F.No. B-110021/18/Sc-01/2020/CAQM

COMMISSION FOR AIR QUALITY MANAGEMENT IN NATIONAL CAPITAL REGION AND ADJOINING AREAS

17th Floor, Jawahar Vyapar Bhawan,
Tolstoy Marg, New Dethi-110001

Dated: 19th January, 2026

NOTICE

Subject: Seeking suggestions regarding additional actions that could be taken to address issues identified in the Report of the Air Quality Experts on "Identification of the causes for worsening AQI in Delhi-NCR"

Pursuant to the Hon'ble Supreme Court's order dated 06.01.2026 in Writ Petition (Civil) No. 1135/2020 in the matter of "M.C. Mehta Vs. Union of India & Ors.", a panel of identified domain experts deliberated in detail to identify the causes of worsening AQI. The experts unanimously finalised a Report on "Identification of the causes for worsening AQI in Delhi-NCR".

2. The CAQM invites the general public to share their suggestions, if any, regarding the Report of the Air Quality Experts on "Identification of the causes for worsening AQI in Delhi-NCR". Suggestions may be submitted to the CAQM, latest by **10.02.2026**, through following mode:

i. Preferably through email : **preeti.gunwani@gov.in**

OR

ii. By post : Commission for Air Quality Management, 17th Floor, Jawahar Vyapar Bhawan, Tolstoy Marg, New Dethi-110001.

19/1/26

(Preeti Gunwani)
Scientist D, CAQM

Report of the Air Quality Experts

on

Identification of the causes for worsening AQI in Delhi-NCR

CAQM

Commission for Air Quality Management in NCR and Adjoining Areas

January, 2026

Contents

1. Context

The Hon'ble Supreme Court, vide its order dated 06.01.2026 in WP(C) No. 13029 of 1985 (M.C. Mehta vs. Union of India & Ors.), observed that the Commission for Air Quality Management (CAQM), as the statutory expert body, is primarily obligated to bring domain experts under a single platform to seek a uniform and unanimous opinion on the causes of deteriorating air quality.

The Hon'ble Court noted that this exercise should not be time-consuming, as expert bodies such as the IITs and other agencies have already undertaken the necessary research. By sharing these findings and collating data, CAQM can form a comprehensive understanding of the actual causes and the proportional attribution of each source. Consequently, the Hon'ble Supreme Court directed as follows:

> *"...Let a meeting of the experts, as may be shortlisted by CAQM, be convened within two weeks and based upon their continuous deliberations, a report regarding the major causes of worsening AQI be brought on record as well as in the public domain. Such an exercise must be completed before the next date of hearing...."*

In pursuance of these directions, the Commission shortlisted a panel of experts [as listed in Annexure I] for the identification of causes and the attribution of various pollution sources. This has brought together the domain experts from IITs, academia, research institutes, NGOs and other reputed institutes to provide a unified scientific assessment.

A series of meetings of the Experts, coordinated by a full-time independent Technical Member, CAQM, were held on **08.01.2026, 09.01.2026, 12.01.2026, and 13.01.2026**. The deliberations focused on the following key questions:

1. What are the primary causes for the worsening AQI in Delhi-NCR?
2. What are the major sources of pollution, and what is their sectoral origin?

To expedite this process, the Experts have:

i). Shared, integrated, and analysed existing research and data from various research papers and technical reports to form a 'broad idea' and a unanimous opinion;

ii). Deliberated to identify and validate the specific causes leading to the worsening of the Air Quality Index (AQI) in the Delhi-NCR; and

iii). Estimated the proportional contribution of various pollution sources. A meta-analysis was conducted to reach a consensus on the air pollution contributing sectors to the deterioration of air quality in the Delhi-NCR region.

As per the directive of the Hon'ble Supreme Court, the findings are to be placed in the public domain. Efforts have been made to complete the deliberations and submit the findings within the two-week window stipulated by the Hon'ble Supreme Court (prior to the next hearing).

2. Rationale and Guiding Principles

While conducting the meta-analysis, the primary focus has been to bring a uniform and unanimous opinion on air pollution sources to help bridge the gap between existing data and actionable policies. As several studies with diverse methodologies exist, the Experts collated, aligned and systematically analysed the data to understand the dominant causes and the proportional contribution of each source to effectively target interventions. This has addressed the seasonal trends and patterns in prominence of air pollution sources while recognising the influence of dynamic meteorology and atmospheric conditions through different seasons. It has been recognised that Delhi and NCR's air quality is influenced by both local sources as well as the transboundary effect of regional movement of pollution across the airshed. Recognising $PM_{2.5}$ as the prominent pollutant that determines the AQI of Delhi, the studies conducted between 2015 and 2025 have been considered for the meta-analysis, and no single report has been relied upon.

The rationale for this selection includes:

i). **Reconciling variations:** Different studies often show different results due to varying time periods, different locations, different chemical constituents analysed, and different modelling assumptions. A meta-analysis estimates contributions with reasonable confidence by accounting for these differences.

ii). **Reflecting policy interventions:** Source contributions change over time due to new interventions in the sectors. Selecting studies from the last few years ensures the data reflects the impact of these recent interventions.

iii). **Data reliability:** The selection was limited to studies from experts and peer reviewed publications to ensure the technical integrity of the findings.

This review has recognised the limitations of the studies that may make direct comparison complex. Different studies employ varying methodologies (receptor-based, dispersion-based, or hybrid approaches), sampling strategies, analytical techniques, and modelling frameworks. They are often conducted in different time periods, at different locations, and under varying meteorological conditions. In addition, assumptions related to emission inventories, chemical profiles, source classification, and boundary conditions vary across studies. While such variability in reported source contributions is scientifically expected and does not undermine the validity of individual studies, it limits the direct comparability of results unless the underlying reports, assumptions, and methodological frameworks are carefully examined. Spatial and temporal heterogeneity in emissions, atmospheric chemistry, and transport and removal processes further contribute to observed differences. Availability of studies is also uneven in the region, with most of them focusing on Delhi. As the indicative numbers for the larger NCR are sparse, the meta-analysis is based on the studies carried out for Delhi. The analysis has recognised the importance of both primary emissions (that are emitted directly from the sources (from the tailpipe of vehicles, industrial stacks, open burning, etc.) as well as the secondary particulates that are formed from chemical reactions of gases emitted by the primary anthropogenic combustion and natural sources, in the atmosphere. This analysis will also help sensitise the general public about the dominant pollution sources and reasons for high levels of air pollution in Delhi-NCR. Therefore, the meta-analysis has created a range of estimates for each source and considered the median of the results to provide an indicative estimate for each source. These results may be considered as indicative and not absolute.

3. Trends in Air Quality

As this exercise is premised on the context of high levels of air pollution in the region, it is therefore prudent to understand the air quality trends as well as the changes in the daily AQI and prominent pollutants over time.

3.1 Trends in $PM_{2.5}$ and PM_{10} in Delhi

A gradual decline and stable trends are noted in both $PM_{2.5}$ and PM_{10} concentrations in Delhi since 2016, despite increasing population and rapid urbanisation, however there is still a huge gap to meet the annual NAAQS, as indicated in Figure 1 and Figure 2.

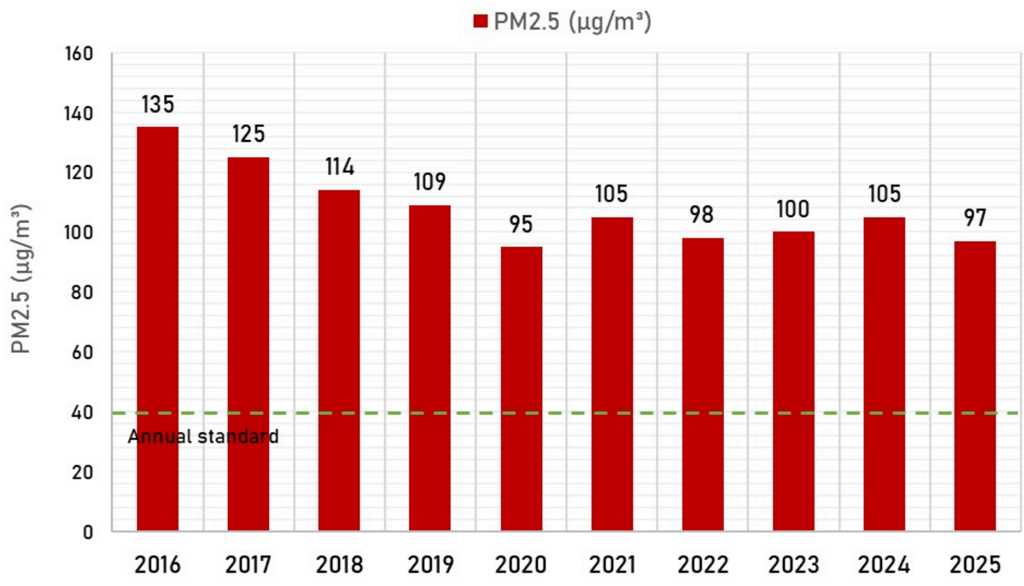

Figure 1: Trend in annual $PM_{2.5}$ concentration in Delhi (from 2016 to 2025)

