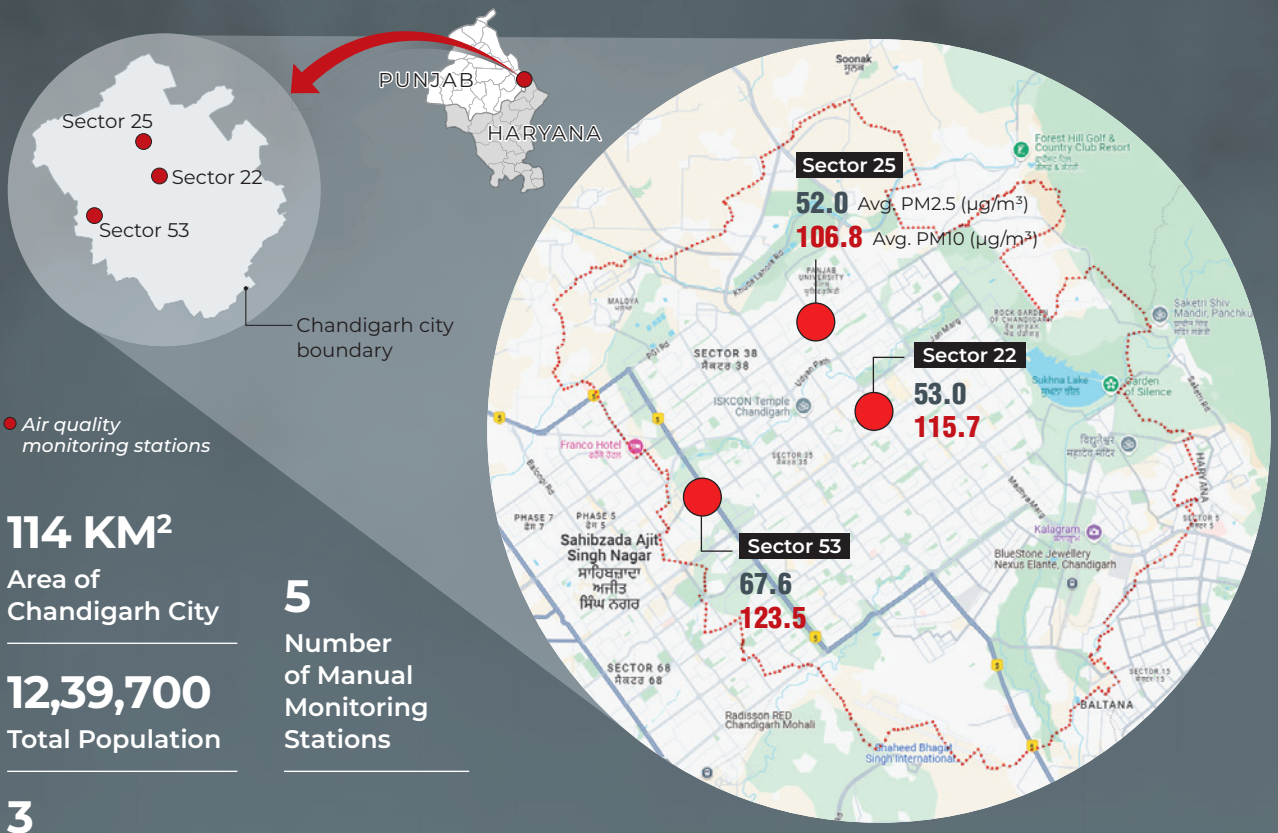
KNOW YOUR CITY AND WHAT YOU BREATHE

CHANDIGARH AIR POLLUTION FACT SHEET

Chandigarh has three Continuous Ambient Air Quality Monitoring Stations (CAAQMS) which are operated and maintained by Chandigarh Pollution Control Committee (CPCC). The stations are located in the Northern and Central part of the city.



