primary pollutants undergo chemical reactions with one another or with natural atmospheric components. (Often triggered by sunlight).

Ground-Level Ozone (O_3): Formed when sunlight reacts with nitrogen oxides (NO) and VOCs; a major component of smog.

Smog: A hazy mixture of smoke, fog, and secondary pollutants that reduces visibility and irritates the respiratory system.

Acid Rain: Formed when sulphur dioxide (SO_2) and nitrogen oxides (NO) mix with water vapour and oxygen in the atmosphere, damaging forests and aquatic life.

Major Sources

- ❖ **Human-Made (Anthropogenic):** Burning fossil fuels for electricity and transportation, industrial manufacturing, waste incineration, and agricultural activities.
- ❖ **Indoor Sources:** Cooking and heating with open fires or simple stoves fuelled by biomass, kerosene, or coal, alongside household chemicals and building materials.
- ❖ **Natural Sources:** Wildfires, volcanic eruptions, and windblown dust.
- ❖ **Human Health:** Exposure is linked to respiratory infections, asthma, heart disease, lung cancer, and strokes. According to the World Health Organization (WHO), nearly the entire global population breathes air that exceeds safe guideline limits.
- ❖ **Environmental Impact:** Contributes to smog, acid rain, damage to crops and forests, and global climate change.

Remedy for AQI

To protect your health and reduce personal exposure when the Air Quality Index (AQI) is high, use a combination of indoor purification, personal protection, and lifestyle adjustments.

Indoor Protection

- **Run a HEPA Air Purifier:** Place a true HEPA air purifier in the rooms where you spend the most time, especially the bedroom overnight, to capture fine PM2.5 particles.
- **Seal Windows and Doors:** Keep windows and doors tightly shut during high-pollution hours (typically late morning and early evening rush hours).
- **Avoid Indoor Pollutants:** Do not light candles, burn incense, smoke, or use dry sweeping (which kicks up settled dust); use wet mopping instead.
- **Add Air-Cleaning Plants:** Incorporate NASA-recommended houseplants like Snake Plants, Spider Plants, or Peace Lilies to help naturally support cleaner indoor air.

Personal Protection Outdoors

- **Wear an N95 or N99 Mask:** If you must go outside during poor air quality, use a properly fitted N95 or N99 respirator mask rather than a cloth or surgical mask, which do not filter fine particulate matter.
- **Skip Outdoor Workouts:** Avoid running, cycling, or exercising outdoors when AQI is high, as heavy breathing forces you to pull deep volumes of toxic particulate matter into your lungs.
- **Monitor Local Forecasts:** Check real-time tools like AQI.in or AirNow.gov before planning outdoor activities.

Health & Hydration Support

- **Stay Hydrated:** Drink plenty of water throughout the day to help your respiratory tract stay moist and clear out irritants naturally.
- **Eat Antioxidant-Rich Foods:** Include foods high in Vitamin C, Vitamin E, and beta-carotene (such as citrus fruits, leafy greens, and turmeric) to help combat oxidative stress from pollution.
- **Watch Vulnerable Groups Closely:** Pay extra attention to children, older adults, pregnant women, and anyone with asthma, COPD, or heart conditions, as they face the fastest and most severe health impacts.

CONCLUSION

Organizations like the U.S. Environmental Protection Agency track criteria air pollutants (particulate matter, ground-level ozone, carbon monoxide, sulphur dioxide, nitrogen dioxide, and lead), while global guidelines are established by the World Health Organization to combat widespread health risks like respiratory disease, heart conditions, and climate change. The primary human-made and natural sources of air pollution stem from combustion, industrial production, and land use.

The 7 Major Causes of Air Pollution

1. Vehicle and Transportation Emissions: Cars, trucks, buses, and aircraft burn petroleum, gasoline, and diesel. They release carbon monoxide (CO), nitrogen oxides (NO), volatile organic compounds (VOCs), and fine particulate matter that create smog.

2. Industrial Activities and Factories: Manufacturing plants, chemical processing facilities, and oil refineries release heavy smoke, sulphur dioxide (SO_2), carbon dioxide (CO_2), and toxic chemicals. Tall smokestacks and unmanaged waste pipelines scatter these contaminants across wide regions.

3. Fossil Fuel Power Generation: Burning coal, oil, and natural gas to generate electricity is a leading global source of greenhouse gases and sulphur emissions. Coal-fired power plants heavily discharge soot and sulphur dioxide, contributing to acid rain and respiratory illnesses.

4. Agricultural Operations: Livestock production, animal waste, and the use of chemical fertilizers and pesticides release massive amounts of ammonia (NH_3) and methane (CH_4).
Open field burning of crop residues adds thick smoke and particulate matter (PM) to the lower atmosphere.

5. Waste Disposal and Landfills: Decomposing organic waste in landfills generates methane gas and carbon monoxide.
Open burning of household and municipal garbage releases toxic fumes, dioxins, and fine soot directly into neighbourhoods.

