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Open Air Quality Data: The Global Landscape

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with contributions from the
OpenAQ Community

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Open Air Quality Data: The Global Landscape

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Executive Summary

Open Air Quality Data: The Global Landscape is the only global assessment of whether and how national governments are producing and sharing air quality data with the public.

Governments have a responsibility to address air pollution, a problem so ubiquitous that almost everyone (99% of the world's population) is breathing unhealthy air.[1] Air pollution is the second leading risk factor (and greatest external threat) for death, cutting lives short by an average of 1.9 years across the globe.[2] Exposure to air pollution starts in the womb and is associated with numerous poor health outcomes over a lifetime, as well as impacts on productivity and quality of life. The burden of air pollution is unequal, harming babies and young children in particular,[3] as well as residents of lower-income communities and countries where pollution tends to be higher.[4]

Air pollution is the greatest external threat for death, cutting lives short by an average of nearly 2 years across the globe.

Reliable and open data on air pollution are fundamental to understanding and taking corrective action to improve air quality. Air pollution measurements are relevant not only to governments keen to improve the health of their citizenry and track progress over time, but also for everyone who breathes air and for those who can lend their skills to solving the problem, such as scientists conducting epidemiological studies, researchers determining the sources of pollution, communicators expanding awareness, and entrepreneurs building forecasting models. Rather than attempting to solve the problem of air pollution in isolation, governments that embrace open data policies can leverage the expertise of others to build more innovative and durable approaches to solving the air pollution crisis.

OpenAQ—an NGO that hosts the world's largest open-source, open-access database of real-time and historical outdoor air quality measurements—analyzed countries across the world to determine which have government-level air quality monitoring programs and whether and how those governments are opening their monitoring data to the public.

Trends and gaps in air quality monitoring

Just 64% of the countries we examined[5] conduct or sponsor continuous air quality monitoring at a national or subnational level in 2024, an increase of only 3% since our last report in 2022. In other words, 36% of countries are not currently monitoring air pollution, one of the greatest global health risks. Major gaps in monitoring persist, with many of the most populated, polluted countries still lacking government-coordinated air quality monitoring programs or conducting very limited monitoring, especially in the Global South.[6] In fact, nearly one billion people live across 71 countries where there is no evidence of government air quality monitoring, 9 out of 10 of whom live in low-income or lower-middle income countries, as classified by the World Bank. Furthermore, for the most populated of the countries whose national government is not monitoring air quality, air pollution is one of the top seven risk factors for death and disability in their country.

In 2024, 36% of countries are not monitoring air pollution, one of the greatest global health risks.

9 out of 10 of the nearly one billion people whose government does not monitor air quality live in low-income or lower-middle income countries.

In the most populated countries without a national government air quality monitoring program, air pollution is one of the top 7 risk factors for death and disability.

Trends and gaps in air quality data sharing

We found that 55% of all countries surveyed share air quality data publicly; however, only 27% of all countries surveyed do so in a fully transparent way.

As one example, many countries share their data through an Air Quality Index (AQI), a good first step toward transparency. AQIs translate complex pollutant concentration data into a simple, understandable format that can alert the public about the immediate threat of polluted air, and AQI providers often share actions that people can take to reduce exposures. However, AQIs lack the detail necessary for most scientific inquiry, and, depending on the methodology used, may even be misleading. (See the OpenAQ AQI Hub to learn more about the benefits and limitations of AQIs.)

[5] All 193 United Nations member states and 5 dependencies or disputed territories with populations greater than one million.

In short, barely over one-quarter of countries provide full and easy public access to maximally useful air quality data–data with the requisite detail to inform scientific inquiry, policies to reduce air pollution, air pollution forecasts, and other important "use cases."

Compared to 2022, there is a slight increase in the number of countries that share their air quality data publicly (up by 2%), and a slight increase in countries making the data fully transparent and accessible (up by 4%).

Barely over 1/4 of countries provide full and easy public access to maximally useful air quality data, missing out on the opportunity to leverage relevant expertise toward clean air solutions.

Recommendations

Measuring and tracking air pollution levels is critical to understanding and developing solutions to poor air quality. Making air quality data open, easily accessible and freely available allows everyone across public, private and civil society to innovate, collaborate and apply effective solutions towards clean air.

To accelerate clean air progress, we recommend:

1. **All governments measure and track air quality.** Recognizing that resources are limited, a government just beginning to monitor should start by installing a reference-grade PM2.5 monitor as described in Our Common Air's 2024 report, "*Accelerating Country-led Air Quality Reporting to Achieve Clean Air*."
2. **All governments share the air quality data they generate in a fully transparent and accessible manner:** in physical units, with station-specific coordinates, in daily or sub-daily frequency, and in a format that is machine-readable.
3. **Funders, such as development banks and philanthropies, support less-resourced governments.** Countries where a relatively small investment would close a serious data gap and effect positive national-level change are identified in the EPIC report, "*The Case for Closing Global Air Quality Data Gaps with Local Actors: A Golden Opportunity for the Philanthropic Community.*"
4. **Funders include conditions for data transparency in funding agreements**. One example of an open data sharing requirement is the EPIC Air Quality Fund.

About OpenAQ

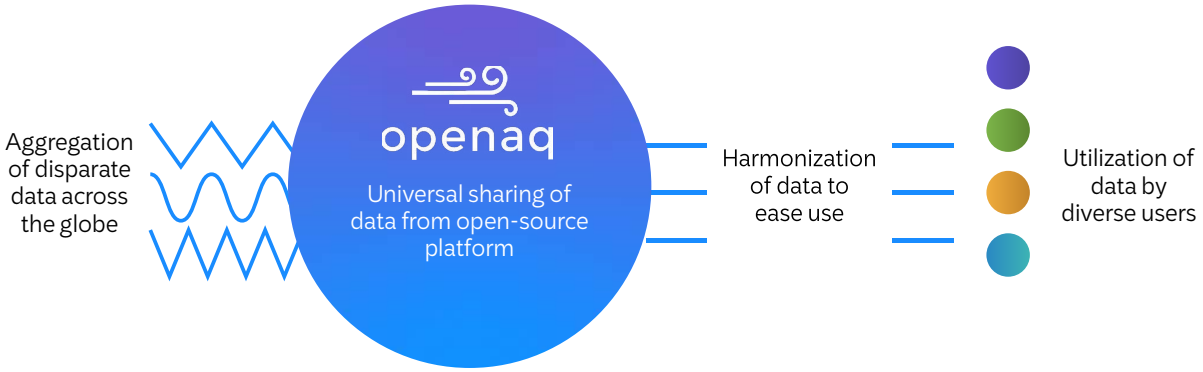


Figure 1. OpenAQ aggregates and harmonizes air quality data from disparate sources (station-level data produced by reference monitors and air sensors across the world) into one single format so that the public can more fully maximize the uses—and ultimate impact—of the data.