114 KM²
Area of Chandigarh City

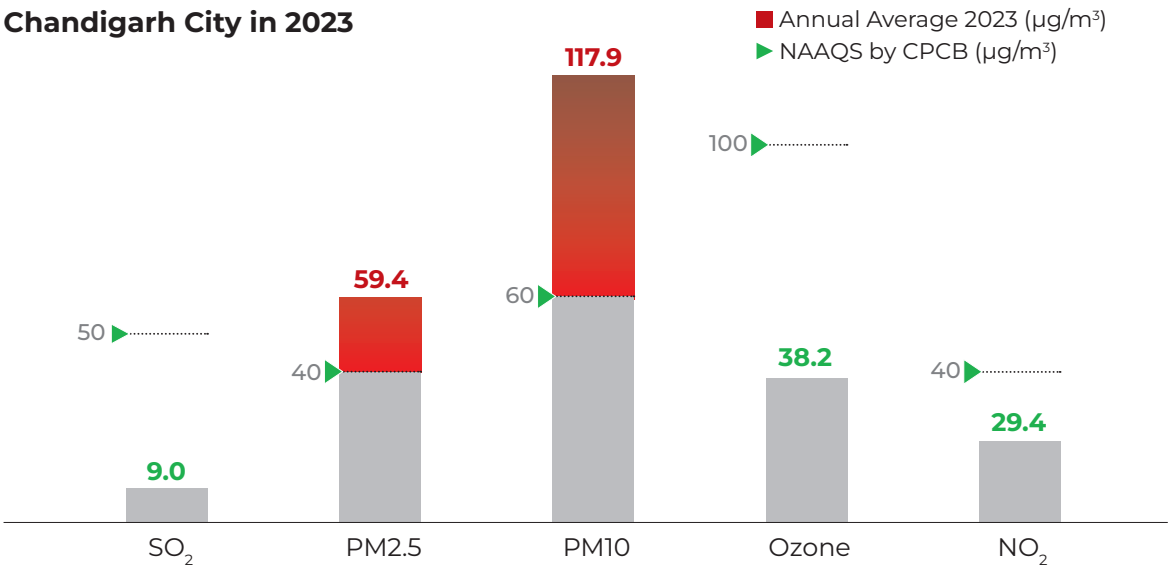
12,39,700
Total Population

5
Number of Manual Monitoring Stations

3
Number of Continuous Monitoring Stations

Pollutant Concentration

Chandigarh City in 2023



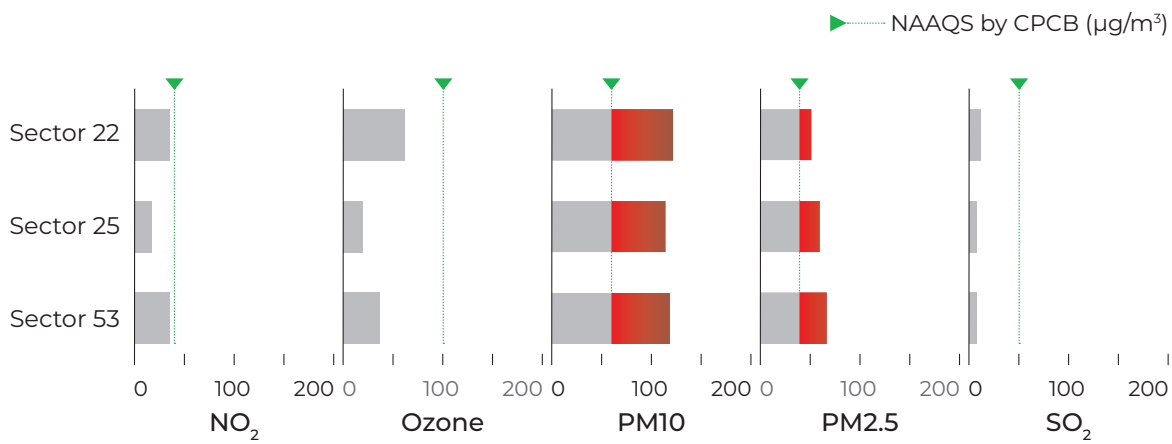
Source: iFOREST Analysis

The annual average PM2.5 and PM10 concentration for 2023 was found to be 59.4 µg/m³ and 117.9 µg/m³ respectively.

The PM2.5 concentration levels in Chandigarh City were around 1.5 times the permissible levels of NAAQS.

The PM10 concentration level in Chandigarh City was around twice the permissible levels of NAAQS.

Concentration of Major Pollutants for year 2023



Annual average PM10 and PM2.5 concentration recorded at **all monitoring stations** is **1.5 to 2 times** NAAQS.

