2024

World Air Quality Report

Region & City PM2.5 Ranking

IQAir

Contents

About this report

The 2024 World Air Quality Report evaluates the global state of air quality for the year 2024. This comprehensive report presents PM2.5 air quality data collected from 8,954 cities across 138 countries, regions, and territories. The data used herein is sourced from over 40,000 regulatory air quality monitoring stations and low-cost sensors, operated by a diverse range of entities, including government agencies, research institutions, non-profit organizations, schools, universities, private sector companies, and dedicated citizen scientists worldwide.

The PM2.5 data is measured in micrograms per cubic meter (µg/m³) and the data is visualized as a function of the World Health Organization (WHO) annual PM2.5 air quality guideline. The air quality metrics included in this 2024 report derive from IQAir's real-time online monitoring platform, which systematically validates, calibrates, and harmonizes data from air quality monitoring stations globally.

For further **historic air quality information** categorized by city, country, and region, the IQAir website offers **an interactive map displaying annual city concentrations** alongside global rankings of air quality for the 8,954 cities featured in this report. IQAir is committed to engaging, informing, and inspiring a collaborative effort among governments, educators, researchers, non-profit organizations, businesses, and citizens to elevate air quality awareness. Our goal is to facilitate informed dialogue and promote actions that enhance air quality and safeguard the health of communities and cities around the world.

Executive summary

Air pollution remains the greatest environmental threat to human health. According to the World Health Organization (WHO), 99% of the global population lives in areas that do not meet recommended air quality guideline levels.[1] Air pollution is the second leading global risk factor for death, and the second leading risk factor for deaths among children under five, following malnutrition, due to its significant impact on respiratory and developmental health.[2] In 2021 alone, 8.1 million total deaths were attributable to air pollution, with 58% of those deaths caused by ambient PM2.5 air pollution.[3]

The United Nations has declared access to healthy air is a universal human right.[4] Exposure to PM2.5 contributes to and exacerbates various health conditions, including asthma, cancer, stroke, and lung diseases.[5] In addition, exposure to elevated levels of fine particles during pregnancy and early childhood are associated with congenital heart defects, eczema and allergic disease, cognitive impairments and delays, neurodevelopmental disorders, and mental health disorders.[6]

The data used to create this report was compiled from over 40,000 air quality monitoring stations and low-cost sensors worldwide, operated by research institutions, government agencies, schools, universities, non-profit organizations, private companies, and citizen scientists.

The 2023 World Air Quality Report included data from 7,812 locations in 134 countries, regions, and territories. In 2024, those numbers have grown to 8,954 cities in 138 countries, regions, and territories. Coverage has expanded in Africa to include Chad, the most polluted country in 2024, along with Djibouti and Mozambique. The countries of Iran, Afghanistan, and Burkina Faso (ranked 5th most polluted country in 2023) are notably absent in 2024 due to a lack of data availability.

Only 12 countries, regions, and territories recorded PM2.5 concentrations below the WHO annual PM2.5 guideline of 5.0 µg/m³, most of which were in the Latin America and Caribbean or Oceania region; however in 2024, 17% of cities included in the report met the WHO annual PM2.5 guideline level, up from 9% in 2023. While this marks some progress, much more work has yet to be done to protect human health, especially that of children. It is our shared responsibility to safeguard the health and well-being of the world's children, who will one day become the leaders of tomorrow. By equipping them with the knowledge and resources they need, we empower them to tackle the global challenges of the future.

Where does the data come from?

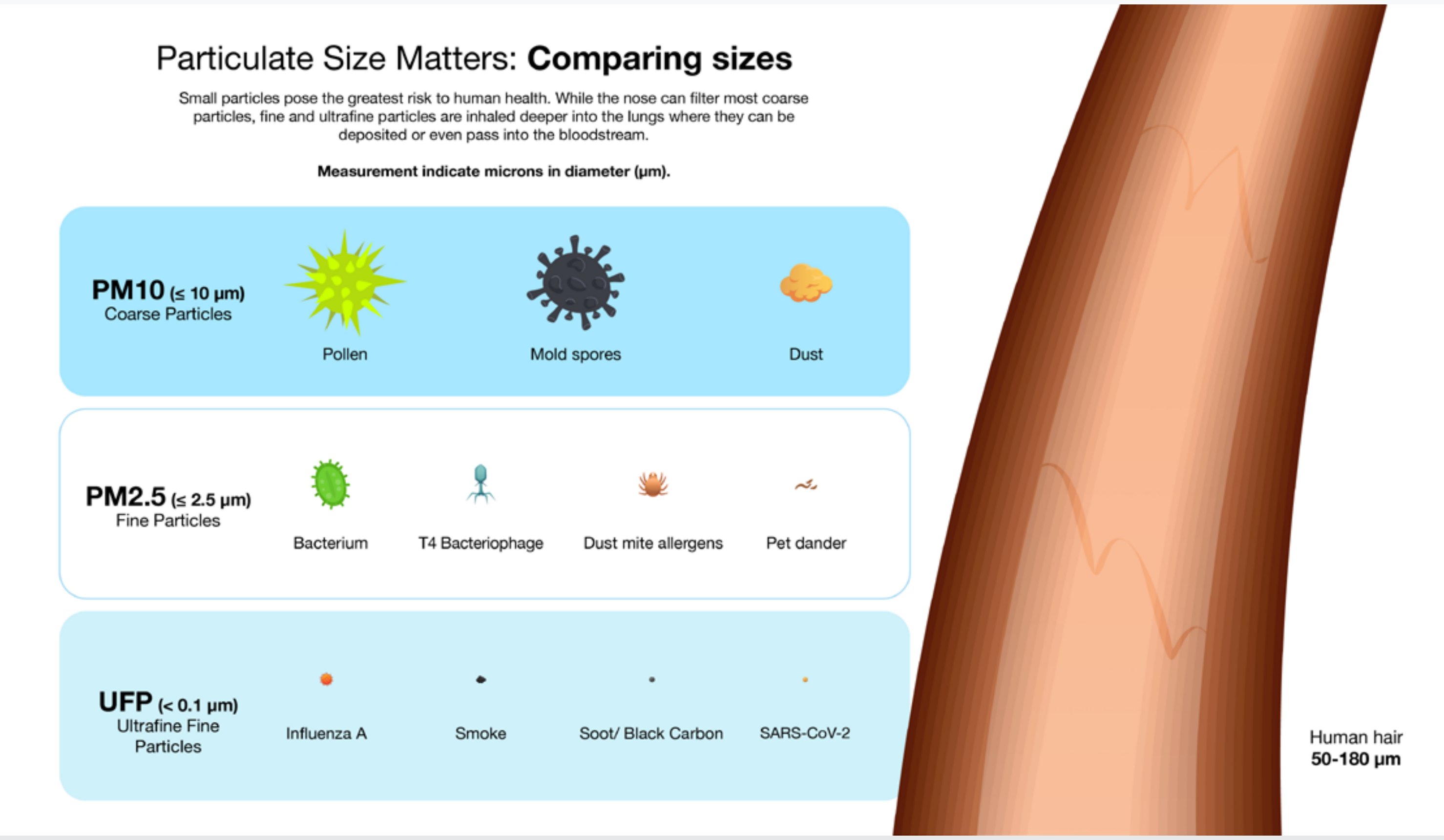
Unlike many air quality reports and applications that rely on modeled satellite data, this report is based solely on empirically measured PM2.5 data collected from ground-level air monitoring stations. The PM2.5 data for this report is aggregated from both regulatory air quality monitoring instruments and low-cost sensors. These instruments are operated by a variety of entities, including government agencies, educational institutions, non-profit organizations, and individual citizens dedicated to tracking local air quality. Most of the data utilized in the World Air Quality Report is collected in real-time, supplemented by historical year-end datasets to ensure the most comprehensive global analysis possible.

The data from individual monitoring stations and sensors are organized into "settlements," indicating cities, towns, villages, counties, or municipalities, reflecting local population distributions and administrative divisions. For the purposes of this report, these "settlements" will be referred to as cities. The annual PM2.5 concentrations and rankings for countries and regions are calculated as population-weighted averages based on city-level data.

Why PM2.5?

PM2.5 concentration, fine particulate matter that is less than or equal to 2.5 microns in diameter, serves as the standard air quality metric for this report. Reported in micrograms per cubic meter (μg/m^3), PM2.5 is one of six key air pollutants recognized and monitored globally due to its significant adverse effects on human health.

PM2.5 originates from a wide array of sources, leading to variations in its chemical composition and physical properties. Common constituents of PM2.5 include sulfates, nitrates, ammonium, and carbon. Major anthropogenic sources of PM2.5 include combustion engines, power generation, industrial activities, crop burning and agricultural practices, and wood and coal burning. Natural sources contributing to PM2.5 include dust storms, sandstorms, and wildfires.



Schools4Earth

Technician installs an air quality monitor in The Gambia, expanding a nationwide network that tracks pollution in real time.

Schools4Earth is IQAir's global initiative to bring real-time air quality monitoring to schools. By providing affordable air monitors, Schools4Earth empowers educators, students, and communities with vital environmental data to protect student health and reduce exposure to harmful air pollution.

IQAir estimates that only 21% of the world's population has access to real-time, hyper-local air quality data. Schools4Earth helps close this gap by turning schools into air quality hubs, equipping them with air quality monitors that track pollutants like PM2.5.

If every school worldwide had a monitor, real-time air quality access could increase to 94% globally.

Through the Schools4Earth program, parents, companies, school administrators and community groups can sponsor a school to monitor air quality, while IQAir provides logistics, installation, data and educational support, making it easy for schools to start environmental monitoring.

Each participating school receives an outdoor air quality monitor, real-time air quality updates via the IQAir platform, full access to their air quality data, and the opportunity to contribute data to global environmental initiatives.

IQAir's goal is to equip over 1 million schools with monitors, expanding access to hyper-local air quality data for more than 7 billion people worldwide.

To learn more or support a school, visit www.iqair.com/us/schools4earth.

Students at Al Ghaf School in Dubai with a Schools4Earth air quality monitor.

The greater impact of PM pollution on children

Particulate matter (PM) pollution, particularly fine particles (PM2.5), poses significant health risks to children due to their unique physiological and behavioral characteristics. Children are more vulnerable to air pollution because they breathe more air per unit of body weight than adults. Combined with their higher relative respiratory rate, this results in children receiving larger doses of air pollution than adults when exposed to the same environment. Additionally, children have less effective nasal filtration and are more likely to breathe through their mouths, bypassing some of the body's natural defenses against airborne particles. These factors collectively heighten their risk of respiratory and other health issues from air pollution.[7]

Inhaled PM2.5 particles can penetrate deep into the respiratory system and, in some cases, enter the bloodstream, increasing the risk of harm to developing organs and immune systems. Research shows that exposure to PM2.5 during critical growth stages can impair lung development, reduce lung function, and raise the likelihood of respiratory conditions such as asthma and bronchitis.[8] Additionally, PM2.5 often contains toxic substances like heavy metals and organic pollutants, which exacerbate oxidative stress in young bodies.[9] This oxidative stress can trigger inflammation, disrupt development, and weaken immune function, increasing susceptibility to infections and chronic diseases later in life.[10]

Children's behavior and activity patterns further heighten their vulnerability to particulate matter pollution. They spend more time outdoors, particularly engaging in physical activities like playing or sports, which elevate their respiratory rates and increase the inhalation of polluted air. Exposure to PM2.5 has also been linked to adverse cognitive and neurodevelopmental effects.[11] Fine particles can cross the blood-brain barrier, disrupting neural development and potentially causing long-term consequences such as diminished academic performance and greater susceptibility to chronic diseases in adulthood.

To protect this vulnerable population, policymakers and educators must prioritize reducing children's exposure to PM pollution. Effective measures include real-time air quality monitoring in schools, enabling swift responses when conditions deteriorate, alongside stricter emissions regulations, incorporating air quality considerations into urban planning and school site selection, developing protocols for outdoor activities during poor air quality conditions, and launching public awareness campaigns. These measures are essential to safeguarding children's health and supporting their long-term well-being.

Data presentation

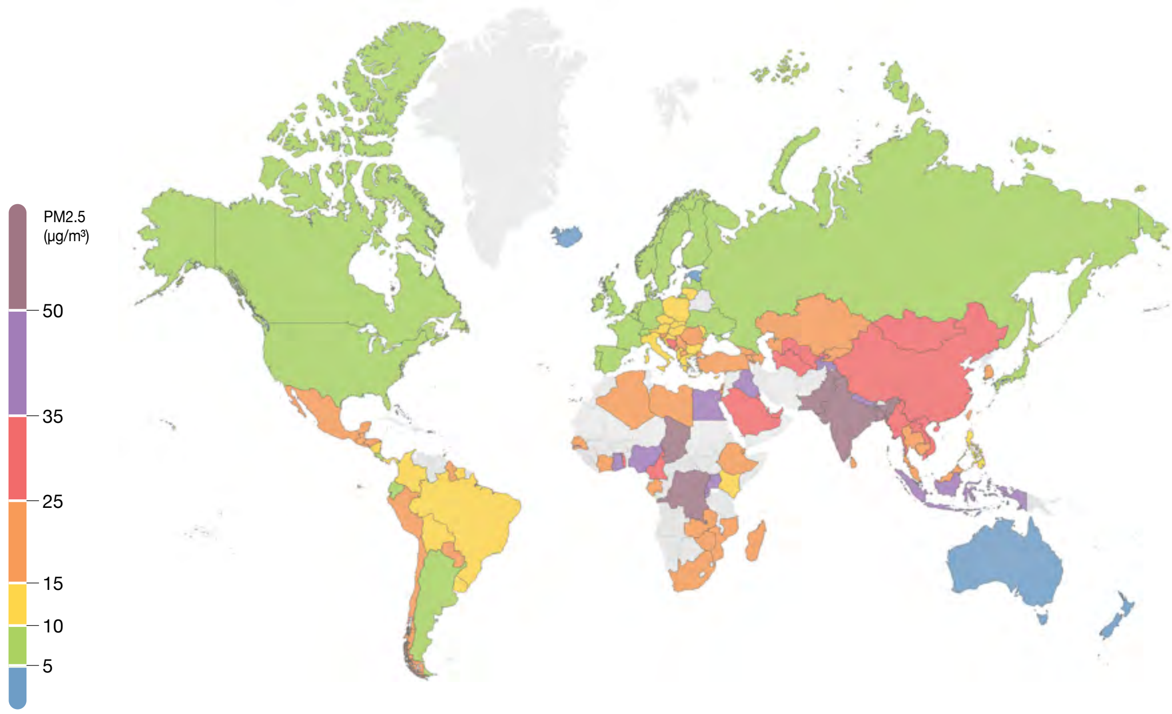
This report uses the (WHO) annual PM2.5 air quality guideline and interim target levels for data visualization. This approach makes it easier to identify cities and regions facing significant health risks due to high concentrations of PM2.5 pollution.

The following table outlines the color-coding framework applied throughout the report. Seven distinct colors are used, each corresponding to a range of PM2.5 concentrations aligned with WHO annual guideline or target values. The color spectrum progresses from blue, displaying the lowest PM2.5 levels in locations meeting the WHO annual guideline, to maroon, which indicates the highest PM2.5 concentrations that surpass the guideline level by more than ten times.

2024 World Air Quality Report visualization framework

Annual PM2.5 breakpoints based on WHO annual PM2.5 guideline and interim targets	PM2.5	Color code	WHO levels
Meets WHO PM2.5 guideline	0-5 (μg/m³)	Blue	Air quality guideline
Exceeds WHO PM2.5 guideline by 1 to 2 times	5.1-10 (μg/m³)	Green	Interim target 4
Exceeds WHO PM2.5 guideline by 2 to 3 times	10.1-15 (μg/m³)	Yellow	Interim target 3
Exceeds WHO PM2.5 guideline by 3 to 5 times	15.1-25 (μg/m³)	Orange	Interim target 2
Exceeds WHO PM2.5 guideline by 5 to 7 times	25.1-35 (μg/m³)	Red	Interim target 1
Exceeds WHO PM2.5 guideline by 7 to 10 times	35.1-50 (μg/m³)	Purple	Exceeds target levels
Exceeds WHO PM2.5 guideline by over 10 times	>50 (μg/m³)	Maroon	Exceeds target levels

2024 Global PM2.5 Map



2024 global map color coded by annual average PM2.5 concentration.

Countries, territories, and regions in Africa and Central and South Asia continue to report the highest population-weighted annual average PM2.5 concentrations. While Africa's air quality monitoring network is expanding, data availability remains inconsistent, with only 24 out of 54 countries or territories reporting data in 2024. West Asia is also underrepresented and requires more robust monitoring. Although Iraq was added to the report this year, key omissions remain, including Afghanistan, Iran, and Oman.

Overall, 10 new countries or territories were included in the 2024 report compared to 2023, with the majority coming from Africa (4) and the Latin America and Caribbean region (5). Globally, only 12 countries or territories recorded PM2.5 concentrations below the WHO guideline of 5.0 µg/m³, most of which were in the Latin America and Caribbean or Oceania regions.

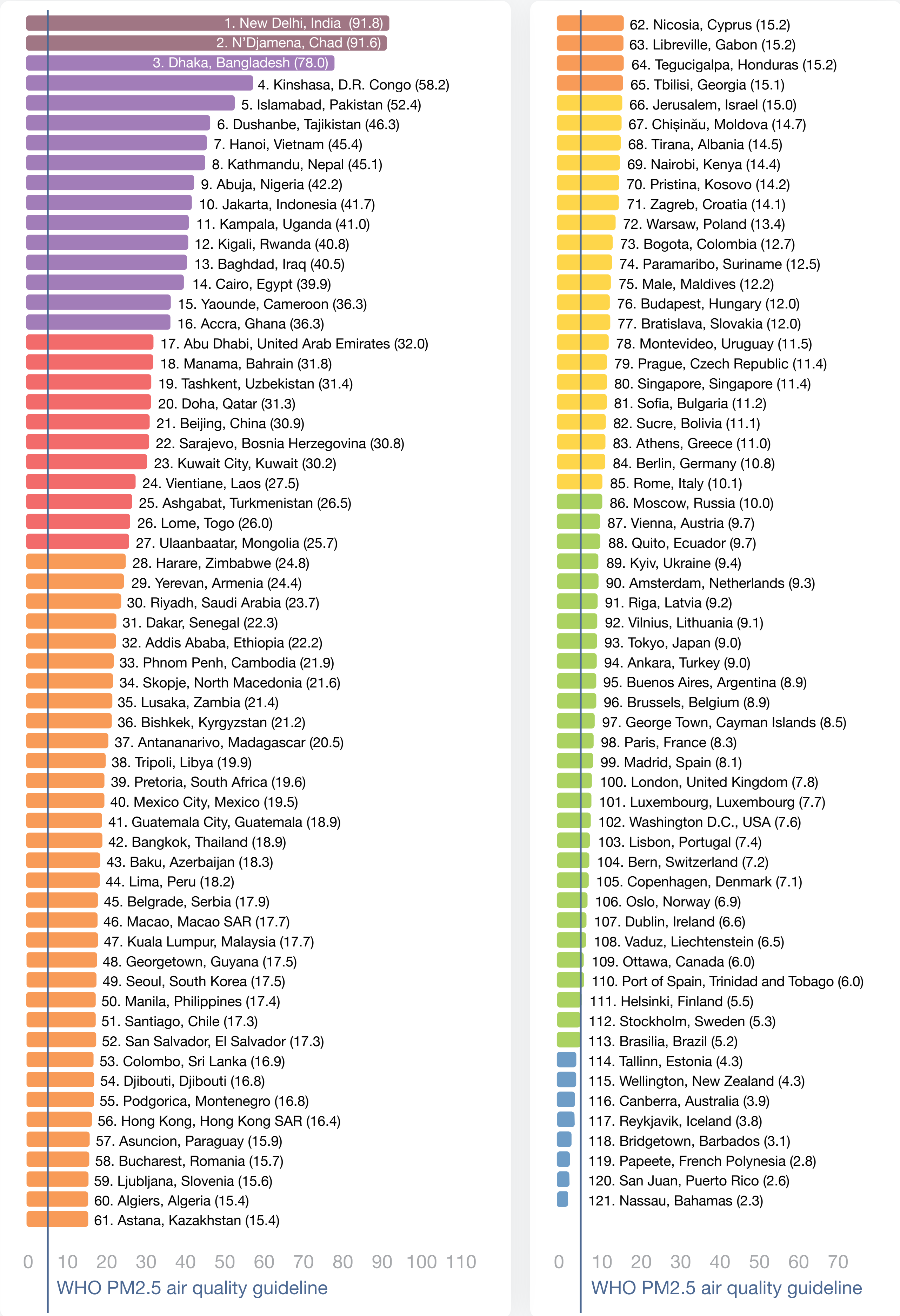
2024 Country/region ranking

Population weighted, 2024 average PM2.5 concentration (µg/m³) for countries, regions, and territories in descending order.

1	Chad	91.8
2	Bangladesh	78.0
3	Pakistan	73.7
4	D.R. Congo	58.2
5	India	50.6
6	Tajikistan	46.3
7	Nepal	42.8
8	Uganda	41.0
9	Rwanda	40.8
10	Burundi	40.3
11	Nigeria	40.1
12	Egypt	39.8
13	Iraq	38.4
14	Ghana	35.8
15	Indonesia	35.5
16	Gambia	35.2
17	United Arab Emirates	33.7
18	Bahrain	31.8
19	Uzbekistan	31.4
20	Qatar	31.3
21	China	31.0
22	Kuwait	30.2
23	Vietnam	28.7
24	Cameroon	27.6
25	Laos	27.5
26	Turkmenistan	26.5
27	Togo	26.0
28	Mongolia	25.6
29	Bosnia Herzegovina	25.3
30	Myanmar	25.2
31	Saudi Arabia	25.1
32	Zimbabwe	24.8
33	Ivory Coast	24.6
34	Armenia	24.4
35	North Macedonia	23.3
36	Libya	22.3
37	Senegal	22.3
38	Ethiopia	22.2
39	Zambia	22.0
40	Cambodia	21.9
41	Kyrgyzstan	21.1
42	Palestine	21.1
43	Madagascar	20.5
44	Serbia	20.2
45	Thailand	19.8
46	Guatemala	18.8
47	South Africa	18.8
48	Malaysia	18.3
49	Azerbaijan	18.3
50	Montenegro	18.0
51	Sri Lanka	17.9
52	Macao SAR	17.7
53	Guyana	17.5
54	Taiwan	17.5
55	Mexico	17.4
56	El Salvador	17.3
57	Israel	17.2
58	Peru	17.1
59	South Korea	17.0
60	Djibouti	16.8
61	Mozambique	16.7
62	Chile	16.6
63	Hong Kong SAR	16.3
64	Paraguay	15.9
65	Algeria	15.4
66	Romania	15.3
67	Turkey	15.3
68	Slovenia	15.2
69	Honduras	15.2
70	Gabon	15.2
71	Kazakhstan	15.1
72	Georgia	15.1
73	Brazil	14.9
74	Philippines	14.8
75	Poland	14.8
76	Nicaragua	14.8
77	Moldova	14.7
78	Albania	14.5
79	Kenya	14.3
80	Italy	14.2
81	Croatia	13.8
82	Colombia	13.8
83	Slovakia	13.6
84	Hungary	12.9
85	Kosovo	12.9
86	Cyprus	12.8
87	Czech Republic	12.7
88	Suriname	12.5
89	Bulgaria	12.4
90	Maldives	12.2
91	Malta	11.7
92	Greece	11.5
93	Uruguay	11.5
94	Singapore	11.4
95	Austria	10.2
96	Lithuania	10.1
97	Panama	10.1
98	Bolivia	10.0
99	Russia	9.8
100	Ecuador	9.7
101	Ukraine	9.2
102	Latvia	9.2
103	Germany	9.0
104	Netherlands	8.9
105	Belgium	8.9
106	Argentina	8.7
107	Spain	8.7
108	Japan	8.6
109	Cayman Islands	8.5
110	France	8.1
111	Luxembourg	7.5
112	Anguilla	7.4
113	United Kingdom	7.4
114	Switzerland	7.3
115	Denmark	7.2
116	USA	7.1
117	Costa Rica	7.0
118	Portugal	6.8
119	Canada	6.7
120	Norway	6.6
121	Liechtenstein	6.5
122	Ireland	6.5
123	Trinidad and Tobago	6.1
124	Andorra	6.0
125	Sweden	5.3
126	Finland	5.2
127	Estonia	4.6
128	Australia	4.5
129	New Zealand	4.4
130	Iceland	4.0
131	Grenada	3.2
132	Barbados	3.1
133	Montserrat	2.7
134	Puerto Rico	2.7
135	U.S. Virgin Islands	2.6
136	French Polynesia	2.5
137	Bermuda	2.5
138	Bahamas	2.3

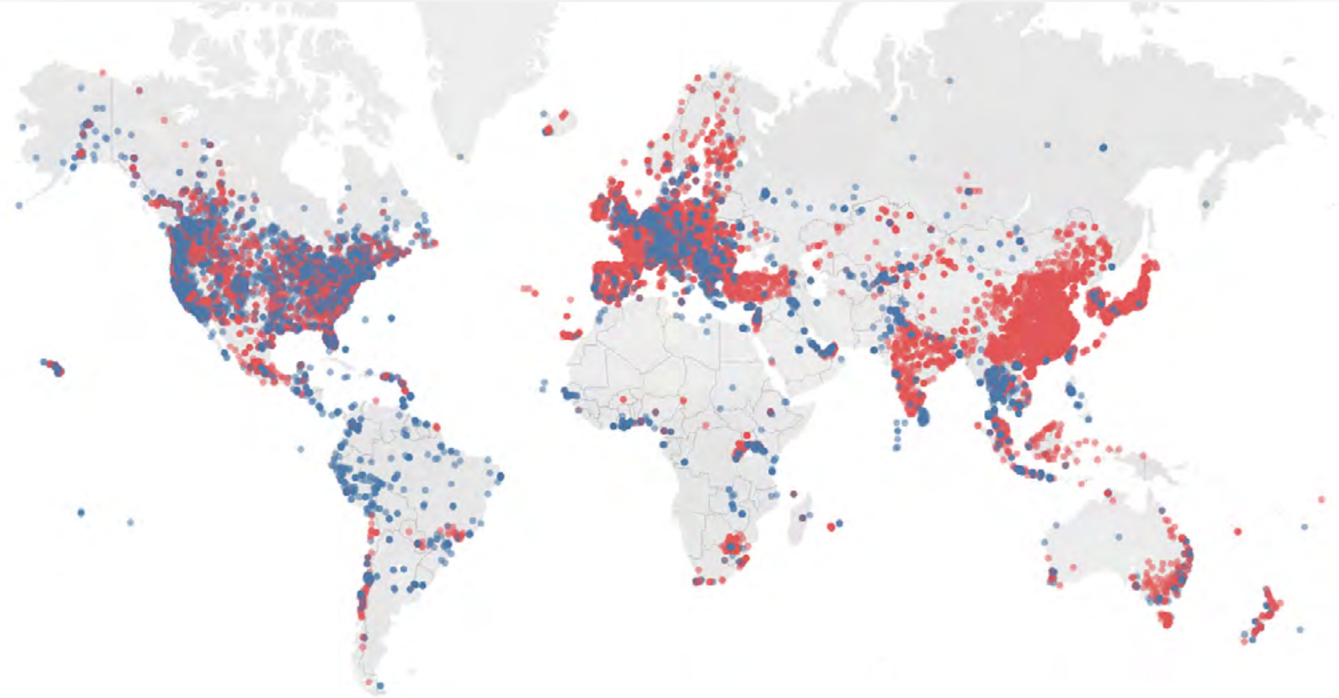
2024 Regional capital city ranking

2024 average PM2.5 concentration (ug/m3) for capital cities in descending order.