Source: Central Pollution Control Board

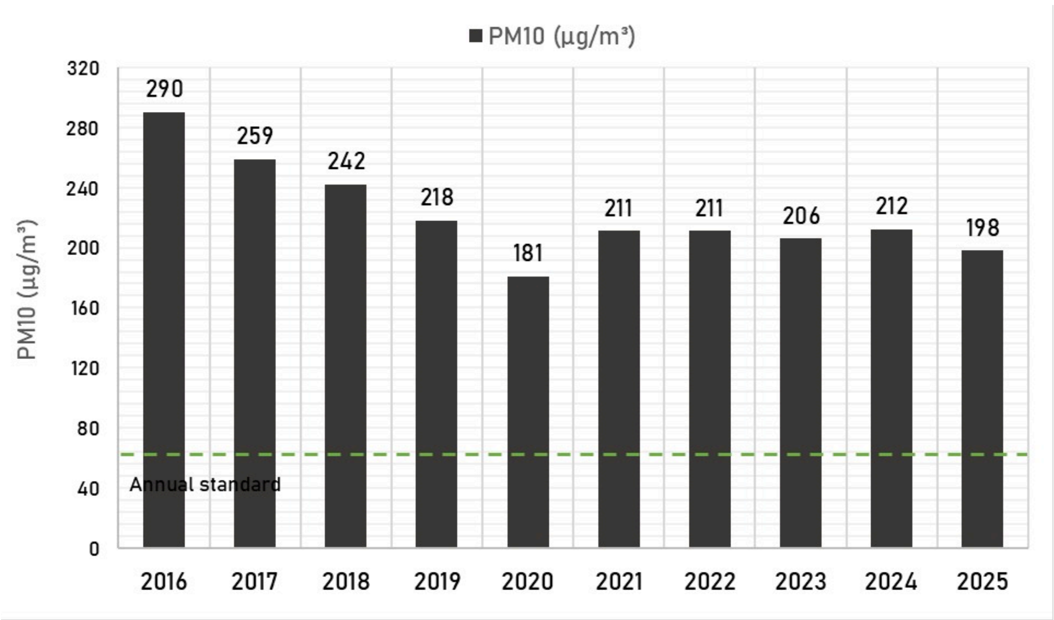

Figure 2: Trend in annual PM_{10} concentration in Delhi (from 2016 to 2025).

Data Source: Central Pollution Control Board

The Delhi-NCR region, as a critical hotspot within the densely populated IGP, faces persistent and extreme air pollution levels due to a combination of rapid urbanisation, fossil fuel dependence, unsustainable behavioural patterns, and geographical traps. During winter, these factors are compounded by meteorological conditions such as low wind speeds and frequent temperature inversions that prevent the dispersion of pollutants, creating a major regional airshed crisis, leading to frequent smog and severe pollution episodes.

The IGP covers only ~18 % of India's land but accommodates ~40 % of its population. This region is estimated to emit ~35 % of India's total emissions, making it an emission hotspot. Rapid urbanisation and lack of public transport/ last-mile connectivity have led to an over-reliance on private vehicles. The use of fossil fuels for various applications drives high emission levels. Construction and Demolition (C&D) activities, including massive infrastructure projects and industrial activities, contribute significantly to ambient dust and debris. Seasonal crop residue burning in adjoining states, combined with local biomass and municipal solid waste (MSW) burning for heating, adds a massive pollutant load during winter. The continuous urban sprawl across the NCR creates a massive, uninterrupted area of high emissions. It is estimated that around two-thirds of the $PM_{2.5}$ in Delhi is contributed by the sources outside Delhi, i.e. NCR districts and outside NCR, including transboundary and around one-third is contributed from the sources within Delhi.

3.2 Seasonality of Air Quality Index and its Trend

The Air Quality Index (AQI) is a tool for the public that communicates to the public how clean or unhealthy the air is at any given moment, making it easy for the general public to understand complex pollution data in terms of numbers and colour codes indicating air quality from Good to Severe category. The AQI is calculated by measuring eight major pollutants (with a minimum of three pollutants) and is determined by the "worst" pollutant of the day, which, for most parts of the year, is $PM_{2.5}$ in Delhi and NCR. This alert is provided on a daily basis to the public. The daily AQI since 2018, depicted in **Figure 3** indicates the seasonality of the high and low index. This visualisation of data shows worsening of the AQI during winter when it reaches very poor and severe categories. Such days are also observed sometimes during summer, but those are far fewer in number. Most of the days during other seasons are in moderate to poor levels. Only monsoon months record days with good to satisfactory levels.

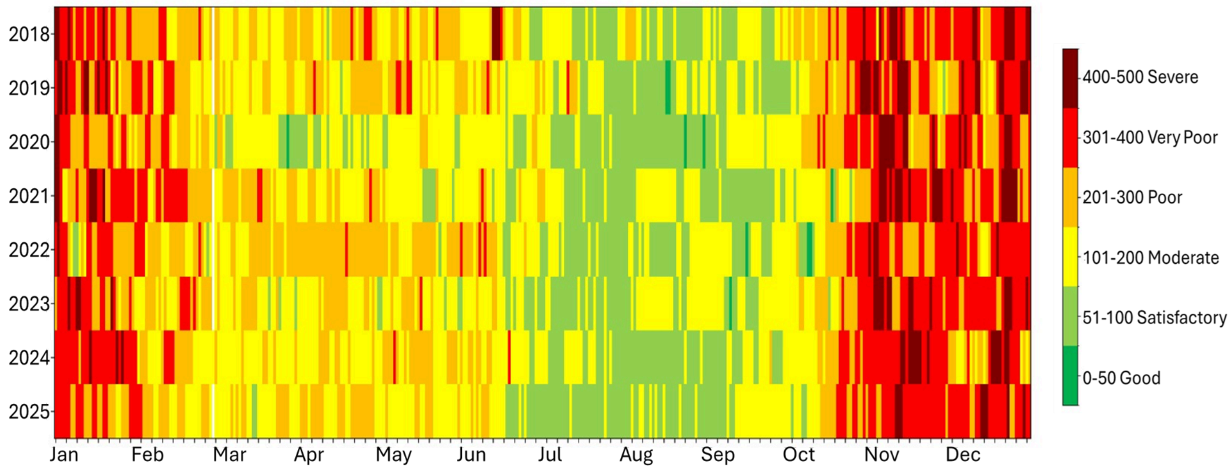

Figure 3: Heatmap: Visualisation of the daily AQI data (2018-2025)
Data source: Central Pollution Control Board

This variability is due to the impact of meteorology and atmospheric conditions, especially during winter **(see box: Why does Air Pollution Intensify during Winter in Delhi-NCR)**. The pollution levels peak during winter, not because of an increase in pollution sources but largely due to atmospheric stagnation, which traps pollutants in the region. However, to prevent such winter peaks, it is necessary to reduce the round-the-year emissions in the region.

The analysis of daily AQI between 2018 and 2025 shows that:

i). Days in the Good to Moderate category show an overall improvement over time, increasing from 159 days in 2018 to about 200 days in 2025.

ii). Poor to Very Poor days declined from 186 days in 2018 to 157 days in 2025.

iii). Severe and Severe+ days reduced substantially from 20 days in 2018 to 8 days in 2025.

The analysis has highlighted the changes in the distribution of days with different categories of AQI since 2018. It shows that the number of days with better AQI has increased over time.

Why does Air pollution intensify during winter in Delhi-NCR?

The intensification of winter air pollution in Delhi arises not from a sudden increase in emissions alone, but from the synergistic effects of sustained emissions, regional transport of pollutants, and unfavourable meteorological conditions of the Indo-Gangetic Plain.

The winter pollution episode in Delhi-NCR can be broadly divided into two phases. The first phase typically occurs from mid-October to November and is largely associated with emissions from agricultural residue burning in neighbouring states, along with decreasing wind speed and shallow planetary boundary layer (PBL) height. Pollutants generated from these activities are transported over long distances and contribute substantially to elevated particulate concentrations across the IGP, including Delhi.

The second phase generally extends from December to January and is dominated by extremely adverse meteorological conditions. Very low wind speeds, shallow mixing layers, persistent fog, and reduced solar radiation severely limit atmospheric dispersion and enhanced secondary aerosol formation. Although emission sources remain relatively constant during this period, except for increased biomass burning for heating, the reduced atmospheric dispersion capacity leads to a pronounced buildup of pollutants, resulting in persistently poor air quality.