The OpenAQ data platform is the world's first and largest open-source, open-access database of outdoor air quality measurements, built to ensure everyone has unfettered access to the data they need to analyze, communicate and advocate for clean air. By providing universal access to data, OpenAQ fulfills its mission to empower a global community of changemakers to solve air inequality—the unequal access to clean air.

The OpenAQ data platform is:

- a centralized "one-stop shop" for real-time and historical air quality data from monitors of all types
- universally and easily accessible–data are free; tools are provided to access and interact with the data
- uniquely valuable–data are harmonized for easy comparison and shared in physical units rather than as an air quality index
- built with open-source code

The OpenAQ Platform is used for a wide variety of applications: air quality, health and climate change research and analysis; air quality forecasting; air sensor calibration and satellite data validation; data-driven communications and journalism; advocacy for solutions; the development, assessment and enforcement of policy; as an educational/instructional resource, and more. By filling a basic data-access gap, OpenAQ empowers a wide variety of individuals, organizations and sectors across the globe to apply data in pursuit of a clean air future.

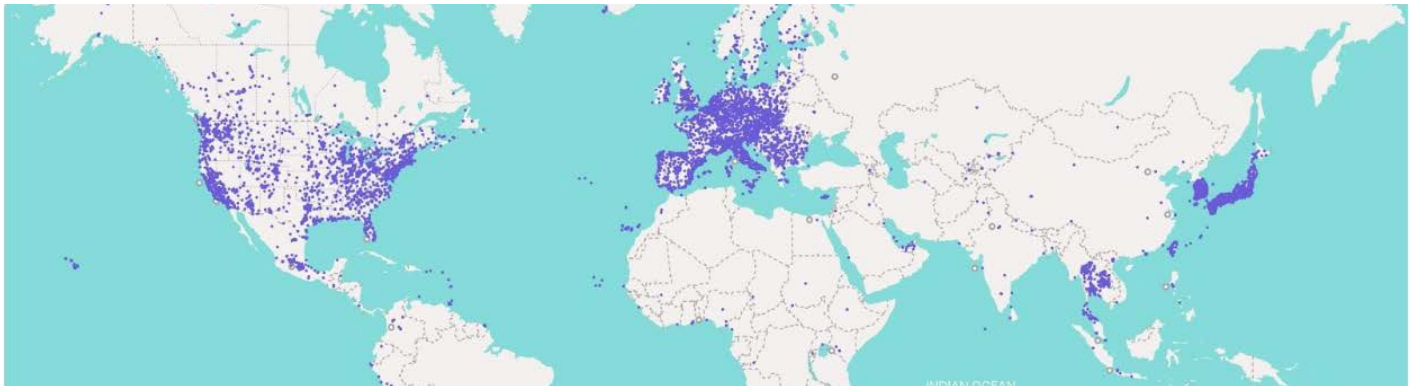


Figure 2. As of November 2024, OpenAQ ingests air quality measurements from more than 18,600 locations in 131 countries.

Harmonized air quality measurements facilitate research. *"This paper would not have been possible without OpenAQ," said the lead author of an award-winning paper investigating nitrogen dioxide and ozone levels across the world during COVID-19 restrictions.*[7] *Aggregated, harmonized data allow researchers to focus on analysis rather than having to find, gather and wrangle disparate data into a consistent format.*

Goals of This Assessment

This assessment reviews the global landscape of air quality data produced by governments.

Air quality data underpin all actions on air pollution. They tell us how much pollution is in the air we breathe. They predict how air pollution will change in space and time. They shape our understanding of how air pollution impacts human health, climate change, ecological health, and economic and social well being. Air quality data serve as an important foundation for the design, implementation, enforcement and assessment of the effectiveness of pollution control policies. In short, air quality data are essential to achieving clean air.

This assessment answers two critical questions:

1. Which countries are (and are not) actively monitoring air quality on a continuous basis?
2. Where government-level air quality monitoring is occurring, are the data being shared publicly, and, if so, to what extent?

By identifying air quality data collection and data-sharing gaps, this assessment:

- Points to the most strategic locations for launching new air quality monitoring and data-sharing efforts.
- Identifies where education about the benefits of open data and investment in data-sharing infrastructure could support governments in providing full public access to the data.

In this assessment, we describe the current global landscape of government air quality monitoring and data accessibility to the best of our knowledge, as gathered via public resources and the OpenAQ community. We welcome feedback. If you would like to contribute new information or submit corrections, please email info@openaq.org.

Open data spurs pollution reductions. *Since 2008, the United States has installed 80 air quality monitors at its embassies around the world, sharing the data openly and posting real-time reports on air quality on X (formerly Twitter). A report examining the first 60 host cities found that fine particulate concentration levels have fallen substantially (an average reduction in fine particulate concentrations of 2-4 micrograms per cubic meter (μg/m^3) each year).*[8]

We use the following terminology in this assessment:

"Air quality open data" is shorthand for ambient, ground-level and station-specific pollutant ($PM_{2.5}$, PM_{10}, SO_2, NO_2, CO, O_3 and/or BC) data collected by or commissioned/sponsored by national or subnational governments.

"Real-time data" is shorthand for data produced on daily or sub-daily levels and released on an approximate daily or sub-daily level.

"Reference monitor" is shorthand for "government monitor," "reference-grade monitor" and "research-grade monitor."

"Air sensors" is used to describe what are commonly referred to as "low-cost sensors."

"Countries" as shorthand for the 193 United Nations member states and 5 dependencies or disputed territories with populations greater than one million.

How Air Quality Is Monitored & Data Are Managed

There are many ways to monitor ambient air quality, including ground-based, airborne, mobile and satellite measurements. This assessment focuses on stationary ground-based monitoring networks that provide real-time data,[9] including reference monitors and air sensors.

Reference monitors

Governments typically evaluate the state of air quality using data from ground-based monitors that are held to a "reference method" standard.[10, 11] Codified reference methods vary across the world, but as long as the monitors are well maintained, data from reference monitors (also referred to as reference-grade or research-grade monitors) tend to be highly accurate. Therefore, measurements gathered from reference monitors are the gold standard for measuring pollutant concentrations, and as such, remain the tool for regulatory compliance.[12]

Air sensors

In recent years, new instrumentation to measure air quality has been developed—air sensors that are more compact, portable and affordable than reference monitors. The quality of data from air sensors varies due to such factors as the technology used, differences in validation and calibration efforts, and weather conditions. Their cost varies from a few hundred to a few thousand US dollars, depending on the technology used, the number of pollutants they measure, and the resources required for calibration and maintenance. Because of this variability, we refer to these instruments as "air sensors," not the other commonly used term, "low-cost sensors."