Overview of public monitoring status

Global distribution of PM2.5 monitoring stations



Global distribution of PM2.5 air quality monitoring stations providing data included in this report. Blue markers denote independently operated monitoring stations, while red markers indicate government-operated stations.

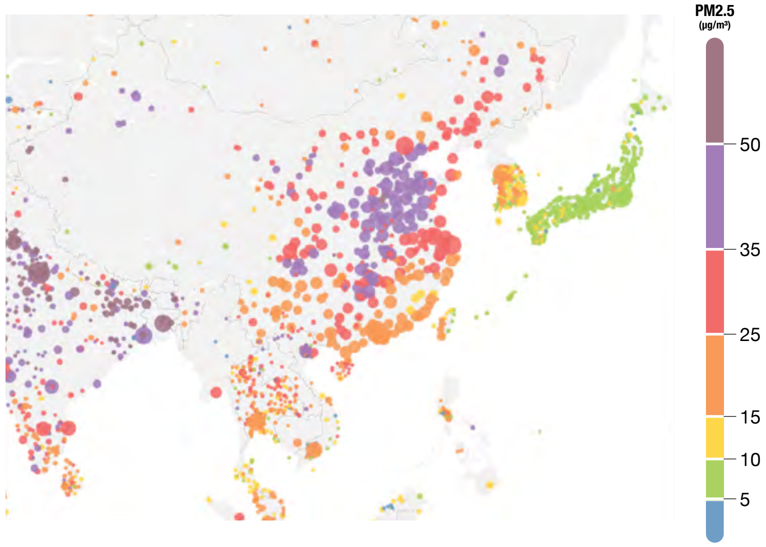
The global map of public air quality monitoring stations highlights significant disparities in data coverage. Many critical regions still lack sufficient monitoring, particularly in Africa and West Asia, where countries have historically recorded some of the highest annual average pollution levels but maintain limited monitoring networks. In 2024, Chad reclaimed the position of having the world's highest annual average PM2.5 concentration after failing to meet data availability standards in 2023. Conversely, Burkina Faso, which ranked fifth in 2023, did not meet the data availability threshold for 2024 and was excluded from the report.

The expansion of cost-effective, non-government air quality monitoring stations has helped improve data availability in areas where government-operated stations are either absent or inaccessible to the public. These independent monitors offer real-time data and can be deployed in remote locations with minimal maintenance requirements, enhancing the global sensor network. In 2024, non-government-operated air quality monitoring provided the only real-time data for several countries and territories, including Afghanistan*, Albania, Antarctica*, Armenia, the Bahamas, Barbados, Benin*, Bermuda, Bolivia, Burundi, Cambodia, Cameroon, Cape Verde*, Costa Rica, Djibouti, the Dominican Republic*, Eswatini*, French Polynesia, Gabon, the Gambia, Greenland*, Grenada, Guyana, Honduras, Jamaica*, Lebanon*, Libya, the Maldives, Mauritius*, Montserrat, Morocco*, Nicaragua, Panama, San Marino*, Sudan*, Suriname, Svalbard and Jan Mayen*, Tanzania*, Tonga*, Trinidad and Tobago, the U.S. Virgin Islands, Uruguay, Venezuela*, Zambia, and Zimbabwe.

**Cities in these countries did not meet the required limit of 60% annual data availability and were therefore excluded from the report.*

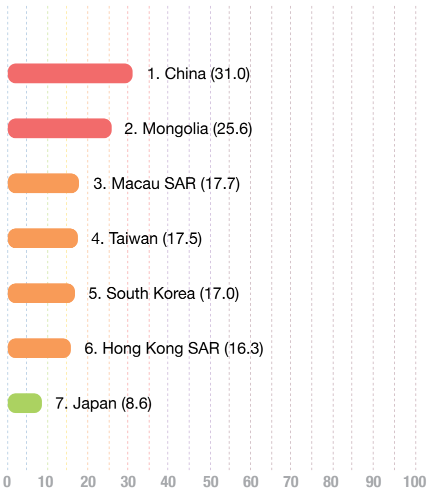
EAST ASIA

China Mainland | Hong Kong SAR | Japan | Macau SAR | Mongolia | South Korea | Taiwan



City markers indicating 2024 PM2.5 levels, size adjusted for population

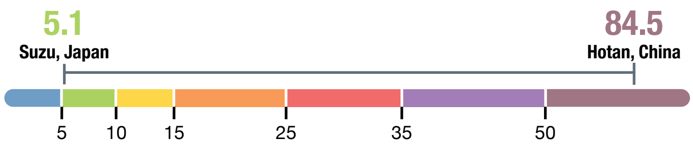
Country/Region Ranking



2024 PM2.5 average (µg/m³)

0%

Regional cities that met the WHO annual PM2.5 guideline in 2024



Range of 2024 average PM2.5 (µg/m³) across regional cities

Most Polluted Regional Cities

Rank	City	2024
1	Hotan, China	84.5
2	Kashgar, China	55.2
3	Kizilsu, China	52.5
4	Xinxiang, China	50.9
5	Hebi, China	50.8
6	Luohe, China	49.2
7	Yigou, China	49.0
8	Anyang, China	48.4
9	Jiaozuo, China	48.3
10	Shahecheng, China	48.1
11	Xuchang, China	47.8
12	Puyang, China	47.6
13	Turpan, China	47.5
14	Linshui, China	47.3
15	Zhoukou, China	47.3

Least Polluted Regional Cities

Rank	City	2024
1	Suzu, Japan	5.1
2	Kashiwazaki, Japan	5.1
3	Godo, Japan	5.2
4	Kushiro, Japan	5.5
5	Sumoto, Japan	5.5
6	Tsubata, Japan	5.6
7	Kamaishi, Japan	5.6
8	Shingu, Japan	5.6
9	Shinshiro, Japan	5.7
10	Minamiaizu, Japan	5.9
11	Tomakomai, Japan	5.9
12	Midoridai, Japan	5.9
13	Mukaiawagasaki, Japan	5.9
14	Oshu, Japan	5.9
15	Wakuya, Japan	5.9

SUMMARY

The East Asia region reported air quality data from 1,279 cities across seven countries and territories. There was no clear regional air quality trend, as annual average PM2.5 concentrations decreased in China, Taiwan, South Korea, and Japan, while Mongolia, Macau, and Hong Kong saw increases. Mongolia recorded the largest increase, rising by 3.1 µg/m³ from 22.5 µg/m³ in 2023 to 25.6 µg/m³ in 2024. This increase pushed Mongolia from achieving the WHO interim target 2 to the more polluted interim target 1. Taiwan saw the most significant decrease, dropping by 2.7 µg/m³ from 20.2 µg/m³ in 2023 to 17.5 µg/m³ in 2024.

Despite the mixed national trends, PM2.5 concentrations generally declined at the city level. Among the 1,067 cities that reported data for both 2023 and 2024, 920 recorded decreases, 129 reported increases, and 18 remained unchanged. Among capital cities, Beijing, Seoul, and Tokyo reported lower annual averages, while Ulaanbaatar experienced a 14% increase, rising from 22.5 µg/m³ in 2023 to 25.7 µg/m³ in 2024.

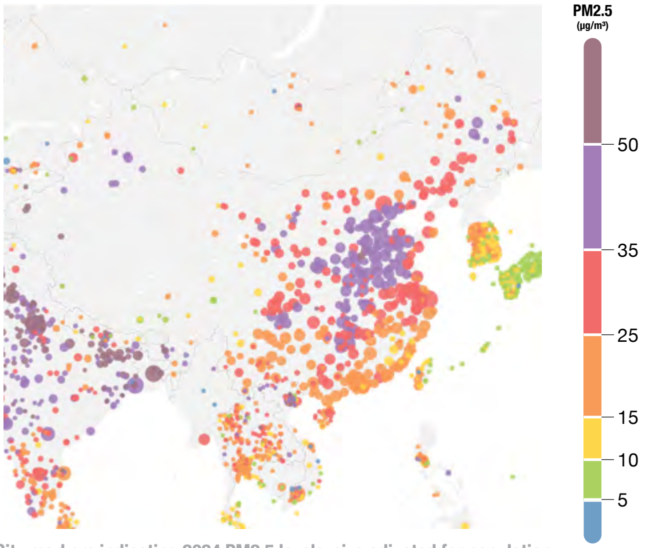
Hotan, China, remains the most polluted city in the region. Despite a slight decrease, its annual average of 84.5 µg/m³ is still more than 16 times the WHO guideline. Meanwhile, the least polluted cities in the region are Suzu and Kashiwazaki, Japan, both reporting concentrations of 5.1 µg/m³. Notably, for the first time in years, no city in East Asia falls below the WHO guideline of 5.0 µg/m³.

MONITORING STATUS

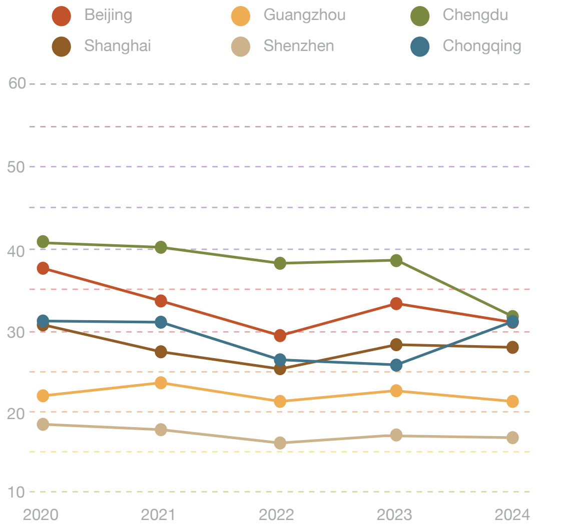
Government-operated monitors remain the primary source of air quality data in East Asia, providing extensive regional coverage. In total, 97.7% of the region's data comes from government monitors, with China, Japan, and South Korea relying on them at rates of 100%, 99%, and 84%, respectively.

Japan continues to offer the highest spatial resolution of monitoring in the region, with a dense network of government-operated monitors spread across its islands. Additionally, Japan recorded the largest expansion in monitoring coverage, with 132 new cities reporting data from locations that were not included in the 2023 report.

CHINA MAINLAND



City markers indicating 2024 PM2.5 levels, size adjusted for population



PM2.5 annual mean (μg/m³) over 5 years

City	2024	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2023
Beijing	31.0	37.1	39.1	42.2	40.0	27.6	26.5	26.2	15.6	16.8	41.8	42.2	17.2	34.1
Chengdu	32.0	65.7	45.8	37.8	27.6	25.9	21.1	13.2	24.0	22.9	23.7	25.7	50.6	39.0
Chongqing	31.1	59.0	44.9	39.8	20.8	21.3	19.0	14.0	16.7	20.3	28.7	29.3	57.3	25.4
Guangzhou	21.3	34.8	19.2	24.3	19.1	18.0	12.0	10.6	18.5	17.0	22.1	20.4	39.2	23.5
Shanghai	28.1	57.6	38.0	37.3	26.7	21.1	20.5	16.7	18.9	13.9	20.2	23.3	43.8	28.7
Shenzhen	16.7	26.4	18.0	20.7	15.8	12.8	7.8	5.7	12.4	12.5	18.2	17.9	32.3	17.1

PROGRESS

China's national annual average PM2.5 concentration decreased from 32.5 μg/m³ in 2023 to 31.0 μg/m³ in 2024. This downward trend was mirrored in key cities such as Beijing, Shanghai, Chengdu, Guangzhou, and Shenzhen, all of which reported reductions in annual average concentrations. Overall, 323 cities recorded lower concentrations compared to the previous year.

However, air quality worsened in Chongqing and 128 other locations, which reported increases in PM2.5 levels.

Geography and location continue to influence pollution levels across the country. The 16 cities with the highest annual concentrations were concentrated in the Xinjiang, Hebei, and Henan provinces. These provinces collectively host 62 cities where the annual average PM2.5 concentration exceeded 35.0 μg/m³.

CHALLENGES

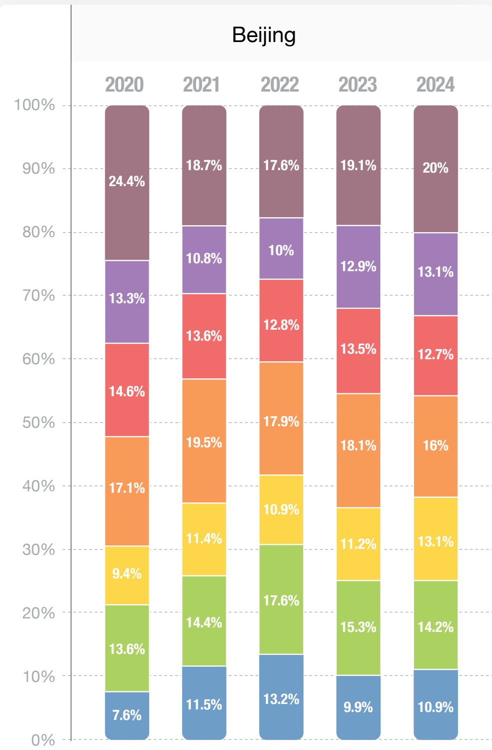
China continues to tighten its national PM2.5 targets and prioritize key areas for reducing pollution and smog. Officials have set ambitious goals to lower the national annual average PM2.5 concentration to below 28 μg/m³ by 2027 and below 25 μg/m³ by 2035.[12] Special attention is being given to the Beijing-Tianjin-Hebei region at the provincial level.[13]

While these targets align with WHO Interim Target 2, they remain significantly above the WHO recommended guideline of 5 μg/m³. Major sources of air pollution in China include dust storms, coal production, cement manufacturing, and transportation.[14,15]

HIGHLIGHT: EMISSION SOURCES AND SPATIAL INCONGRUITY

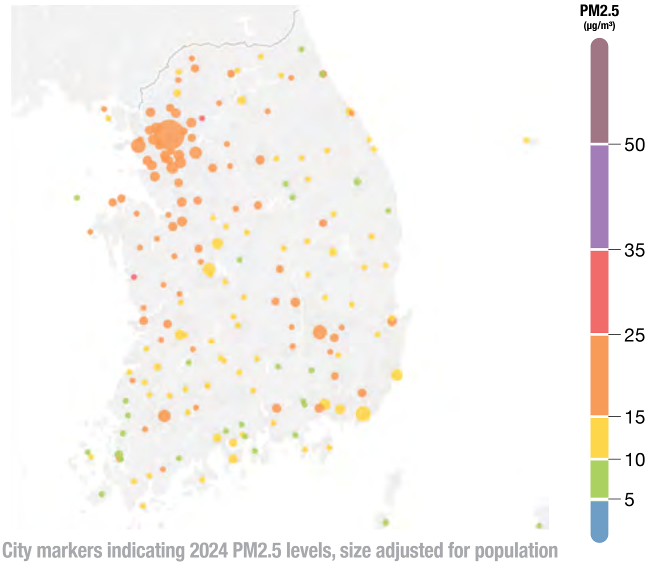
China's vast size and diverse emission sources present unique challenges for mitigating air pollution and shaping the population's air quality experience. In northern provinces, power generation is utilized for heating during cold winter months, resulting in a concentration of coal plants in these regions.[16] While coal plants continue to be commissioned, there are far fewer in 2024 than in previous years. Meanwhile, solar and wind energy production is expanding in some provinces, though others face limited access to these clean energy sources.[17]

Emissions from cement production and vehicles remain common in developing residential areas and major cities. To combat urban pollution, China has increased the production of electric vehicles to address mobile emissions.[18] Additionally, advancements in cement production methods and a decline in real estate construction have contributed to reductions in PM2.5 emissions from this sector.[19]

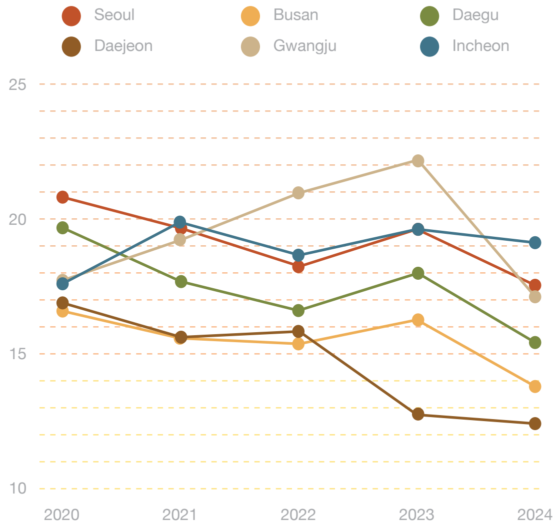


Annual hours spent at different PM2.5 pollution levels

SOUTH KOREA



City markers indicating 2024 PM2.5 levels, size adjusted for population



PM2.5 annual average (μg/m³) over 5 years

City	2024	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2023
Seoul	17.5	24.6	23.3	21.8	21.9	15.5	17.6	11.9	15.7	9.2	13.0	16.6	19.4	19.7
Busan	13.8	18.4	15.4	19.0	21.4	13.8	15.9	7.8	11.0	7.6	8.3	11.6	15.0	16.2
Daegu	15.4	22.8	19.7	21.1	20.1	13.0	14.7	8.0	9.5	8.1	11.0	21.5	15.3	18.0
Daejeon	12.4	21.4	20.6	15.6	12.5	9.9	8.3	4.4	7.7	5.9	12.4	15.1	16.9	12.8
Gwangju	17.1	24.7	24.9	24.0	17.9	15.8	18.4	10.3	13.8	10.8	10.6	12.8	15.0	22.2
Incheon	19.1	26.8	27.1	21.7	23.6	16.4	18.6	13.9	18.7	11.5	16.7	18.2	18.6	19.7

PROGRESS

South Korea reversed last year's increase in PM2.5 concentration, reporting a decrease of 2.2 μg/m³, from 19.2 μg/m³ in 2023 to 17.0 μg/m³ in 2024. All highlighted cities recorded declines, ranging from a slight reduction of 0.4 μg/m³ in Daejeon to a significant improvement of 5.1 μg/m³ in Gwangju.

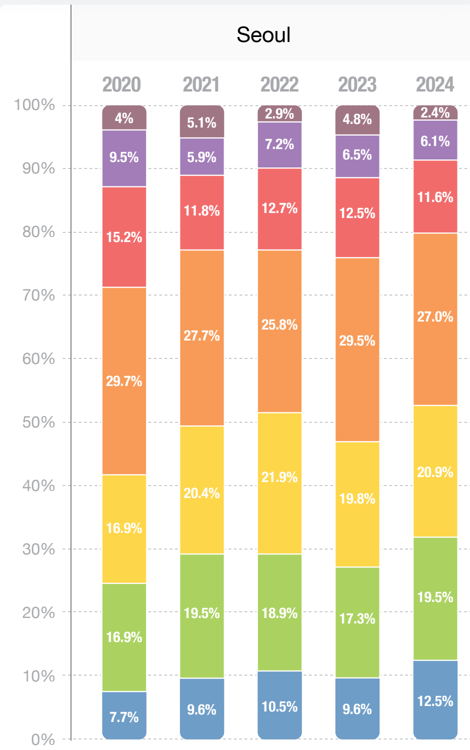
Seoul, the capital, reported its lowest annual average in eight years and marked its fourth consecutive year below 20.0 μg/m³. More than 90% of cities that provided data for both 2023 and 2024 showed lower annual averages. Despite nationwide improvements in air quality, no South Korean city met the WHO's air quality guideline, and only four cities reported concentrations below 10.0 μg/m³.

CHALLENGES

South Korea has various sources of PM2.5 emission such as biomass burning, coal combustion, mobile emissions, and waste incinerators.[20] The emission distribution often varies by time of year. During the spring months, pollution from dust storms becomes a more dominant source.[21,22] Air pollution from energy generation such as coal combustion is a larger PM2.5 contributor during the colder winter months.[23] While the country has set goals to reduce carbon emitting power plants, there are still domestic coal plants that emit pollution to surrounding areas.[24]

HIGHLIGHT: TRANSBOUNDARY POLLUTION AND REGIONAL PARTNERSHIP

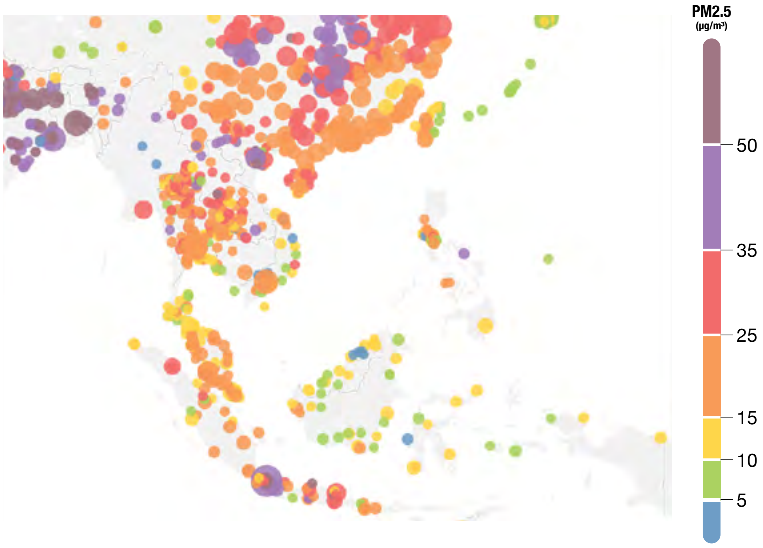
Pollution in the region extends beyond national borders, affecting areas far from their original source.[25] China and North Korea have historically been major contributors to transboundary PM2.5 pollution for South Korea.[26,27] While some of these fine particulate pollutants come from natural sources like dust storms, a significant portion originates from industrial activities and emissions from energy production.[28] In response, South Korea's environmental agencies are implementing programs to monitor air quality and develop solutions.[29] Per legislation passed in 2019, local governments must take emergency dust reduction measures when daily average PM2.5 exceeds 50 μg/m³. Emergency steps include limiting construction sites activities and restricting coal power plants' operation hours. In February 2024, the Ministry of Environment recommended the additional step of encouraging people to work from home on emergency days.[30]



Annual hours spent at different PM2.5 pollution levels

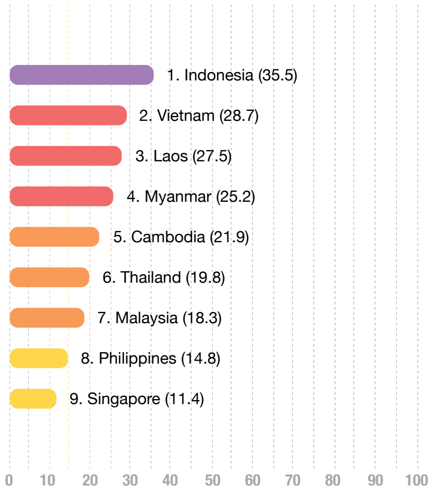
SOUTHEAST ASIA

Cambodia | Indonesia | Laos | Malaysia | Myanmar | Philippines | Singapore | Thailand | Vietnam



City markers indicating 2024 PM2.5 levels, size adjusted for population

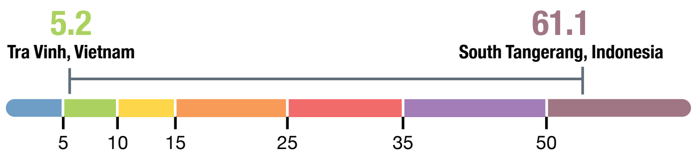
Country/Region Ranking



2024 PM2.5 average (µg/m³)

0%

Regional cities that met the WHO annual PM2.5 guideline in 2024



Range of 2024 average PM2.5 (µg/m³) across regional cities

Most Polluted Regional Cities

Rank	City	2024
1	South Tangerang, Indonesia	61.1
2	Tangerang, Indonesia	55.6
3	Cikarang, Indonesia	52.8
4	Thanh Pho Phu Ly, Vietnam	50.9
5	Depok, Indonesia	50.3
6	Hanoi, Vietnam	45.4
7	Tay Ho, Vietnam	44.7
8	Banting, Malaysia	43.2
9	Luong Son, Vietnam	43.1
10	Bekasi, Indonesia	42.5
11	Serpong, Indonesia	42.4
12	Jakarta, Indonesia	41.7
13	Bac Ninh, Vietnam	41.6
14	Bandung, Indonesia	40.0
15	Phaya Kaeo, Thailand	39.2

Least Polluted Regional Cities

Rank	City	2024
1	Tra Vinh, Vietnam	5.2
2	Kapit, Malaysia	7.1
3	Carmona, Philippines	7.4
4	Sampit, Indonesia	7.5
5	Bo Put, Thailand	7.8
6	Sintang, Indonesia	8.8
7	Pangkalan Bun, Indonesia	8.9
8	Limbang, Malaysia	8.9
9	Sri Aman, Malaysia	9.1
10	Calamba, Philippines	9.2
11	Sarikei, Malaysia	9.5
12	Mukah, Malaysia	9.6
13	Mueang, Thailand	9.7
14	Balikpapan, Indonesia	9.8
15	Batulicin, Indonesia	9.8

SUMMARY

In 2024, air quality in Southeast Asia showed slight improvement, with PM2.5 concentrations decreasing across all countries. Indonesia remained the most polluted, ranking 15th globally, despite a modest drop in PM2.5 levels. Malaysia saw the largest reduction, with concentrations falling by 4.2 µg/m³, while Singapore remained the least polluted. However, 45% of cities reported PM2.5 levels three to five times the WHO guideline, and 22% exceeded the WHO Interim Target 1 of 35 µg/m³. No city met the WHO annual guideline of 5 µg/m³.

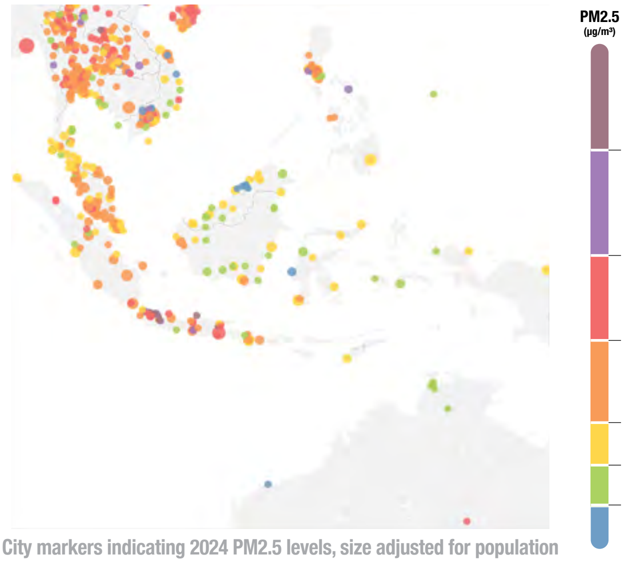
Thailand saw a 14.9% decrease in PM2.5, though seasonal biomass burning continued to drive severe pollution in northern provinces. Malaysia's air quality improved due to reduced transboundary haze from Indonesia, but localized PM2.5 spikes occurred during open burning and heatwaves. Vietnam remained the second most polluted country, with Hanoi recording its fifth consecutive annual increase in PM2.5 levels, while coastal cities had lower concentrations.