The atmospheric chemistry within the IGP airshed significantly amplifies particulate pollution through secondary aerosol formation. SO_2 emissions (primarily from coal combustion and brick kilns) undergo oxidation on aerosol surfaces and gas-phase reactions with OH radicals, forming sulfuric acid (H_2SO_4). Further, NO_x emissions undergo photochemical and nocturnal oxidation to form nitric acid (HNO_3). Both H_2SO_4 and HNO_3 react with ammonia (NH_3) from agricultural activities and human/animal excreta to form ammonium sulfate and ammonium nitrate aerosols. In a similar way, ammonium chloride can also form, which stays in the atmosphere for a longer time. These acids can also react with dust and form a layer of corresponding salts on the dust particles. Volatile organic compounds (VOCs) from vehicular emissions, biomass burning, industries and vegetation undergo oxidation to form Secondary Organic Aerosol (SOA).

Winter meteorology significantly restricts pollutant dispersion and often favours secondary aerosol formation. Calm wind conditions, reduced atmospheric mixing height, low temperatures, frequent fog formation, and diminished solar radiation collectively inhibit vertical and horizontal dilution of pollutants. These conditions promote the accumulation and persistence of particulates and gaseous pollutants near the surface.

3.3. Seasonality of Pollution and Meteorology

Air quality in Delhi-NCR is also governed by a recurring seasonal cycle of meteorological parameters. The city's highest pollution levels are systematically linked to "stagnant" winter conditions, while the monsoon and pre-monsoon periods offer natural relief through dispersion and wet removal. The temperatures peak in May and June. Rainfall is minimal from January to May, peaks sharply in July and August, and drops rapidly after September.

Wind speed and planetary boundary layer height move in tandem. They reach their maximum in May and June, facilitating atmospheric mixing, and gradually decline to their lowest values during winter. Trends of the meteorological parameters are depicted in **Figure 4**. The seasonal degradation of air quality in Delhi is a result of the Planetary Boundary Layer (PBL) height and wind speed acting as a "lid." When these are high (Summer/Monsoon), pollutants are ventilated fast; when they are low (Winter), pollutants are trapped close to the ground and disperse very slowly **(see box: Why Air Pollution Intensifies during Winter in Delhi-NCR).** Seasonal breakdown of air quality drivers is presented in **Table 1**.

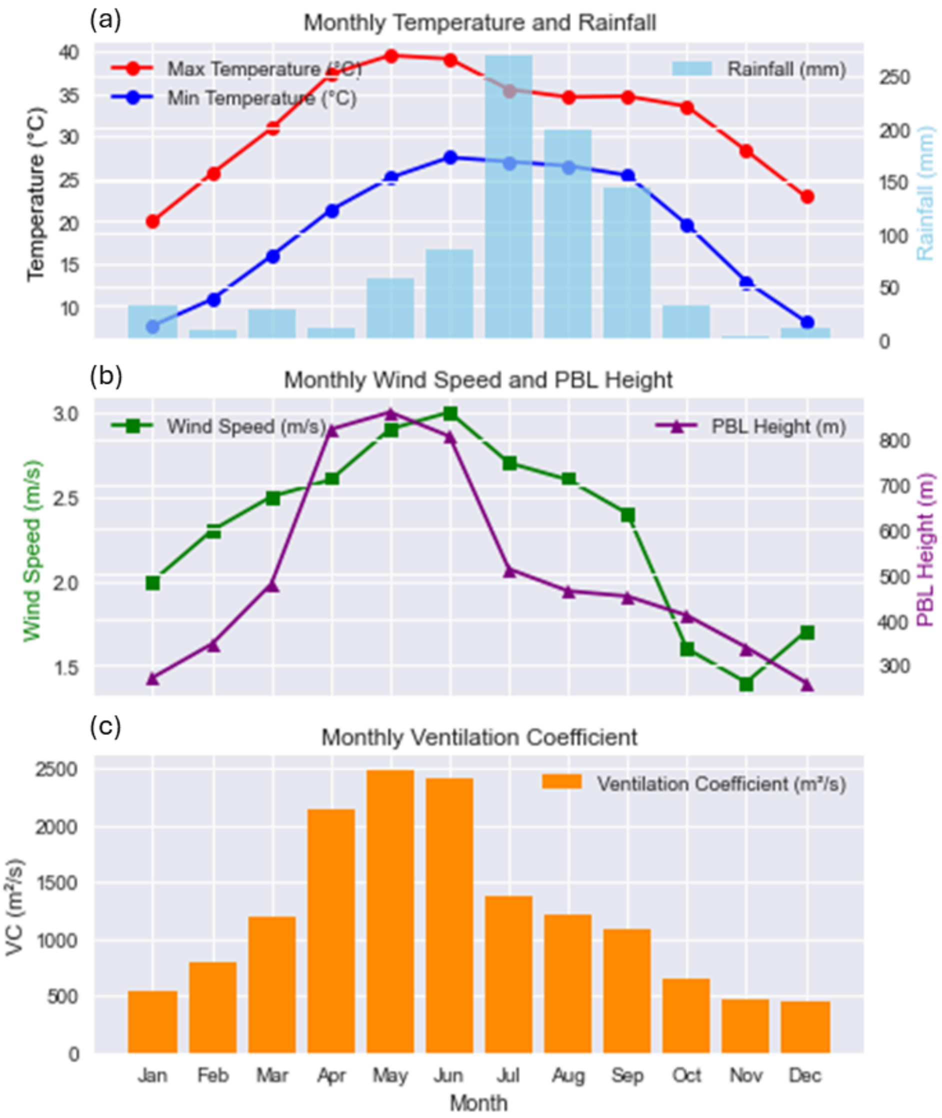

Figure 4. Meteorological Trends (2015–2025) *(a) monthly average of maximum temperature (red), Minimum temperature (Blue) and Rainfall (Bar Chart) from 2015 to 2025. (b) shows the monthly average of wind speed (Green) and Planetary boundary layer height (maroon) over Delhi from 2015 to 2025, and (c) represents the ventilation coefficient. (Data Source: IMD)*

Table 1: Seasonal Breakdown of Air Quality Drivers

Season*	Meteorological Characteristics	Impact on Air Quality
Monsoon (Jun–Sep)	High temperatures, strong winds, high Planetary Boundary Layer (PBL) height, and substantial rainfall.	**Improved:** Efficient dispersion and wet removal of pollutants.
Post-Monsoon (Oct–Nov)	Decreasing temperature, wind speed, PBL height, and rainfall.	**Accumulation:** Marks the onset of rising pollutant levels.
Winter (Dec–Feb)	Lowest temperatures, wind speeds, and PBL heights of the year.	**Worst:** Shallow boundary layers and weak winds suppress dispersion.
Summer (Mar–May)	Increasing temperatures, wind speeds, and PBL heights.	**Relief:** Enhanced vertical mixing and dispersion reduce concentrations.

4. Methods to ascertain the Sources of Air Pollution

Source Apportionment is a scientific approach used to identify and quantify the relative contribution of different emission sources to ambient air pollution. Broadly, there are two main methods used for Source Apportionment (SA) of air pollution for proportional attribution to the sources of air pollution. The schematic of Source Apportionment methods is depicted in **Figure 5**.

a. **Receptor Modelling (Observation-Based) - Top Down Approach**

Receptor Modelling is a scientific technique used to apportion ambient air pollution by analysing pollutant concentration measured at receptor locations, where a sample of aerosols (PM) is taken at a site and later analysed in the laboratory for its different chemical composition. Using the chemical composition of PM at a receptor site, along with source profiles and applying statistical techniques such as Positive Matrix Factorization (PMF), Chemical Mass Balance (CMB) or Principal Component Analysis (PCA), contributions from vehicles, industries, biomass burning, or dust, etc. are inferred. This method is sensitive to the location of measurement and source profiles. This method, while identifying the sources, cannot provide the exact location of the source.

b. Chemical Transport Modelling (CTM, Process-Based) - Bottom Up Approach

Chemical Transport Models (CTMs) based source apportionment is a process-driven approach that uses emissions inventories, meteorological data, and atmospheric chemistry to simulate how pollutants are formed, transformed, dispersed, and transported. In this, suitable CTMs such as WRF-Chem, CMAQ, CAMx can be used to quantify contributions from different sectors such as vehicles, industries, biomass burning and also to quantify the source contribution regions, such as how much is coming from within Delhi or outside Delhi by considering the movement of pollutants. However, this method depends on the accuracy of the emission inventories and is subject to model uncertainties.