The small size, portability and relative affordability of air sensors has contributed to their easy deployment and has resulted in a surge in their use in the last several years, including by some government entities that have incorporated air sensors into their air quality monitoring networks, allowing for greater geographic coverage.

While reference monitors remain the gold standard, air sensors are playing an increasingly important role in helping governments and other air quality stakeholders understand what is in the air.

Generating data is the first step. A data management system is also required to process and store the data, conduct quality control, visualize and interpret the data, and share the data. These data management systems can be costly to build, and currently entities new to air quality monitoring must either choose to rely on proprietary systems or build the system from scratch as described in the Clean AIr Fund blog "Data management systems: Vital infrastructure needed to inform action on air quality." A project to build an easy-to-use, customizable open-source data management system, available for anyone to tailor to their needs, has just begun.

Maldives could benefit from centralized data management. Maldives has several distinct monitoring networks: reference monitors run by the The Maldives Climate Observatory (MCOH) in Hanimaadhoo with data retained by the Maldives Meteorological Service (MMS); donated reference monitors to be set up in Hulhumale and Male by the Ministry of the Environment or the Maldives Environmental Protection Agency; an air sensor network in major islands, including, Male, Funadhoo, Fuvahmulah and Villingili run by IQAir; and a TSI BlueSky $PM_{2.5}$ air sensor network in various regions run by the US Department of State and planned for turnover to the Maldivian government by 2025. Public access to this data varies. If the public requires data from the MCOH monitors, the request must be put to MMS, which then obtains it from MCOH and forwards it to the public recipient. On the other hand, the public can access real-time data from the IQAIr sensor network. The lack of a centralized data management system and mutual data sharing policies across data providers creates inefficiencies and inhibits transparency.

Air sensor manufacturer platforms as data management systems for governments. Some national and subnational-level governments use existing private air sensor manufacturer platforms or dashboards to manage their air quality data. Others embed the dashboard from the manufacturer on their government webpage. Examples (non-exhaustive list) are listed in Table 1.

[9] Cases where we found governments using offline methods (*e.g.*, filter-based sampling) were also taken as evidence of air monitoring.

Table 1. Examples of private-sector platforms that display and/or manage air quality data for governments.

Manufacturer	Location	Government relies on air sensor manufacturer to manage and share data
AirQo	Kisumu City, Kenya	city.kisumu.go.ke/kisumu-county-air-quality/
	Kampala, Uganda	kcca.go.ug/kampala-air-quality-monitoring-network
IQAir	Zimbabwe	iqair.com/us/profile/6jttnou-l
	Guyana	iqair.com/us/profile/epa-guyana
Clarity	Cabo Verde	openmap.clarity.io/ (search for locations in the search bar)
	Bishkek, Kyrgyz Republic	openmap.clarity.io/
Airqoon	Kadıköy Municipality, Istanbul, Türkiye	map.airqoon.com/kadikoy-belediyesi
	Inegol Municipality, Bursa, Türkiye	map.airqoon.com/inegol-belediyesi
Smart Sense	Municipality of Topusko, Croatia	explore.openaq.org/locations/2907571
	City of Krizevci, Croatia	explore.openaq.org/locations/2907572

Why This Assessment Focuses on Government Data

Air quality monitoring is not the sole purview of governments. Academic institutions, civil society organizations, private companies and individuals also monitor air quality and, in some cases, share the data they collect. But data from air quality monitoring conducted or sponsored by governments provides unique value to air quality stakeholders. Compared to non-government efforts, government efforts tend to offer:

- **Data on more pollutants.** Governments typically monitor a number of air pollutants.
- **More sustained data collection.** Government-generated measurements are typically sustained longer–over the course of multiple years at any given location.
- **Greater uniformity of measurements and methodology.** Although monitoring practices and data quality assurance methods vary, most countries have similar frameworks and objectives and focus on the same pollutants of key interest. Non-governmental efforts rarely share goals or coordinate across projects.
- **Data that can be used for regulatory purposes.** Government-generated data are used for regulatory compliance and in litigation.
- **Greater legitimacy and accountability.** The public tends to place greater trust in government monitoring and typically has a say in demanding data accountability.

Despite these benefits, a number of gaps still exist in government monitoring and data sharing. This is particularly true where data on air quality are most needed—highly populated and highly polluted countries typically classified as low- and middle-income. This report highlights these gaps.

Four Key Criteria for Fully Open Air Quality Data

Open air quality data facilitate many "use cases" that support governments in reducing air pollution, such as epidemiological studies, "source apportionment" studies that identify the sources of pollution and their relative contribution, forecasting models, and communications that raise awareness. When governments open the air quality data they collect to the public, they no longer have to solve the issue of air pollution in isolation.

> ***Enabling ingenuity***. *The key of open data is to enable full data use for everyone, not just data producers. An analogy can be made with music: Imagine a world where only those who produce musical instruments (data producers) are allowed to be musicians (data users). Such a world would greatly limit musical creativity! The same goes for data: If access is limited to those who produce the data, the uses of the data will be much more limited in scope than if the data are fully open and available for the public at large to apply their expertise and ingenuity to making the most of the data.*

While there are certainly valid cases where access to data should be restricted,[13] air quality data is not one of those cases. Air is a common resource shared by all; air quality measurements at any given time or place are factual; and hoarding air pollution data impedes the development and implementation of solutions.

> ***The world's most comprehensive study of causes of death, diseases, and injuries relies on open air quality data***. *The Global Burden of Disease (GBD) study is a critical resource for informed policymaking worldwide. GBD air quality publications and tools rely on open air quality data found on the OpenAQ platform.*

Despite the benefits of open air quality data, there is considerable variability in whether and how governments share the data they generate. Governments can maximize the usefulness of open air quality data by providing the data in formats that (1) are easily 'harmonizable' with other data sources into a single format and (2) allow the most use cases to be built on top of the underlying data. More specifically, this assessment deems a source of air quality data as fully accessible and open if the source meets the following Four Key Open Data Criteria:

A. **Physical Units**: Data are shared in physical units, as opposed to an Air Quality Index (AQI), Air Pollution Index, Pollution Standard Index, or other indicator that summarizes measurements.

   Example: $PM_{2.5}$ data are shared in units of micrograms per cubic meter ($\mu g/m^3$), as opposed to a unitless Air Quality Index value.