Despite improvements, air pollution remains a major challenge, driven by industrial emissions, biomass burning, coal-fired power, and transportation. Transboundary haze pollution is a pressing issue, with widespread public health and economic impacts. As Malaysia prepares to assume the ASEAN Chair in 2025, civil society groups are urging the government to lead efforts in establishing a legally binding ASEAN Agreement on Transboundary Haze Pollution. Emerging policies, such as Malaysia's push to enshrine the right to clean air into law, underscore the urgency for action.

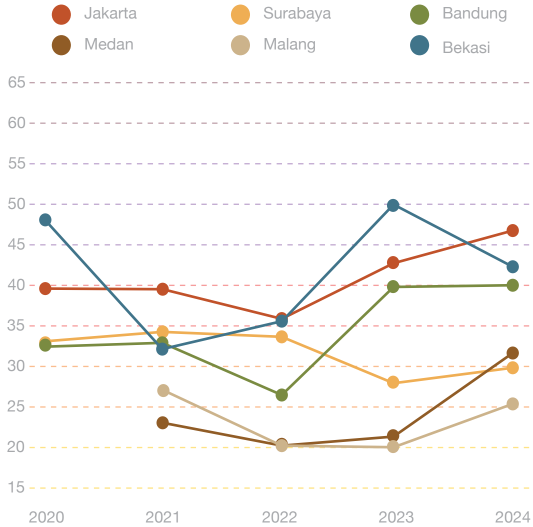
MONITORING STATUS

Air quality monitoring in Southeast Asia remains uneven, with nearly all countries having significant gaps in government-led initiatives. In 2024, 173 out of 392 cities in the region lacked government monitoring stations. Cambodia had no official government monitoring, while Vietnam saw the greatest expansion, with 15 additional cities reporting data compared to 2023. Thailand led the region in city-level monitoring, with 214 reporting cities. Malaysia's air quality monitoring network remains extensive, with nearly 40% of the population living within 10 km of a ground-based PM2.5 monitoring station.[31] Government-operated monitors account for 88% of all stations in the country, playing a critical role in tracking pollution trends and informing policy decisions. Despite improvements, many areas still rely on independent and citizen-led monitoring networks to provide critical air quality data. Strengthening government involvement and expanding real-time monitoring infrastructure remains essential for improving air quality management in the region.

INDONESIA



City markers indicating 2024 PM2.5 levels, size adjusted for population



PM2.5 annual average (µg/m³) over 5 years

City	2024	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2023
Jakarta	41.7	26.0	28.2	31.1	41.4	61.1	55.3	51.8	54.4	44.6	47.7	40.9	17.8	43.8
Surabaya	29.8	28.7	31.9	32.6	32.2	30.9	31.3	31.5	25.6	30.2	29.5	32.8	20.3	27.6
Medan	31.7	31.7	37.6	42.8	38.7	41.7	31.0	41.0	30.3	25.1	23.0	19.4	25.5	21.3
Malang	25.2	22.8	23.7	22.0	22.5	31.7	28.2	27.1	26.4	29.5	23.6	30.4	15.5	20.1
Bekasi	42.5	21.3	29.0	23.6	42.2	65.0	57.9	57.5	56.0	45.8	53.9	43.2	16.9	49.9
Bandung	40.0	31.2	34.8	30.1	40.9	61.1	51.5	45.4	42.2	41.4	44.6	41.8	15.3	39.6

PROGRESS

In 2024, Indonesia's average PM2.5 concentration decreased by 4% compared to 2023, reaching an annual average of 35.5 µg/m³. Despite this slight improvement, Indonesia remains the most polluted country in Southeast Asia and ranks as the 15th most polluted country globally. In Jakarta, the capital, PM2.5 levels fell by nearly 5% from 2023, with an annual average of 41.7 µg/m³.

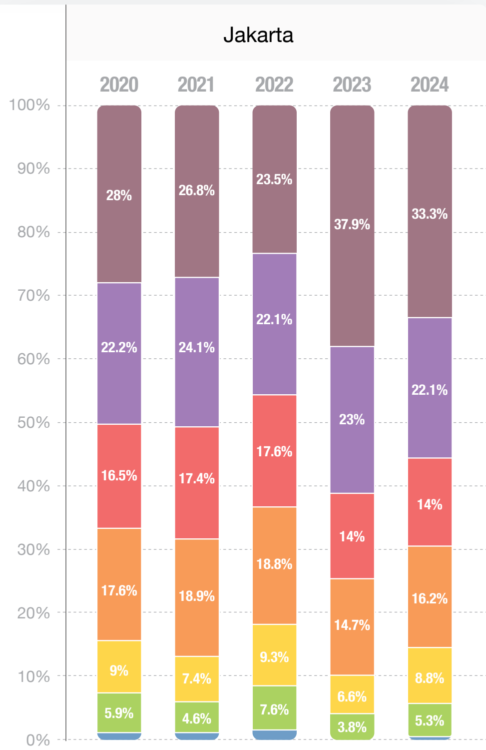
The easing of El Niño, a dry climate pattern that had intensified wildfires in 2023, likely contributed to a 60% reduction in fire hotspots in 2024, leading to lower emissions from biomass burning.[32] However, the nationwide average PM2.5 levels still exceeded the World Health Organization's (WHO) annual guideline of 5 µg/m³ by more than tenfold. In 2024, no Indonesian city met the WHO's air quality standard.

CHALLENGES

Rapid urbanization and industrialization in Indonesia have significantly increased the demand for power in a country where coal burning generates two-thirds of the electricity.[33] In addition to coal combustion, emissions from transportation and biomass burning are major contributors to particulate matter levels.[34] According to a report by the Centre for Research on Energy and Clean Air (CREA), Indonesia's coal power capacity grew by 15% between July 2023 and July 2024. This growth was largely driven by the expansion of captive coal fired power plants (CFPP), power plants that produce electricity for on-site industrial applications such as nickel processing.[35]

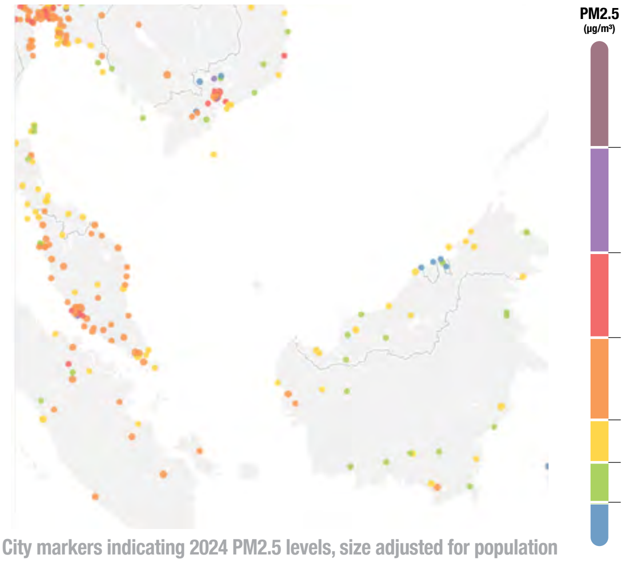
HIGHLIGHT: COAL-POWERED NICKEL REFINEMENT UNDERMINES CLEAN ENERGY GOALS

Low-carbon technologies, such as electric vehicles and renewable energy storage, rely heavily on key energy transition minerals, like nickel, due to their unique chemical and physical properties.[36] As the world's leading producer of nickel, Indonesia plays a pivotal role in its mining, extraction, and refinement. However, the refinement of nickel is extremely energetically costly, and the demand for electricity to support the industry has resulted in the rapid expansion of captive CFPP, tripling in capacity in the past 5 years.[37] Without the implementation of emission control measures on CFPPs and coal-based smelting processes, it is estimated the economic public health burden will reach $3.42 billion dollars in 2030, rising to $20 billion in 2040.[38]

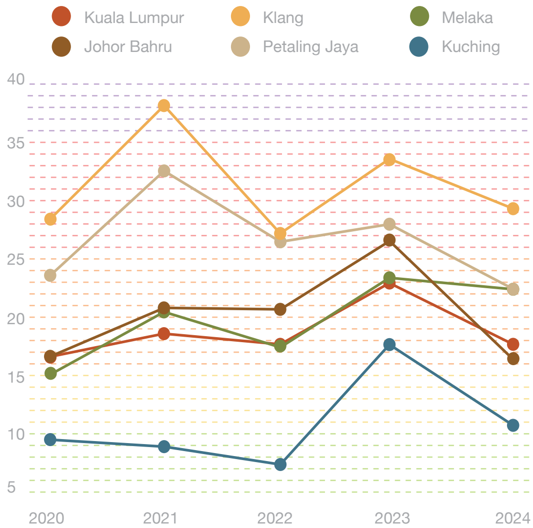


Annual hours spent at different PM2.5 pollution levels

MALAYSIA



City markers indicating 2024 PM2.5 levels, size adjusted for population



PM2.5 annual average (µg/m³) over 5 years

City	2024	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2023
Kuala Lumpur	17.7	14.9	17.4	23.4	26.2	17.2	18.7	22.8	17.0	16.3	14.5	11.6	12.3	22.9
Klang	29.3	38.2	32.8	37.0	41.9	34.6	29.8	31.9	26.2	22.3	17.0	17.3	21.7	33.5
Johor Bahru	16.5	12.4	14.7	16.9	19.2	15.9	17.8	20.2	18.2	19.9	21.9	10.8	9.3	26.6
Petaling Jaya	22.4	20.8	25.5	34.4	37.6	30.9	23.9	23.4	17.2	17.7	16.5	10.2	10.8	28.0
Melaka	22.4	14.8	18.1	26.6	28.3	17.3	25.7	31.5	23.1	20.1	17.9	NO DATA	NO DATA	23.4
Kuching	10.8	7.1	9.4	11.5	8.6	8.0	9.7	17.7	10.4	23.3	11.5	6.4	5.7	17.8

PROGRESS

In 2024, Malaysia experienced a notable improvement in air quality, with annual average PM2.5 concentrations declining by 19%. The national annual average concentration fell to 18.3 µg/m³, down from 22.5 µg/m³ in 2023. This reduction was largely due to reduced transboundary haze from Indonesia, which had a severe wildfire season during the 2023 dry period. The capital city, Kuala Lumpur, saw a steeper decline in pollution levels, with PM2.5 concentrations dropping by nearly 23%, reaching an annual average of 17.7 µg/m³.

Despite the overall improvement, Malaysia faced severe air quality challenges in early 2024. Open burning increased in January and February, significantly raising PM2.5 levels in Kedah, Selangor, and Sabah compared to the previous year.[39] An El Niño-driven historic heatwave in March and April exacerbated haze events nationwide.[40]

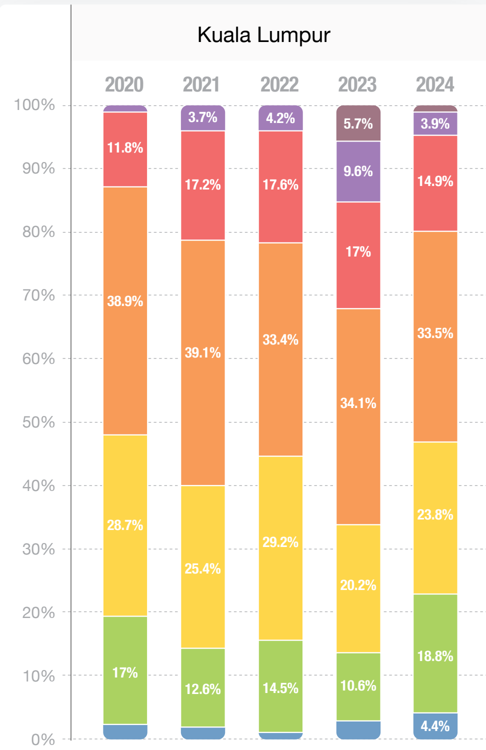
While Malaysia made notable progress in reducing overall pollution levels, the country still faces seasonal air quality challenges. Strengthening enforcement against open burning and enhancing haze mitigation regional cooperation remains crucial for sustaining long-term air quality improvements.

CHALLENGES

Malaysia's primary air pollution sources include vehicle emissions, industrial manufacturing, power generation, and biomass burning.[41] Haze pollution is a significant issue, caused by domestic peatland combustion and transboundary haze from Indonesia's seasonal agricultural fires. These fires, primarily driven by oil palm and pulpwood production peatland drainage, are challenging to extinguish due to undetected, long-smoldering combustion.[42] Malaysian government officials announced plans during London Climate Action Week in June 2024 to retire all coal-fired power plants by 2044.[43] This shift is significant; in 2022, coal supplied 24% of Malaysia's total energy supply and 47% of its total electricity generation.[44]

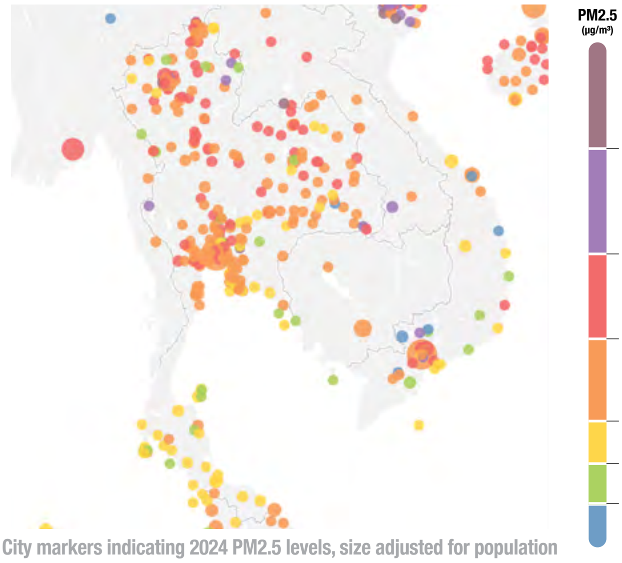
HIGHLIGHT: MALAYSIAN HUMAN RIGHTS COMMISSION RELEASES RIGHT TO CLEAN AIR REPORT

On September 27, 2024, the independent Malaysian Human Rights Commission (SUHAKAM) released a human rights report addressing haze pollution in Southeast Asia. The report identified gaps in Malaysia's legal framework and formalized policy recommendations to make constitutional changes guaranteeing the right to a clean and healthy environment. If adopted, the recommendations would legally strengthen environmental protections and hold the government accountable for addressing pollution and public health issues.

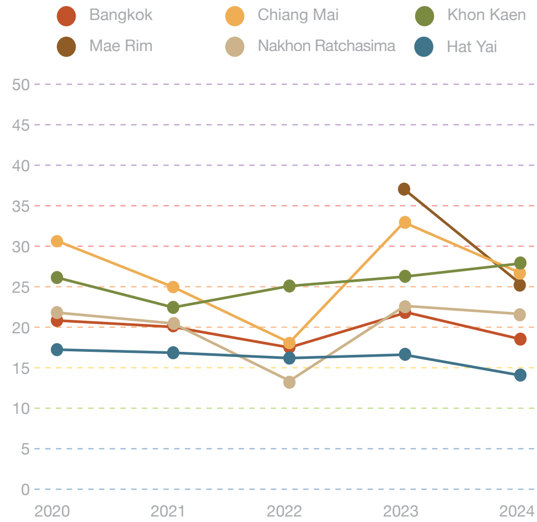


Annual hours spent at different PM2.5 pollution levels

THAILAND



City markers indicating 2024 PM2.5 levels, size adjusted for population



PM2.5 annual average (μg/m³) over 5 years

City	2024	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2023
Bangkok	18.9	36.1	29.5	24.3	24.4	17.1	6.5	6.8	6.1	10.8	15.7	21.0	28.0	21.7
Mae Rim	25.2	22.2	25.6	57.5	61.0	21.1	10.7	10.0	8.7	8.9	21.0	25.1	34.8	36.9
Chiang Mai	26.4	25.1	36.0	71.6	76.8	27.3	6.6	6.2	5.3	6.2	14.4	17.0	24.6	33.4
Nakhon Ratchasima	21.5	32.9	47.9	39.1	37.2	17.2	5.8	5.4	6.2	7.1	15.4	18.3	26.2	22.7
Khon Kaen	23.7	24.0	43.5	43.1	45.1	20.8	8.0	7.3	10.0	9.7	23.0	23.1	27.5	26.2
Hat Yai	14.3	17.2	18.5	19.9	20.5	15.7	11.9	14.2	12.0	9.7	10.0	9.7	12.6	16.5

PROGRESS

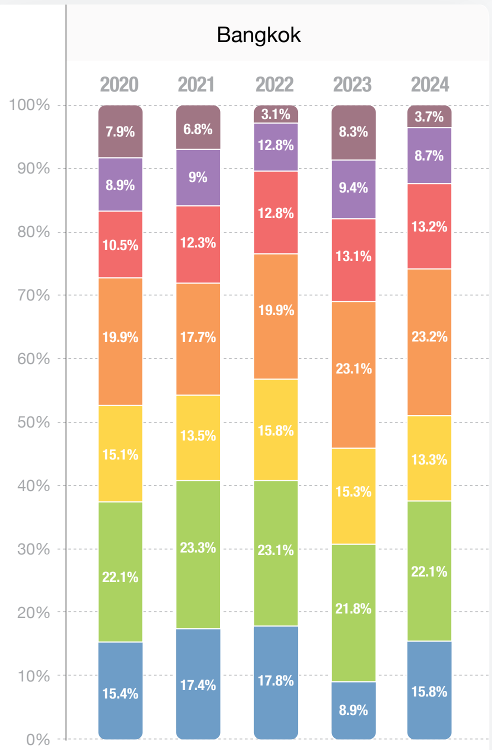
In 2024, Thailand experienced improvement in air quality, with annual average PM2.5 levels decreasing by 14.9% to 19.8 μg/m³, down from 23.3 μg/m³ in 2023. Despite this progress, no city in the country met the WHO's annual PM2.5 guideline of 5 μg/m³. In the capital, Bangkok, where air pollution remains a serious public health concern, PM2.5 levels saw a more modest decline of 3%, reaching 18.9 μg/m³ from 21.7 μg/m³ the previous year. The health burden of air pollution in Bangkok is substantial, with an estimated 1,317 cardiopulmonary and 370 lung cancer deaths attributed to PM2.5 exposure annually.[45] In 2021, Thailand's Pollution Control Department reported that tightening the national 24-hour PM2.5 standard to 37.5 μg/m³ could save 1.85 billion THB in health costs in Chiang Mai alone. This finding contributed to the adoption of WHO Interim Target 3 values as Thailand's national air quality standards in 2023.

CHALLENGES

Major sources of PM2.5 pollution in Thailand include industrial emissions, urban traffic, transboundary pollution, and seasonal biomass burning. In the northern provinces of Chiang Mai, Chiang Rai, and Nan, PM2.5 levels surged in March and April 2024, with 32 cities reporting monthly averages exceeding 10 times the WHO annual guideline. Mae Sai, Wiang Phang Kham, and Wiang, recorded pollution levels more than 20 times the recommended limit. Meanwhile, in Bangkok, PM2.5 concentrations peaked in January and February 2024, prompting Governor Chadchart Sittipunt to direct Metropolitan Administration staff to work from home and urge others to do the same in an effort to mitigate exposure.[46] Vehicle emissions, which account for approximately 25% of Bangkok's air pollution, were a major contributor to the high pollution levels during this period.

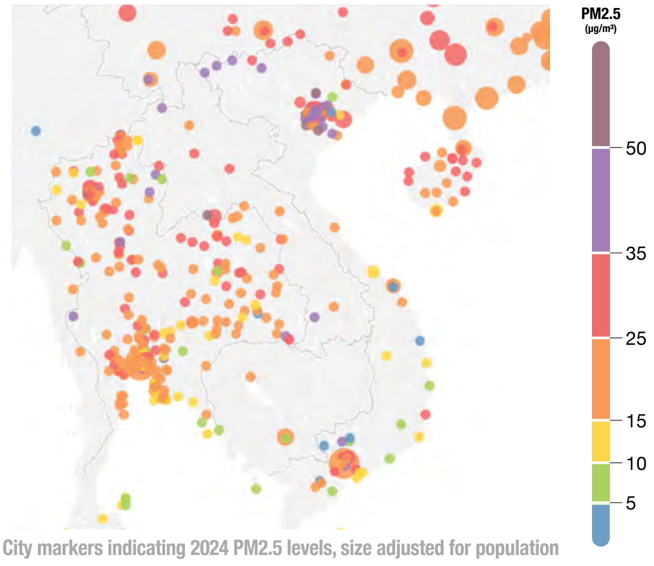
HIGHLIGHT: SOURCE APPORTIONMENT

Source apportionment studies from Chiang Mai in northern Thailand have identified seasonal variations in PM2.5 pollution, with agricultural practices playing a significant role.[47] The expansion of large-scale maize farming has led to an increase in slash-and-burn practices, contributing up to 51% of PM2.5 emissions during the hot, dry season (February-April).[48] A study published in 2024 found that up to 23% of PM2.5 pollution in the region originates from transboundary pollution from India during the smoke-haze period of the year.[49] In contrast, during the non-smoke-haze period (May–October), traffic emissions in the region become the dominant source, accounting for 76% of PM2.5 pollution.

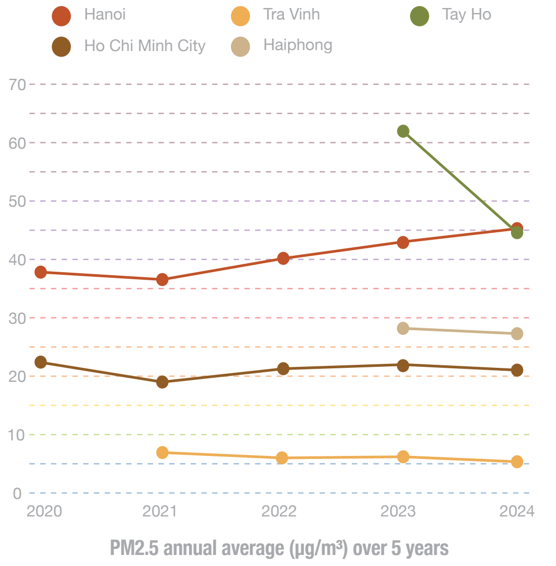


Annual hours spent at different PM2.5 pollution levels

VIETNAM



City markers indicating 2024 PM2.5 levels, size adjusted for population



PM2.5 annual average (µg/m³) over 5 years

City	2024	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2023
Hanoi	45.4	49.8	45.3	63.2	51.2	31.9	27.6	16.9	25.1	30.1	51.6	65.5	85.8	43.7
Tra Vinh	5.2	5.4	5.5	6.2	5.2	4.8	4.7	5.0	4.1	NO DATA	5.2	5.9	5.4	5.6
Tay Ho	44.7	54.7	46.5	54.8	45.8	29.9	25.4	17.1	23.6	29.2	51.9	66.6	90.4	61.5
Ho Chi Minh City	20.9	33.9	18.4	24.0	11.8	16.7	18.1	14.9	14.2	16.0	24.7	25.2	32.6	21.8
Haiphong	27.2	37.0	27.7	36.9	28.4	17.5	9.1	7.6	11.4	27.8	30.5	39.4	53.1	28.7

PROGRESS

Vietnam remained relatively consistent with a slight reduction in its national annual average PM2.5 concentration, decreasing from 29.6 µg/m³ in 2023 to 28.7 µg/m³ in 2024. Despite this improvement, the country remains the second most polluted in the region.

The capital city, Hanoi, saw its fifth consecutive annual increase in PM2.5 levels, rising from 37.9 µg/m³ in 2020 to 45.4 µg/m³ in 2024—more than nine times the WHO recommended guideline. However, some coastal cities reported concentrations closer to the guideline. Tra Vinh in southern Vietnam recorded an annual average of 5.2 µg/m³, while Hue, further north, measured 11.4 µg/m³.

