



SMOG INC. 2.0

2024 Diwali: Nature of the first smog event of the season A briefing note

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Summary highlights of the Diwali pollution

Season's first smog event quite predictably built up on the Diwali day with a rapid and substantial increase in particulate pollution compared to the pre-Diwali days.

Sharp rise on Diwali night: Particulate Matter 2.5 (PM_{2.5}) levels that were already rising steadily during the preceding five days leading up to Diwali, showed a marked increase of 46 per cent from October 28 through October 31. By midnight on October 31, PM_{2.5} hit a peak of 603 microgram per cubic metre ($\mu\text{g}/\text{m}^3$)—13 per cent higher than Diwali peaks observed in both 2022 (when Diwali had occurred on October 24) and 2023 (on November 12). (see Graph 1: Hourly movement of PM_{2.5} in Delhi)

High peak on Diwali night: The 12-hour (from 8 PM to 8 AM) of PM_{2.5} concentration on Diwali night in 2024 was 34 per cent higher than Diwali night in October 2022,-- which was also an October celebration-- going from 289 $\mu\text{g}/\text{m}^3$ to 386 $\mu\text{g}/\text{m}^3$. Moreover, PM_{2.5} levels this year were more than twice as high as the average night-time pollution recorded over the seven nights before Diwali. (*Graph 2: PM_{2.5} levels Diwali-night (8 pm-8 am) vs average of nights in the week preceding Diwali*)

Quick build up and dissipation of Diwali night pollution: However, the unique pattern of Diwali trend this year was sudden sharp increase at night and also quicker dissipation the day after. The PM_{2.5} was in the poor category during the afternoon of October 31st. But the evening build-up peaked to hit the severe levels during mid-night and stayed elevated until early morning next day. This time the dissipation has occurred quicker compared to previous years – not lasting as a smog episode (that is remaining elevated at severe level for at least three consecutive days). It came down to more moderate levels of 97 $\mu\text{g}/\text{m}^3$ by noon. (see Graph 3: Trend in Diwali night Pollution in Delhi).

Favourable atmospheric conditions helped: The reasons behind this late build up and early dissipation of pollution on Diwali day were warm atmospheric conditions with relatively more efficient natural ventilation and adequate wind in the city. This is supposed to be one of the warmest October this year.

Differing trend during the day: Interestingly, the daytime (6 AM to 4 PM) air pollution on Diwali day showed comparatively higher levels. The average PM_{2.5} concentration during the day was 92 per cent higher than last year's Diwali daytime average that was affected by the deeper inversion conditions of the winter. This reflects high local and regional pollution aided by the sharp increase in the share of farm fires.

Pollution hotspots on Diwali night: There was a massive build-up of pollution in different parts of the city on Diwali night – hitting severe levels and increasing the peak exposure levels for a large section of the population. This year, 9 out of 38 air quality monitoring stations recorded PM_{2.5} concentrations exceeding the critical threshold of 900 $\mu\text{g}/\text{m}^3$ on Diwali night. The highest levels were observed at Nehru Nagar, reaching 994 $\mu\text{g}/\text{m}^3$, followed closely by Anand Vihar at 992 $\mu\text{g}/\text{m}^3$, Pusa IMD at 985 $\mu\text{g}/\text{m}^3$, Wazirpur at 980 $\mu\text{g}/\text{m}^3$, and JLN Stadium at 963 $\mu\text{g}/\text{m}^3$. Other affected areas are Okhla, CRRI-Mathura



Road, Karni Singh Stadium, Lodi Road, Siri Fort etc (Graph 4: Hourly peak pollution in different parts of Delhi on Diwali-night)

Contribution from farm fires increased sharply on Diwali day: There was sudden and sharp escalation in farm fire count on the day of Diwali and that combined with the change of wind direction to north westerly. This increased the share of its contribution to Delhi’s air quality by 27 per cent. According to the data from the IARI the fire count had increased from 60 on October 30 to 605 on October 31. (See Graph 5: Contribution of farm fire peaks on Diwali day). Punjab accounted for the highest share at 80 percent, followed by Uttar Pradesh at 13 percent, and Haryana at 7 percent. North-westerly winds prevailed during the day on October 31, amplifying the impact of stubble burning on Delhi’s air quality.