B. **Station-Specific Coordinates:** Data are provided at the most transparent geographic scale at which they are collected—station-scale—and with location metadata in the form of readily available geographic coordinates, ideally to five places past the decimal.

   Example: Data that are provided originate from a single station, as opposed to an aggregation or average of several stations over a city. Additionally, the geographic coordinates from which the data originate are also shared (*e.g.*, the station is located at: 101.89322° N, 30.29571° E).

C. **Timely Fine-Scale Temporal Information [near Real-Time]:** Data are provided at daily or sub-daily levels in near real-time or in a timely manner with time-of-collection stamps and averaging periods.

   Example: Data are shared as hourly averages within a few hours after they are produced (or, at the very least, within a month), as opposed to yearly averages of pollution levels shared a couple of years later.

D. **Programmatic Access:** Data and metadata as defined in the preceding criteria are publicly accessible in a programmatic or machine-readable form.

   Example: Data are shared via an Application Programming Interface (API), FTP server, or other method that allows machine-to-machine interaction, including a standardized format amenable to

[13] Examples of valid reasons to restrict data access: data that contains personal information or where consent has not been given for release, data with confidential commercial information, or situations where release of the data could harm a public good, *e.g.*, endangered species, archaeological sites, national security.

programming (*e.g.,* JSON, comma- or tab-delimited files) as opposed to data shared in an unstandardized fashion, as a non-computable file (such as PDF), a proprietary file format, or on a website as a graphic, table or spreadsheet form that requires a user to click a 'download' button.

By meeting the above criteria, governments can accelerate air pollution solutions by allowing everyone—civil society, government, private sector, academia—to lend their expertise. Diversity of knowledge, skill, and experience leads to more innovative and durable approaches.

Open data raises public awareness. *The mobile app Sh**t I Smoke! compares air pollution to cigarette smoking, helping people understand the severity of air pollution. Smokey, an air quality chatbot on Facebook Messenger and X answers two questions for users: "How bad is the air quality around me right now?" and "What can I do about it?" OMG Wildfires is an innovative air quality map that represents air quality in terms of emojis. A Telegram app called @pm10check uses air quality data to deliver local alerts. All of these digital tools for the public were built by individuals and rely on open air quality data.*

Open data help validate NASA air quality forecasting. *"A platform such as OpenAQ, compiling open air quality data in near real-time into a publicly available database, is essential to the global air quality forecasting community," said Dr. Emma Knowland, a research scientist who works on NASA's GEOS Composition Forecast System, a global air quality forecasting system.*

Methodology

We conducted a thorough assessment of air quality monitoring carried out by governments in all 193 United Nations member states and 5 dependencies or disputed states with populations exceeding one million [N=198]. The results are current as of September 2024.

We sought online evidence of an active air quality monitoring program that is conducted regularly and that is either led, sponsored or commissioned by a national or subnational government. Many subnational governments conduct and lead air monitoring efforts; for some countries, this is fiscally sponsored by the national government and run by the subnational government. Others monitor independent of the national government. For example, the state-level environmental protection agency in Nigeria conducts air quality monitoring for Lagos State. Whereas Quezon City in the Philippines conducts their own air quality monitoring assisted by external, non-governmental funding.[14]

If no electronic media evidence was found through the web search, we consulted with our global network, including people from the EPIC Clean Air Program Air Quality Entities Registry and other trusted sources. We included government monitoring programs using air sensors, and we included countries with limited monitoring (*e.g.,* in one city). We utilized a wide range of sources, including government agency websites and reports, the World Health Organization's Ambient Air Quality Database, publicly available air quality data platforms (such as AQICN and OpenAQ), reports by multinational nonprofit organizations specializing in air quality, and peer-reviewed scholarly articles. The compiled data was validated by consultations with experts in the field. Additionally, we incorporated governmental decrees on air pollution, social media posts from governmental organizations, and various governmental departments (like departments of environment, meteorology, climate change, statistics, communications and scientific research institutions) providing air quality information.

We allowed for diverse types of monitoring technologies and different types of programs, accounting for the evolving landscape of air quality monitoring with new technologies being featured in government programs. We designed our review process as per the 'scoping review' methodology originally developed by Arksey and O'Malley (2005), along with notable improvements that have followed, such as the inclusion of expert consultations to complement the original methodology and refining the search strategy iteratively. [15] Detailed methodology can be found in Appendix A. Figure 3 illustrates the steps we took to categorize the countries we researched.