While an Emission Inventory (EI) provides the quantification and location of pollutant emissions from different sources, such as transport, industry, power plants, biomass burning, and natural dust, it does not really provide the actual contribution of the source to the ambient air pollution. EI needs to be combined with Chemical Transport Models for source apportionment studies. CTMs can give us the relationship between emissions and concentrations and tell us which sources are contributing to the pollutant concentrations. They can also be used to identify the impact of reducing emissions from one or more sources on concentrations. Both methods have their own limitations and uncertainties. Therefore, both methods should be used together to obtain a holistic picture of what is polluting.

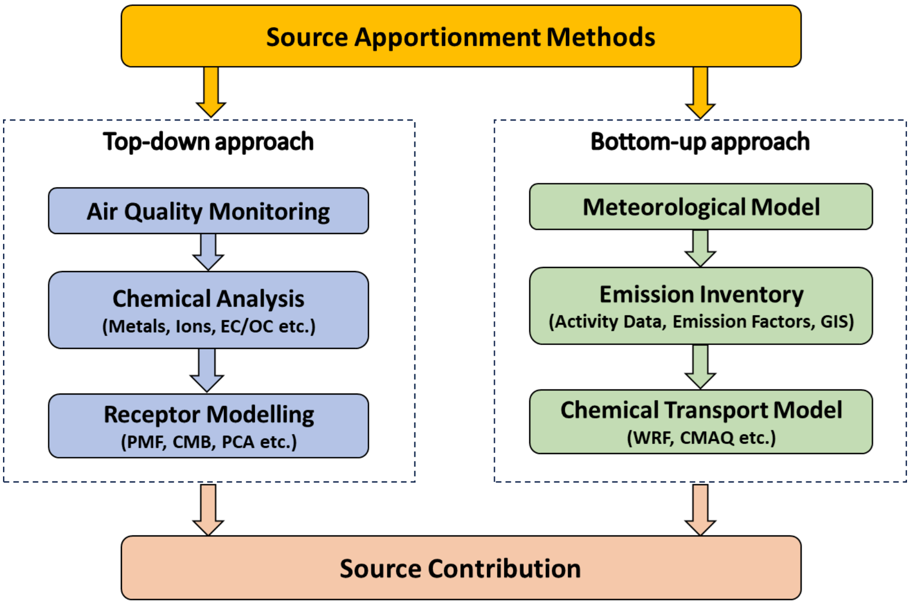

Figure 5: Source Apportionment Methods

Pollution source attribution often differs across studies due to several scientific and operational factors such as location and time period of study, recent interventions, data resolution, differences in the number of chemical constituents analysed, methodological differences and underlying assumptions, including the scope of the study **(see box: Why do different studies show different results?).** Because of these inherent variations, a meta-analysis, combining results from multiple studies, is often required to estimate source contributions with high confidence.

Why do different studies show different results?

Air pollution is inherently dynamic and is complex in nature because of multi-pollutant and multi-sectoral contributions. This makes source apportionment studies highly sensitive to several factors: the location of monitoring sites, the time period of analysis, the methodology applied (whether receptor modelling or Chemical Transport Models), the input data used (such as emission inventories or chemical speciation), and the underlying assumptions built into the models. Seasonal influences, recent policy interventions like fuel standards or restrictions on certain activities, and differences in chemical constituents analysed further add to the variation. As a result, different studies often report different source contributions, reflecting the dynamic nature of air quality. It is generally not expected that all results will exactly match, but broadly should indicate the sources of pollution. Therefore, a meta-analysis integrating multiple studies provides source contribution estimates within a range but with greater confidence. The Source Apportionment results can further be analysed to develop strategies for the abatement of air pollution.

5. Identification of Dominant Sources of Air Pollution in Delhi NCR

It has been recognised that Delhi and NCR's air quality is influenced by both local sources as well as the transboundary effect of regional movement of pollution within the airshed. A meta-analysis of studies from 2015 to 2025 attributes $PM_{2.5}$ in Delhi to a mix of primary emissions and secondary particulate formation (**Table 2**) from sources within NCR and beyond. The most prominent primary contributors are Transport, Dust (Road + Construction and Demolition), Biomass Burning, Industry, including Thermal Power Plants (TPPs). A small share falls into "Other sources" that include diesel generator sets, crematorium, solvents, natural sources etc. A significant part of the overall particulate concentration in the air is contributed by the secondary particulates that are formed from gases emitted by the primary sources. Contributions shift markedly between seasons. Overall contribution of the combustion sources, including transport, biomass burning, and industry increase during winter, while the share of dust, which is higher during summer, reduces. The secondary particulate matter rises in winter.

Table 2: Dominant pollution sources impacting air quality in Delhi from sources within NCR and beyond

	Winter		Summer	
Sector	**Contribution (%)**	**Range (%)**	**Contribution (%)**	**Range (%)**
Transport	23	19-24	19	18-21
Industry (includes TPPs)	9	8-10	14	9-15
Dust (Road+Soil+C&D)	15	10-18	27	25-31
Biomass Burning (includes MSW, residential, crop-residue burning)	20	17-23	12	11-14
Secondary Particulate (transformed from gaseous emissions from Transport, Industries, Biomass burning, etc.)	27	24-28	17	16-19
Other sources*	6	-	11	-

Percentage contribution to $PM_{2.5}$ concentrations. Typical average $PM_{2.5}$ Concentration in Summer (Mar-June): 73 µg/m³ and in Winter (Nov-Feb): 178 µg/m³

***Other sources** refer to small dispersed and unclassified sources not typically categorized within the above mentioned major sectors

Types of studies conducted: These numbers have been derived from the meta-analysis of studies that are available for Delhi or data shared by the Experts. It may be noted that there are differences in the type of studies showing different results (Box: **Why do different studies show different results?**). As the pollutants level varies across NCR, the sources impacting air quality also varies. The mitigation of sources in the entire NCR airshed will result in improvement of AQI in Delhi as well as in NCR. The experts deliberated to identify and validate the specific causes leading to the worsening of the Air Quality Index (AQI), and reach a consensus on the proportional contribution of various pollution sources as shown in Table 2.

6. Understanding the Sector-specific Causes of Pollution

6.1 Transport

Transport repeatedly emerges as the most prominent pollution source within Delhi. The transport source category includes off & on-road vehicles; petrol, diesel and CNG-powered vehicles. Tailpipe emissions from vehicles constitute a major source of urban air pollution. The magnitude of vehicular emissions varies primarily by vehicle type, vehicle age and mileage, fuel type, fuel standard, and maintenance condition. Vehicles compliant with newer emission standards, such as Bharat Stage VI (BS-VI), emit significantly lower pollutants compared to vehicles certified under earlier standards, including BS-IV, BS-III, II, I, and pre-BS regimes. Older vehicles, particularly those operating beyond their regulatory life, exhibit higher emission intensity due to engine deterioration and compromised emission control performance. The nature of vehicular pollutants differs by fuel type. Diesel vehicles are a major source of particulate matter and oxides of nitrogen and sulphur, whereas CNG vehicles predominantly emit oxides of nitrogen, with comparatively lower particulate emissions.

Although the large-scale substitution of diesel-based public and local commercial fleets with CNG vehicles has been achieved and the phase-out of older vehicles is underway, the sector's impact remains high. Vehicular emissions are also strongly influenced by traffic conditions. Under congested and slow-moving traffic, inefficient combustion results in higher emissions per vehicle, whereas operation at optimal speeds enables more efficient combustion and lower emission rates. These factors underscore that emission outcomes are shaped not only by vehicle technology but also by traffic flow and road network conditions.

Travel activity levels are rising due to growing demand, leading to increased total vehicle-kilometres travelled. Lack of adequate, integrated public transport and safe pedestrian or cycling infrastructure has increased dependence on personal vehicles. This high travel intensity is further aggravated by the daily influx of vehicles from outside the city, contributing to Delhi's air quality. In this context, the expansion and strengthening of mass public transport systems assumes critical importance.

Further, maintenance of a vehicle also impacts the emissions heavily. The current PUC system does not monitor PM from the tailpipe, so it is not a true representative of emissions.

Many vehicles run without PUCC and are not maintained properly, emitting higher amounts of pollutants than the norms.

Urban and long-distance freight movement is also increasing alongside regional economic growth. Beyond tailpipe exhaust, vehicles are responsible for significant non-exhaust emissions from brake wear, tyre abrasion, and resuspended road dust. Transport sector emissions are further compounded by off-road sources, including construction machinery and agricultural tractors. Consequently, the region requires a rapid and comprehensive transition toward zero-emission pathways.