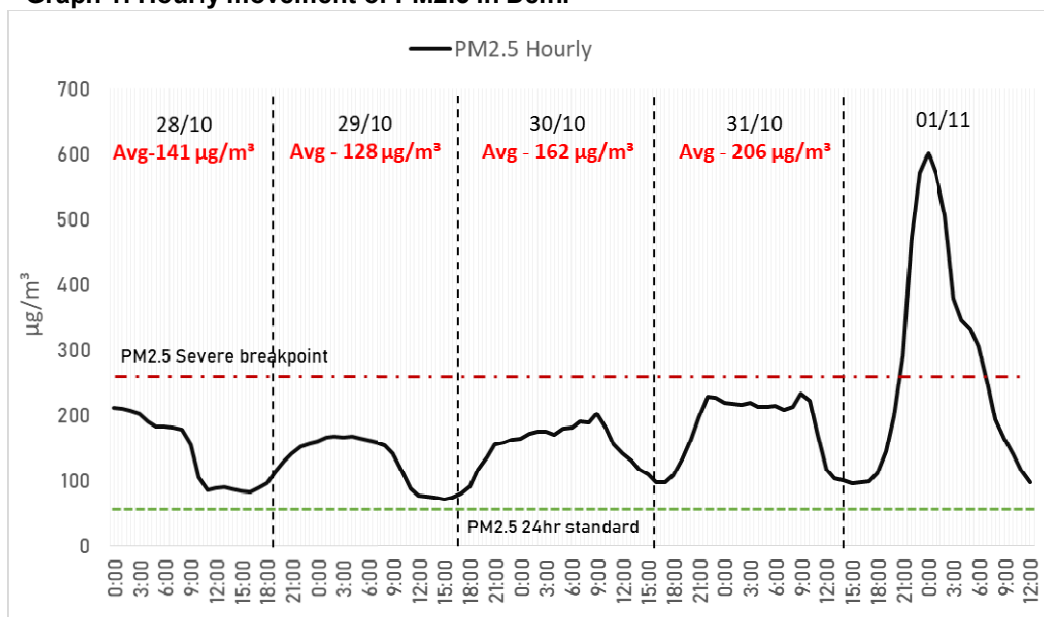
End point

The favourable atmospheric conditions during the warm October of 2024 has contributed towards quicker dissipation of the night time pollution peak and also prevented a more durable smog episode from building up. But further intensification of air pollution is expected to happen with the anticipated worsening of inversion conditions that lead to cold and calm weather conditions during winter that traps and thickens pollution.

It is important to note that this time, air quality of Delhi has turned from poor to very poor even when the share of smoke from farm fires has been less than one to three per cent. This brings out the high impact of local air pollution sources that require urgent mitigation at scale and with speed.

Snapshots of data analysis

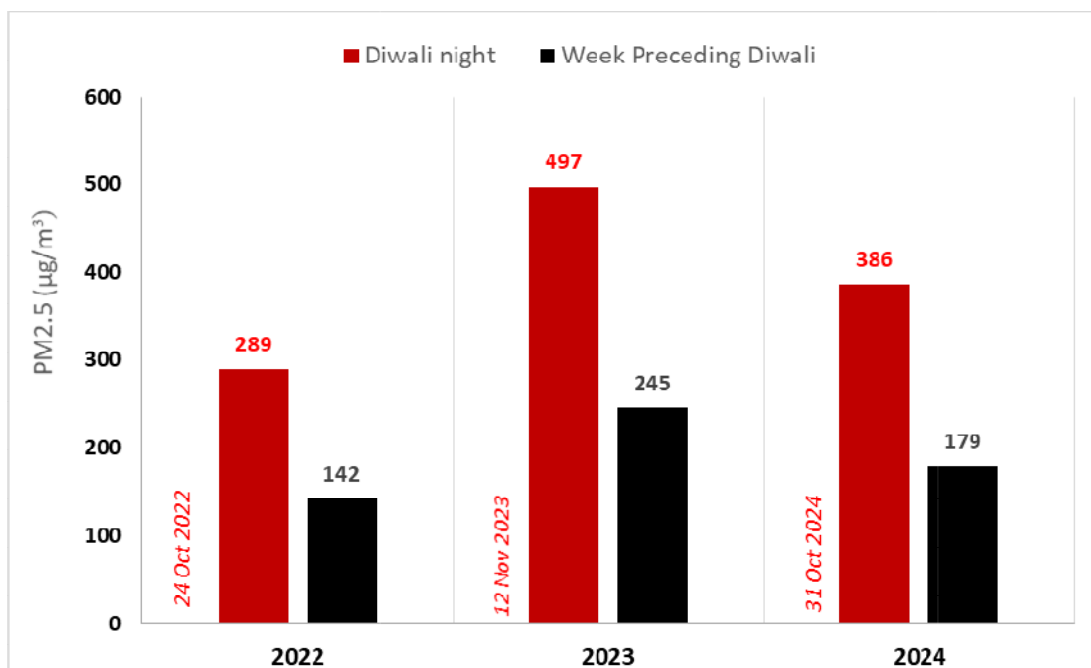
Graph 1: Hourly movement of PM2.5 in Delhi