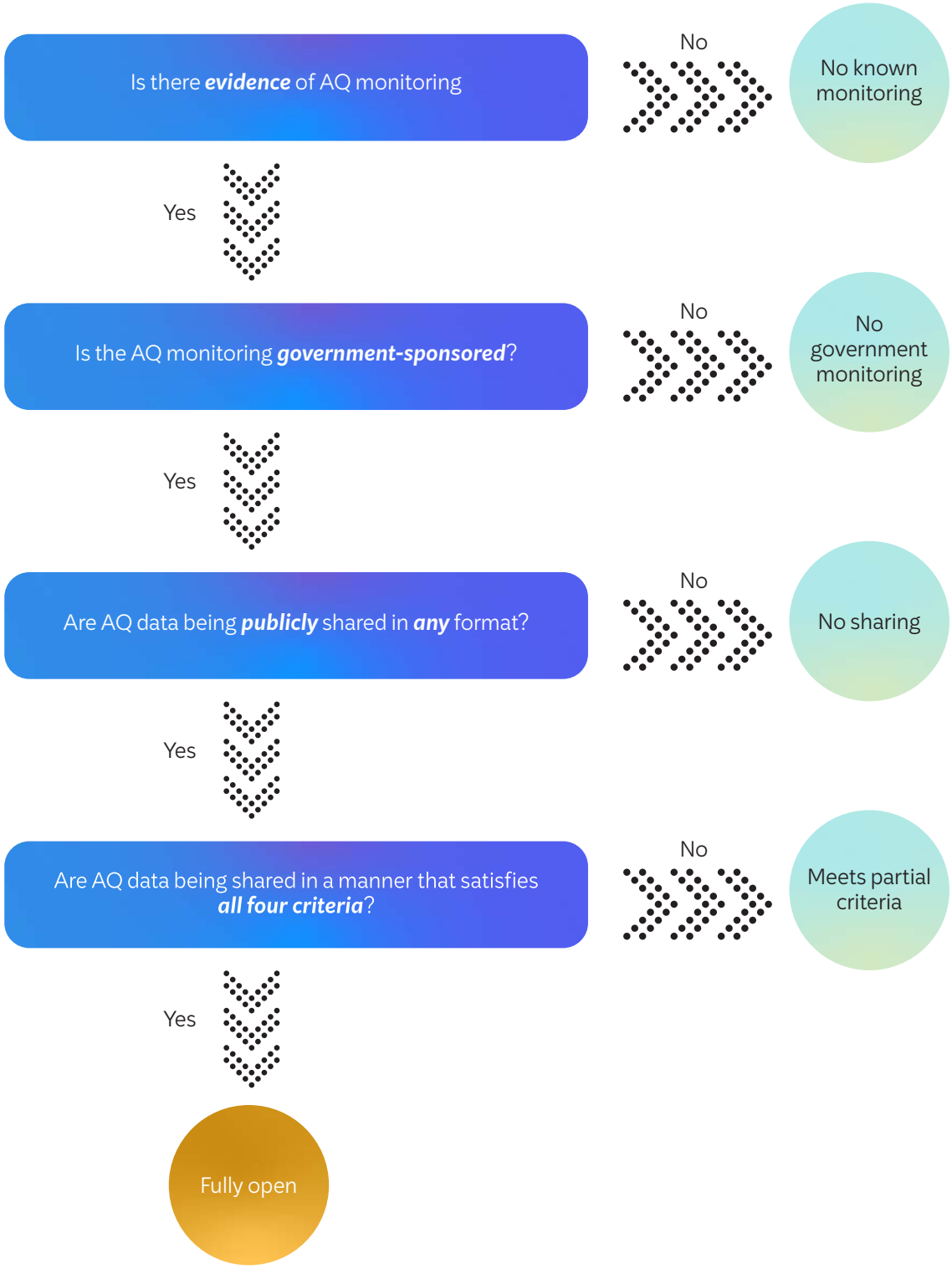


Figure 3. Flowchart of the scoping procedure utilized in this review.

Four Key Insights

Key Insight #1: 36% of national governments are not monitoring air pollution. Investing in air quality monitoring programs in 71 countries could support the health of nearly 1 billion people.

We found evidence that 64% [N=127] of the world's countries [N=198] are generating air quality data on a regular basis. This means that 36% [N=71] are not regularly monitoring air quality, despite the fact that air pollution is the second leading risk factor (and leading environmental risk factor) for death worldwide.[17]

Since our last assessment in 2022, (1) armed conflict has interrupted monitoring in Ukraine and Palestinian territories, and (2) lack of technical support or funding for continued operation and maintenance has caused interruptions in countries such as Ethiopia and Algeria.[18, 19]

The populations of the 71 countries add up to nearly one billion people, 9 out of 10 of whom live in low-income or lower-middle income countries, as classified by the World Bank.

Table 2 shows the most populous (20 million and above) out of 71 countries where there appears to be no evidence of a public national-level government program for long-term ground-level ambient air quality monitoring. These are also countries where particulate matter (PM) pollution ranks as one of the top seven risk factors for death and disability.

Table 2. Populous high-risk countries without evidence of a public national-level[a] government air quality monitoring program.

Country	Population (in millions)[b]	Ranking of 'air pollution' as an in-country risk factor for death and disability[c]	Number of deaths attributable to ambient particulate matter pollution[d]	Life-years lost due to air pollution[e]
North Korea (Korea, Dem. People's Rep.)	26.2	#1	8,810	1.33
Cameroon	28.6	#2	5,900	2.7
Tanzania	67.4	#2	4,710	1.29
Afghanistan	42.2	#2	4,500	1.17
Yemen, Rep.	34.4	#2	12,500	1.15
Niger	27.2	#2	3,940	0.54

[16] 193 United Nations member states and 5 dependencies or disputed territories with populations greater than one million.

[18] The status of air monitoring in Ethiopia was confirmed from in-country sources through personal communications.

Country	Population (in millions)[b]	Ranking of 'air pollution' as an in-country risk factor for death and disability[c]	Number of deaths attributable to ambient particulate matter pollution[d]	Life-years lost due to air pollution[e]
Côte d'Ivoire	28.9	#1	6,700	0.53
Sudan	48.1	#2	17,300	0.51
Burkina Faso	23.3	#2	3,720	0.36
Mali	23.3	#2	4,800	0.16
Congo, Dem. Rep.	102.3	#3	6,340	2.91
Zambia	20.6	#3	2,240	1.68
Angola	36.7	#3	8,250	1.57
Malawi	20.9	#3	1,070	1.24
Iran, Islamic Rep.	89.2	#5	49,500	1.35
Iraq	45.5	#6	28,800	2.69
Syrian Arab Republic	23.2	#7	12,800	1.75
Ukraine	37.0	#7	56,400	0.57

[a] "Public National-level" connotes a nationally coordinated effort, as opposed to a single city-led or subnational effort, where information on the program is available on a publicly accessible website.

[b] World Bank figures as of 2023.

[c] Includes ambient ($PM_{2.5}$, O_3 & NO_2) & household air pollution. Ranking according to Global Burden of Disease 2021. Full description available in The Lancet, Vol 403, Issue 10440, p. 2169. See also Air Pollution -Level 2 Risk.

[d] Health Effects Institute, *State of Global Air*. 2024

[e] According to the 2024 Air Quality Life Index. Calculated with respect to ambient $PM_{2.5}$ exposure.

Compared to 2022, we see a net increase in countries that monitor air quality. 64% [N=127] of countries have a continuous monitoring program, a net increase of 3% [N=5]. Some countries stopped monitoring (Albania, Cuba, Dominican Republic, Iran, Iraq, Tunisia, Ukraine), and others began (Belize, Djibouti, Guinea-Bissau, Honduras, Laos, Mozambique, San Marino, Seychelles, Somalia, St. Vincent & the Grenadines, Venezuela, Zimbabwe). (Figure 4)

Percentage of countries monitoring their air quality

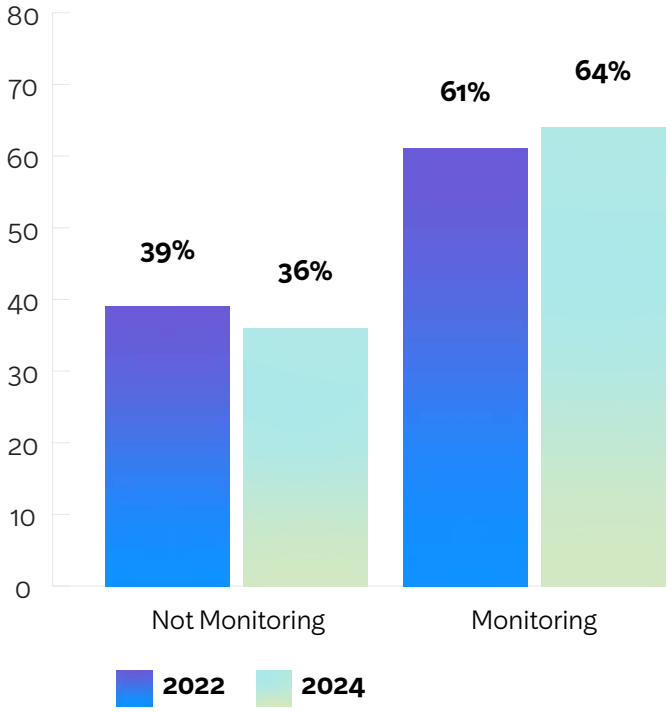


Figure 4. A net increase in the number of countries monitoring air quality is seen from 2022 to 2024. The y-axis describes the percentage out of total countries, N=198.