6.2 Industries and TPPs

The industrial source category includes furnaces and boilers, metal casting and refining operations, coal combustion, dry fly ash ponds, the burning of heavy oils, etc. All coal-fired power plants in Delhi have been decommissioned, and major polluting industrial units have been relocated outside the city limits. Following the implementation of the amended Approved Fuel List in 2022, industrial areas have transitioned to Piped Natural Gas (PNG). However, the higher PNG cost discourages PNG adaptation.

Despite these systemic changes, significant challenges remain due to a large number of small, unorganised units—including plastic recycling and small-scale manufacturing—operating in unauthorised or peripheral areas. Industrial pollution is also exacerbated by the illegal burning of non-hazardous industrial waste, such as plastic and rubber, along with fugitive emissions. In the broader NCR, there are numerous industrial clusters characterised by a heavy presence of small-scale units. These units often utilise small boilers and furnaces that urgently require a transition to clean fuels and modern technologies.

6.3 Biomass Burning (MSW, Residential & Crop Residue)

This source category comprises a diverse group of open burning activities, including the use of solid fuels in households such as wood and dung, burning of agricultural crop residues, plant branches and leaves, as well as open burning of municipal solid waste (MSW), including plastics, paper boards, used tyres, and wires. Altogether, this sector contributes to 17-23% in winter and 11-14% in summer. The problem intensifies severely during the winter months due to several overlapping factors highlighted as follows:

6.3.1 Open MSW Burning

Open burning of MSW is largely driven by inadequate waste management infrastructure. This wide gap between waste generation and processing capacity leads to major leakages, often resulting in open burning. There is a need for augmentation of waste processing facilities, such as Waste to Energy, CBG plants, and Recycling plants. While biomining of the landfill/dumpsites is underway, they are prone to fire risks from external triggers or methane-induced spontaneous combustion, especially during summer. Additionally, the open burning of horticulture waste such as dry leaves, twigs, and garden trimmings, particularly during seasonal pruning and leaf-fall periods, further adds to the emissions. Due to lack of awareness, MSW burning is often perceived as a convenient disposal method, especially where collection is irregular. During winter, MSW mixed with biomass is widely burned for warmth by low-income/homeless populations and outdoor workers, often involving plastics and rubber. This significantly worsens air quality across the Delhi-NCR region.

6.3.2 Residential Biomass Burning

The use of unclean cooking and heating fuels such as crop residue, firewood, cardboard, and cow dung remains one of the sources of air pollution across the NCR, particularly in rural, semi-urban areas and urban slums. While LPG penetration is fairly high in the NCT region, the use of solid fuels is prevalent in urban slums. Further, burning of solid fuels is highly prevalent in the semi-urban areas of NCR districts for both cooking and heating needs. Emissions from household activities, primarily cooking and space heating, contribute substantially to ambient particulate pollution. Biomass burning, which continues year-round among low-income households, intensifies significantly in winter due to increased heating demand.

6.3.3 Crop Residue Burning

Around 28 Million Tonnes of paddy stubble are generated within a short 30-day harvest window in Punjab, Haryana, and Uttar Pradesh-NCR, leaving farmers with limited time to prepare fields for the next crop. Despite various initiatives to manage stubble, such as subsidies for CRMs for in-situ management, promotion of ex-situ utilization and public awareness, many farmers still resort to the practice of stubble burning as the cheapest and quickest method to clear residue to prepare the field for the next crop. The practice of burning releases large amounts of fine particulate matter and other gaseous pollutants, contributing to deteriorating air quality in the region through prevailing meteorological conditions, transporting pollutants from the north west towards Delhi. While its annual contribution to ambient $PM_{2.5}$ is low, various studies have shown that the stubble burning impact can go up to 40% of Delhi's air pollution load during peak harvesting season, adding to the pollution load in Delhi-NCR in the months of October-November.

6.4 Soil and Road Dust

Road dust, managed by ULBs and road owning agencies, continues to be one of the major contributors to air pollution in Delhi-NCR because it functions as both a primary emission and a persistent source. This source category includes air-borne dust particles from roads & shoulders, vehicle movement, dry soil, road wear, etc. Strong winds lift loose soil from open areas and roads, worsening air quality. The poor road surfaces, potholes, broken edges, unpaved roads, road, tyre, brake wear, debris falling from C&D material transportation, etc., become the major source of road dust. The road dust is repeatedly resuspended by vehicular traffic, particularly during dry meteorological conditions. This cycle ensures that emissions persist in the atmosphere even in the absence of new dust-generating activities. The dust resuspension due to manual sweeping also contributes to air pollution requiring removal of dust through mechanised sweeping. There is a need for proper road dust management measures along with long-term interventions. These include the comprehensive redevelopment of road infrastructure with fully paved shoulders and integrated footpaths, alongside aggressive greening initiatives.

6.5 C&D Dust

This source category includes particles arising from Construction & Demolition activities, raw material storage, ready mix concrete plant, and loading & unloading operations. Delhi-NCR is going through massive infrastructure development involving construction, demolition, renovation, and large infrastructure projects such as buildings, roads, flyovers, and metro systems. These construction activities release large amounts of dust from excavation, cutting, drilling, mixing of concrete, and movement of materials, which contribute to air pollution. The C&D activities generate large amounts of C&D waste every day, which is dumped illegally near roads and open areas, making it one of the prominent sources of PM pollution. The existing construction practices and limited awareness among builders, contractors, and citizens are also among the causes of not following the dust mitigation measures during construction.

Secondary pollutants: formation and control challenges

Secondary pollutants are not emitted directly from sources like exhaust pipes or industrial stacks; instead, they are formed in the atmosphere when specific gases emitted from combustion undergo chemical transformations in the air, often influenced by sunlight, moisture, and temperature. In Delhi and the NCR, these pollutants represent a major portion of the total particulate burden, significantly intensifying during the winter months. The key precursor gases are Sulphur Dioxide (SO_2), Nitrogen Oxides (NO_x), Ammonia (NH_3), and Volatile Organic Compounds (VOCs). For example, SO_2 from power plants and industry oxidises to form H_2SO_4, which then reacts with NH_3 (from agriculture, livestock and waste) to create ammonium sulphate particles. NO_x (primarily from vehicles) transforms into nitric acid, which combines with NH_3 to form ammonium nitrate particles. The atmospheric formed ammonium sulphates and ammonium nitrates etc. are referred to as Secondary Inorganic Aerosols (SIA). VOCs from trees/plants, fuels and solvents react with atmospheric oxidants to form complex organic particles like Secondary Organic Aerosols (SOA).

Winter in Delhi is characterised by high moisture and frequent fog. This moisture can accelerate the conversion of gases into particles several times faster than usual. Colder conditions also promote the "gas-to-particle" conversion, particularly for ammonium nitrate, which is more stable in cold weather. In winter, the Planetary Boundary Layer Height drops significantly and creates a "lid" that traps precursor gases in a smaller volume of air, leading to higher concentrations and more frequent collisions between gas molecules, which speed up secondary formation. Calm winds prevent these newly formed particles from dispersing, leading to massive regional accumulation.

Secondary particles are microscopic in size and can remain airborne for days, travelling long distances. Secondary pollutants do not originate from a single, controllable source, complicating mitigation strategies. They are often more toxic, reactive, or persistent than their precursor pollutants. They have substantial adverse impacts on human health—particularly respiratory and cardiovascular systems—as well as on vegetation, materials, and ecosystems.

Because secondary pollutants do not originate from a single, controllable point source, developing effective mitigation strategies needs to address a diverse set of combustion sources like vehicles, industry, power plants and biomass burning, etc. Controlling these combustion sources will not only result in a reduction in primary pollutants but also in secondary pollutants.

6.6 Secondary Particulate

Secondary particulate matter accounts for 27% in winter and 17% in summer. The secondary particulates are formed from chemical reactions of gases emitted by the primary anthropogenic combustion sectors, such as TPPs, industries, vehicles, biomass, etc. The natural biogenic sources also contribute to the secondary particle formation. The growing evidence highlights the importance of controlling precursor gases responsible for secondary particulate formation. However, because of limited understanding and underlying complexity, it is challenging to pinpoint the primary sources of pollution. **(see box: Secondary pollutants: formation and control challenges)**

6.7 Other sources (DG sets, crematoria, brick kilns, etc.)

"Other sources" remain a significant challenge because they are geographically dispersed and highly sensitive to enforcement. These sources often operate in close proximity to residential areas, creating local hotspots that increase regional background pollution during periods of poor atmospheric dispersion. The use of Diesel Generator (DG) sets has increased substantially across the NCR due to unreliable grid electricity. Moreover, older or poorly maintained DG sets act as super-emitters in the absence of Emission Control Devices (ECDs). These units are a major concern because they result in direct, ground-level exposure to emissions. Cremation without modern filtration and efficient technology remains a source of air pollution. Hotels and restaurants are identified as consistent area sources due to their continued reliance on solid fuels and a widespread lack of adequate emission control systems. Operations at regional airports also contribute to the pollution burden, primarily through the release of gaseous pollutants during flight activities. Airports contribute to air pollution through aircraft emissions during taxing, landing and takeoff. Brick kilns in and around NCR also contribute to the air quality in Delhi-NCR. In addition to anthropogenic sources, the natural sources such as dust storms, forest fires and natural biogenic emissions contribute to the PM levels.