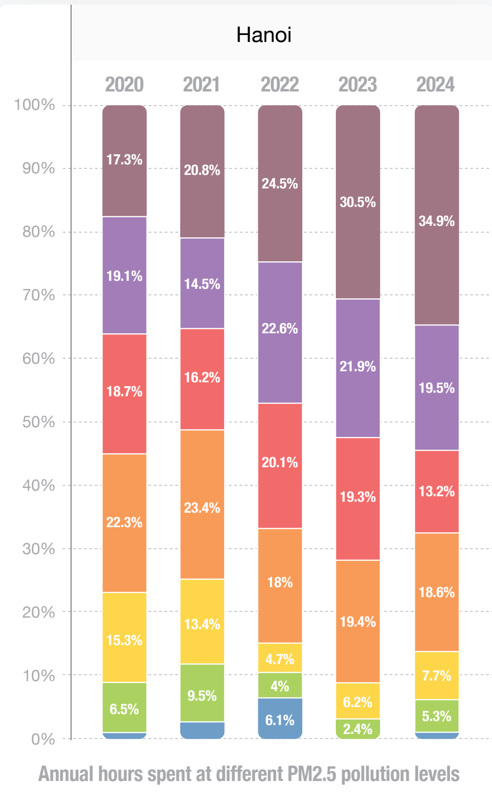
CHALLENGES

Common sources of PM2.5 pollution in Vietnam include biomass burning, coal and heavy fuel oil combustion, emissions from vehicles, industrial activities, construction dust, municipal solid waste burning, and long-range transport of aerosols.[50,51] Much of this pollution is seasonal: agricultural burning increases PM2.5 levels during the dry season, while emissions from transportation and construction dust can persist due to atmospheric conditions, such as the presence of inversion layers.[52] Additionally, transboundary emissions from power plants in neighboring countries contribute to air pollution during colder months.[53]

HIGHLIGHT: CITIZEN IMPACT AND EMPOWERMENT

Acute air pollution events in Vietnam have severely impacted daily life, with disruptions to air travel leading to flight diversions at multiple airports.[54,55] Beyond logistical challenges, air pollution has exacted a heavy toll on the nation's economy and society, contributing to losses estimated at around 4% of Vietnam's GDP.[56] These environmental conditions pose significant health risks, particularly for vulnerable groups such as pregnant women and children.[57]

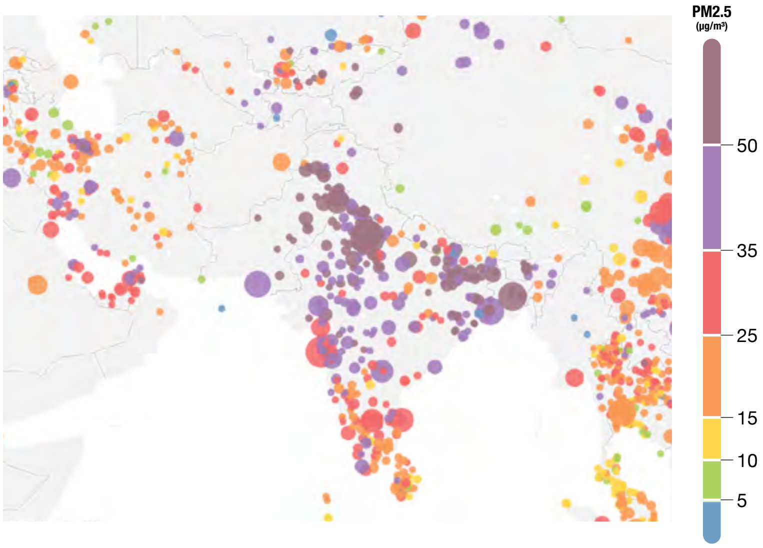
In response, various organizations are empowering citizens through information campaigns aimed at raising awareness and fostering protective measures. Community initiatives are promoting sustainable agricultural practices, such as reducing straw burning, while advocating for responsible household waste disposal to minimize pollution.[58] Government and international bodies are also championing efforts to expand air quality monitoring, providing critical data to support both public health strategies and academic research.[59]



Annual hours spent at different PM2.5 pollution levels

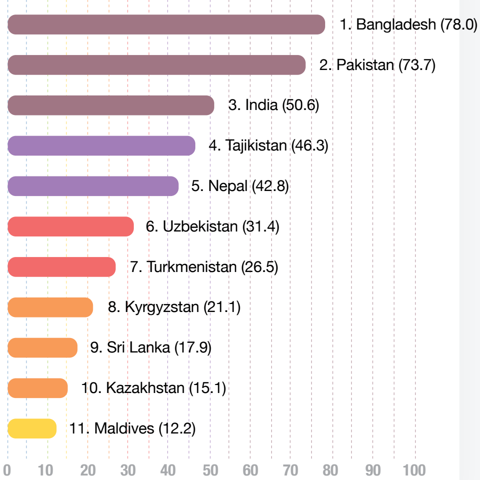
CENTRAL & SOUTH ASIA

Bangladesh | India | Kazakhstan | Kyrgyzstan | Maldives | Nepal | Pakistan | Sri Lanka | Tajikistan | Turkmenistan | Uzbekistan



City markers indicating 2024 PM2.5 levels, size adjusted for population

Country/Region Ranking



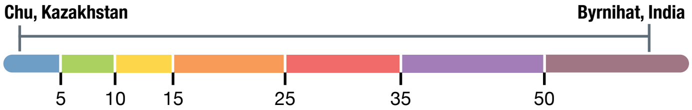
2024 PM2.5 average (µg/m³)

0.8%

Regional cities that met the WHO annual PM2.5 guideline in 2024

1.5
Chu, Kazakhstan

128.2
Byrnihat, India



Range of 2024 average PM2.5 (µg/m³) across regional cities

Most Polluted Regional Cities

Rank	City	2024
1	Byrnihat, India	128.2
2	Delhi, India	108.3
3	Karaganda, Kazakhstan	104.8
4	Lahore, Pakistan	102.1
5	Faridabad, India	101.2
6	Loni, India	91.7
7	Multan, Pakistan	91.4
8	Peshawar, Pakistan	91.0
9	Sialkot, Pakistan	88.8
10	Gurugram, India	87.4
11	Ganganagar, India	86.6
12	Greater Noida, India	83.5
13	Bhiwadi, India	83.1
14	Muzaffarnagar, India	83.1
15	Hanumangarh, India	79.9

Least Polluted Regional Cities

Rank	City	2024
1	Chu, Kazakhstan	1.5
2	Zhezqazghan, Kazakhstan	2.3
3	Beyneu, Kazakhstan	3.4
4	Shchuchinsk, Kazakhstan	7.5
5	Shetpe, Kazakhstan	8.0
6	Nepalgunj, Nepal	11.1
7	Yeraliyev, Kazakhstan	11.4
8	Kokshetau, Kazakhstan	11.6
9	Maqat, Kazakhstan	12.3
10	Kok Jar, Kyrgyzstan	13.1
11	Gangtok, India	13.2
12	Raichur, India	13.4
13	Deniya, Sri Lanka	14.2
14	Aqtobe, Kazakhstan	14.4
15	Tiruppur, India	14.5

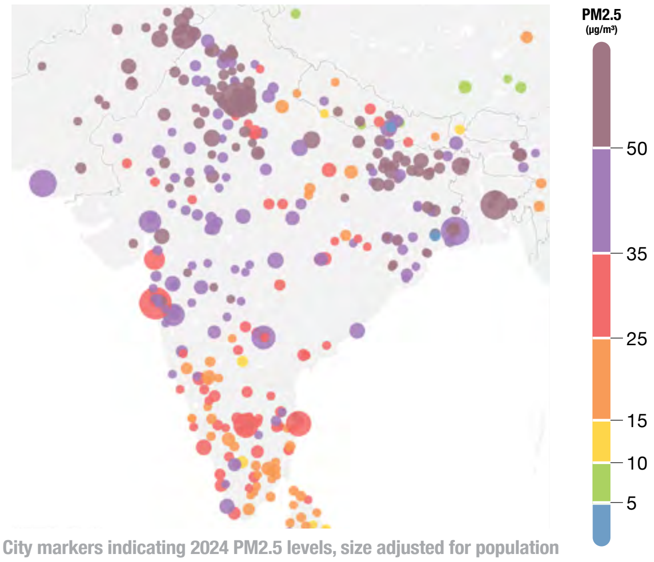
SUMMARY

Central and South Asia continues to experience some of the worst air pollution in the world, with five of the ten most polluted countries and nine of the ten most polluted cities globally. In 2024, air quality data was reported from 371 cities across 11 countries, with India being the most monitored, hosting more than half of the region's stations. Nearly one-third of cities recorded annual PM2.5 concentrations exceeding ten times the WHO guideline, posing a severe health risk to millions. Major pollution sources include vehicular emissions, industrial discharges, construction dust, and widespread burning of biomass for heating and agriculture. The Indo-Gangetic Plain remains a pollution hotspot, where meteorological factors trap pollutants and exacerbate winter smog. Cities like Delhi and Lahore frequently experience hazardous conditions, with seasonal spikes in pollution leading to emergency measures such as school closures and public space shutdowns. In Pakistan, Lahore's air quality deteriorated further, exceeding an annual PM2.5 concentration of 100 µg/m³ for the first time in six years. While governments have implemented measures to curb pollution, challenges persist due to policy enforcement gaps, rapid urbanization, and the continued reliance on polluting fuel sources.

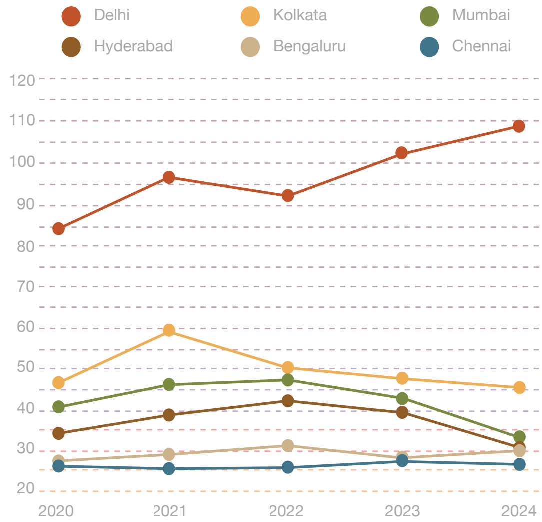
MONITORING STATUS

In 2024, government-operated monitoring stations accounted for 56% of all air quality data in Central and South Asia, reflecting a significant role in tracking pollution levels. However, in some of the most polluted cities, including Lahore, Dhaka, and Peshawar, non-governmental stations provided the majority of real-time air quality data, highlighting the growing role of community-driven monitoring. India continues to lead the region in government monitoring infrastructure, operating more than half of the total stations. Despite this, many areas in India remain under-monitored, particularly in smaller cities and rural regions. Expanding and strengthening monitoring networks remains critical for improving air quality management and informing effective pollution control policies.

INDIA



City markers indicating 2024 PM2.5 levels, size adjusted for population



PM2.5 annual average (µg/m³) over 5 years

City	2024	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2023
Delhi	108.3	219.3	110.3	76.8	64.6	84.4	52.6	39.6	26.6	42.8	120.1	276.5	185.9	102.4
Kolkata	45.6	104.6	68.9	44.8	41.7	20.2	21.7	16.7	21.1	21.0	36.5	74.4	76.6	47.8
Mumbai	33.7	51.5	48.9	34.9	31.2	23.3	13.8	12.3	11.6	13.6	34.1	65.3	64.2	43.8
Hyderabad	30.6	39.5	31.5	33.8	35.4	28.3	20.7	16.5	19.8	22.9	31.1	50.3	37.2	39.9
Bengaluru	30.0	44.0	37.9	45.3	34.4	24.1	15.4	14.3	19.5	20.8	30.7	39.1	34.7	28.6
Chennai	26.0	45.0	34.0	28.4	16.8	14.4	16.2	16.9	14.5	19.1	27.5	43.0	36.2	28.0

PROGRESS

India saw a 7% decline in PM2.5 concentrations in 2024, averaging 50.6 µg/m³ compared to 54.4 µg/m³ in 2023. Yet six of the world's ten most polluted cities are in India. The capital, New Delhi, maintained consistently high pollution levels, with an annual average of 91.6 µg/m³, nearly unchanged from 92.7 µg/m³ in 2023. India ranked as the world's fifth most polluted country, down from third the previous year.

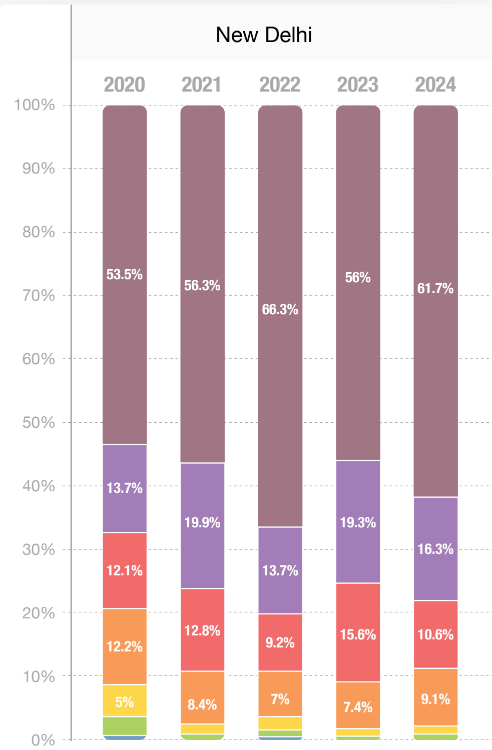
Air pollution remains a significant health burden in India, reducing life expectancy by an estimated 5.2 years.[60] Severe pollution episodes persisted in 2024, particularly in northern states. January air quality was especially poor in Delhi and Himachal Pradesh. The city of Baddi, in southwestern Himachal Pradesh, saw a January monthly PM2.5 average of 165 µg/m³. Air quality deteriorated sharply in Manipur in October, while November saw extreme pollution levels in Delhi, Punjab, Chandigarh, Haryana, and Himachal Pradesh with crop stubble burning remaining a major contributor to PM2.5 levels, accounting for 60% of pollution during peak periods.[61] Overall, 35% of Indian cities reported annual PM2.5 averages exceeding ten times the WHO guideline.

CHALLENGES

India faces significant air quality challenges, with major pollution sources including vehicular emissions, industrial discharges, construction dust, and the burning of crop residues. In urban centers like Delhi, vehicular emissions are a leading contributor to fine particulate matter (PM2.5), exacerbated by traffic congestion and fuel adulteration.[62] Seasonal agricultural practices, particularly the burning of crop residues in states like Punjab and Haryana, further deteriorate air quality during winter months. Industrial emissions and construction activities also contribute significantly to pollution levels. Despite governmental measures, such as the National Clean Air Programme aiming to reduce pollution levels, challenges persist due to inconsistent policy implementation and inadequate infrastructure.[63]

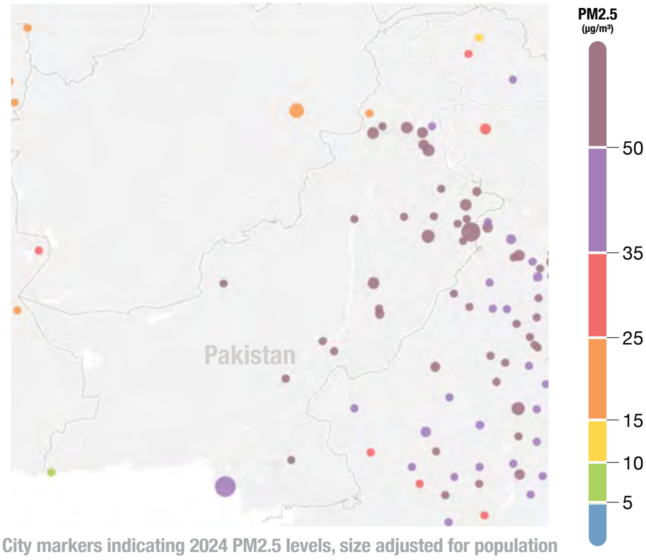
HIGHLIGHT: CLEAN ENVIRONMENT A FUNDAMENTAL RIGHT

In October 2024, India's Supreme Court affirmed that breathing clean, pollution-free air is a fundamental right.[64] The Court found that the federal government and the governments of Delhi, Punjab, Haryana, Uttar Pradesh, and Rajasthan must more effectively control air pollution at its source. Despite numerous rulings requiring government action, the Court determined that the governments had taken only limited action to curb stubble burning and must submit reports demonstrating compliance with court orders. During a November hearing, the Supreme Court criticized Delhi officials for "serious lapses" in curbing pollution under the Graded Response Action Plan, multi-stage emergency measures for reducing pollution during poor air quality days.[65]

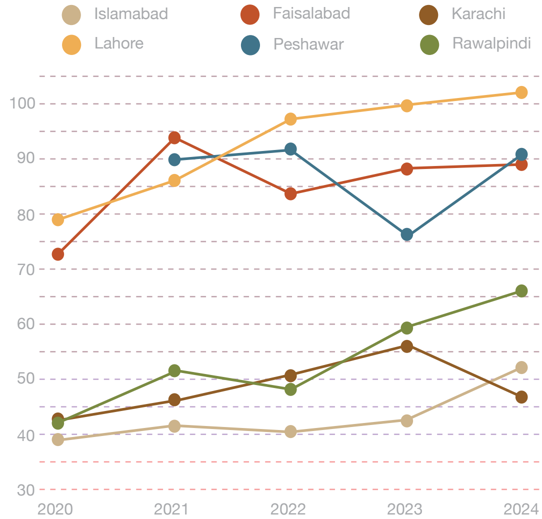


Annual hours spent at different PM2.5 pollution levels

PAKISTAN



City markers indicating 2024 PM2.5 levels, size adjusted for population



PM2.5 annual average (µg/m³) over 5 years

City	2024	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2023
Islamabad	52.4	156.6	57.5	31.9	19.9	23.7	30.3	29.0	22.7	31.5	48.5	83.8	92.4	42.4
Faisalabad	88.8	211.6	104.4	61.6	39.1	51.8	43.4	53.0	45.7	57.7	120.4	204.7	175.8	88.2
Karachi	47.1	114.5	67.4	46.8	31.0	27.1	28.9	28.3	22.5	27.7	38.4	47.6	85.8	56.4
Lahore	102.1	148.4	116.9	83.9	47.0	61.1	39.6	61.5	40.4	61.1	127.6	286.2	152.5	99.5
Peshawar	91.0	245.7	81.8	49.1	30.9	32.5	37.6	40.2	42.5	62.7	108.7	160.1	197.1	76.5
Rawalpindi	65.8	194.5	81.8	48.2	24.6	27.5	28.5	29.5	25.3	35.3	56.6	104.6	134.9	59.5

PROGRESS

Pakistan remains among the top three most polluted countries, recording a national annual average PM2.5 concentration of 73.7 µg/m³ for 2024—the same as the previous year. Despite the unchanged national average, key cities including Islamabad, Faisalabad, Rawalpindi, Lahore, and Peshawar experienced increases in PM2.5 concentrations. 12 cities in Pakistan had annual average concentrations more than ten times the WHO guidelines, or above 50.0 µg/m³.

November was particularly polluted, with five cities reporting monthly averages exceeding 200 µg/m³. December followed as another heavily polluted month, with nine cities recording monthly averages above 120 µg/m³. Lahore, the country's most polluted city, breached an annual average PM2.5 concentration of over 100 µg/m³ for the first time since 2018. Many cities experienced consistently high pollution levels from late fall through winter, reflecting seasonal air quality challenges.

CHALLENGES

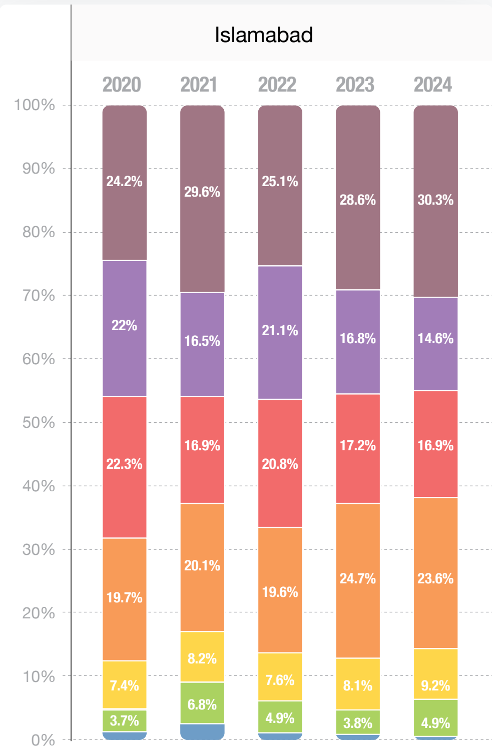
Pakistan faces persistently high levels of pollution from various sources, including biomass burning, industrial activities, vehicular emissions, brick kilns, and construction dust.[66] PM2.5 levels often spike to dangerous levels during winter, driven by a combination of agricultural stubble burning and temperature inversions that trap particulate matter near the ground.[67]

This seasonal confluence results in consistently high pollution during winter months, with multiple months recording average PM2.5 concentrations exceeding 100 µg/m³—more than 20 times the WHO recommended guideline.

HIGHLIGHT: RECORD-SETTING POLLUTION

In November, air quality reached hazardous levels due to a combination of festival celebrations, brick kiln emissions, and adverse weather conditions. The severe pollution led to school closures and the shutdown of public spaces such as zoos, parks, and playgrounds to minimize exposure, particularly for children.[68] Many were hospitalized with respiratory conditions as a result of exposure to poor air quality.[69]

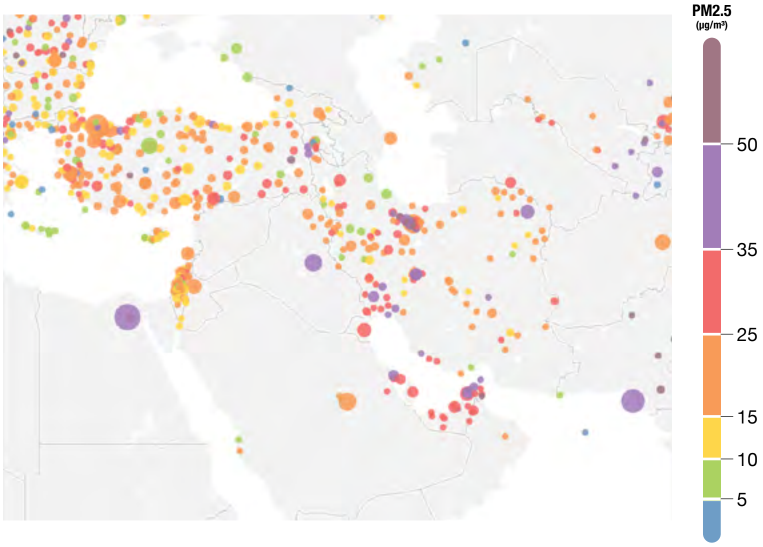
While the government has made efforts to regulate pollution from brick kilns, numerous facilities continue to emit harmful pollutants.[70] Additionally, Diwali celebrations, including widespread use of firecrackers, exacerbated transboundary pollution across the region.[71]



Annual hours spent at different PM2.5 pollution levels

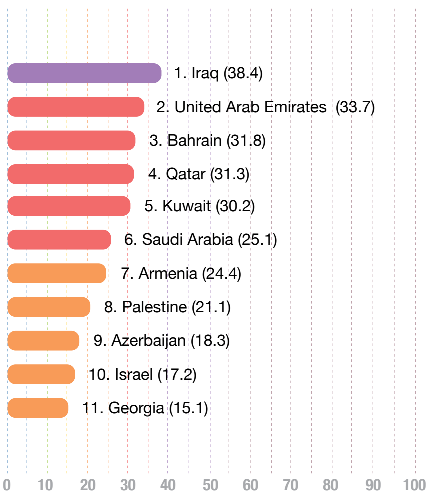
WEST ASIA

Armenia | Azerbaijan | Bahrain | Georgia | Iraq | Israel | Kuwait | Palestine | Qatar | Saudi Arabia | United Arab Emirates



City markers indicating 2024 PM2.5 levels, size adjusted for population

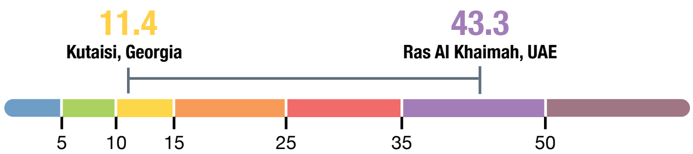
Country/Region Ranking



2024 PM2.5 average (µg/m³)

0%

Regional cities that met the WHO annual PM2.5 guideline in 2024



Range of 2024 average PM2.5 (µg/m³) across regional cities

Most Polluted Regional Cities

Rank	City	2024
1	Ras Al Khaimah, UAE	43.3
2	Baghdad, Iraq	40.5
3	Khobar, Saudi Arabia	38.8
4	Dammam, Saudi Arabia	35.4
5	Dubai, UAE	33.4
6	Dhahran, Saudi Arabia	32.7
7	Abu Dhabi, UAE	32.0
8	Manama, Bahrain	31.8
9	Doha, Qatar	31.3
10	Al Jubayl, Saudi Arabia	30.5
11	Kuwait City, Kuwait	30.2
12	Gayathi, UAE	30.2
13	Ruwais, UAE	29.6
14	Sweihan, UAE	29.5
15	Madinat Zayed, UAE	28.6

Least Polluted Regional Cities

Rank	City	2024
1	Kutaisi, Georgia	11.4
2	En Boqeq, Israel	11.6
3	Batumi, Georgia	11.9
4	Netanya, Israel	13.8
5	Mitzpe Netofa, Israel	14.0
6	Zikhron Ya'akov, Israel	14.2
7	Ketura, Israel	14.4
8	Mi'ilya, Israel	14.5
9	Avigdor, Israel	14.5
10	Timorim, Israel	14.5
11	Jerusalem, Israel	15.0
12	Tbilisi, Georgia	15.1
13	Ashkelon, Israel	15.1
14	Kiryat Ata, Israel	15.2
15	Bethlehem, Palestine	15.2

SUMMARY

In 2024, air quality in West Asia showed moderate improvements, with PM2.5 levels dropping in each country across the region, although air pollution remains a significant challenge. Iraq (38.4 µg/m³) and the United Arab Emirates (33.7 µg/m³) continued to rank among the most polluted countries globally, with Iraq holding the 13th position and the UAE ranked 17th. Despite reductions in PM2.5 levels, both countries remained the most polluted in the region. Iraq saw a drop in PM2.5 levels, with the capital city of Baghdad registering an annual average concentration of 40.5 µg/m³, still exceeding WHO target levels. However, all other national capitals in the region met WHO Interim Target 1 levels, with annual average PM2.5 concentrations not exceeding 35 µg/m³. Ras Al Khaimah, in the UAE, recorded the highest annual average PM2.5 concentration in West Asia at 52 µg/m³.

While the region experienced an overall reduction in PM2.5 levels, there is still significant room for improvement. In 2024, 59% (47) of cities in West Asia had annual PM2.5 concentrations 3-5 times above the WHO annual guideline level, a reduction from 75% in 2023. However, no city in the region met the WHO annual guideline level for PM2.5. The United Arab Emirates and Kuwait saw the most notable reductions in PM2.5 concentrations, with the UAE experiencing a 22% drop and Kuwait a 24% reduction compared to 2023.

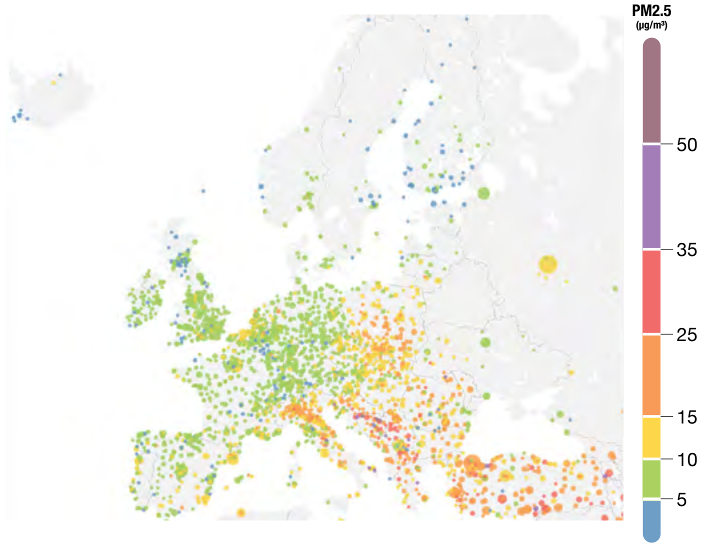
MONITORING STATUS

The monitoring status in West Asia remains a major challenge due to limited coverage. Less than 1% of the global ground-based air quality monitoring stations producing data for this report are in the region, and while 79 cities out of 151 reporting cities met the data availability threshold for inclusion in the report, more robust monitoring systems are necessary.

Approximately 36% of monitoring stations in the region are in the UAE, and 29% are in Israel. In Israel, 89% of the data comes from government-operated monitors, while in Armenia, there is no government-sourced air quality data available to the public. Interestingly, 60% of the data in the region comes from low-cost sensors, with the remaining 40% derived from government monitors. This highlights the growing role of non-governmental sources in air quality monitoring across the region, driven by citizens' increasing demand for reliable air quality data.