Air pollution and its impact on a country's population are not immediately solved by monitoring air quality; however, securing baseline measurements, conducting ongoing monitoring, and sharing monitoring data publicly are vital steps toward cleaner air.

Barriers and Opportunities

For countries interested in establishing a regular air quality monitoring program, the most significant barrier is resource constraints, such as lack of financial resources and/or technical expertise. A 2022 survey, Strengthening Air Quality Management Guidance: Achieving Scale and Impact, covering 110 countries, primarily low- and middle-income, found that less than one-third have been able to successfully implement monitoring networks due to these challenges. Direct financial support through such entities as development banks and philanthropies could support countries unable to monitor regularly. Currently, only 0.5% of international development funding between 2015 and 2020 supported clean air,[20] and less than 0.1% of philanthropic foundation funding supported clean air between 2015 and 2022.[21] The UNEA-6 Air Quality Resolution calls for robust financing streams to ensure that governments have the funding they need to build air quality monitoring capacity.

Intercountry and local government monitoring efforts are increasing:

- Some countries participate in a regional intergovernmental effort that includes monitoring, such as the International Centre for Integrated Mountain Development (ICIMOD) which serves the Hindu Kush Himalaya region and Air Quality Central Asia which supports monitoring in Kazakhstan, Kyrgyzstan, Uzbekistan and Tajikistan.
- Cities are stepping up in a big way. Breathe Cities, an initiative to combine data from stationary and mobile air sensors with grassroot campaigns to build awareness of air pollution and support municipal action, is a prime example. After the highly successful Breathe London pilot, London Mayor Sadiq Khan called for the creation of Breathe Cities at COP26, with a goal of cutting air pollution in participating cities by 30% by 2030. Fourteen cities, spanning four continents, have joined so far, and the effort continues to scale. Air quality data collected by Breathe Cities is used for research into the causes of air pollution to provide local governments and communities with evidence for implementing new policies

Monitoring projects by non-governmental organizations are adding value:

- Academic institutions, community-based organizations, civic groups and citizen scientists are working to fill in the gaps in some countries. These are extremely valuable efforts that should be expanded, but they should supplement, not replace, the need for continuous government monitoring.
  - » The Clean Air Catalyst, a global partnership to accelerate clean air solutions, is an example of an NGO-led effort that is deeply engaging with local governments in its pilots in Indore (India), Jakarta (Indonesia) and Nairobi (Kenya). The local teams are applying a data-to-impact methodology–building understanding of pollution sources, designing locally tailored solutions, and creating strategic coalitions to enact long-lasting change. The reference monitors that have been installed by the teams will be passed on to the local governments when the pilots are complete.
  - » The Energy Policy Institute at the University of Chicago (EPIC) has created a public registry of self-identified local actors who are working to fill $PM_{2.5}$ data gaps across the world.

International bodies are stepping up to provide greater technical support:

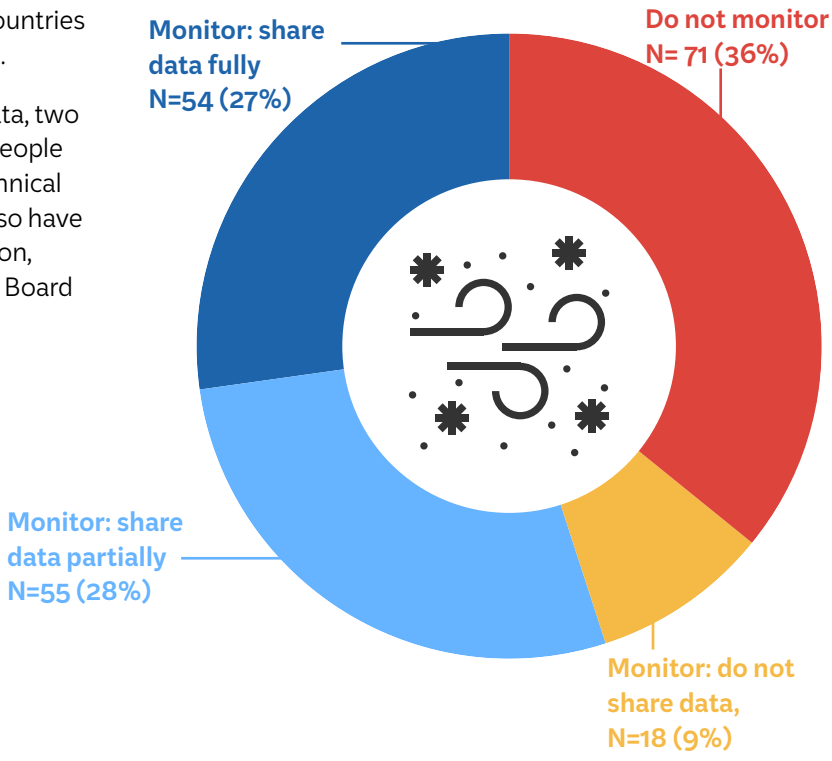
- The Climate and Clean Air Coalition's (CCAC's) Air Quality Management Exchange Platform (AQMx) provides guidance and resources for air quality managers worldwide, including curated guidance for air quality monitoring. Convened by the UN Environment Programme (UNEP), CCAC is also hosting regional AQMx workshops.

Key Insight #2: Only a little over half of the world's governments publicly share air quality data. A few more generate data, but do not share.

We found evidence that 55% [N=109] of countries [N=198] share air quality data publicly, half in a fully transparent way [N=54] and half in a partially transparent way [N=55] (discussed in Key Insight #3). However, 9% [N=18] countries do not publicly share the air quality data they collect.