Note: Average PM2.5 concentration is based on the mean of daily values recorded at CAAQM stations in the city that have adequate data. 24-hr average is based on midnight to midnight.

Source: CSE analysis of CPCB’s real-time air quality data

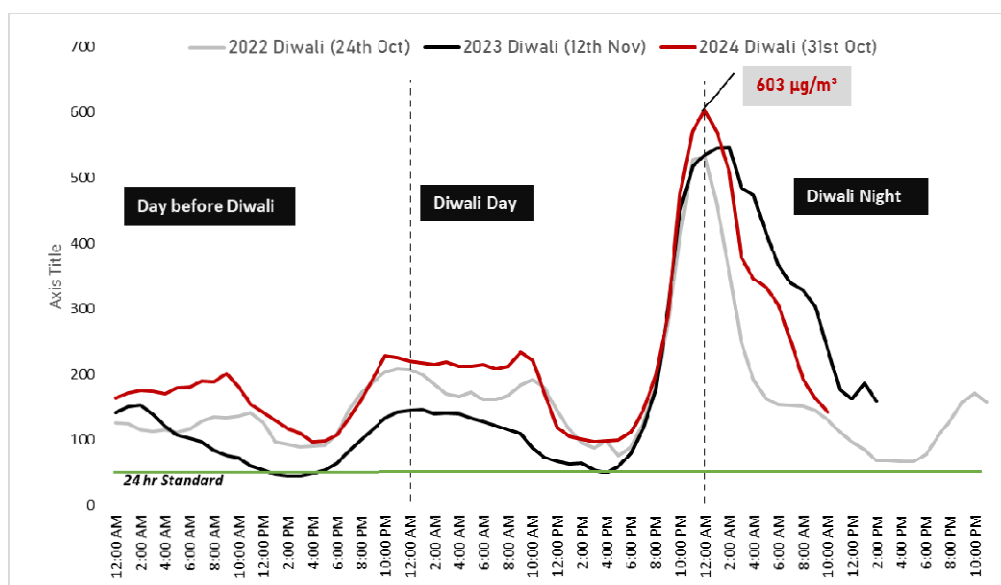
Graph 2: PM2.5 levels Diwali-night (8 pm-8 am) vs average of nights in the week preceding Diwali



Note: Average concentration is based on mean of 12hr values recorded at CAAQM stations in the city that have adequate data for all three years. Nighttime is 8pm to 8am. Pre-diwali night average is mean of nighttime levels of seven preceding nights.