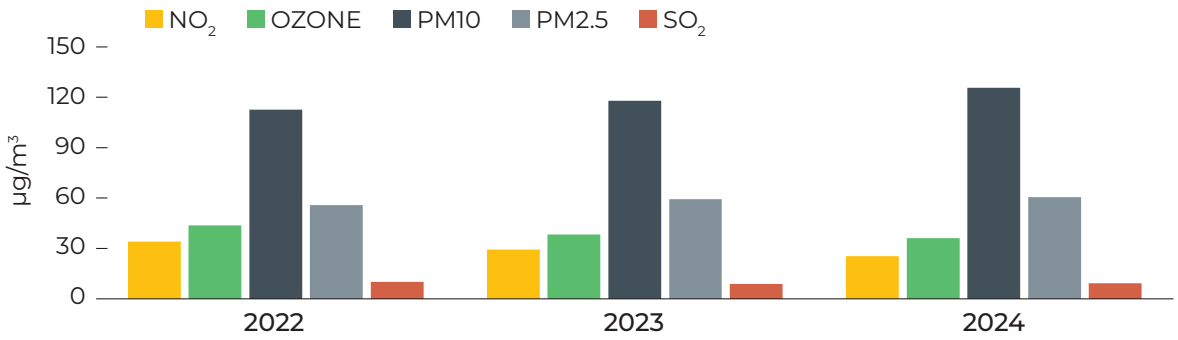
Sector 22 monitoring site shows **lowest PM2.5 concentration**, however, it shows highest **NO_2 and SO_2** concentration. **Sector 25 monitoring** site shows **lowest PM10, NO_2, Ozone and SO_2** concentration.

Annual average **SO_2, NO_2** and **Ozone** concentration are **well within NAAQS** at all stations.

Concentration trends in Chandigarh city

ANNUAL

Average Concentration (µg/m³) of key pollutants (2022-2024)



The **average PM 10** concentration has **increased by around 11.5%** since 2022.

The average **PM2.5 concentration** has **increased by around 8.4%** since 2022.

NO_2 concentration has **fallen by 25.7%** since 2022.

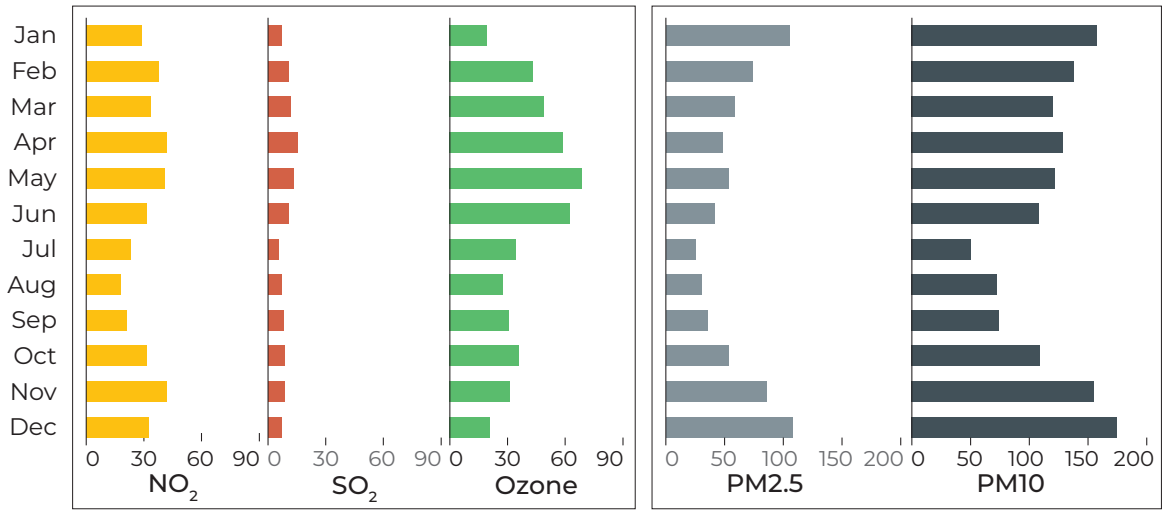
SO_2 and Ozone Concentrations have **decreased by 6.7% and 17%** respectively since

Annual PM10 and PM2.5 Trends

Years	PM10	% Decrease/Increase		PM2.5	% Decrease/Increase	
2022	112.6			55.8		
2023	117.9	5%	↑ Rise	59.4	6%	↑ Rise
2024	125.6	7%	↑ Rise	60.5	2%	↑ Rise