Within the countries that monitor and share their data, two countries, Kazakhstan and Türkiye, share only with people located within their geographical boundary. The technical solutions China uses for its data-sharing platform also have limitations that can prevent outside access. In addition, accessing data from India's Central Pollution Control Board limits programmatic access through human verification techniques.

Figure 5. Percentage of countries that monitor air quality and their data sharing status. Total N=198.



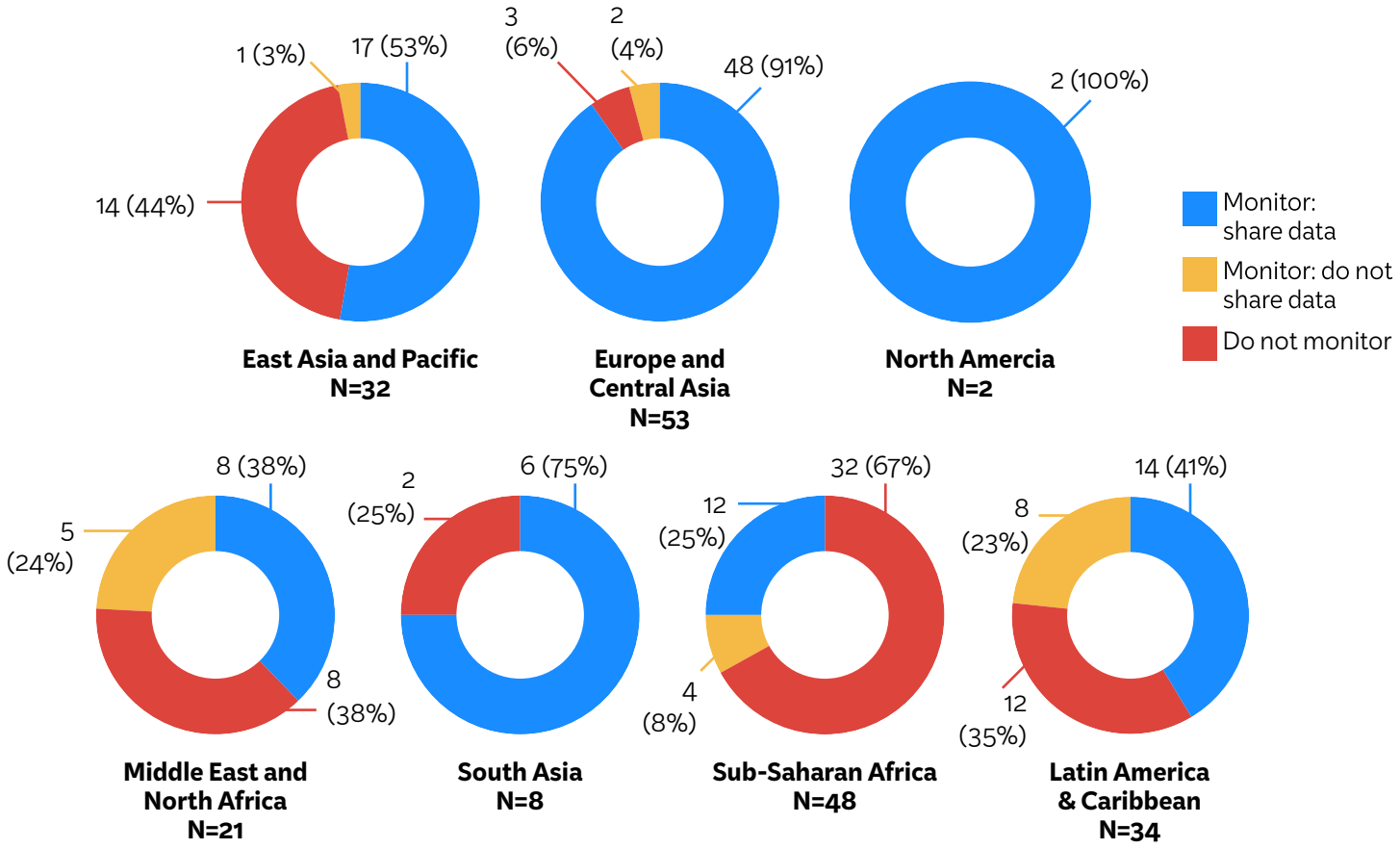


Figure 6. Fraction of countries and dependencies or disputed territories with more than one million people that generate and share air quality data for each World Bank region.[22]

As Compared to 2022

Compared to 2022, we see a slight net increase in both the number of countries that made their data publicly available, and those that do not. Of the countries that monitor, 55% [N=109] now make their data publicly available, a net increase of 2% [N=4] from last year. On the other hand, 9% [N=18] of the countries that monitor do not make their data publicly available, a net increase of 1% [N=1] from last year. The net increase for both "publicly" and "non-publicly available" is because of the net increase in the number of countries that now monitor but were not monitoring in 2022. The countries that began sharing their data include Cabo Verde, Ghana, Guatemala, Kyrgyzstan, Moldova, Tajikistan, and Uruguay. (Figure 7)

Percentage of countries sharing (left) and not sharing (right) their air quality data

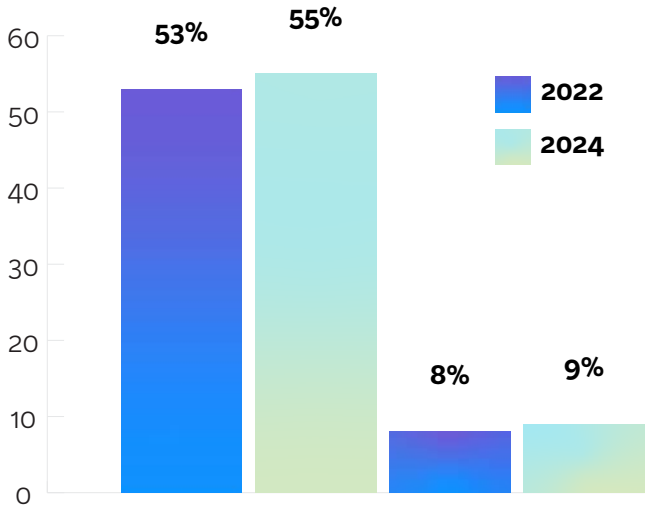


Figure 7. A slight net increase in both the number of countries publicly sharing and not publicly sharing their air quality data is seen from 2022 to 2024. The y-axis describes the percentage out of total countries, N=198.

[22] Because of rounding, the total of the percentages (in parentheses) may not exactly be 100%

Barriers and Opportunities

Governments may be reluctant to share air quality data if they are concerned about public perception, do not want the quality of their air to be compared to other places, or simply don't have the staff capacity to review and analyze the data independently or respond to press or public inquiries.