These broad sources were acknowledged and identified by the Commission in its Policy to Curb Air Pollution in National Capital Regional formulated in 2022, which also outlines the broad actions to be initiated against such identified sectors to address the issue.

7. New Source Apportionment Study for Delhi-NCR

The assessment of existing emission inventory and source apportionment studies for Delhi NCR indicates several limitations arising from different methodologies, assumptions, geographical boundaries, source sectors and activities, data collection methods, temporal variations, emission factors and partial consideration of subsequent policy and regulatory interventions. In addition to the precision of emission factors, the accuracy and frequency of data collection methods play a critical role in emission estimation. (Box: **Why do different studies show different results?**). While these studies provide valuable insights into emission sources and sectoral contributions, they may not fully represent current emission scenarios.

The Commission noted differences in existing approaches for emission inventory and source apportionment. It was further recognised that a unified, data-driven approach is essential to reduce emission uncertainty for developing effective air quality management in Delhi NCR. Accordingly, the Commission constituted a Steering Committee under the Chairmanship of a full-time Technical Member of the Commission, comprising Members from NEERI, CPCB, HSPCB, RSPCB, UPPCB, DPCC, IIT Kanpur, IITM Pune, UNEP Delhi, ARAI Pune, IIT Delhi and TERI. Based on the deliberations, CAQM developed a Framework for Emission Inventory and Source Apportionment for Delhi-NCR in April, 2025, which outlines high-resolution emission mapping (500 m × 500 m grid) across major polluting sectors like transport, industry, households, crop residue burning, road dust, and waste burning as outlined in this report.

The Commission entrusted CPCB with the task to implement the framework, and a consortium of four institutes led by ARAI, Pune and partners from IIT Delhi, TERI and IITM Pune has been awarded with the work of developing a new emission inventory and source apportionment study for Delhi NCR with 2026 as the base year. The updated inventory will incorporate recent activity data, improved methodologies, and ongoing policy measures to provide a more accurate assessment of emissions. The emissions will be used for predictive modelling using Chemical Transport Models for emission-based Source Apportionment, to further strengthen source apportionment and improve real-time assessment of pollution sources.

The developed emission inventory will be utilised in the Air Quality Early Warning System (AQEWS) and the Decision Support System (DSS) developed by IITM Pune, which provides air quality forecasts and near real-time source contribution analysis, offering temporal-spatial information and enabling policy interventions and targeted actions. It will also be useful for scientists and researchers to conduct advanced studies on source attribution, scenario modelling, and the development of mitigation strategies for Delhi-NCR.

8. Annexure I - Bio-Sketch of the Experts

Dr. S. D. Attri
Member Technical, Commission for Air Quality Management (CAQM), New Delhi

Dr. S. D. Attri holds a PhD in Environmental Sciences and Engineering, with over 36 years of experience in meteorological services, environmental and air quality monitoring networks, air quality modelling and management, climate change, urban meteorology and agrometeorology. He has more than 120 publications to his credit with research papers in national and international journals, Met. Monographs and books. He has provided guidance to Global Atmospheric Programmes as Member of Commission for Atmospheric Sciences Management Group, Expert Member, Task forces of Global Framework for Climate Services, and Primary Country Contact of Global Atmosphere Watch of WMO, Geneva, United Nations. He has served as Member of the Environmental Appraisal Committees (Thermal Power, Industries Mining & Coal Mining) of the MoEFCC. He has been awarded Commendation Certificate by the Hon'ble Prime Minister of India, for his contribution to the work of the IPCC, which is the Joint Winner of the Nobel Peace Prize 2007.

Prof. Mukesh Sharma
Professor-Emeritus, Department of Civil Engineering, Indian Institute of Technology Kanpur, Kanpur

Prof. Mukesh Sharma is a leading air quality expert and a Fellow of the Indian National Academy of Engineering and serves on the WHO advisory group for air pollution and UN Sustainable Development Goals. With a PhD from the University of Waterloo, Canada, he has contributed extensively to air quality monitoring, modeling, and management. He led the CPCB sponsored National AQI project which has been implemented to report daily AQI. He headed the project on Air Quality Standards which were notified in 2009 and currently he is the Principal Investigator of the project Review of National Ambient Air Quality Standards. He has published over 130 papers and advised national and international bodies on environmental health and risk assessment.

Prof. Chandra Venkataraman
Professor, Chemical Engineering and Climate Studies, Indian Institute of Technology Bombay, Mumbai

Prof. Chandra Venkataraman's research lies at the intersection of technology, emissions, air pollution and climate. She has pioneered the SMoG-India emissions inventory and the PAVITRA model for air quality and climate assessment. She has co-authored over 155 papers, a book and 4 patents. She is a fellow of the INAE (2016), IASc (2018), INSA (2022) and The World Academy of Science (TWAS, 2025) and received a Distinguished Alumni award (2024) from her alma mater, IIT Delhi. She advises the CCAC of UNEP.

Prof. Bhola Ram Gurjar
Director, National Institute of Technical Teachers Training & Research (NITTTR), Chandigarh (On-lien from Indian Institute of Technology Roorkee, Roorkee)

Prof. Bhola Ram Gurjar has extensively worked in the areas of urban emissions, air quality, health risk, and environmental sustainability. He has (co)authored more than 200 publications including 12 books and one patent. He has developed two popular NPTEL online courses, namely "Sustainable Transportation Systems" and "Air Pollution and Control". He is serving on several national committees, e.g., (i) National Knowledge Network, National Clean Air Program (NCAP), (ii) Environmental Services Sectional Committee of Bureau of Indian Standards (BIS), and (iii) National Working Group (NWG)-5 on Environment and Circular Economy of the International Telecommunications Union – Telecommunications Sector (ITU-T). Prof. Gurjar is currently on lien from IIT Roorkee to lead NITTTR, Chandigarh, as its Director.

Prof. Shiva Nagendra S. M.
Professor, Department of Civil Engineering, Indian Institute of Technology Madras, Chennai

Dr. Shiva Nagendra SM holds over 24 years of experience in research, teaching, and technology in air quality management. He was the former Chairman of GATE and JAM 2025, IIT Madras. He has published 150+ journal papers and 120+ conference papers, authored two Springer reference books, and holds five patents. He serves as Associate Editor for Frontiers in Sustainable Cities and Journal of the Institution of Engineers (India): Series A. He is the Founder-Chairman of Indian International Conference on Air Quality Management Series, Founder-President of Air Quality Management Association, Director of the CEPHA Network (UKRI-supported), and a WHO subject-matter expert.

Prof. Sagnik Dey
Professor, Centre for Atmospheric Sciences, Indian Institute of Technology Delhi, New Delhi

Prof. Sagnik Dey is the Head and Vipul and Mahesh Chaturvedi Chair Professor in Policy Studies at the Centre for Atmospheric Sciences, IIT Delhi, and Adjunct Professor at the Department of Health, Policy and Management, Korea University, Seoul. He received his PhD and M.Tech. from IIT Kanpur and worked as a Postdoctoral Scientist at the University of Illinois at Urbana-Champaign, USA. His research focuses on the air quality–climate change–health nexus and remote sensing of the Earth's climate system. He is an international collaborator of NASA's MAIA mission and the Global Burden of Disease Study and serves on several WHO and national expert committees.

Prof. Suresh Jain
Professor, Department of Civil & Environmental Engineering, Indian Institute of Technology Tirupati, Tirupati

Prof. Suresh Jain is a leading expert in air pollution and environmental health, currently serving as Professor and Head, Department of Civil & Environmental Engineering at the Indian Institute of Technology Tirupati, and formerly as Dean (Academic Affairs). With over 20 years of experience in research, teaching, and policy-oriented consultancy, his expertise spans air quality modelling, urban transport emissions, exposure assessment, and air quality management. He holds a PhD from IIT Delhi and an M.Tech. from IIT Kanpur. Prof. Jain has played key roles in NCAP implementation, state environmental governance, and international academic collaborations, contributing significantly to evidence-based air quality policy and environmental health assessment.