Source: CSE analysis of CPCB’s real-time air quality data

Graph 3: Trend in Diwali night Pollution in Delhi

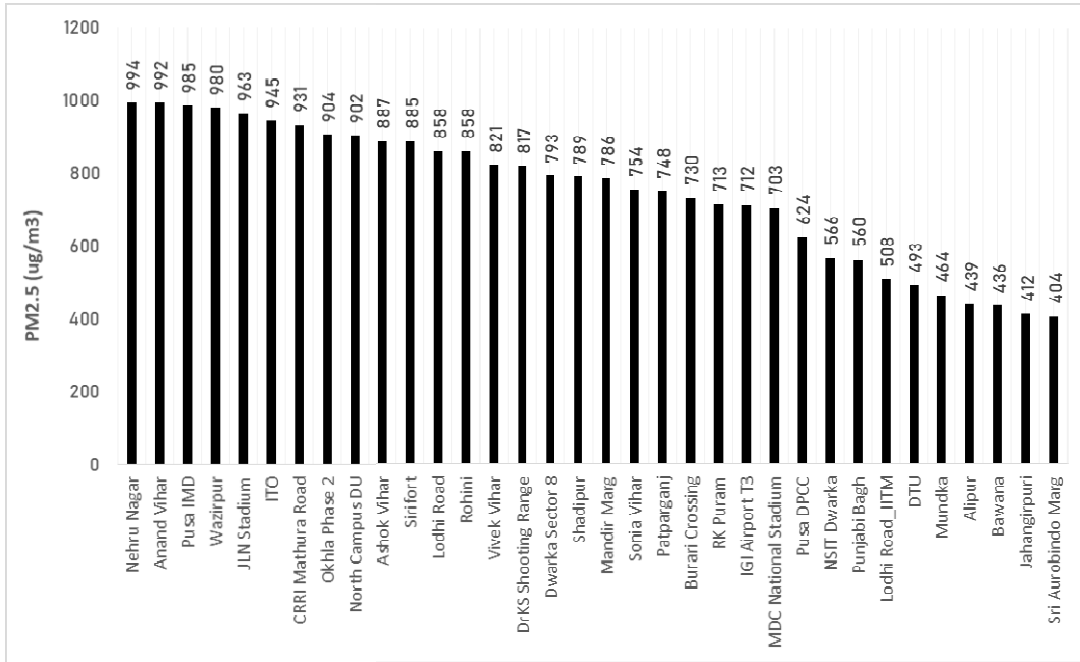


Note: Average PM_{2.5} concentration is based on the mean of daily values recorded at CAAQM stations in the city that have adequate data.