6. Residential and Commercial Combustion: Burning wood, coal, or oil for indoor heating and cooking releases smoke, particulate matter, and carbon monoxide. Household products like paints, chemical solvents, varnishes, and aerosol sprays leak volatile organic compounds (VOCs) into both indoor and outdoor air.

7. Natural Events (Wildfires and Volcanic Eruptions): Uncontrolled forest and wildfires release dense plumes of smoke, carbon dioxide, and fine particulates across continents. Volcanic eruptions inject large volumes of ash, sulphur dioxide, and toxic gases straight into the stratosphere.

Current Air Quality Index (AQI) levels across major Indian cities show severe pollution spikes, particularly in northern India and urban centres:

- Kolkata: ~185–191 (Unhealthy / Moderate-to-Poor category)
- Delhi / New Delhi: ~361 to 391 (Very Poor to near-Severe, with peaks over 450–475 in specific areas like Rohini and IIT Delhi)
- Mumbai: ~169 (Unhealthy / Moderate-to-Poor category)
- Greater Noida / Gurugram: Exceeding 520–780 (Hazardous levels)
- Hyderabad: ~110 (Poor / Unhealthy for sensitive groups)
- Chennai: ~131 (Poor)
- Bengaluru: ~74 (Moderate)

Key Factors Contributing to Current Levels

- Seasonal Stubble Burning: Agricultural burning in northern states like Punjab, Haryana, and Uttar Pradesh significantly contributes to regional smog.
- Weather & Low Winds: Cooler temperatures, low wind speeds, and mist trap pollutants close to the ground.
- Pre-Diwali Emissions: Vehicular traffic, construction dust, and early firecracker use have escalated $PM_{2.5}$ and PM_{10} concentrations. During **Diwali**, India's Air Quality Index (AQI) typically plummets into the "very poor" (301–400) or "severe" (401–500) categories, particularly across northern India and the National Capital Region (NCR).

Current Situation in Delhi-NCR (Diwali 2026)

- Delhi AQI Levels: Ahead of Diwali, Delhi's overall AQI has hovered around 364 to 389 (classified as "very poor"), with specific areas like IIT Delhi (443), Punjabi Bagh (433), and Narela (409) crossing into the "severe" band.
- GRAP Restrictions: Authorities have invoked Stage-III GRAP (Graded Response Action Plan) measures across Delhi-NCR, which restrict certain vehicles, halt construction and demolition activities, and increase enforcement against open burning.
- Contributing Factors: The spike is compounded by winter temperature inversions, slow wind speeds, and crop-residue (stubble) burning in neighbouring states like Punjab and Haryana, which mix with emissions from Diwali firecrackers.

Status in Other Major Indian Cities

- Mumbai: Financial hub Mumbai has experienced fluctuating air quality, with recent pre-Diwali spikes reaching the "very poor" range earlier in the season before settling into moderate or satisfactory levels, though local authorities remain on high alert for firecracker emissions.
- Kolkata & Eastern India: Cities like Kolkata often see moderate pre-Diwali AQI levels that experience temporary localized spikes on Diwali night and the following morning due to firecracker use before gradually dispersing.

During **Holi**, air quality in parts of India can experience sharp localized spikes—often related to wood burning from *Holika Dahan* and residual dust or particulate matter—though levels generally vary significantly by city compared to winter festival peaks like Diwali.

- Bhopal: Following *Holika Dahan*, the air quality index (AQI) spiked to nearly 300 (poor category), tripling from 85 just a few days prior, according to

reports covered by The Times of India.

- Delhi / National Capital Region: During past spring Holi periods, weather conditions have occasionally favoured better dispersion than winter months, with Delhi recording "satisfactory" air quality around 85 during mid-March windows as reported by First post, though local smoke and particulate spikes can still occur.

During **Durga Puja** in India (particularly in hubs like Kolkata), air quality often shows a unique trend: AQI tends to improve or remain moderate during the festival days due to strict traffic management, vehicle bans around pandals, and pedestrian movement, before backsliding and deteriorating rapidly once the celebrations end and winter sets in.

Key AQI Trends during Durga Puja

- Pandal Days / Festival Period: Controlled vehicle movement, restrictions on goods/private traffic near major pandals, and people walking instead of driving often help keep daily mean AQI in the satisfactory to moderate range (dropping to levels like 44–74 on key days depending on weather and rain).
- Other Cities: In regions like Ranchi or industrial/urban hubs, local vehicular pressure from festival crowds can push AQI higher into the 140–160+ (moderate to unhealthy) range.
- Post-Puja Spike: Once traffic restrictions are lifted and cooler winter air begins trapping ground-level smoke and particulate matter $PM_{2.5}$ and PM_{10}), the AQI quickly climbs back into the poor and unhealthy categories.

REFERENCE

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