EUROPE

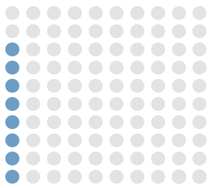
Albania | Andorra | Austria | Belgium | Bosnia Herzegovina | Bulgaria | Croatia | Cyprus | Czech Republic | Denmark | Estonia | Finland | France | Germany | Greece | Hungary | Iceland | Ireland | Italy | Kosovo | Latvia | Liechtenstein | Lithuania | Luxembourg | Malta | Moldova | Montenegro | Netherlands | North Macedonia | Norway | Poland | Portugal | Romania | Russia | Serbia | Slovakia | Slovenia | Spain | Sweden | Switzerland | Turkey | Ukraine | United Kingdom

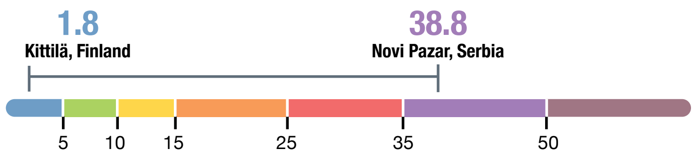


City markers indicating 2024 PM2.5 levels, size adjusted for population

8.0%

Regional cities which met the WHO annual PM2.5 guideline in 2024





Range of 2024 average PM2.5 (µg/m³) across regional cities

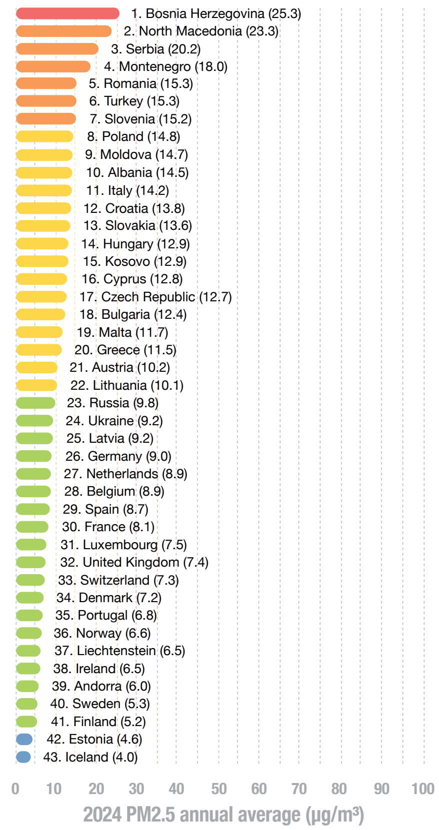
Most Polluted Regional Cities

Rank	City	2024
1	Novi Pazar, Serbia	38.8
2	Bijelo Polje, Montenegro	32.4
3	Pljevlja, Montenegro	31.1
4	Valjevo, Serbia	31.0
5	Sarajevo, Bosnia Herzegovina	30.8
6	Banja Luka, Bosnia Herzegovina	29.9
7	Vogosca, Bosnia Herzegovina	29.3
8	Tetovo, North Macedonia	29.3
9	Kosjeric, Serbia	29.3
10	Tuzla, Bosnia Herzegovina	29.2
11	Kicevo, North Macedonia	28.9
12	Strumica, North Macedonia	28.9
13	Lipe, Serbia	28.4
14	Cagliari, Italy	27.9
15	Cacak, Serbia	27.9

Least Polluted Regional Cities

Rank	City	2024
1	Kittilä, Finland	1.8
2	Bredkalen, Sweden	2.5
3	Gardabaer, Iceland	2.6
4	Monaghan, Ireland	2.6
5	Lamas de Olo, Portugal	2.6
6	Sainte-Ode, Belgium	2.7
7	Mounio, Finland	2.8
8	Zorita del Maestrazgo, Spain	2.8
9	Utö, Finland	3.0
10	Faro, Portugal	3.0
11	Santana, Portugal	3.0
12	Saint-Joseph, France	3.1
13	Portoscuso, Italy	3.2
14	Alacant, Spain	3.2
15	Castello de la Plana, Spain	3.2

Country/Region Ranking



SUMMARY

Europe includes data from 2,105 cities across 43 countries, the highest number of countries in any region globally. Iceland recorded the lowest annual average PM2.5 concentration in the region at 4.0 µg/m³. Despite overall decreases in PM2.5 levels, Bosnia and Herzegovina remained the most polluted country in the region for another consecutive year, with an annual average concentration of 25.3 µg/m³. Fourteen countries reported increases in PM2.5 levels, with Hungary showing the largest rise at 1.3 µg/m³. Conversely, 23 countries recorded decreases. Only two countries—Iceland and Estonia—met the WHO air quality guideline of 5.0 µg/m³. Finland, which had met the guideline last year, recorded a slight increase of 0.3 µg/m³, bringing its annual average to 5.2 µg/m³.

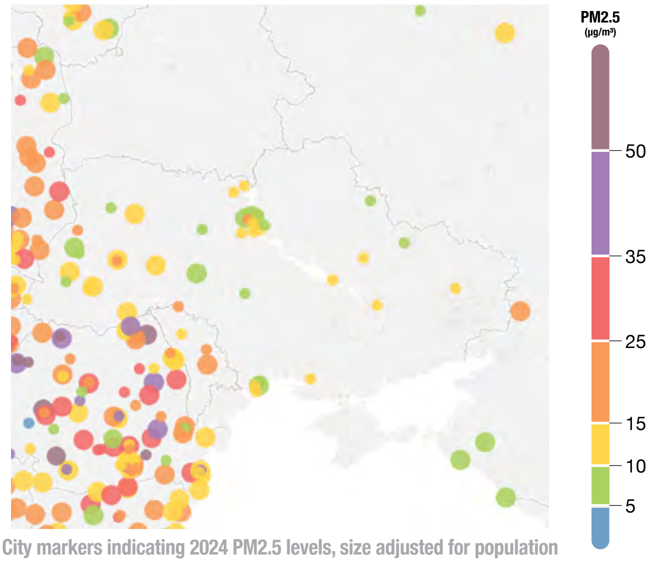
In 2024, 167 cities across Europe remained below the WHO air quality guideline of 5.0 µg/m³, representing 8% of the region's total cities. These cities spanned 19 countries, with the United Kingdom and Finland leading the count at 26 and 25 cities, respectively. Overall, air quality in Europe showed a slight improvement. Among cities that reported data for both 2023 and 2024, 851 recorded decreases in annual average PM2.5 concentrations, compared to 674 cities that saw increases. This trend underscores progress in reducing particulate pollution across the region.

MONITORING STATUS

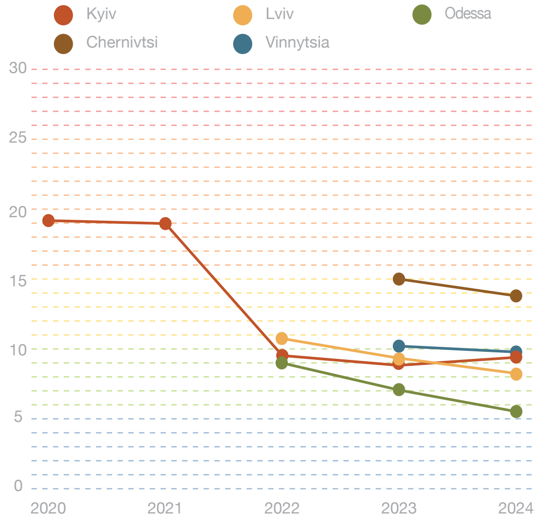
Europe boasts a robust air quality monitoring network, with 79.5% of its data sourced from government monitors. Germany continues to lead in city representation, with 283 cities providing data, followed by the United Kingdom with 242 cities and France with 234 cities.

Non-government monitors play a critical role in enhancing data resolution, particularly in countries like Turkey and Greece, where over 60% of the air quality data comes from non-government sources. This collaborative approach helps ensure comprehensive coverage across the diverse countries in the region.

UKRAINE



City markers indicating 2024 PM2.5 levels, size adjusted for population



PM2.5 annual average (µg/m³) over 5 years

City	2024	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2023
Kyiv	9.4	13.0	10.1	14.0	5.4	5.1	5.9	7.2	8.1	11.4	9.5	11.9	11.1	8.9
Lviv	8.1	11.8	9.7	12.6	5.3	4.2	5.5	7.8	7.4	7.6	7.6	9.5	8.2	9.3
Odessa	5.5	8.2	6.3	8.2	4.0	3.2	4.3	6.3	4.7	4.2	4.1	6.3	6.3	7.1
Chernivtsi	13.8	24.8	18.1	19.1	7.9	6.2	7.5	9.2	9.9	10.4	16.9	20.0	15.6	15.1
Vinnytsia	9.7	14.0	12.3	18.0	7.0	5.8	6.7	7.6	7.8	8.3	9.5	11.0	8.2	10.2

PROGRESS

Ukraine reported a slight increase in its national annual average PM2.5 concentration, rising from 8.6 µg/m³ last year to 9.2 µg/m³ this year. The overall trend showed that larger cities, including Lviv, Odesa, Chernivtsi, and Vinnytsia, experienced reductions in pollution levels, while smaller cities generally saw increases. Among the 23 cities that reported data both this year and last, 12 recorded decreases, while 11, including the capital Kyiv, reported increases.

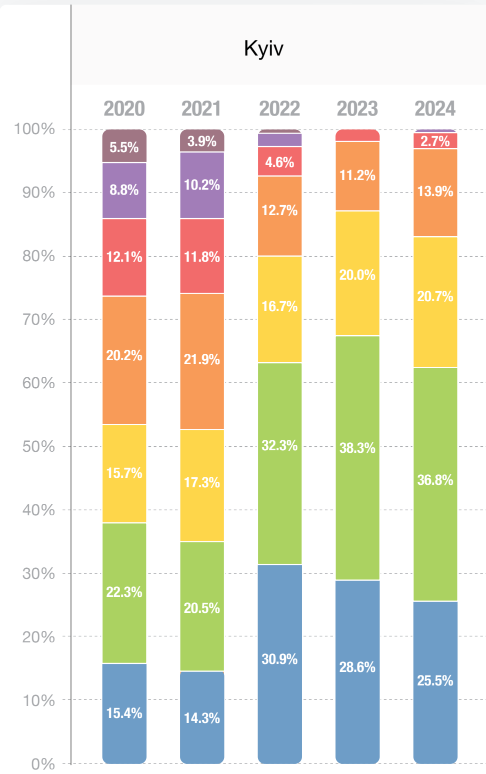
The government monitoring network expanded, adding data from 15 new government monitors in new cities to the 2024 report alone. This effort continues to be supplemented by non-government sources, with Kyiv serving as a key example of a city with a significant non-government sensor network. As in previous years, air pollution remains higher during the winter months due to increased energy demands.

CHALLENGES

Ukraine continues to face air quality challenges from the ongoing aggression from Russia. Aside from the harm to human life, the use of missiles and bombs, the movement of military equipment, and the destruction of civilian infrastructure leads to significant releases of particulate matter.[72] The purposeful destruction of energy infrastructure in the winter months led to energy shortages which resulted in higher instances of burning solid fuel for heating and cooking.[73,74] Additionally, there were wildfires and burning peatlands that added natural sources of air pollution alongside the anthropogenic emissions from the conflict.[75]

HIGHLIGHT: WARTIME LONG-TAILED POLLUTION

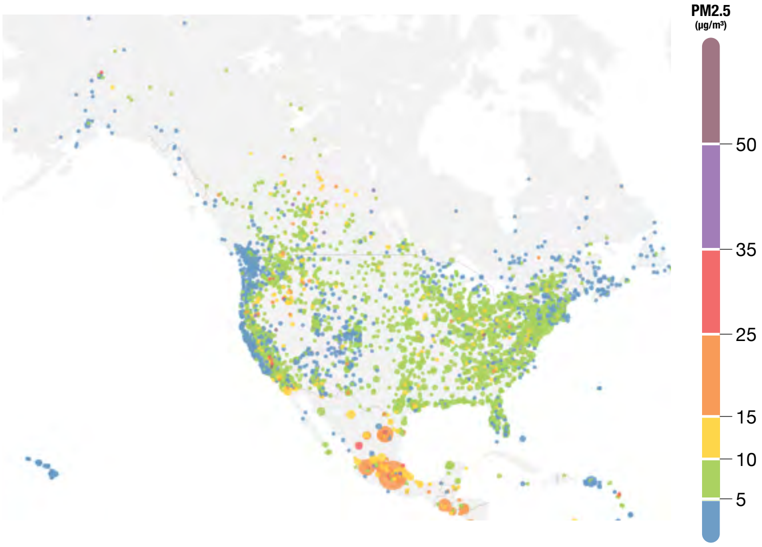
Attacks on civilian dwellings and infrastructure have an immediate impact on PM2.5 air pollution in the affected area.[76] The destruction of power plants necessitates reconstruction, leading to increased emissions from diesel vehicle transportation and the demolition of remaining structures. Additionally, rebuilding civilian infrastructure contributes to air pollution through disturbed dust particles and emissions from concrete production.[77] Post-war reconstruction may further drive higher industrial output, resulting in increased industrial pollution.[78]



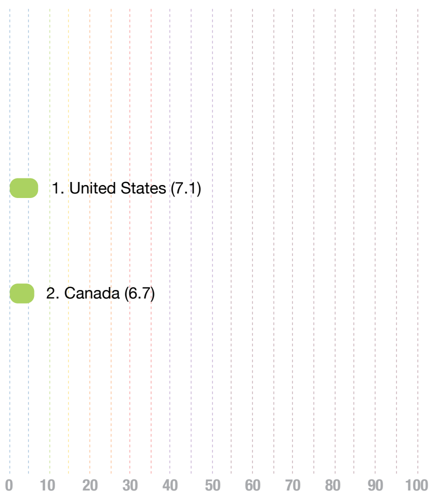
Annual hours spent at different PM2.5 pollution levels

NORTHERN AMERICA

Canada | United States



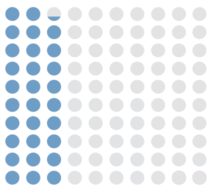
City markers indicating 2024 PM2.5 levels, size adjusted for population

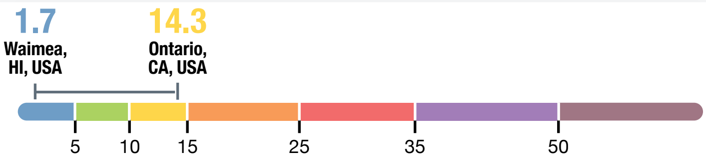


2024 PM2.5 average (µg/m³)

29.3%

Regional cities that met the WHO annual PM2.5 guideline in 2024





Range of 2024 average PM2.5 (µg/m³) across regional cities

Most Polluted Regional Cities*

Rank	City	2024
1	Ontario, CA, USA	14.3
2	Bloomington, CA, USA	13.9
3	Huntington Park, CA, USA	13.6
4	San Bernardino, CA, USA	12.9
5	Fontana, CA, USA	12.7
6	Fort McMurray, Canada	12.5
7	Visalia, CA, USA	12.5
8	Mission, TX, USA	12.4
9	Glendora, CA, USA	12.3
10	Fort Saskatchewan, Canada	12.2
11	Hanford, CA, USA	12.2
12	Maple Ridge, Canada	12.0
13	Conroe, TX, USA	12.0
14	Compton, CA, USA	11.9
15	Claremont, CA, USA	11.7

*For the region of Northern America, only cities with populations >5,000 are ranked here

Least Polluted Regional Cities

Rank	City	2024
1	Waimea, HI, USA	1.7
2	Ocean View, HI, USA	2.1
3	Prince Rupert, Canada	2.2
4	Powell River, Canada	2.4
5	Seaside, CA, USA	2.5
6	Stanwood, WA, USA	2.5
7	Mountain View, HI, USA	2.6
8	Lander, WY, USA	2.6
9	Astoria, OR, USA	2.7
10	Tillamook, OR, USA	2.7
11	Silverdale, WA, USA	2.7
12	Kihei, HI, USA	2.8
13	Enumclaw, WA, USA	2.8
14	Snoqualmie, WA, USA	2.8
15	Williams Lake, Canada	2.9

SUMMARY

In 2024, air quality in Northern America showed moderate improvements, with PM2.5 levels decreasing across the region. The USA reclaimed the top spot as the most polluted country in Northern America, with an annual average PM2.5 concentration of 7.1 µg/m³. Canada, in contrast, saw a significant drop in PM2.5 levels, decreasing from 10.3 µg/m³ in 2023 to 6.7 µg/m³ in 2024, thanks to a milder wildfire season.

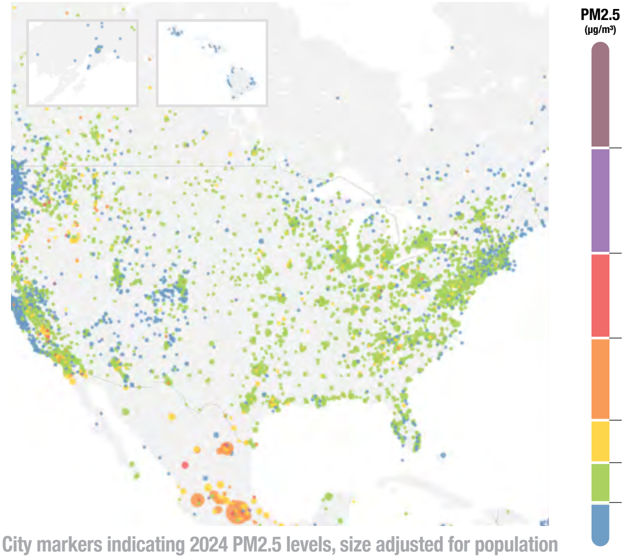
A significant portion of cities in the region showed improvements, with 67% of cities having annual average PM2.5 concentrations between 1-2 times the WHO guideline value. The number of cities meeting the WHO annual guideline value of 5 µg/m³ grew, with 29% (1,203 cities) now meeting this target. This year, only 4% of cities exceeded WHO air quality guidelines by 2-3 times, a major improvement from 27% last year. Despite these positive trends, air quality remains a challenge in certain areas of the region.

MONITORING STATUS

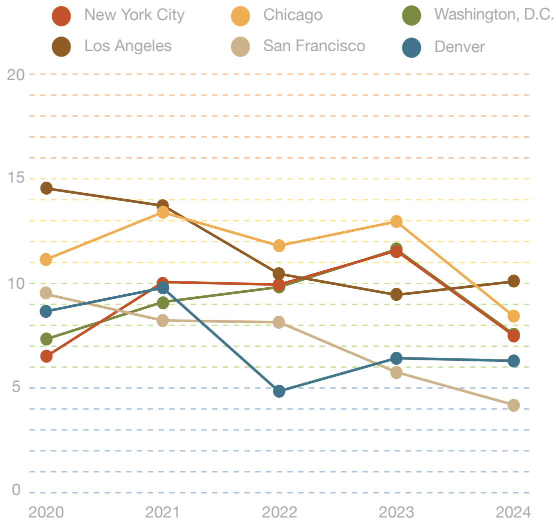
Northern America has a robust air quality monitoring infrastructure, contributing 56% of the total number of ground-based air quality monitoring stations and 46% of the total number of cities included in the report. The region saw a substantial increase in the number of cities represented, rising from 3,242 in 2023 to 4,106 in 2024.

The use of low-cost sensors has also contributed to the increase in monitored cities, with an ongoing shift towards more accessible, community-driven air quality monitoring solutions. In 2024, these sensors contributed 89% of the region's ground-based monitoring data, with 66% of cities relying solely on low-cost sensors. This expanding network is not only improving the accuracy and coverage of air quality assessments but also enhancing the ability to track rapidly changing pollution events, such as wildfires and local pollution hotspots, in real time.

UNITED STATES



City markers indicating 2024 PM2.5 levels, size adjusted for population



PM2.5 annual average (µg/m³) over 5 years

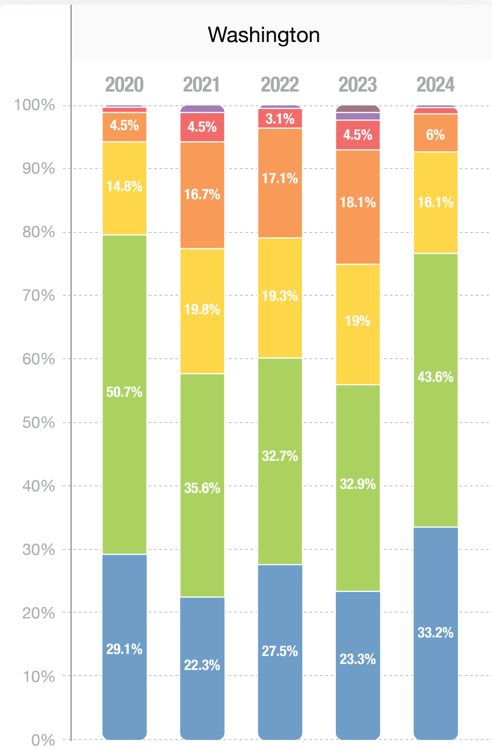
City	2024	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2023
Washington, D.C.	7.6	8.8	10.0	5.8	6.1	6.3	8.5	9.2	8.9	5.2	6.6	6.1	10.2	11.7
New York City	7.5	8.0	7.9	6.3	6.1	6.7	8.2	10.9	9.8	5.5	6.2	6.3	8.3	11.6
Los Angeles	10.1	9.1	6.4	5.9	7.6	9.5	10.4	11.0	9.8	11.1	13.7	8.6	17.3	9.5
Chicago	8.4	12.6	12.6	7.1	5.5	6.5	6.9	9.0	9.0	6.9	6.9	7.4	10.4	13.0
San Francisco	4.2	4.0	3.0	2.3	3.3	3.8	4.3	3.7	3.8	4.3	4.3	3.9	10.3	5.8
Denver	6.3	6.8	5.3	6.4	4.8	4.4	5.5	10.2	6.2	8.3	8.3	5.9	5.1	6.4

PROGRESS

In 2024, the United States saw a significant reduction in PM2.5 levels, with the annual average dropping by more than 22%, from 9.1 µg/m³ in 2023 to 7.1 µg/m³ in 2024. This improvement was driven by large reductions in air pollution across various regions. Chicago and New York City both experienced more than 30% reductions in PM2.5 levels, while cities in Northern California and the Pacific Northwest, including San Jose, San Francisco, and Seattle, met the World Health Organization (WHO) annual PM2.5 guideline level. San Francisco, with an annual average of 4.2 µg/m³, recorded the lowest PM2.5 level seen in the past five years.

In the Midwest, cities such as Columbus, Chicago, and Indianapolis experienced significant drops in PM2.5 levels, with reductions of 35-40%. However, Los Angeles had the highest PM2.5 annual average among the 25 most populated U.S. cities, at 10.1 µg/m³. Texas continues to face air quality challenges, with four of its cities ranking in the top 10 most polluted cities in the U.S.[79]

Southwestern cities like Phoenix and Las Vegas saw a rise in PM2.5 levels in 2024, with annual averages increasing by nearly 30%, reaching 7.4 µg/m³ and 6.3 µg/m³, respectively.



Annual hours spent at different PM2.5 pollution levels

CHALLENGES

In the United States, PM2.5 emissions continue to be a critical air quality challenge. A recent comprehensive study on trends in PM2.5 source apportionment over the past 20 years found that, while pollution control measures have significantly reduced emissions from fossil-fueled power generation, there has been little to no decrease in PM2.5 emissions from vehicles and biomass burning.[80] In 2024, wildfires burned nearly nine million acres, an area roughly the size of Taiwan.[81] Over the past 20 years, biomass and wood burning emissions have contributed to a growing proportion of total PM2.5 emissions. Despite advances in pollution control technology for other sectors, the persistent emissions from vehicles and biomass burning remain a significant obstacle to improving air quality and reducing health risks associated with fine particulate matter exposure.

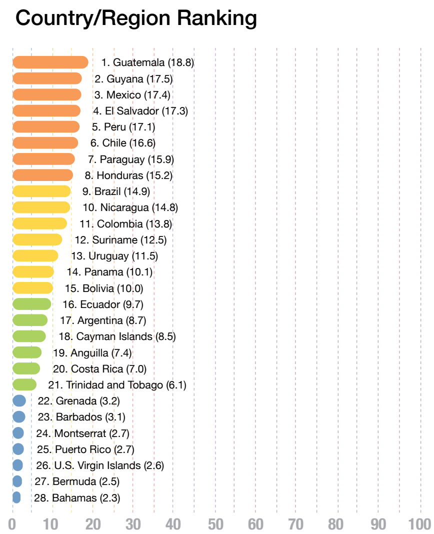
HIGHLIGHT: U.S. EPA LOWERS PM2.5 NATIONAL STANDARD

In February 2024, the U.S. Environmental Protection Agency (EPA) lowered the PM2.5 National Ambient Air Quality Standards (NAAQS) from 12.0 to 9.0 µg/m³. The NAAQS are legally enforceable federal ambient air quality limits on pollution levels. The EPA expects that by 2032, this stricter standard could save up to $46 billion by preventing 800,000 asthma cases, 290,000 lost workdays and 4,500 premature deaths.[82]

LATIN AMERICA & CARIBBEAN

Anguilla | Argentina | The Bahamas | Barbados | Bermuda | Bolivia | Brazil | Cayman Islands | Chile | Colombia | Costa Rica | Ecuador | El Salvador | Grenada | Guatemala | Guyana | Honduras | México | Montserrat | Nicaragua | Panama | Paraguay | Perú | Puerto Rico | Suriname | Trinidad and Tobago | U.S. Virgin Islands | Uruguay

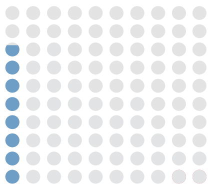
City markers indicating 2024 PM2.5 levels, size adjusted for population

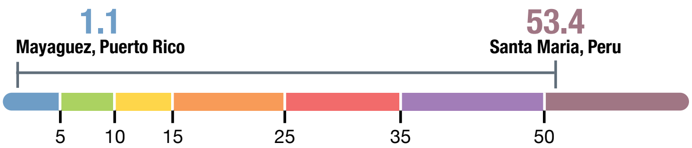


2024 PM2.5 average (µg/m³)

7.8%

Regional cities that met the WHO annual PM2.5 guideline in 2024





Range of 2024 average PM2.5 (µg/m³) across regional cities

Most Polluted Regional Cities

Rank	City	2024
1	Santa Maria, Peru	53.4
2	Coyhaique, Chile	40.5
3	Pitrufquen, Chile	36.6
4	Nacimiento, Chile	30.4
5	Porto Velho, Brazil	29.5
6	San Juan de Lurigancho, Peru	27.5
7	Sena Madureira, Brazil	27.3
8	Victoria, Chile	26.7
9	Osorno, Chile	26.4
10	Puente Piedral, Peru	26.2
11	Itagui, Colombia	25.7
12	Comas, Peru	25.4
13	Padre las Casas, Chile	25.0
14	San Borja, Peru	24.7
15	Carabayllo, Peru	24.6

Least Polluted Regional Cities

Rank	City	2024
1	Mayaguez, Puerto Rico	1.1
2	Nassau, Bahamas	2.3
3	Bathsheba, Barbados	2.3
4	Pembroke, Bermuda	2.5
5	San German, Puerto Rico	2.5
6	Rowans, Barbados	2.6
7	San Juan, Puerto Rico	2.6
8	Saint Croix, U.S. Virgin Islands	2.6
9	Brades, Montserrat	2.7
10	Carolina, Puerto Rico	2.7
11	Checker Hall, Barbados	2.9
12	Aguadilla, Puerto Rico	3.0
13	Bridgetown, Barbados	3.1
14	Crane, Barbados	3.1
15	Saint George's, Grenada	3.2

SUMMARY

In 2024, the Latin America and Caribbean region was represented by 28 countries and territories, with increased data availability allowing Paraguay, the Cayman Islands, Barbados, Montserrat, and the U.S. Virgin Islands to be included after being absent from the 2023 report. Among these newly added locations, Barbados (3.1 µg/m³), Montserrat (2.7 µg/m³), and the U.S. Virgin Islands (2.6 µg/m³) reported annual average PM2.5 concentrations below the WHO guideline of 5.0 µg/m³.