MONTHLY

Average Concentration (µg/m³) of key pollutants (2022- 2023)



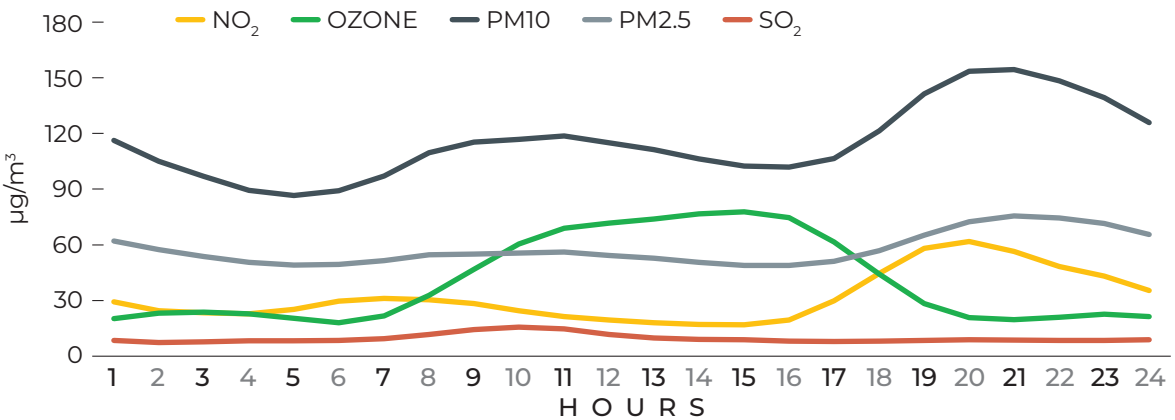
Pollutants	NO_2	SO_2	Ozone	PM2.5	PM10
Most polluted month	November	April	May	December	December
Least Polluted month	August	July	January	July	July

PM2.5 concentration **during monsoon** months – July to September – **falls within limits** set by NAAQS.

Ozone, NO_2 and SO_2 concentration is **high during summer months** – April to June – but it falls within limits set by NAAQS.

HOURLY

Average Concentration (µg/m³) of key pollutants (2022-2023)



The morning and evening peaks for PM10 and PM2.5 are observed around 8-10AM and 7-9PM.	**NO_2 concentration peaks between 7 to 9PM and is around 1.2 times the daily average.**	**Ozone concentration is high between 2 to 4PM. It is around 1.1 times higher than the daily average.**	**SO_2 concentration is stable throughout the day, with a minor peak between 9 to 11AM.**

What does PM2.5/PM10 reveal?

The PM2.5/ PM10 value varies between 0.46 and 0.52 in the assessment years. A lower value (<0.5) indicates existence of higher PM particles.

Air Pollution data availability in Chandigarh City

ANNUAL AVERAGE (2019-2023)

Years	NO_2	OZONE	PM10	PM2.5	SO_2
2019	8%	10%	9%	8%	10%
2020	30%	31%	31%	31%	31%
2021	43%	44%	44%	45%	43%
2022	84%	86%	88%	88%	84%
2023	88%	90%	91%	91%	85%

MONTHLY AVERAGE (2022-2023)

Months	NO_2	OZONE	PM10	PM2.5	SO_2
January	61%	62%	62%	62%	60%
February	90%	88%	91%	90%	88%
March	92%	93%	94%	95%	91%
April	93%	94%	97%	97%	93%
May	91%	90%	93%	94%	87%
June	91%	91%	93%	93%	89%
July	87%	88%	91%	89%	84%
August	88%	90%	94%	94%	88%
September	89%	92%	94%	93%	89%
October	87%	94%	95%	96%	86%
November	92%	94%	97%	97%	92%
December	73%	75%	77%	77%	72%

STATION AVERAGE (2022-2023)

Locations	NO_2	OZONE	PM10	PM2.5	SO_2
SECTOR 22	81%	83%	86%	85%	80%
SECTOR 25	89%	91%	92%	92%	89%
SECTOR 53	89%	89%	91%	91%	86%

Refer to the methodology adopted in *page 7.*

Overall quality of air pollution data from CAAQMS in Chandigarh City **is in Category 'Excellent'** during 2022-2023.