Prof. Umesh Chandra Kulshrestha
Professor, School of Environmental Sciences, Jawaharlal Nehru University, New Delhi

Prof. Umesh Chandra Kulshrestha has served as a member of the Environmental Pollution Control Authority (EPCA) and the EIA-AC of QCI-NABET. Currently, he chairs the Air Pollution Working Group of the RAC of the Asia Oceania Geosciences Society. He is also the Deputy Director at the South Asian Nitrogen Centre and serves on the Steering Committee of the International Nitrogen Initiative (INI). His engagement with air pollution and acid rain research dates back to the 1990s during the Taj Mahal pollution issue. He is a Fellow of the Indian Geophysical Union and has received several prestigious honors. He is the author of five books, has more than 200 publications and has guided 19 PhD students.

Dr. Manish K Naja
Director, Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital

Dr. Manish Naja's primary area of research covers various subfields of the lower atmosphere such as trace gases, aerosols, meteorology, wind dynamics, air pollution and climate change. He has co-authored more than 100 research papers and has supervised 8 students for their PhD. He is a member of the expert committee on Atmospheric Sciences of the Ministry of Earth Sciences, Govt. of India. Dr. Naja has played a key role in establishing the ASTRAD facility at ARIES and many other collaborative projects in the field of atmospheric research.

Prof. Neeraj Rastogi
Professor, Geosciences Division, Physical Research Laboratory, Ahmedabad

With 25+ years of research experience, Prof. Neeraj Rastogi is known to initiate new aerosol research fields in India such as 'Aerosol Oxidative Potential', online brown carbon, 'Applications of Isotopes' in aerosol studies, etc., and has published >100 peer-reviewed articles. Using chemical and isotopic compositions as tools, he investigates sources and processes affecting the abundances and characteristics of ambient aerosols over India and surrounding oceans. He has received three 'Group Achievement Award' from NASA. He is serving as a Vice-President of IASTA, and knowledge partner in NCAP.

Prof. Ravindra Khaiwal
Professor, Community Medicine and School of Public Health, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh

Prof. Ravindra Khaiwal is a leading environmental health expert at PGIMER, Chandigarh, with over 25 years of research experience in air pollution, climate change, and public health. He obtained a D.Sc. from the University of Antwerp, Belgium, and served as a scientist in the UK with visiting professorships in Europe. He has contributed extensively to air pollution research. He has authored over 200 peer-reviewed publications with around 20,000 citations and an h-index of 65. He is ranked among the top 0.05% of researchers worldwide in air pollution science and leads national initiatives on health impacts of air pollution and climate change. Dr Khaiwal is globally recognized for translating complex science into effective policy and public communication.

Prof. Anant Mohan
Professor and Head, Dept. of Pulmonary, Critical Care and Sleep Medicine, All India Institute of Medical Sciences (AIIMS), New Delhi

Dr. Anant Mohan is an expert in respiratory and critical care medicine, with clinical and research interests including lung cancer, chronic obstructive pulmonary disease, and interventional pulmonology. He was awarded UK Commonwealth Fellowship in Chest Medicine and Interventional Pulmonology (2008–2009) and Honorary Professorship in University College London. Dr. Mohan is a Fellow of the Royal College of Physicians (London) and the American College of Chest Physicians and has played a key role in advanced clinical services such as lung transplantation at AIIMS.

Dr. B. Sengupta
Ex-Member Secretary, Central Pollution Control Board, New Delhi

Dr. B. Sengupta is a distinguished environmental scientist with over 34 years of service in the Government of India. He has extensive expertise in air and water quality management, industrial pollution control, environmental standards, EIA, hazardous and solid waste management, clean technologies, climate change, and remediation of contaminated sites. He has represented India in several international forums organised by UNEP, WHO, World Bank and others. Post-VRS, he continues to contribute as Chairman/member of several national technical committees and as consultant to organisations such as the World Bank, ICCT and Heinrich Böll Stiftung.

Dr. V. K. Soni
Scientist-G, India Meteorological Department (IMD), New Delhi

Dr Vijay Kumar Soni is M.Sc in Physics from IIT, Roorkee and PhD in Atmospheric Science from University of Pune. He joined the IMD in 1999 as Meteorologist. Since then, he has served the IMD in various capacities. At present, he is working as Scientist-G and Head, Environmental Monitoring and Research Centre, IMD, New Delhi. He is Executive Editor of Mausam journal and Editorial Board Member of Discover Atmosphere journal. He is also a faculty in the Meteorological Training Institute of IMD. He has published 86 research papers in peer reviewed journals, 7 Meteorological Monographs on various subjects and 4 chapters in books.

Dr. S. K. Goyal
Chief Scientist & Head, CSIR-National Environmental Engineering Research Institute (CSIR-NEERI), New Delhi

Dr. S. K. Goyal is an air pollution expert with over 35 years of research and professional experience at CSIR-NEERI, Nagpur. He is currently Chief Scientist and Head of the NEERI Delhi Zonal Centre. His core expertise includes ambient and stack air quality monitoring, emission inventory development, vehicular emission modeling, source apportionment, air quality management planning, and carrying capacity–based sustainable development studies. In recent years, he has led and contributed to important air pollution studies pertaining to stubble burning contribution assessment, airshed delineation, vehicular & road dust re-suspension. He has contributed more than 100 peer reviewed publications.

Dr. Tuhin Kumar Mandal
Chief Scientist, CSIR-National Physical Laboratory (NPL), New Delhi

Dr. Tuhin Kumar Mandal is a Chief Scientist at CSIR–NPL, New Delhi, with over 25 years of experience in atmospheric physics, air pollution, and climate science. He earned his PhD from the University of Delhi and has received the BOYSCAST Fellowship (DST, Germany) and the START Young Scientist Award (USA). He has contributed to major programs including INDOEX, ICARB, CAWSES, APHH, SANH, and national CSIR–NPL air quality monitoring initiatives. His expertise includes atmospheric chemistry, aerosol characterization, source apportionment, emission inventories, trace gases, isotopic analysis, health risk assessment, and policy-relevant air pollution mitigation.

Dr. Sumit Sharma
Deputy Head, United Nations Environment Programme (UNEP), New Delhi

Dr. Sumit Sharma's expertise includes emission inventories, air quality monitoring, source apportionment, urban and regional air quality modelling and development of air quality management plans. With over 23 years of professional experience across nearly 100 projects, his work spans scientific research, policy advocacy, capacity building and outreach in environment and air quality management. He has also contributed to the formulation of India's National Clean Air Programme in 2019.

Prof. Vinayak Sinha
Professor, Department of Earth and Environmental Sciences, Indian Institute of Science Education and Research (IISER) Mohali, Mohali

Prof. Vinayak Sinha is currently an expert member of the United Nation's World Meteorological Organization (WMO) Environmental Pollution and Atmospheric Chemistry Scientific Steering Committee (EPAC SSC), the International Commission on Atmospheric Chemistry and Global Pollution, and the International Global Atmospheric Chemistry (IGAC), a Global Research Project under Future Earth. He has previously served as the first Indian Co-chair (2017-2020) and a Scientific Steering Committee (SSC) Member (2015-2020) of the Integrated Land Ecosystem-Atmosphere Processes Study, another Global Research Project under Future Earth.

Dr. Arunabha Ghosh
CEO, Council on Energy, Environment and Water (CEEW), New Delhi

Dr Arunabha Ghosh is an internationally recognised public policy expert, author, columnist, and institution builder. He advises governments, industry, civil society, and international organisations around the world. Last year, the Government of India appointed him to the Commission for Air Quality Management. In May 2025, the Government of Brazil appointed him as a Special Envoy for COP30 climate negotiations. He currently co-chairs the World Economic Forum's Global Future Council on the Energy Nexus. He served on the Government of India's G20 Finance Track Advisory Group and advised the Sherpa Track for India's G20 Presidency in 2022-23. In 2022, the UN Secretary-General appointed him to the High-level Expert Group on the Credibility and Accountability of Net-Zero Announcements by Non-State Actors. Dr Ghosh has been a member of the UN Committee for Development Policy since 2019 (nominated by the UN Secretary-General; Vice-Chair 2023-25).

Sh. Bharat Kumar Sharma
Member Secretary, Central Pollution Control Board, New Delhi

With decades of experience in environmental regulation and pollution control, he has previously led the Hazardous Waste Management Division in CPCB and later as Regional Director of CPCB Regional Directorate Pune. He possesses strong technical expertise in waste management and industrial pollution control, along with extensive experience in regulatory enforcement and institutional capacity building. Presently, as Member Secretary CPCB, he is strengthening India's environmental enforcement by enhancing coordination with key stakeholders, improving compliance monitoring mechanisms, and driving effective implementation measures for air, water, and waste management.