Among the 23 countries and territories that reported data in both 2023 and 2024, nine recorded increases in annual average PM2.5 concentration, 13 saw decreases, and one remained unchanged. Ecuador and Brazil experienced the largest increases, each rising by 2.3 µg/m³, while the Bahamas saw the most significant decline, dropping by 2.9 µg/m³, followed closely by Mexico, which recorded a decrease of 2.6 µg/m³.

Seven countries and territories in the region now report PM2.5 concentrations below the WHO guideline of 5.0 µg/m³: Grenada, Barbados, Montserrat, Puerto Rico, the U.S. Virgin Islands, the Bahamas, and Bermuda.

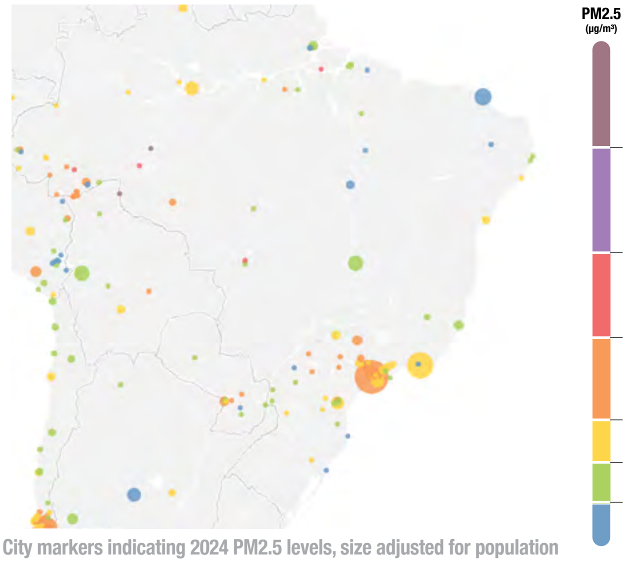
Key sources of PM2.5 pollution in the region include deforestation, uncontrolled fires, vehicle emissions, and pollution from extractive industries. Climate change exacerbates these issues, increasing health risks through extreme weather events and worsening air quality. In response, grassroots activism and policy initiatives promoting clean energy adoption remain central to efforts to improve air quality across the region.

MONITORING STATUS

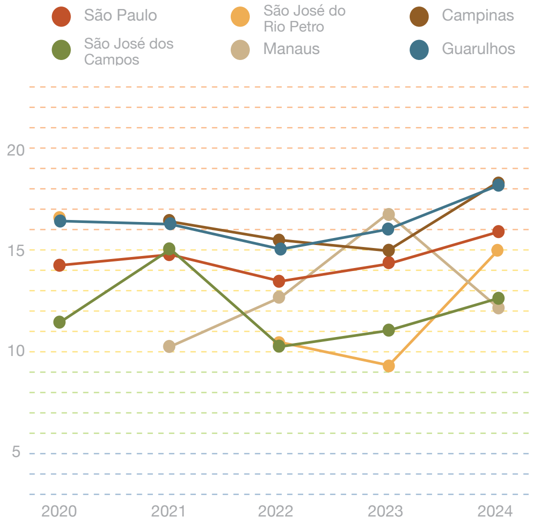
The air quality monitoring network in the Latin America and Caribbean region continues to expand, with 40 more cities included in 2024 compared to 2023. Among these new cities, 15 recorded annual average concentrations below the WHO guideline. Many of these locations rely on non-government-operated monitors, reflecting strong citizen engagement and interest in local air quality. Ongoing efforts to enhance data availability have contributed to the development of a robust non-government monitoring network in the region.

Chile, Brazil, and Mexico lead in the number of cities reporting air quality data, with 69, 50, and 46 cities, respectively. Brazil saw the largest increase in participation, with 11 additional cities reporting data compared to last year.

BRAZIL



City markers indicating 2024 PM2.5 levels, size adjusted for population



PM2.5 annual average (µg/m³) over 5 years

City	2024	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2023
São Paulo	15.9	7.8	10.3	10.0	15.4	15.2	21.5	21.5	24.8	34.1	13.3	9.3	8.2	14.3
São José dos Campos	12.7	7.8	8.1	7.9	12.5	13.6	17.2	16.1	18.2	27.2	9.9	7.5	6.7	11.0
Campinas	18.2	9.7	11.7	11.7	19.1	19.8	21.8	22.5	26.9	37.7	13.8	11.4	8.3	15.0
Manaus	12.2	4.8	5.8	5.5	3.2	3.7	6.1	9.2	30.3	25.8	15.9	27.8	8.2	16.8
São José do Rio Preto	15.0	5.6	5.6	4.8	9.8	13.7	15.8	19.2	28.4	44.5	21.1	6.4	5.7	9.3
Guarulhos	18.1	10.1	11.7	13.5	17.2	19.5	24.4	23.8	28.2	35.3	12.4	11.7	9.6	16.0

PROGRESS

Brazil's annual average PM2.5 concentration increased from 12.9 µg/m³ in 2023 to 14.9 µg/m³ in 2024, placing it within the WHO interim target 3 category. This national rise was mirrored in the highlighted cities of São Paulo, São José dos Campos, Campinas, Guarulhos, and São José do Rio Petro. Notably, Rio de Janeiro did not meet the yearly data availability threshold and was therefore excluded from the 2024 report. This gap underscores the need for improved air quality monitoring in one of Brazil's most populous cities, by both government and non-government sources.

Additionally, PM2.5 concentrations were higher nationwide from June through September due to the 2024 wildfire season. In September, monthly concentrations in several cities exceeded 50.0 µg/m³—more than ten times the WHO guideline.

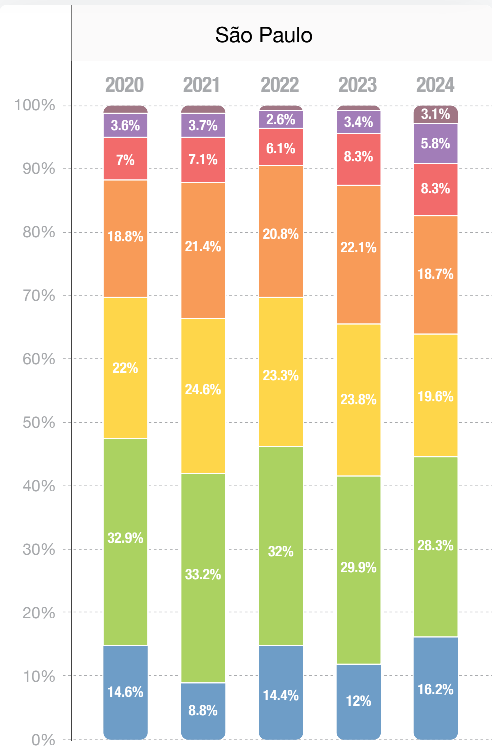
CHALLENGES

Wildfires in Brazil's rainforests continue to contribute to high PM2.5 emissions during wildfire season. August through September 2024 brought emission totals that rivaled record setting measurements from 2007.[83] High temperatures and a long-term drought exacerbated fire prone conditions leading to record numbers of fires and burnt acreage.[84] Furthermore, illegal deforestation and poor soil management are anthropogenic contributors to the intense blazes.[85] Brazil also contends with high vehicular emissions and industrial pollution from densely populated parts of the country and industrial centers.[86]

HIGHLIGHT: DROUGHT FUELS FOREST FIRES

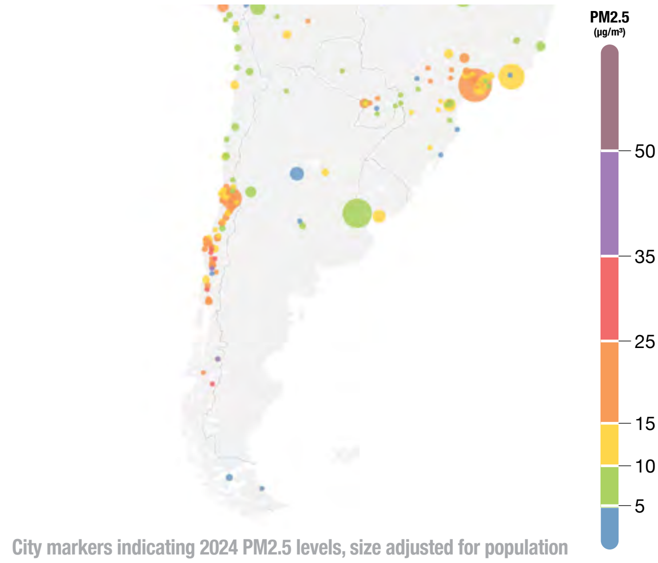
Brazil faced an especially severe wildfire season in 2024, with over 120,000 fire outbreaks reported in the Amazon—a more than 50% increase from the same period in 2023 and the highest count since 2007.[87] This surge in wildfires is reflected in air quality data, as many cities recorded elevated PM2.5 concentrations from June through September. The impact extended to public health, with a notable rise in hospitalizations for respiratory issues following periods of intense wildfire smoke exposure.[88]

In response, Brazil introduced new legislation in 2024 to mitigate the harmful effects of air pollution and raise public awareness. The regulations aim to establish a fund to strengthen air quality monitoring networks and set targets for future air quality improvements.[89,90]

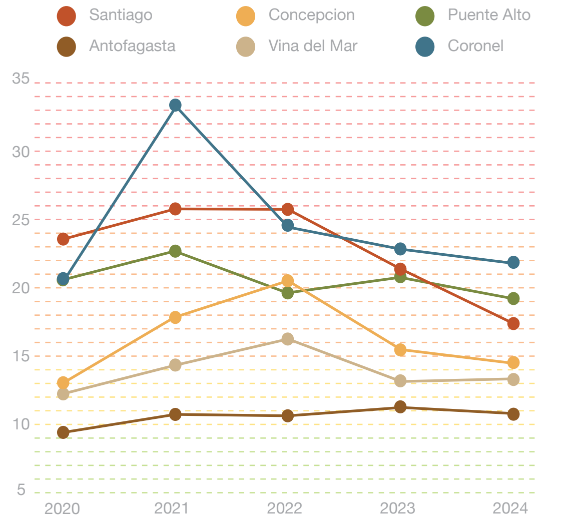


Annual hours spent at different PM2.5 pollution levels

CHILE



City markers indicating 2024 PM2.5 levels, size adjusted for population



PM2.5 annual average (μg/m³) over 5 years

City	2024	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2023
Santiago	17.3	11.0	11.1	10.7	15.4	26.0	22.5	38.9	24.4	16.3	12.9	8.4	9.9	21.3
Concepcion	14.5	6.5	7.9	7.6	12.7	31.3	15.2	34.8	21.5	10.2	9.4	7.1	8.2	15.5
Puente Alto	19.2	10.9	10.6	12.2	16.2	24.4	19.8	36.7	26.0	18.9	17.8	16.6	19.7	20.8
Antofagasta	10.8	5.9	5.6	7.0	9.2	13.8	14.8	15.3	13.3	12.7	11.0	10.3	10.7	11.2
Vina del Mar	13.2	10.7	14.4	12.0	11.1	18.5	17.0	26.7	11.4	10.2	8.5	7.9	9.5	13.1
Coronel	21.9	10.2	10.7	10.4	23.5	50.2	24.0	52.1	32.8	16.6	13.6	8.5	8.8	22.9

PROGRESS

Chile's national annual average PM2.5 concentration continued to decline, dropping from 18.8 μg/m³ in 2023 to 16.6 μg/m³ in 2024. This trend is reflected in Santiago, the capital, which recorded an annual average of 17.3 μg/m³—the lowest in the past six years.

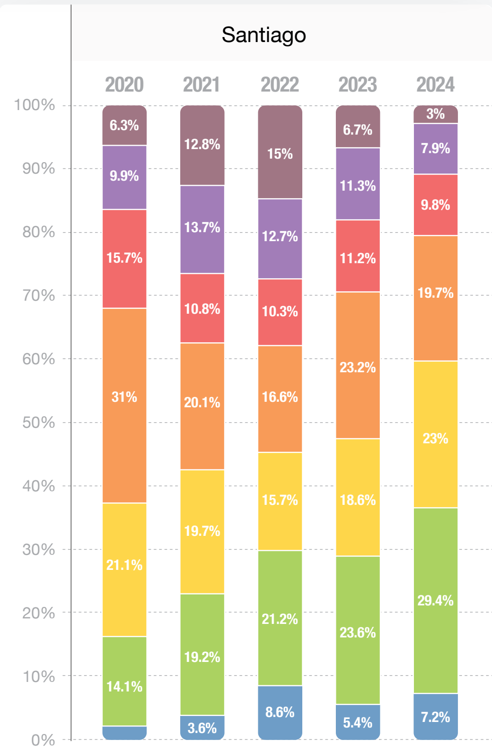
More than two-thirds of Chilean cities that reported data in both 2023 and 2024 saw reductions in PM2.5 levels, including Concepción, Antofagasta, Coronel, and Santiago. Viña del Mar was the only highlighted city to record a slight increase of 0.1 μg/m³. Chile is home to one city that met the WHO's air quality guideline: Punta Arenas, with an annual average of 4.5 μg/m³.

CHALLENGES

Chile continues to face air pollution risks from anthropogenic and natural sources. Road transportation and wood burning for heating and cooking are significant sources for PM2.5 pollution in the southern areas of the country.[91] Some cities in southern Chile can apportion more than 80% of the ambient PM2.5 pollution to wood combustion.[92] There are also variations in PM2.5 concentration with temperature and atmospheric conditions: meteorological conditions can trap pollution close to the ground and prevent dissipation.[93] Chile has endured a particularly bad wildfire season which compounded the anthropogenic sources. Blazes in February alone amounted to over 165 concurrent active fires causing hundreds of fatalities and burning over 150,000 acres.[94]

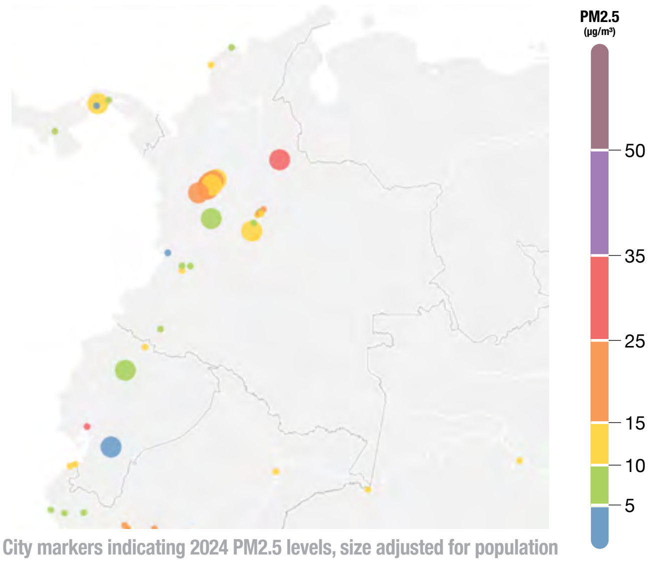
HIGHLIGHT: CHILEAN METEOROLOGY AND POLLUTION

Chile has experienced a prolonged multiyear drought, worsening wildfire-prone conditions at the start of the year.[95] In February, a massive heatwave struck major cities, increasing stress on the power grid due to higher cooling demands and further intensifying wildfire risks.[96] In Santiago, temperature inversions trap pollution near the surface, exposing residents to harmful air quality.[97] The combination of these factors leads to spikes in PM2.5 levels, particularly during the already polluted winter months.

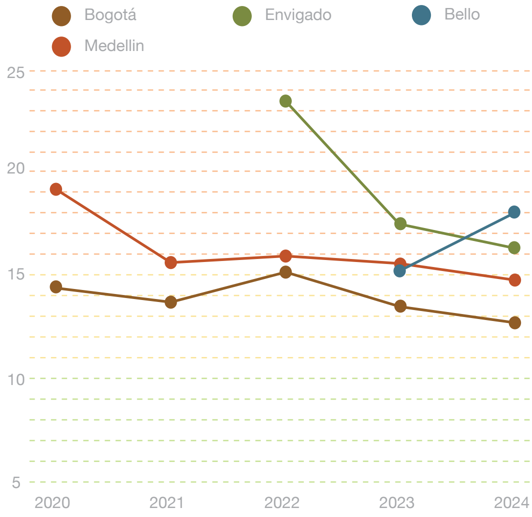


Annual hours spent at different PM2.5 pollution levels

COLOMBIA



City markers indicating 2024 PM2.5 levels, size adjusted for population



PM2.5 annual average (µg/m³) over 5 years

City	2024	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2023
Bogotá	12.7	17.0	16.5	24.9	19.4	8.0	8.3	4.5	8.7	11.4	9.9	10.7	13.6	13.4
Medellin	14.8	18.0	16.6	26.8	20.0	11.9	10.4	10.6	13.4	16.0	11.6	10.6	12.1	15.5
Bello	18.0	20.5	19.4	30.4	23.5	14.8	12.4	12.4	14.7	18.0	15.2	14.4	NO DATA	15.2
Envigado	16.3	19.9	18.8	30.1	21.7	13.8	10.8	10.7	14.2	16.0	12.6	10.7	16.3	17.4

PROGRESS

Colombia's national annual average PM2.5 concentration continues to decline, reaching 13.8 µg/m³. This trend is reflected in key cities such as Bogotá, Envigado, and Medellín, which recorded decreases of 0.7 µg/m³, 1.1 µg/m³, and 0.7 µg/m³, respectively. Bogotá, the capital, reported an annual average of 12.7 µg/m³—the lowest since data collection began in 2017.

Many cities in Colombia experienced their highest PM2.5 concentrations in March, driven by temperature inversions and other meteorological factors. During this period, Bello and Envigado recorded values exceeding 30.0 µg/m³, more than six times the WHO annual guideline level.

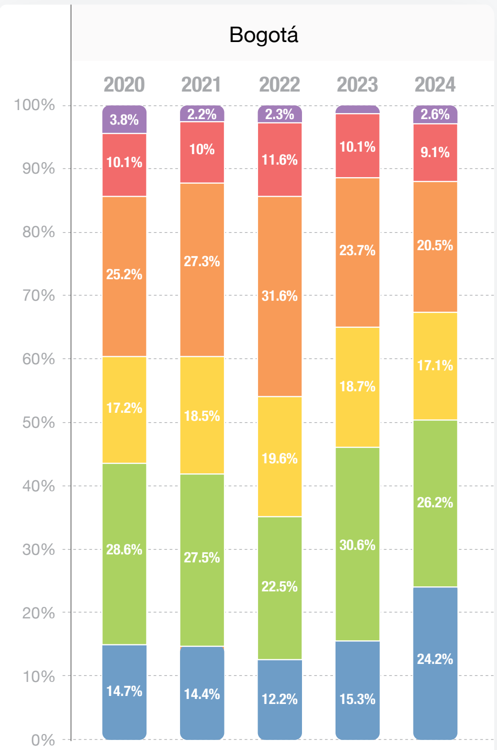
Despite overall improvements at both the city and national levels, no Colombian city met the WHO's annual air quality guideline.

CHALLENGES

Colombia has sources of PM2.5 from within the country and from long range transport. The domestic sources of PM2.5 pollution come from vehicle emissions, resuspended dust from unpaved roads, industry, and wildfires.[98] Colombia's wildfire season highly contributed to seasonal variations in particulate concentration which coincided with the dry season lasting from late December through March.[99] Transboundary sources of air pollution include emissions from biomass burning, dust, and volcanic degassing.[100] The combination of domestic and transboundary emissions sources require regulation within the country and international cooperation to reduce the population's risk of exposure.

HIGHLIGHT: SPATIAL POLLUTION DIFFERENCES WITHIN COLOMBIA

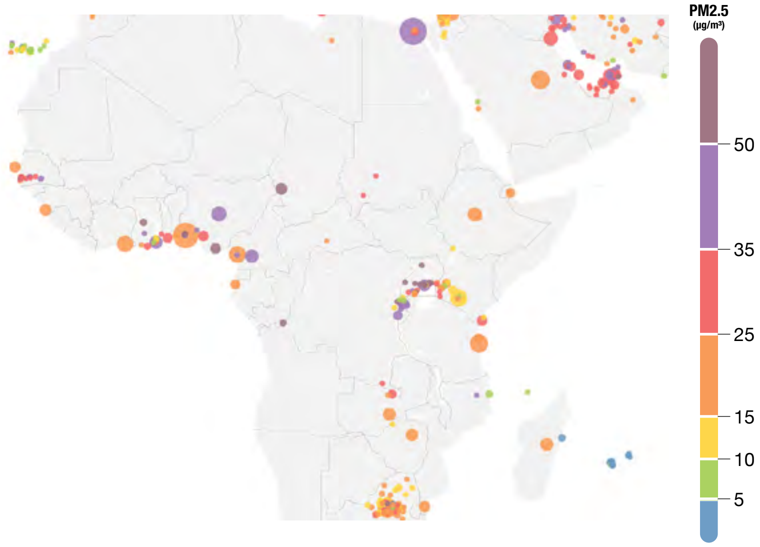
Agricultural zones contribute to emissions through biomass burning and other agricultural pollution sources.[101,102] Pollution is particularly intense in industrial corridors, where many people live and work.[103] Meanwhile, residents near the Nevado del Ruiz volcanic valley face heightened exposure to volcanic gas emissions.[104] These diverse pollution sources may lead to potential regional epigenetic changes in exposed populations.[105] Given the seasonal and regional variations in pollution, increased monitoring and localized programs are essential to protecting public health in Colombia.



Annual hours spent at different PM2.5 pollution levels

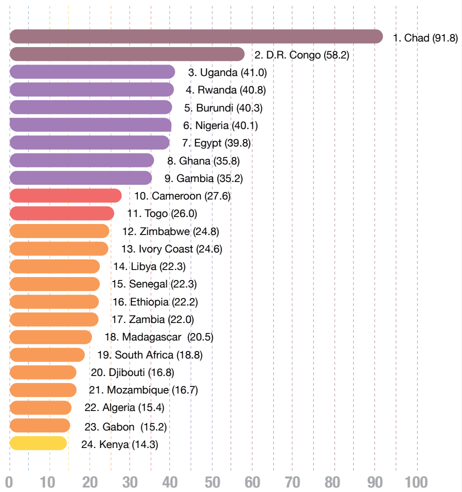
AFRICA

Algeria | Burundi | Cameroon | Chad | Democratic Republic of the Congo | Djibouti | Egypt | Ethiopia | Gabon | Gambia | Ghana | Ivory Coast | Kenya | Libya | Madagascar | Mozambique | Nigeria | Rwanda | Senegal | South Africa | Togo | Uganda | Zambia | Zimbabwe



City markers indicating 2024 PM2.5 levels, size adjusted for population

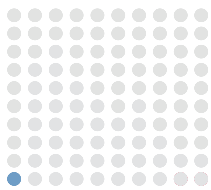
Country/Region Ranking

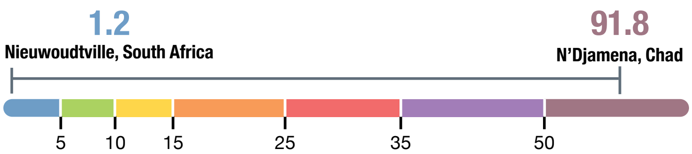


2024 PM2.5 average (µg/m³)

1%

Regional cities that met the WHO annual PM2.5 guideline in 2024





Range of 2024 average PM2.5 (µg/m³) across regional cities

Most Polluted Regional Cities

Rank	City	2024
1	N'Djamena, Chad	91.8
2	Kinshasa, D.R. Congo	58.2
3	Abuja, Nigeria	42.2
4	Kampala, Uganda	41.0
5	Kigali, Rwanda	40.8
6	Basse Santa Su, Gambia	40.5
7	Bujumbura, Burundi	40.3
8	Cairo, Egypt	39.9
9	Kumasi, Ghana	39.6
10	Serrekunda, Gambia	38.4
11	Centurion, South Africa	37.0
12	Yaounde, Cameroon	36.3
13	Accra, Ghana	36.3
14	Vereeniging, South Africa	34.0
15	Bakau, Gambia	33.0

Least Polluted Regional Cities

Rank	City	2024
1	Nieuwoudtville, South Africa	1.2
2	Worcester, South Africa	6.5
3	Cape Town, South Africa	7.2
4	Kapsabet, Kenya	7.5
5	Mossel Bay, South Africa	8.3
6	eSikhaleni, South Africa	8.4
7	George, South Africa	8.6
8	Port Shepstone, South Africa	8.8
9	Sunset Beach, South Africa	9.4
10	Gqeberha, South Africa	10.4
11	Empangeni, South Africa	10.6
12	Nakuru, Kenya	11.2
13	Richards Bay, South Africa	11.4
14	Iten, Kenya	11.7
15	Mokopane, South Africa	12.3

SUMMARY

Africa's air quality in 2024 remains a major public health crisis, with five of the world's ten most polluted countries located in the region. N'Djamena, Chad, recorded the highest annual PM2.5 concentration at 91.8 µg/m³, followed by Kinshasa, Democratic Republic of the Congo, at 58.2 µg/m³—a 40% increase from the previous year, partly due to expanded data availability. The number of reporting cities grew from 79 in 2023 to 106 in 2024, yet only 24 of Africa's 54 countries had cities that met data inclusion requirements. With just 400 monitoring stations—only 0.6% of the global total—significant data gaps persist, most notably in Lagos, Africa's second most populous city, which was absent from the report due to insufficient data. In 2024, 34% of African cities reported PM2.5 levels three to five times the WHO guideline, while 24% had levels five to seven times higher. Only one city met the WHO standard.

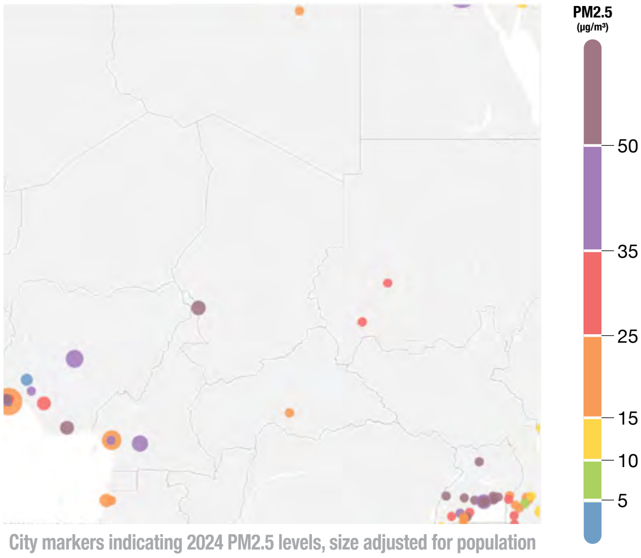
Rapid urbanization, population growth, and limited air quality monitoring exacerbate Africa's pollution crisis. The region's population, currently 1.5 billion (18% of the global total), is expected to triple by 2050.[106] Kinshasa, Africa's most populous city with 17.6 million people, saw a sharp rise in PM2.5 levels. The Gambia's PM2.5 average increased by 23% to 35.2 µg/m³, an increase influenced by an expansion in monitoring. Chad remains the world's most polluted country, influenced by the Bodélé Depression, one of the largest global sources of atmospheric dust. Without urgent investment in air quality infrastructure, pollution-related deaths and economic burdens will continue to rise.