Source: CSE analysis of CPCB’s real-time air quality data

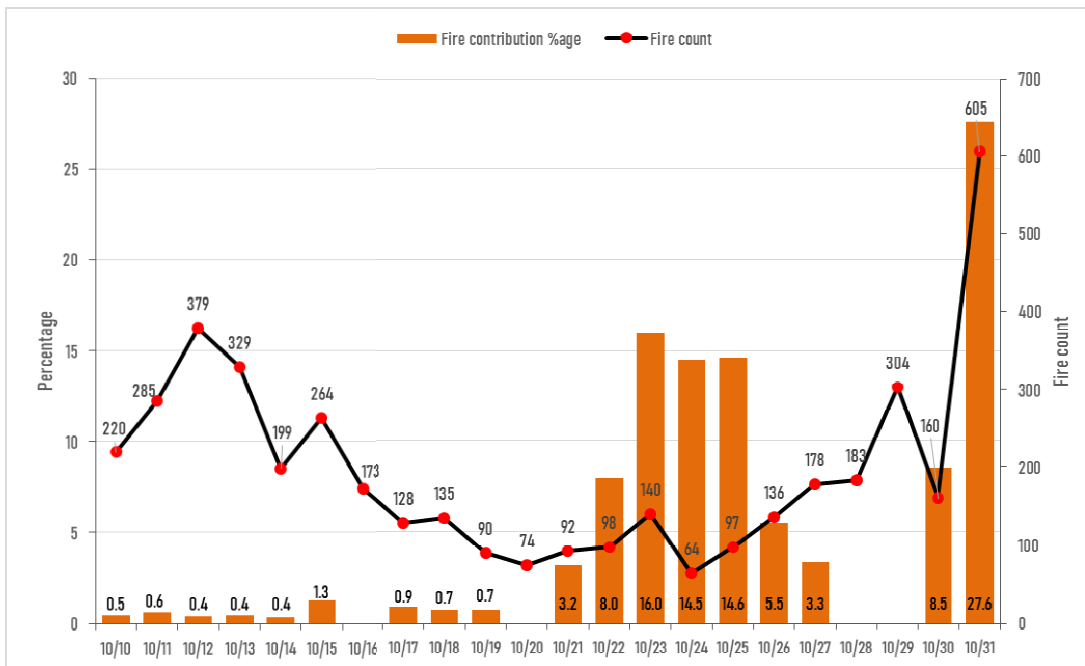


Graph 4: Hourly peak pollution in different parts of Delhi on Diwali-night



Source: CSE analysis of CPCB real time air quality data

Graph 5: Contribution of farm fire peaks on Diwali day

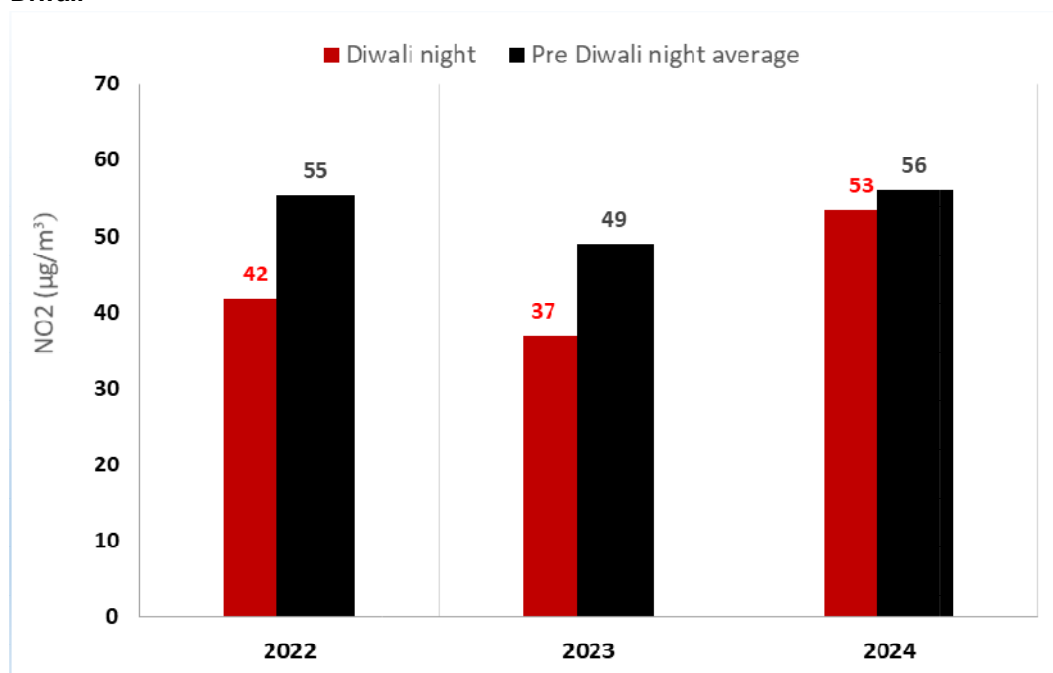




Note: Farm stubble fire smoke contribution to Delhi's PM2.5 level is based on the SAFAR India publication and Farm stubble fire count data is based on the IARI data. Data from October 10- 31, 2024. Source: CSE analysis based on the IARI and SAFAR data.

Diwali traffic shows up as elevated NO2 levels: Diwali night this year had higher NO2 levels compared to last year Diwali night. NO2 level in last three years have been higher on Diwali night and also the nights preceding it, which is indicative of congestion and high traffic conditions in the city leading to the festival night. ITO had highest NO2 levels in the city with night-time average of 182 $\mu\text{g}/\text{m}^3$. JLN Stadium and Patparganj with 104 $\mu\text{g}/\text{m}^3$ and 101 $\mu\text{g}/\text{m}^3$ were the other NO2 hotspot on Diwali night. Lodhi Road with just 2 $\mu\text{g}/\text{m}^3$ of NO2 was the least affected area in the city.

Graph 5: Diwali-night (8pm-8am) NO2 levels vs average NO2 level at nights in the week preceding Diwali



Note: Average concentration is based on mean of 12hr values recorded at CAAQM stations in the city that have adequate data for all four years. Nighttime is 8pm to 8am. Pre-Diwali night average is mean of nighttime levels of seven preceding nights.

Source: CSE analysis of CPCB's real-time air quality data

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