Ms. Anumita Roychoudhury
Executive Director, Research and Advocacy, Centre for Science and Environment (CSE), New Delhi

Ms. Anumita Roychowdhury has led major policy research and advocacy on air pollution, clean and low-carbon transportation, sustainable built structures, and resilient urban habitats. She has helped to build and guide some of the key policy campaigns on air pollution, transport and mobility strategies, and frame multi-sector climate and clean air strategies for cities and states. She has played an active role in several national and global environmental forums and platforms on clean air and climate change. Currently, she is also the contributory author to the report on cities and climate change of the International Panel on Climate Change.

Dr. Sachin Ghude
Scientist-F, Indian Institute of Tropical Meteorology (IITM), Pune

Dr. Sachin D. Ghude is an expert on atmospheric chemistry, urban air quality and fog modelling, and chemical data assimilation. He heads MAQWS (Metropolitan air quality and Weather Services) WIFEX and Thunderstorms Dynamics at IITM. He leads India's Winter Fog Experiment (WiFEx) and heads a research group on atmospheric chemistry and modelling. He earned his PhD from the National Physical Laboratory, based on greenhouse gas measurements at Maitri, Antarctica. His research supports socio-economic applications related to air quality, fog, health and climate, and he serves in key international scientific bodies including iLEAPS, iCACGP and MAP-AQ.

Sh. Moqtik Bawase
Sr. General Manager, Automotive Research Association of India (ARAI), Pune

Sh. Moqtik Bawase holds more than 25 years of experience in the field of air quality management, alternate fuels, sustainable transport, environmental life cycle assessment, and vehicle-exhaust emissions measurement & control. He has led many multi-disciplinary projects of national significance, which included development of emission factors and source profiles of the vehicle tailpipe emissions. Since 2005, he is actively involved in the studies involving source apportionment of particulate matter using scientific tools & techniques. He and his team have made significant contributions to understanding the effects of alternative fuels on materials used in fuel systems of vehicles. He was recently honoured by the Pune Municipal Corporation as a Paryavaran-Doot in recognition of his active contribution to Air Quality Management.

Dr. Sri Harsha Kota
Associate Professor, Department of Civil Engineering, Indian Institute of Technology Delhi, New Delhi

Dr. Sri Harsha Kota is CERCA Chair Professor at the IIT Delhi. He was honored with the prestigious Young Engineer Award for 2021 by the Indian National Academy of Engineering (INAE). With over 15 years of research experience in air quality management, Dr. Kota holds Master's and PhD degrees in Civil Engineering, with a specialization in air quality, from Texas A&M University, USA. His research interests encompass regional and urban air quality management, the development of air purifiers, the relationship between air pollution and human health, indoor air pollution, and the creation of emission inventories for air pollutants and greenhouse gases in India. Dr. Kota is actively engaged in collaborative research with scientists from India, the USA, the UK, the European Union, and China. He is currently involved in leading several nationally significant funded projects, amounting to 15 crores INR. These projects include revising the Indian national ambient air quality standards, developing clean air action plans for approximately 10% of non-attainment cities in India, forecasting air quality in Indian metropolitan areas, and assessing the impact of climate change on vector-borne diseases in India.

Dr. Anju Goel
Associate Director, Air Quality Research, The Energy and Resources Institute, New Delhi

Dr. Anju Goel leads the Air Quality Research Division at TERI. She holds an M.Tech from IIT Delhi and a PhD from the University of Surrey, UK, where she was a Commonwealth Scholar. With over 17 years of experience, Dr. Goel has been closely involved in the development of air quality management plans at city, state, and national scales. Her expertise includes sectoral emissions inventories, pollution load estimation, and carrying capacity studies. She has authored several policy briefs and technical reports and has published widely in peer-reviewed journals, with a particular focus on airborne ultrafine particles at traffic intersections.

Dr. Sarath Guttikunda
Founder/Director, Urbanemissions

Dr. Sarath Guttikunda is recipient of the International Award by the American Geophysical Union in 2022, given annually in recognition of furthering the Earth and space sciences for the benefit of society in developing nations. He conducts research in an independent capacity at UrbanEmissions to support science, policy, and public dialogue on air pollution in India and cities across Asia, Africa, and Latin America. He received his Bachelors in Chemical Engineering at the Indian Institute of Technology (Kharagpur, India, 1997) and Doctorate from the University of Iowa (USA, 2002).

Ms. Swagata Dey
Policy Specialist, Group Head, Policy Development and Outreach, Center for Study of Science, Technology and Policy (CSTEP), Noida

Ms. Swagata holds over 10 years of experience in developing sectoral inventories, pollution load estimation, carrying capacity studies and developing city level and ward level action plans for NCAP cities. She has also worked on testing air quality sensors for complementing regulatory monitors across India. Core areas of interest are vehicular emissions, DG sets, and agriculture waste burning. Has published book chapters, reports and peer reviewed papers on air quality, liveable cities and sustainability. Ms. Swagata holds Masters from TERI University and Ohio State University, USA.

Dr. Mohammad Rafiuddin
Programme Lead, Council on Energy, Environment and Water (CEEW), Delhi

Dr. Mohammad Rafiuddin's work involves air quality data analysis and modelling, developing decision support systems for various stakeholders and supporting NCAP implementation through technical and policy assistance to urban local bodies. He has a PhD in atmospheric sciences from the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), a post graduate diploma in urban environmental management and law from the National Law University (NLU) and a bachelor's in mechanical engineering from JNTU, Hyderabad.

Dr. Manoj Khare
Senior Director & HoD ES&EG Group, Centre for Development of Advanced Computing (C-DAC), Pune

Dr. Manoj Khare is Scientist G and head of HPC - Earth Science, Engineering & Geospatial Application Group at C-DAC Pune. He has 30 years' experience in Remote Sensing and GIS. His research areas involved mainly the development of scientific applications for weather and urban air quality management, Disaster management and natural resource management. Currently he is leading the urban modelling project for the development of an automated modelling framework and decision support system for weather, air quality, and urban flood forecasting under National Supercomputing Mission of MeitY and DST.

Ms. Sakshi Batra
Scientist C, Central Pollution Control Board (CPCB), New Delhi

Ms. Sakshi Batra has over 20 years of experience in environmental governance, air quality policy, and urban air quality management. She has played a key role in formulating, reviewing, and implementing national air quality policies in India. Currently, she oversees execution and monitoring of the National Clean Air Programme (NCAP) and contributes to the review and upgradation of National Ambient Air Quality Standards (NAAQS). She led the development of the PRANA National Dashboard to track city action plans and NCAP targets, and conceptualized the micro-planning framework for quantifiable, source-specific strategies.

Dr. Rajeev Kumar Mishra
Associate Professor and Scientist, Department of Environmental Science and Engineering, Delhi Technological University (DTU), New Delhi

Dr. Rajeev Kumar Mishra has extensively contributed in the fields of Urban Air and Noise Pollution Management, Ultrafine Particles, Indoor Air Pollution, Health Risk Assessment and Sustainable Development. He has more than 14 Years of experience involving government-funded projects, interdisciplinary collaborations, and expert advisory roles. He has successfully led major research initiatives funded by prestigious government bodies like CPCB. Dr. Mishra has also made a remarkable impact on public understanding of environmental issues. He has published over 80 research papers and 93 newspaper articles in prominent regional, national and international newspapers, simplifying complex environmental science topics for the general public. His consistent engagement with the public underscores the societal value and real-world relevance of his research.

Dr. Saroj Kumar Sahu
UGC Faculty, Department of Environmental Science, Berhampur University, Berhampur

Prof. Saroj Kumar Sahu has more than two decades of experience in the development of national and megacity emission inventories, urban air quality management, climate and atmospheric chemistry modelling, pollutant and meteorological measurements, and health impact studies. He completed his PhD at the Indian Institute of Tropical Meteorology (IITM), Pune, followed by postdoctoral research at Forschungszentrum Jülich, Germany, and the National Institute for Environmental Studies (NIES), Japan. He was also a scientific member of the 28th Indian Expedition to Antarctica during 2008–09. To date, he has published more than 70 peer-reviewed research papers and 10 book chapters. He has supervised four PhD scholars and is currently leading and contributing to several national and international research projects, including ANRF-PAIR, MoES, and UGC initiatives.

Dr. Vikas Singh
Scientist E, Commission for Air Quality Management, New Delhi

Dr. Vikas Singh has over two decades of research experience in the field of air quality. He earned his PhD in air quality modelling from the University of Brescia, Italy, followed by post-doctoral work in UK/EU air pollution projects. As former scientist at the National Atmospheric Research Laboratory, Gadanki, under the Department of Space, his research contributed to the improved understanding of air pollution by integrating surface, satellite and air quality modelling data sets. He has published over 50 research papers in high-impact, peer-reviewed international journals and has worked on a number of national and international projects on air pollution.

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