MONITORING STATUS

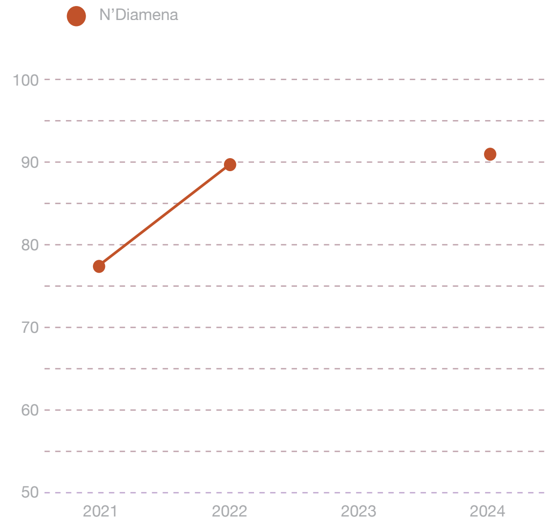
Vast regions of Africa still lack consistent air quality data, leaving many without a clear picture of the air they breathe throughout the year. Notably absent from the 2024 report are several key countries that were included in 2023. This includes Burkina Faso, which had the highest reported PM2.5 concentration in Africa and the fourth highest globally last year, along with Mauritius and Angola, which recorded the lowest concentrations in Africa in 2023. While increased data availability enabled Chad's return to the report, many other regions of Africa still require additional monitoring stations to empower communities with knowledge about their air quality.

A growing share of Africa's air quality monitoring network now comes from non-government sources. In 2024, non-government monitors accounted for 67% of all air quality sensors in African cities, up from 42% in the previous year. This expansion highlights increased citizen engagement but also underscores the need for government-led monitoring to match and support this growth.

CHAD



City markers indicating 2024 PM2.5 levels, size adjusted for population



PM2.5 annual average (µg/m³) over 4 years

City	2024	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2023
N'Djamena	91.8	192.8	126.9	167.3	160.8	138.9	54.2	20.6	20.0	24.9	40.4	70.6	102.1	NO DATA

PROGRESS

Chad was the most polluted country in the world in both 2022 and 2024. Due to a lack of data in 2023, a direct comparison for that year is not possible. Air quality slightly worsened in 2024 compared to 2022, with the annual average PM2.5 concentration rising from 89.7 µg/m³ to 91.8 µg/m³.

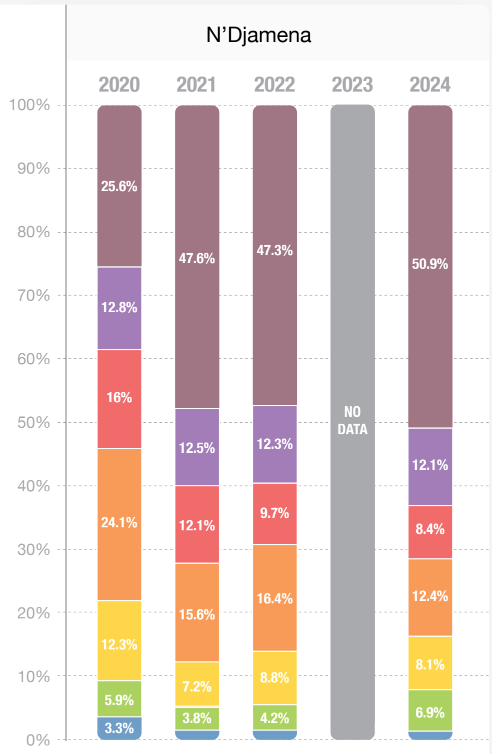
While PM2.5 levels in most months of 2024 were similar to or slightly lower than in 2022, concentrations spiked significantly in April and May. In April, PM2.5 levels surged by 55%, increasing from an already high 103.7 µg/m³ to 160.8 µg/m³. In May, concentrations rose even more dramatically: by 87% from 74.2 µg/m³ to 138.9 µg/m³.

CHALLENGES

Mineral dust in the Sahara Desert is the primary source of air pollution in Chad. Persistent exposure to mineral dust can lead to many serious health problems, including asthma and lung disease.[107] Other emission sources impacting the nation's air quality are vehicle emissions, uncontrolled crop burning, and pollutants from the meatpacking, oil, and textile industries.[108] Biomass fuel use and traditional stoves, which can lead to dangerous levels of indoor air pollution, can also affect community air quality. Limited air quality monitoring and access to air quality data remains a serious challenge across Sub-Saharan Africa in countries like Chad, often due to inconsistent access to power, poor connectivity, and in remote rural environments frequently exposed to dust storms, maintenance and logistics issues.

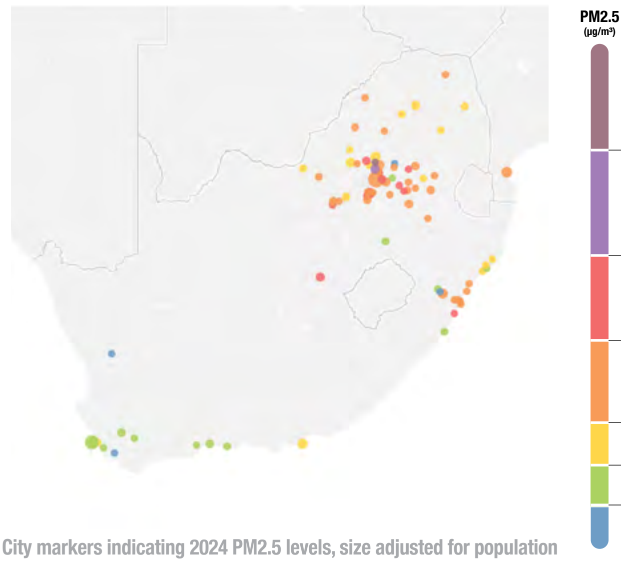
HIGHLIGHT: THE BODÉLÉ DEPRESSION

The Bodélé Depression, a dry, prehistoric lakebed in Northern Chad, may be the source of roughly half of the Sahara Desert's mineral dust and is the primary source of air pollution in Chad.[109] The dry and windy Harmattan season in Africa occurs between November and March. Because these winds blow between the Tibesti and Ennedi Plateau, the Depression serves as a wind tunnel, capable of regularly generating massive plumes of dust. Those windblown dust plumes can be carried across the entire width of the Sahara Desert and transport dust as far distant as the Amazon.[110] 400,000 annual preventable infant deaths in Sub-Saharan Africa have been attributed to exposure to particulate matter. As many as 40 percent of all infant deaths in the region are related to these pollutants.[111]

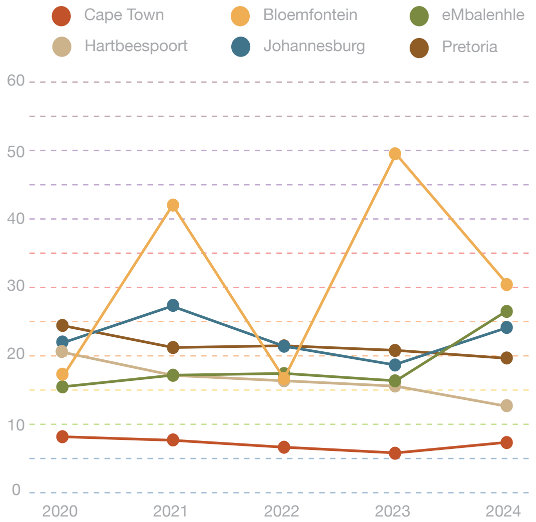


Annual hours spent at different PM2.5 pollution levels

SOUTH AFRICA



City markers indicating 2024 PM2.5 levels, size adjusted for population



PM2.5 annual average (μg/m³) over 5 years

City	2024	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2023
Cape Town	7.2	5.7	6.0	4.0	5.7	5.9	11.8	9.6	7.5	7.1	9.8	6.6	6.9	5.9
Bloemfontein	30.6	9.0	19.7	24.9	29.0	96.1	62.2	40.2	31.9	20.1	17.4	8.1	7.7	49.4
eMbalenhle	26.7	14.5	17.9	17.1	20.4	41.0	47.1	48.1	40.0	24.9	19.8	15.6	12.4	16.5
Hartbeespoort	13.2	9.7	9.0	9.1	11.7	24.1	25.2	22.8	15.4	11.4	8.4	6.4	4.4	15.6
Johannesburg	24.0	16.9	16.3	15.6	19.4	41.2	50.1	36.9	31.5	22.9	15.7	12.2	9.0	18.7
Pretoria	19.6	12.1	11.3	9.5	13.2	29.5	31.3	40.3	31.0	20.5	15.2	10.6	9.9	21.1

PROGRESS

South Africa recorded a slight decrease of 1.1 μg/m³ in its annual average PM2.5 concentration, dropping from 19.9 μg/m³ in 2023 to 18.8 μg/m³ in 2024. This decline was reflected in the capital, Pretoria, which fell below 20 μg/m³ for the first time since its inclusion in the report in 2019.

However, PM2.5 concentrations increased in Johannesburg and eMbalenhle, with the latter experiencing a sharp rise of over 10 μg/m³—from 16.5 μg/m³ to 26.7 μg/m³—exceeding the WHO guideline by more than five times.

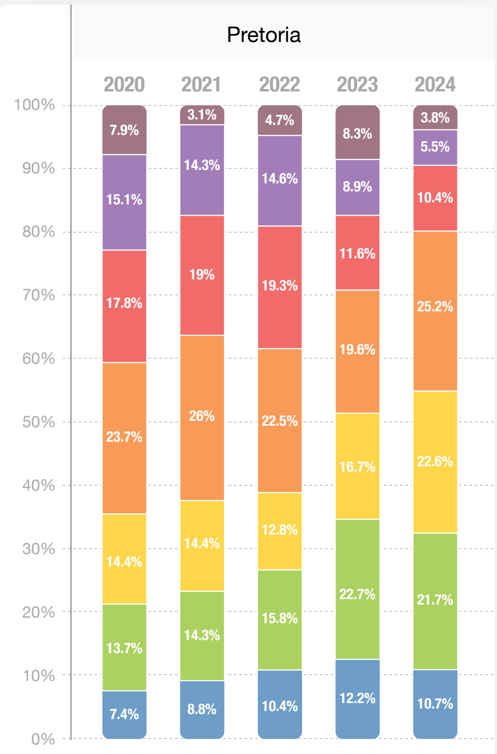
Among the cities that reported data in both 2023 and 2024, 20 saw an increase in annual PM2.5 concentration, while 18 recorded decreases. Only one city, Nieuwoudtville, remained below the WHO guideline in 2024, maintaining a concentration below 5.0 μg/m³ for the fourth consecutive year.

CHALLENGES

South Africa has a variety of PM2.5 emission sources that pose health hazards to the population. Sulphates from industrial plants and secondary pollution fossil fuel combustion come from regions with high industrial output and mobile sources.[112] South Africa continues to use coal as a primary fuel for many of the nation's power plants.[113] Wind can transport soil and mineral dust from arid regions to impact large areas of the country.[114,115] In the winter, a higher portion of the PM2.5 pollution comes from heating and transportation emissions.[116] Other seasonal sources include agricultural burning and wildfires.[117,118]

HIGHLIGHT: CHILDREN'S HEALTH

Residents of low- and middle-income countries like South Africa bear a disproportionate burden from air pollution-related diseases; children are particularly susceptible and at-risk. South Africa suffers the 8th largest number of child deaths under the age of five globally. Over 3,365 children under the age of five died in South Africa during 2021 due to air pollution.[119] Young South Africans, aware of the harm being done to them, mobilized to "cancel coal," through litigation.[120] The landmark December 9, 2024 High Court decision halted government plans to build out 1,500 megawatts of coal-fired power capacity.[121] The litigants successfully argued that the government has a constitutional duty to protect children from cancer and respiratory illness-causing air pollutants, and from contributing to climate change.



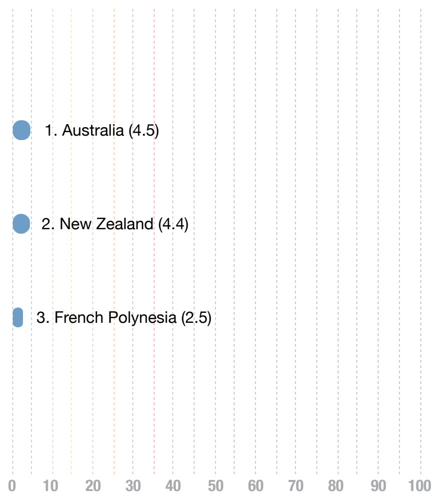
Annual hours spent at different PM2.5 pollution levels

OCEANIA

Australia | French Polynesia | New Zealand

City markers indicating 2024 PM2.5 levels, size adjusted for population

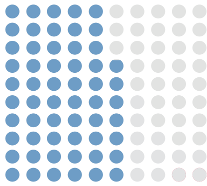
Country/Region Ranking

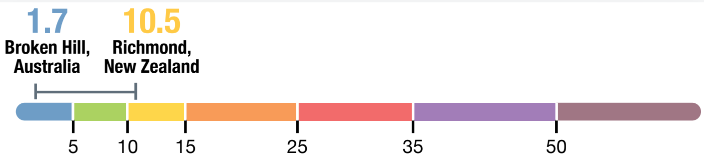


2024 PM2.5 average (µg/m³)

56.9%

Regional cities that met the WHO annual PM2.5 guideline in 2024





Range of 2024 average PM2.5 (µg/m³) across regional cities

Most Polluted Regional Cities

Rank	City	2024
1	Richmond, New Zealand	10.5
2	Blenheim, New Zealand	9.9
3	Kaiapoi, New Zealand	9.8
4	Darwin, Australia	9.7
5	Tokoroa, New Zealand	9.3
6	Singleton, Australia	9.0
7	Taihape, New Zealand	8.9
8	Stockton, Australia	8.8
9	Collie, Australia	8.8
10	Longford, Australia	8.6
11	Brighton, Australia	8.4
12	Taupo, New Zealand	8.4
13	Florey, Australia	8.3
14	Thurgoona, Australia	8.2
15	Carlton, Australia	8.2

Least Polluted Regional Cities

Rank	City	2024
1	Broken Hill, Australia	1.7
2	White Cliffs, Australia	1.8
3	Underwood, Australia	1.8
4	Hay, Australia	2.0
5	Lameroo, Australia	2.1
6	Romaine, Australia	2.1
7	Kyalite, Australia	2.2
8	Fingal, Australia	2.2
9	Judbury, Australia	2.2
10	Euston, Australia	2.3
11	Mornington, Australia	2.3
12	Cobar, Australia	2.5
13	Walgett, Australia	2.5
14	Walpeup, Australia	2.5
15	Condobolin, Australia	2.6

SUMMARY

Oceania continued its streak as the least polluted region in the world in 2024. All three countries in the region maintained annual national average PM2.5 concentrations below the WHO guideline of 5.0 µg/m³. Australia reported an unchanged national concentration of 4.5 µg/m³, New Zealand saw a marginal increase of 0.1 µg/m³, and French Polynesia recorded a decrease of 0.7 µg/m³.

The capitals of all three countries also reported annual average concentrations within the WHO guideline. Wellington, New Zealand, however, experienced a year-over-year increase of 1.2 µg/m³, reaching 4.3 µg/m³. Although still within the guideline, continued increases at this rate could eventually breach the limit. Oceania maintained the highest percentage of cities meeting the WHO guidelines, with over 56% of monitored cities reporting annual average concentrations below 5.0 µg/m³.

Despite generally clean air, seasonal and localized threats persist. Australia's wildfire season poses acute air quality risks due to smoke, and residents in larger cities face additional pollution from mobile emission sources, including cars and diesel-powered vehicles.

MONITORING STATUS

Oceania maintains a robust network of non-governmental monitoring stations that complement government-operated monitors. In Australia, all eight states and internal territories with cities featured in this year's report included both government and non-government monitoring stations.

Non-government sources account for over 60% of Australia's monitors, yet the network of government stations continues to expand, growing by more than 20% since 2023.

However, several locations in the region still lack reliable data. Guam and New Caledonia remain absent from this year's report, having last appeared in 2022. Tonga and American Samoa also require more consistent data sources to accurately assess air quality conditions.

Next Steps

What can governments do?

Decrease air pollution emissions

- Integrate WHO air quality guidelines into future standards.
- Commit to decarbonization.
- Dedicate funding for renewable energy projects.
- Expand the use of clean, renewable energy in public transport systems.
- Establish incentive programs to promote clean air vehicles for personal and commercial use.
- Use trade-in initiatives and other financial incentives to encourage divestment from internal combustion engines.
- Provide subsidies for battery-powered and human-powered transport methods.
- Support infrastructure initiatives that promote pedestrian traffic.
- Strengthen emission limits for vehicles and industrial activities.
- Engage in responsible forest management practices to reduce wildfire risk.
- Prohibit agricultural and biomass burning.
- Foster innovative approaches to tackle local air quality challenges.

Expand the air quality monitoring framework

- Increase the number of government-operated air quality monitoring stations.
- Offer financial incentives to community organizations, universities, and individuals who establish their own monitoring stations.

What can I do?

- Advocate for local and national air quality projects, including initiatives, propositions, and measures that target pollution.
- Support organizations, community leaders, and policymakers who prioritize air quality improvement.
- Communicate air quality concerns to local representatives.

Limit your exposure to air pollution

- Download the free IQAir AirVisual app for real-time air quality updates.
- Reduce outdoor activities when air quality is unhealthy.
- Wear a high-quality mask outdoors during unhealthy air quality periods.
- Monitor real-time outdoor air quality reports and forecasts.
- Choose eco-friendly alternatives over wood-burning stoves for heating and cooking.
- Improve indoor air quality with air filtration and purification systems.
- When outdoor air quality is poor, set A/C systems to recirculation mode and close doors and windows to block polluted air.
- When outdoor air quality is healthy, open doors and windows for ventilation and set A/C systems to fresh air intake.

GET IT ON Google Play

Download on the App Store

Lower your personal air pollution footprint

- Walk, bike, or take public transportation whenever possible.
- Save money and reduce energy consumption by lowering energy use.
- Decrease waste by recycling, upcycling, and buying less.

Become an air quality data contributor

Expanding global awareness of air pollution issues and access to air quality data is crucial in addressing the shared challenge of poor air quality. Local access to air quality information empowers individuals to advocate for clean air initiatives in their communities.

Despite the increasing number of air quality monitoring stations, too many areas worldwide still lack real-time data. Local efforts to strengthen air quality monitoring, whether led by government bodies, community organizations, educational institutions, or concerned citizens, are essential.

Advancements in low-cost sensor technology have improved the ability to collect accurate air quality data using easily deployable devices. As more monitoring stations become operational, additional data becomes available for researchers, policymakers, corporations, and community members, fostering awareness, informed discussions, and actions that lead to cleaner air and healthier communities.

To learn more about how to contribute as an individual or as part of a larger community effort, please visit https://www.iqair.com/air-quality-community/become-a-contributor-today.

Methodology

Data sources

The PM2.5 data used in the 2024 World Air Quality Report is derived solely from ground-level air quality monitoring stations. Among these stations, 38% are operated by government entities, while the remaining 62% are managed by non-profit community organizations, educational institutions, and individual citizens utilizing low-cost sensors.

The data presented here is primarily sourced via real-time data collection, however additional year-end historical data is supplemented to the global dataset to ensure analysis is performed on the most comprehensive dataset possible.

Data validation

Both regulatory-grade air quality monitors and low-cost sensors are vulnerable to data anomalies caused by sensor defects or brief environmental disruptions. To address these potential irregularities, IQAir's cloud-based data platform implements comprehensive quality assurance protocols and quality control procedures on collected air quality measurements. Suspected data anomalies from individual devices are flagged and isolated before publication on the IQAir platform. These flagged measurements are validated through comparison with time series data from the same sensor as well as pollutant levels recorded by nearby sensors. Data points that fail to meet IQAir's quality control standards are excluded from both the platform and this report.

Data calibration

The air quality data in this report includes measurements from low-cost sensors that detect airborne PM2.5 levels using laser scattering technology. Calibration factors are applied to these sensors to account for environmental influences that may skew concentration readings.

Data calculation

The annual average PM2.5 concentrations provided in this report are based on data collected by individual air quality monitoring stations within the geographic boundaries of each location. These stations frequently sample and timestamp PM2.5 concentrations measured from ambient air. Each station consolidates and averages all validated data points obtained during a 60 minute period to calculate an hourly average PM2.5 concentration. Over a full year, this series of hourly averages forms the basis for calculating the annual average PM2.5 concentrations for cities. To derive annual averages for countries, regions, and territories, these values are weighted based on population data.

City level data

This report includes city-level data, featuring both annual and monthly average PM2.5 concentrations. Monthly averages are calculated by averaging all hourly PM2.5 concentration readings collected within the city's boundaries over a month, ensuring consistent data weighting across different monitoring stations and times. Similarly, annual averages are determined by averaging all hourly PM2.5 concentrations recorded within the city throughout the year.

Country/region data

Annual average PM2.5 concentrations for countries, territories, and regions are calculated based on city-level annual average PM2.5 concentrations and the total population of cities within each area. Cities that do not meet the 60% threshold for hourly data availability required for report inclusion are not included in these aggregations. In the following text, "area" will be used as a general term for "country, territory, or region."

IQAir's goal is to deliver a clear picture of global air quality, enabling meaningful comparisons across locations with a focus on airborne pollution exposure and health impacts. A simple average of all city-level PM2.5 concentrations within an area would not adequately reflect the relative air quality experienced by residents.

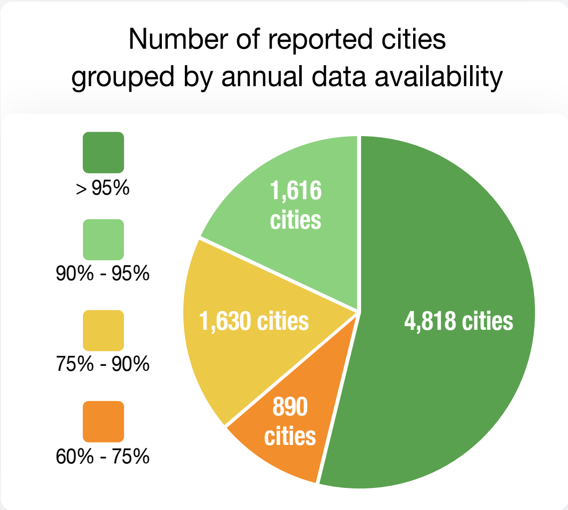
Therefore, population data from cities reporting PM2.5 levels is used to portray a more accurate human perspective on air quality within an area. This population-weighted approach gives greater influence towards air quality conditions in densely populated cities, ensuring the annual area-level average better reflects individual experiences. This approach provides essential context for global air quality comparisons.

The calculation below determines area-level annual average PM2.5 concentrations based on city-level data, weighted by city populations to enhance global context.

$$\frac{\Sigma \ \text{city mean PM2.5 } (\mu g/m^3) \ \ X \ \ \text{city population}}{\text{Total regional population covered by available city data}}$$

Data availability

The primary metric used to assess whether a city's reported annual average PM2.5 concentration accurately reflects the city's air quality conditions in 2024 is the annual data availability. To be included in this report, cities must have hourly PM2.5 data available for at least 60% of the year, equating to a minimum of 5,256 hours out of 8,760 total hours. A summary of the 2024 data availability for PM2.5 data included in this report is provided below.



Distribution of the total number of reported cities (8,954) by annual data availability.

Disclaimer

The PM2.5 data in this report is sourced from ground-level air quality monitoring stations, which include both regulatory-grade monitors and low-cost sensors. All data included in the report represents air quality measurement data observed within the 2024 calendar year.

IQAir maintains political neutrality. Maps, graphs, and other content in this report are presented to provide insights into the global data set and should not be interpreted as reflecting any political stance. Regional maps were created using data visualization tools.

FAQ

Why are some locations (city/country/region) not included in this ranking?

Regions lacking sufficient PM2.5 data that fail to meet the 60% data availability threshold are not included in the 2024 World Air Quality Report. This report focuses exclusively on data from ground-based PM2.5 monitoring stations and does not incorporate satellite-derived air quality measurements to ensure accurate representation of real-world conditions.

Why does the data provided within this report differ from the data provided by my government?

Citywide PM2.5 averages can be computed based on hourly, daily, monthly, or yearly data. IQAir uses hourly station averages to compile a citywide average, reducing the potential influence of data outliers. The PM2.5 data in this report is collected from various sources, including both government-operated and privately managed air quality monitors. Data from independent citizens using low-cost sensors is often excluded from government datasets and reports. However, incorporating this data can provide a more geospatially comprehensive picture of local and global air quality conditions.

Why is the report missing some locations that are available on the IQAir website?

To be included in this report, cities must meet a minimum data availability requirement of 60% of the total hours of air quality data available over the course of the year. For locations without real-time ground-level monitoring, IQAir's **AirVisual platform** includes satellite-derived PM2.5 data, marked with an asterisk (*), which extends real-time coverage but is excluded from this report.

Where can I find the complete city ranking of all locations included in the report?

The **IQAir website** features interactive global city rankings, which include monthly and historical PM2.5 concentration averages, providing a more detailed perspective on city pollution levels.

What is adequate data availability?

With the continuous development of air quality monitoring networks in various regions, the 2024 World Air Quality Report maintains a 60% data availability standard for inclusion. At minimum, cities must have hourly PM2.5 data for 60% of the total hours in 2024 to ensure validity while also accommodating data from emerging regions with growing air quality infrastructures.