As this is not the case **for years 2019-2021**, these years have not been considered for the analysis.

Month wise data availability **is 'Good' to 'Excellent'** for 2022-2023.

Station wise data availability is **'Excellent'** for 2022-2023.

ANNEXURE

Context and significance of big data analytics for air pollution

- Understanding air pollution phenomena using big data analysis techniques helps support critical decision making for improving air quality
- The real time and continuous pollutant concentration data recorded by the ground air pollution monitoring stations in the city, typically known as Continuous Ambient Air Quality Monitoring Stations (CAAQMS), can be aggregated to form the big data that can be analysed to understand pollution patterns.
- CAAQMS record concentration of various pollutants at an average frequency of 15 seconds. Data recording at such short intervals of 15 seconds provides rich data for correlation with economic activities for source mapping.
- Big data regarding concentration of pollutants can also help policy makers understand the trends- Yearly, Monthly and Hourly of different pollutants in different locations and identify hot spots for suitable action.
- However, data cleaning to remove biases and poor quality data, is a critical step while using big data analysis before calculating average pollutant concentrations at every location.
- Recommendations based on this assessment can help in formulation of hyper-local action plans for the city.

Guidelines available for Air Pollution measurements

PM10	PM2.5	NO_2	SO_2	Ozone

- The key pollutants, as per the CPCB guidelines, for calculation of Air Quality Index and consideration of a zone as non-attainment or polluted zone are PM10, PM2.5, NO_2, SO_2 and Ozone .
- According to CPCB, the region or location is considered as polluted or is considered as a non-attainment region, if the annual average, taken of 104 measurements, that is 2-day data for each week, 4-hour sample for gaseous and 8-hour sample for PM, exceeds the values mentioned in the National Ambient Air Quality Standards (NAAQS). The permissible level or standard for the key pollutants are:
  - PM 10 : 60 µg/m^3.
  - PM2.5 : 40 µg/m^3.
  - NO_2 : 40 µg/m^3.
  - SO_2 : 50 µg/m^3.
  - Ozone : 100 µg/m^3.
- According to World Health Organization (WHO), a region or a zone is considered as prone to health risks, if the Annual average concentration and 99th percentile of day's average, particularly in case of SO_2, exceeds the values mentioned in the guidelines. The WHO guidelines for the key pollutants are :
  - PM 10 : 15 µg/m^3.
  - PM2.5 : 5 µg/m^3.
  - NO_2 : 10 µg/m^3.
  - SO_2 : 40 µg/m^3.
- According to National Centre for Biotechnology Information PM2.5/ PM 10 ratio is an important factor in understanding the source of pollution in the region. A high PM2.5/PM10 ratio (>0.5) typically suggests that fine particles and secondary particulates such as NO^3-, SO^42- NH4+, and organics, are major contributors. Conversely, a lower PM2.5/ PM10 ratio indicates the dominance of coarse particles.

METHODOLOGY ADOPTED

For Continuous Ambient Air Quality Monitoring Station (CAAQMS) data to be reliable, especially in cases where pollutant concentrations and meteorological parameters like wind speed are being recorded, a robust methodology for data cleaning, aggregation, and analysis is crucial. This ensures accurate yearly, monthly, and hourly trend analysis as well as hot spot identification based on 'Good' quality data.

Methodology

Collection of time series data (15 minute frequency) of pollutants recorded at different CAAQMS in the city from Central Pollution Control Board website.

↓

Aggregating data to form big-data of the complete city.

↓

Clearing out the monthly data points of pollutant, if the data recorded in any month for any year is less than 60%.

↓

Clearing out daily data points of pollutant, if the data recorded on any day is less than 60%.

↓

Data Visualisation and Analysis.

Data Quality Based on clean data availability

Data Availability %	Data Quality
>80%	Excellent
60%-80%	Good
40%-59%	Moderate
<40%	Poor

Major pollutant hots pots have been identified in this factsheet on the basis of relative average annual concentration of the pollutants across locations and the guidelines specified by Central Pollution Control Board.

Cleaned data → Relative pollutant concentration analyzed by taking an average of the pollutant for available data points

iFOREST INTERNATIONAL FORUM FOR ENVIRONMENT, SUSTAINABILITY & TECHNOLOGY