References

1. World Health Organization. (October 24, 2024). Ambient (outdoor) air pollution. https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health
2. Health Effects Institute. 2024. State of Global Air 2024. Special Report. Boston, MA. https://www.stateofglobalair.org/resources/report/state-global-air-report-2024
3. Health Effects Institute. 2024. State of Global Air 2024. Special Report. Boston, MA. https://www.stateofglobalair.org/resources/report/state-global-air-report-2024
4. United Nations. UN General Assembly declares access to clean and healthy environment a universal human right. Published July 28, 2022. https://news.un.org/en/story/2022/07/1123482
5. U.S. Environmental Protection Agency. Health and environmental effects of particulate matter (PM). Published July 16, 2024. https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm
6. Boston College, MassCleanAir. Children's health. https://www.bc.edu/bc-web/centers/schiller-institute/sites/masscleanair/articles/children.html
7. Aithal SS, Sachdeva I, Kurmi OP. Air quality and respiratory health in children. Breathe. 2023: 19(2). https://doi.org/10.1183/20734735.0040-2023
8. Gauderman WJ, Avol E, Gilliland F, et al. The effect of air pollution on lung development from 10 to 18 years of age. The New England Journal of Medicine. 2004: 351(11), 1057–1067. https://www.nejm.org/doi/full/10.1056/NEJMoa040610
9. Pope CA, Dockery DW. Health effects of fine particulate air pollution: Lines that connect. Journal of the Air & Waste Management Association, 2006: 56(6), 709–742. https://pubmed.ncbi.nlm.nih.gov/16805397/
10. Pizzino G, Irrera N, Cucinotta M, et al. Oxidative stress: Harms and benefits for human health. Oxidative Medicine and Cellular Longevity. 2017. https://doi.org/10.1155/2017/8416763
11. Mann JK, Lutzker L, Holm SM, et al. Traffic-related air pollution is associated with glucose dysregulation, blood pressure, and oxidative stress in children. Environmental Research. 2021: 19. https://doi.org/10.1016/j.envres.2021.110870
12. Power MC, Adar SD, Yanosky JD, et al. Exposure to air pollution as a potential contributor to cognitive function, cognitive decline, brain imaging, and dementia: A systematic review of epidemiologic research. NeuroToxicology. 2016: 56, 235–253. https://pubmed.ncbi.nlm.nih.gov/27328897/
13. Reuters. China proposes new target for better air quality. Published January 11, 2024. https://www.reuters.com/world/china/china-adjusts-2027-2035-targets-better-air-quality-2024-01-11/
14. Energy Policy Institute at the University of Chicago (EPIC). Air Quality Life Index: China Fact Sheet. Published August, 2024. https://aqli.epic.uchicago.edu/wp-content/uploads/2024/08/China-FactSheet_2024.pdf
15. Centre for Research on Energy and Clean Air. Air quality improves as China eases reliance on coal and heavy industries: Key trends from H1 2024. Published September 20, 2024. https://energyandcleanair.org/publication/air-quality-improves-as-china-eases-reliance-on-coal-and-heavy-industries-key-trends-from-h1-2024/
16. Cai X, Zheng S, Zhang X, et al. The impact of CO2 emission synergy on PM2.5 emissions and a dynamic analysis of health and economic benefits: A case study of China's transportation industry. Journal of Cleaner Production. 2024: 471 https://www.sciencedirect.com/science/article/abs/pii/S0959652624028543
17. Craig G. Coal production: China risk series. URSA Space. Published September 11, 2024. https://ursaspace.com/blog/coal-production-china-risk-series/
18. Greenpeace East Asia. China approved 10.34 GW of new coal in the first half of 2024, a -79.5%year-on-year decrease: Greenpeace. Published August 20, 2024. https://www.greenpeace.org/eastasia/press/8605/china-approved-10-34-gw-of-new-coal-in-the-first-half-of-2024-a-79-5year-on-year-decrease-greenpeace/
19. Reuters. China auto market hits milestone as EVs, hybrids make up half of July sales. Published August 8, 2024. https://www.reuters.com/business/autos-transportation/chinas-car-sales-extend-declines-fourth-month-2024-08-08/
20. Reuters. China proposes new target for better air quality. Published January 11, 2024. https://www.reuters.com/world/china/china-adjusts-2027-2035-targets-better-air-quality-2024-01-11/
21. Cheong Y, Kim T, Ruy J, et al. Source apportionment of PM2.5 using DN-PMF in three megacities in South Korea. Air Quality, Atmosphere & Health. 2024: 17 2579-2599. https://doi.org/10.1007/s11869-024-01584-5
22. Volland A. A wall of dust over the Korean Peninsula. NASA Earth Observatory. Published April 26, 2024. https://earthobservatory.nasa.gov/images/152728/a-wall-of-dust-over-the-korean-peninsula
23. Yoon L. South Korea: number of yellow dust days in Seoul by season 2024. Statista. Published October 18, 2024. https://www.statista.com/statistics/1268948/south-korea-number-of-yellow-dust-days-in-seoul-by-season/
24. Won SR, Lee K, Song M, et al. Characteristic of PM2.5 concentration and source apportionment during winter in Seosan, Korea. Asian Journal of Atmospheric Environment. 2024: 18(22). https://doi.org/10.1007/s44273-024-00044-x
25. International Trade Administration. South Korea nuclear energy. Published September 30, 2024. https://www.trade.gov/market-intelligence/south-korea-nuclear-energy
26. World Bank Group. Air pollution knows no borders in South Asia, neither do solutions. Published September 5, 2024. https://www.worldbank.org/en/news/feature/2024/09/05/air-pollution-knows-no-borders-in-south-asia-neither-do-solutions
27. Lim YH, Kim S, Han C, et al. Source country-specific burden on health due to high concentrations of PM2.5. Environmental Research. 2020: 182. https://doi.org/10.1016/j.envres.2019.109085
28. Soo-Jung L. Yellow dust blankets Korea as warnings to 'stay indoors' are issued. Korea JoongAng Daily. Published April 17, 2024. Updated April 18, 2024. https://koreajoongangdaily.joins.com/news/2024-04-17/national/socialAffairs/Yellow-dust-blankets-Korea-as-warnings-to-stay-indoors-are-issued/2027272
29. Hyun-soo K. S. Korea, NASA to kick off joint air quality research across Asia. Yonhap News Agency. Published February 18, 2024. https://en.yna.co.kr/view/AEN20240218000300315
30. Jaeeun L. Korea recommends work from home when fine dust levels high. The Korea Herald. Published February 22, 2024. https://www.koreaherald.com/article/3329761
31. Centre for Research on Energy and Clean Air and Greenpeace. The health and economic impacts of ambient air quality in Malaysia. Published June 2022. https://energyandcleanair.org/wp/wp-content/uploads/2022/06/HIA_AmbientAQ_Malaysia-FINAL.pdf

32. Malay Mail. Report: Indonesia sees 60pc decrease in forest and land fires in 2024 so far. Published October 14, 2024. https://www.malaymail.com/news/world/2024/10/14/report-indonesia-sees-60pc-decrease-in-forest-and-land-fires-in-2024-so-far/153606?utm_source=chatgpt.com#google_vignette

33. Suroyo G, Nangoy F. Global plan for early ditch of coal power hits Indonesia hurdle. Reuters. Published: September 24, 2024. https://www.reuters.com/sustainability/climate-energy/global-plan-early-ditch-coal-power-hits-indonesia-hurdle-2024-09-25/

34. Permadi DA, Sofyan A, Oanh NTK, et al. Assessment of emissions of greenhouse gases and air pollutants in Indonesia and impacts of national policy for elimination of kerosene use in cooking. Atmospheric Environment. 2017: 154, 82-94. https://doi.org/10.1016/j.atmosenv.2017.01.041

35. Hasan K, Hummer L. Indonesia's captive coal on the uptick. Centre for Research on Energy and Clean Air. Published November 8, 2024. https://energyandcleanair.org/wp/wp-content/uploads/2024/11/EN-CREA_GEM_Indonesia-Captive_2024.pdf

36. IEA. The role of critical minerals in clean energy transitions. Published May 2021. https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/

37. Hasan K, Hummer L. Indonesia's captive coal on the uptick. Centre for Research on Energy and Clean Air. Published November 8, 2024. https://energyandcleanair.org/wp/wp-content/uploads/2024/11/EN-CREA_GEM_Indonesia-Captive_2024.pdf

38. Hasan K, Hummer L. Indonesia's captive coal on the uptick. Centre for Research on Energy and Clean Air. Published November 8, 2024. https://energyandcleanair.org/publication/indonesias-captive-coal-on-the-uptick/

39. Malay Mail. Kor Ming: Drastic increase in open burning cases in first two months of 2024. Published March 30, 2024. https://www.malaymail.com/news/malaysia/2024/03/30/kor-ming-drastic-increase-in-open-burning-cases-in-first-two-months-of-2024/126351

40. Chun HK. Alamak! Jerub lagi! Clean air law needed to tackle haze pollution. Greenpeace. Published April 29, 2024. https://www.greenpeace.org/malaysia/story/52890/alamak-jerebu-lagi/

41. Suarez, I. The health & economic impacts of ambient air quality in Malaysia. Centre for Research on Energy and Clean Air. Published June 8, 2022. https://energyandcleanair.org/publication/hia-ambient-aq-malaysia/

42. Suhakam. Silent enemy: Report on haze pollution & the right to clean air. Published 2024. https://www.greenpeace.org/static/planet4-malaysia-stateless/2024/09/f830a9eb-suhakam-report-on-haze-pollution-right-to-clean-air.pdf?utm_campaign=clean-environment&utm_source=website&utm_medium=organic&utm_content=silent-enemy-report-suhakam&utm_term=haze-clean-air

43. Yun, TZ. Fadillah: Malaysia aims for complete retirement of coal-fired power plants by 2044. The Edge Malaysia. Published June 26, 2024. https://www.tnb.com.my/assets/newsclip/26062024c.pdf

44. International Energy Agency. Malaysia. https://www.iea.org/countries/malaysia

45. Fold NR, Allison MR, Wood BC,et al. An assessment of annual mortality attributable to ambient PM2.5 in Bangkok, Thailand. International Journal of Environmental Research Public Health. 2020: 17 (19), 7298. https://doi.org/10.3390/ijerph17197298

46. Wessharasartar N, Thepgumpanat P, Setboonsarng C. Thailand warns of high pollution in capital, officials to work from home. Reuters. Published February 15, 2024. https://www.reuters.com/world/asia-pacific/thailand-warns-high-pollution-capital-asks-govt-staff-work-home-2024-02-15/

47. Chansuebsri S, Kolar P, Kraisitnitikul P, et al. Chemical composition and origins of PM2.5 in Chiang Mai (Thailand) by integrated source apportionment and potential source areas. Atmospheric Environment. 2024: 327. https://doi.org/10.1016/j.atmosenv.2024.120517

48. Evrard O, Mostafanezhad M. Becoming a crisis: Shifting narratives of seasonal air pollution in Northern Thailand (1996-2019). Southeast Asian Studies. 2023: 12(2) 333-361. Doi: 10.20495/seas.12.2_333. https://www.jstage.jst.go.jp/article/seas/12/2/12_333/_pdf

49. Chansuebsri S, Kolar P, Kraisitnitkul P, et al. Chemical composition and origins of PM2.5 in Chiang Mai (Thailand) by integrated source apportionment and potential source areas. Atmospheric Environment. 2024: 327. https://doi.org/10.1016/j.atmosenv.2024.120517

50. Makkonen U, Vestenius M, Huy LN. Chemical composition and potential sources of PM2.5 in Hanoi. Atmospheric Environment. 2023: 299. https://doi.org/10.1016/j.atmosenv.2023.119650

51. Dominutti P, Mari X, Jaffrezo JL, et al. Disentangling fine particles (PM2.5) composition in Hanoi, Vietnam: Emission sources and oxidative potential. Science of The Total Environment. 2024: 923 https://doi.org/10.1016/j.scitotenv.2024.171466

52. Tran N, Fujii YF, Khan MF. Source apportionment of ambient PM2.5 in Ho Chi Minh City, Vietnam | Asian Journal of Atmospheric Environment 2024: 18(1). https://link.springer.com/article/10.1007/s44273-023-00024-7

53. Linh BD, Le HA, Truong NX. Physico-chemical properties and transboundary transport of PM2.5 in Bien Hoa City, Dong Nai Province, Southeastern Vietnam. Environmental Science and Pollution Research. 2022: 30 36533-36544. https://link.springer.com/article/10.1007/s11356-022-24801-z

54. Vu K. Hanoi flights halted as city faces worsening air pollution. Reuters. Published February 1 2024. https://www.usnews.com/news/world/articles/2024-02-01/hanoi-flights-halted-as-city-faces-worsening-air-pollution

55. Symons A. Air pollution is so bad in this Asian capital that flights are being diverted due to low visibility. EuroNews. Published February 2, 2024. https://www.euronews.com/green/2024/02/02/air-pollution-is-so-bad-in-this-asian-capital-that-flights-are-being-diverted-due-to-low-v

56. Pratt A, Khaidi R, Flowers R. Viet Nam's heavy air pollution needs stronger action. Unicef. Published June 5, 2024. https://www.unicef.org/vietnam/stories/viet-nams-heavy-air-pollution-needs-stronger-action

57. Tully C. Unicef and partners fight air pollution in Vietnam. Unicef USA. Published July 24, 2024. https://www.unicefusa.org/stories/unicef-and-partners-fight-air-pollution-vietnam

58. Pandey B. Community partnerships and action to reduce pollution from open burning in Vietnam. Winrock International. Published September 10, 2024. https://winrock.org/community-partnerships-and-action-to-reduce-pollution-from-open-burning-in-vietnam/

59. Ministry of Natural Resrouces and Environment of the Socialist Republic of Vietnam. UNDP-WHO supports VietNam in addressing air pollution. Published November 15, 2024. https://en.monre.gov.vn/undpwho-supports-vietnam-in-addressing-air-pollution-8478.htm

60. The University of Chicago, AQLI: Air Quality Life Index. Country Spotlight: India. Published August 28, 2023. https://aqli.epic.uchicago.edu/country-spotlight/India/

61. Irfan U. Why is it still so hard to breathe in India and Pakistan? Vox. Published November 22, 2024. https://www.vox.com/climate/387135/india-pakistan-air-pollution-delhi-lahore-aqi?

62. Gurjar BR. Air pollution in India: Major issues and challenges. The Energy and Resources Institute. Published April 5, 2021. https://www.teriin.org/article/air-pollution-india-major-issues-and-challenges

63. Li S. India's novel attempts at battling deadly air pollution are falling short. The Wall Street Journal. Published December 15, 2024. https://www.wsj.com/world/india/india-air-pollution-short-term-solutions-5815e58d

64. Dayal, S. Pollution-free environment a 'fundamental right', India's top court says. Reuters. Published October 23, 2024. https://www.reuters.com/world/india/pollution-free-environment-fundamental-right-indias-top-court-says-2024-10-23/

65. Patnaik S. Supreme Court Review 2024: Speaking green, acting grey on key environmental issues. Supreme Court Observer. Published January 4, 2025. https://www.scobserver.in/journal/supreme-court-review-2024-speaking-green-acting-grey-on-key-environmental-issues/

66. Mohyuddin S, Alam K, Zeb B, et al. Characterization and source identification of PM2.5 during intense haze episodes in an urban environment of Lahore. Atmospheric Environment: X. 2024: 23. https://doi.org/10.1016/j.aeaoa.2024.100276

67. Munjal M. In India and Pakistan, a shared blight: smog. Reuters. Published November 26, 2024. https://www.reuters.com/graphics/PAKISTAN-POLLUTION/znpnljqdbpl/

68. Mubasher B, Shahid A. Muslims in Pakistan's smog-shrouded Punjab Province pray for rain. Reuters. Published November 15, 2024. https://www.usnews.com/news/world/articles/2024-11-15/pakistans-punjab-shuts-construction-and-schools-and-lockdown-looms-to-fight-smog

69. Zhuang Y, ur-Rehman Z. Record air pollution hospitalizes hundreds in Pakistani City. New York Times. Published November 7, 2024. https://www.nytimes.com/2024/11/07/world/asia/pakistan-air-pollution-punjab.html

70. Mehmood A. Brick kilns continue polluting methods. The Express Tribune. Published September 28, 2024. https://tribune.com.pk/story/2499205/brick-kilns-continue-polluting-methods

71. AP News. New Delhi's air quality plunges into 'severe' category a day after Diwali. Published November 1, 2024. https://apnews.com/article/india-diwali-pollution-new-delhi-c18ca0b631e56e177026dfa56bb3d89c

72. Malarvizhi AS, Liu Q, Terfonides TS, et al. The spatial dynamics of Ukraine air quality impacted by the war and pandemic. International Journal of Digital Earth. 2023: 16(1), 3680–3705. https://doi.org/10.1080/17538947.2023.2239762

73. United Nations Human Rights, Office of the High Commissioner, Ukraine. Attacks on Ukraine's Energy Infrastructure: Harm to the Civilian Population. Published September 2024. https://ukraine.ohchr.org/sites/default/files/2024-09/Attacks%20on%20Ukraine%E2%80%99s%20Energy%20Infrastructure-%20%20Harm%20to%20the%20Civilian%20Population.pdf

74. Wynveen R. Monitoring of distribution of solid fuel 2023-24. UNHCR, The UN Refugee Agency. Published April 14, 2024. https://storymaps.arcgis.com/stories/2632fd16135e4f66ad150d706cce68c1

75. Euronews. Kyiv residents told to stay indoors as air pollution blankets the Ukrainian capital. Published September 20, 2024. https://www.euronews.com/green/2024/09/20/residents-in-kyiv-told-to-stay-indoors-as-air-pollution-blankets-the-ukrainian-capital

76. Meng X, Lu B, Liu C, et al. Abrupt exacerbation in air quality over Europe after the outbreak of Russia-Ukraine war. Environment International. 2023: 178. https://doi.org/10.1016/j.envint.2023.108120

77. Yan H, Li Q, Feng K, et al. The characteristics of PM emissions from construction sites during the earthwork and foundation stages: an empirical study evidence. Environmental Science and Pollution Research. 2022: 30(22), 62716–62732. https://doi.org/10.1007/s11356-023-26494-4

78. McDuffie EE, Martin RV, Spadaro JV, et al. Source sector and fuel contributions to ambient PM2.5 and attributable mortality across multiple spatial scales. Nature Communications. 2021: 12. https://doi.org/10.1038/s41467-021-23853-y

79. Wulfeck A. Raging fires in Mexico send smoke over southern US, reducing air quality readings from Texas to Florida. Fox Weather. Published May 17, 2024. https://www.foxweather.com/weather-news/smoke-alert-map-south-us-forecast

80. Zhu Q, Liu Y, Hasheminassab S. Long-term source apportionment of PM2.5 across the contiguous United States (2000-2019) using a multilinear engine model. Journal of Hazardous Materials. 2024: 472. https://doi.org/10.1016/j.jhazmat.2024.134550

81. National Interagency Fire Center. National Fire News. Published 2025. https://www.nifc.gov/fire-information/nfn

82. Environmental Protection Agency. Final rule to strengthen the national ambient air quality standards for particulate matter. Published February 7, 2024. https://www.epa.gov/system/files/documents/2024-02/2024-pm-naaqs-final-overview-presentation.pdf

83. Copernicus. South America sees historic emissions during 2024 wildfire season. Published September 20, 2024. https://atmosphere.copernicus.eu/south-america-sees-historic-emissions-during-2024-wildfire-season

84. Copernicus. South America sees historic emissions during 2024 wildfire season. Published September 20, 2024. https://atmosphere.copernicus.eu/south-america-sees-historic-emissions-during-2024-wildfire-season

85. Scaramboni C, Farias CN, de Castro Vasconcellos P, et al. Characterization of cross-continental PM2.5: Insights into emissions and chemical composition. Atmospheric Research. 2024: 305. https://doi.org/10.1016/j.atmosres.2024.107423

86. Hoinaski L, Will R, Ribeiro CB. Brazilian Atmospheric Inventories – BRAIN: a comprehensive database of air quality in Brazil. Earth System Science Data. 2024: 16, 2385–2405. https://doi.org/10.5194/essd-16-2385-2024

87. WWF. Wildfires continue to rise in Brazil's main biomes in 2024. Published November 4, 2024. https://www.wwf.org.br/?90121/Wildfires-continue-to-rise-in-Brazils-main-biomes-in-2024

88. Requia WJ. Fires in Brazil: health crises and the failure of government action. The Lancet Regional Health - Americas. 2024: 39. https://doi.org/10.1016/j.lana.2024.100913

89. Tavella RA, de Moura FR, El Khouri Miraglia SG, et al. A new dawn for air quality in Brazil. The Lancet Planetary Health. 2024: 8(10), e717-e718. https://doi.org/10.1016/S2542-5196(24)00203-1

90. Bezerra LG, Tevizan VP, de Mendonça Costa RF, et al. Brazil's national policy on air quality passes houses, with certain vetoes. Mayer Brown. Published May 21, 2024. https://www.mayerbrown.com/en/insights/publications/2024/05/brazils-national-policy-on-air-quality-passes-houses-with-certain-vetoes

91. OECD. OECD Environmental Performance Reviews: Chile 2024. Published March 7, 2024. https://www.oecd.org/en/publications/oecd-environmental-performance-reviews-chile-2024_5bc65d36-en.html

92. Villalobos AN, Barraza F, Jorquera H, et al. Wood burning pollution in southern Chile: PM2.5 source apportionment using CMB and molecular markers. Evironmental Pollution. 2017: 225 514-523. https://doi.org/10.1016/j.envpol.2017.02.069

93. Busch P, Rocha P, Lee KJ, et al. Short-term exposure to fine particulate pollution and elderly mortality in Chile. Communications Earth & Environment. 2024: 5, 469. https://doi.org/10.1038/s43247-024-01634-x

94. Center for Disaster Philanthropy. 2024 Chile wildfires. Published July 30, 2024. https://disasterphilanthropy.org/disasters/2024-chile-wildfires/

95. National Centers for Environmental Information. Global drought narrative. Published October 2024. https://www.ncei.noaa.gov/access/monitoring/monthly-report/global-drought/202410

96. Cortes N. Chile's capital faces heat wave, experts warn of more to come. Reuters. Published February 2, 2024. https://www.reuters.com/world/americas/chiles-capital-faces-heat-wave-experts-warn-more-come-2024-02-02/

97. Olivares I, Langer J, Soto C, et al. Vertical distribution of PM2.5 in Santiago de Chile studied with an unmanned aerial vehicle and dispersion modelling. Atmospheric Environment. 2023: 310. https://doi.org/10.1016/j.atmosenv.2023.119947

98. Supporting action and planning to reduce short-lived climate pollutants in Bogotá. https://www.sei.org/projects/supporting-action-and-planning-to-reduce-short-lived-climate-pollutants-in-bogota/

99. Septer Q. Unprecedented fire season has raged through one of Earth's biodiversity hotspots. Scientific American. Published February 16, 2024. https://www.scientificamerican.com/article/unprecedented-fire-season-has-raged-through-one-of-earths-biodiversity-hotspots/

100. Velásquez-García MP, Santiago Hernández K, Vergara-Correa JA, et al. Long-range transport of air pollutants increases the concentration of hazardous components of PM2.5 in northern South America. Atmospheric Chemistry and Physics. 2024: 24(20), 11497–11520. https://doi.org/10.5194/acp-24-11497-2024

101. Velásquez-García MP, Santiago Hernández K, Vergara-Correa JA, et al. Assessing the influence of long-range transport of aerosols on the PM2.5 chemical composition and concentration in the Aburrá Valley. EGUsphere [preprint]. 2024. https://doi.org/10.5194/egusphere-2024-695

102. Interactive Country Fiches. Pollution / Colombia. Published 2018. https://dicf.unepgrid.ch/colombia/pollution

103. UNFCC. Fostering Cleaner Production | Colombia. https://unfccc.int/climate-action/momentum-for-change/women-for-results/fostering-cleaner-production

104. Global Volcanism Program | Nevado del Ruiz. Published January 2025. https://volcano.si.edu/volcano.cfm?vn=351020

105. Hernández Bonilla Bogotá JM. Pollution in Bogota: Air pollution is causing epigenetic changes in Bogotá residents. EL PAÍS. Published August 13, 2024. https://english.elpais.com/health/2024-08-13/air-pollution-is-causing-epigenetic-changes-in-bogota-residents.html

106. Ekanem S. Africa's top 10 most populated cities in 2024. Business Insider Africa. Published December 6, 2024. https://africa.businessinsider.com/local/lifestyle/africas-top-10-most-populated-cities-in-2024/6dqfl7l

107. Georgakopoulou VE, Taskou C, Diamanti A, et al. Saharan dust and respiratory health: Understanding the link between airborne particulate matter and chronic lung diseases (Review). Experimental and Therapeutic Medicine. 2024: 28(6) 460. https://doi.org/10.3892/etm.2024.12750

108. Betterly S. Improving Chad's air qualty. The Borgen Project. Published June 9, 2024. https://borgenproject.org/chads-air-quality/

109. NASA Earth Observatory. Bodélé dust. Published December 12, 2019. https://earthobservatory.nasa.gov/images/146011/bodele-dust

110. UN Environment Programme. Chad: Pollution. https://dicf.unepgrid.ch/chad/pollution

111. Horton M. Air pollution a major cause of infant deaths in sub-Saharan Africa. Stanford Earth Matters magazine. Published June 27, 2018. https://earth.stanford.edu/news/air-pollution-major-cause-infant-deaths-sub-saharan-africa

112. Alfeus A, Molnar P, Boman J, et al. PM2.5 in Cape Town, South Africa: Chemical characterization and source apportionment using dispersion-normalised positive matrix factorization. Atmospheric Pollution Research. 2024: 15(3). https://doi.org/10.1016/j.apr.2023.102025

113. Department of Mineral Resources & Energy. Coal. https://www.dmre.gov.za/energy-resources/energy-sources/coal/overview

114. McDuffie EE, Martin RV, Spadaro JV, et al. Source sector and fuel contributions to ambient PM2.5 and attributable mortality across multiple spatial scales. Nature Communications. 2021: 12. https://doi.org/10.1038/s41467-021-23853-y

115. Adeyemi A, Molnar P, Boman J, et al. Particulate Matter (PM2.5) Characterization, Air Quality Level and Origin of Air Masses in an Urban Background in Pretoria. Archives of Environmental Contamination and Toxicology. 2022: 83(1), 77-94. https://doi.org/10.1007/s00244-022-00937-4

116. Alfeus A, Molnar P, Johan Boman J, et al. PM2.5 in Cape Town, South Africa: Chemical characterization and source apportionment using dispersion-normalised positive matrix factorization. Atmospheric Pollution Research. 2024: 15(3). https://doi.org/10.1016/j.apr.2023.102025

117. Bauer SE, Im U, Mezuman K, et al. Desert dust, industrialization, and agricultural fires: Health impacts of outdoor air pollution in Africa. Journal of Geophysical Research: Atmospheres. 2019: 124(7), 4104-4120. https://doi.org/10.1029/2018JD029336

118. Oliver T. Situation Report - South Africa. International Association of Wildland Fire. https://www.iawfonline.org/article/situation-report-south-africa/

119. UNICEF. Air pollution accounted for some 3,365 deaths of children under five years across South Africa in 2021. Published June 20, 204. https://www.unicef.org/southafrica/press-releases/air-pollution-accounted-some-3365-deaths-children-under-five-years-across-south

120. Evans J. 'Not without a fight' — young activists take Mantashe, Nersa to high court over new coal power plans. Daily Maverick. Published October 10, 2024. https://www.dailymaverick.co.za/article/2024-10-10-not-without-a-fight-young-activists-take-mantashe-nersa-to-high-court-over-new-coal-power-plans/

121. Center for Child Law. CCL welcomes landmark High Court decision on children and youth's demand to cancel new coal-fired power generation in South Africa. Published December 9, 2024. https://www.centreforchildlaw.co.za/2024/12/ccl-welcomes-landmark-high-court-decision-to-cancel-new-coal-fired-power-generation-in-south-africa

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About IQAir

IQAir is a Swiss-based air quality technology company that seeks to empower individuals, organizations and communities to breathe cleaner air through information, collaboration and technology solutions.

IQAir's AirVisual global air quality information platform aggregates, validates and calibrates air quality data from a wide variety of sources, including governments, private citizens and organizations. The AirVisual platform supports the free integration of air quality data from a wide variety of data sources and monitoring devices.