In reality, open data can improve public perception. Open data demonstrate government accountability and responsiveness. They can also correct public misperceptions and increase public support for evidence-based interventions. For example, if government data from reference-grade air quality monitors are kept private, but less-precise data from air sensors are made open, the public only has access to the air sensor data, not the reference monitor data, and might misinterpret the severity of the problem. This is not meant to dismiss the value of data from air sensors: they fill in gaps that can't be filled with regulatory monitors. But the picture is incomplete without open regulatory data.

Open data also facilitate knowledge sharing across government agencies whose responsibilities are directly or indirectly related to air pollution, which can lead to better governance and more efficient delivery of services.

Where resources are scarce, one way to expand capacity is to leverage the interest and expertise of reputable academic institutions and NGOs to help analyze and present data, develop high-level messages, train journalists, develop data management systems, and otherwise reduce concerns that open data could create too much work for the government agency.

There are many organizations working with governments to demonstrate the value of open data and to help them on their open data journey. For example, the international Open Data Charter outlines six principles developed by governments, civil society and experts that describe the value of open data in helping to advance sustainable development goals. And the World Bank's Open Government Data Toolkit helps governments understand the benefits of open data and plan and implement an open data program.

Key Insight #3: Only 54 countries share maximally open air quality data.

Honing in on countries that share air quality data [N=109] (Figure 5), we found that 50% [N=54] of them share data in a manner that meets all Four Key Open Data Criteria (Table 3). Out of the total number of countries surveyed [N=198], this equates to 27% [N=54], which means that barely over one-quarter of the world's countries provide open access to maximally useful air quality data.

Table 3. Of countries that share air quality data, the number and percentage that meet the Four Key Open Data Criteria. The full list of countries and tags indicating whether the criteria are met can be found here (https://link.openaq.org/2024-ReportWorksheet). All percentages are expressed out of "Countries that share data" column, and these categories are not mutually exclusive, so country counts for A, B, C and D total over 100%.

Year	Countries that share data*	A: Physical Units	B: Station-Specific Coordinates	C: Timely Fine Scale	D: Programmatic Acces	All criteria met
2022 (absolute)	105	88	70	92	47	45
2022 (%)	-	84	74	88	45	43
2024 (absolute)	109	92	91	104	55	54
2024 (%)	-	84	83	95	50	50

*including in-country sharing only (Kazakhstan and Türkiye)

As Table 3 and Figure 8 depict, all countries that monitor and share data fulfill at least one key criterion for fully open data, with "timely fine scale" being the most fulfilled, and "programmatic access" being the least fulfilled. In fact, most countries fulfill more than one criterion. For example, some countries provide a dashboard reporting live data, but only with air quality indices, or they report data for a large region as an aggregate without specifying the exact location/s of the monitoring station/s.

Sharing air quality data via social media and digital apps

These countries are demonstrating a basic level of commitment to data transparency even if they do not meet the Four Key Open Data Criteria:

Ghana *provides daily AQI updates in the Legon region using X (formerly known as Twitter).*

Senegal, Cambodia, India, *and* Tanauan City *and* San Juan City *in the Philippines provide regular AQI updates across the country using Facebook.*

India has an app for mobile devices called "Sameer" that provides an hourly update of its national AQI

As Compared to 2022

Compared to 2022, we see an increase in countries that fulfill all Four Key Open Data Criteria for open data from 43% [N=45] to 50% [N=54]. Out of the total number of countries surveyed [N=198], this is an overall increase from 23 to 27%. This year, Cabo Verde, Hong Kong, Italy, Japan, Kenya, Kosovo, Kyrgyzstan, Netherlands, Peru, South Africa, Uganda all fulfilled the Four Key Open Data Criteria.

Percentage of countries (out of total countries that share)
***Including those sharing in-country only**

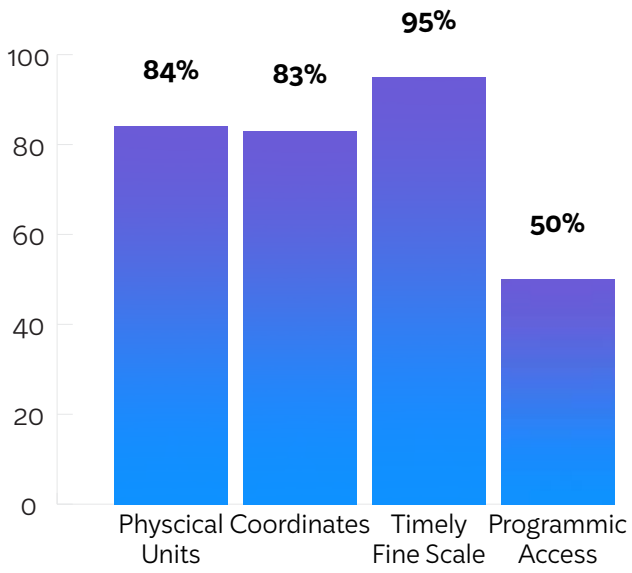


Figure 8. Percentage of countries (out of N=109 countries that share data) that fulfill the respective key criteria for fully open data.

Percentage of countries that meet the Four Key Criteria

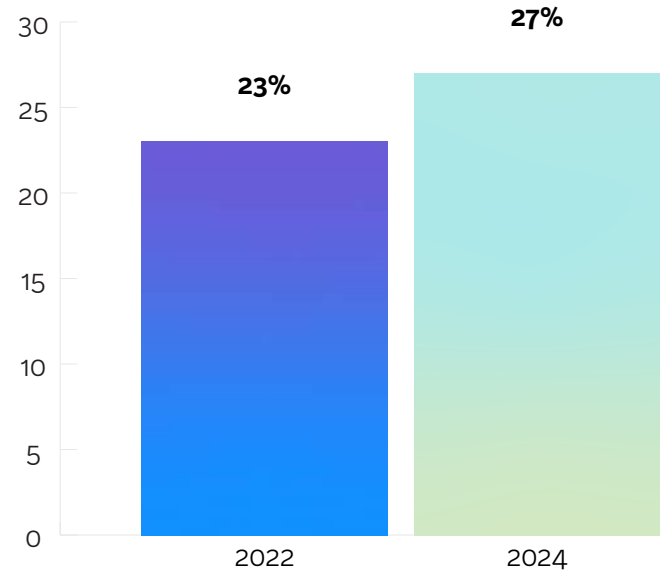


Figure 9. A modest increase in the number of countries providing maximally useful data is seen from 2022 to 2024. The y-axis describes the percentage out of total countries, N=198.

Despite some forward movement, the fact remains that barely over one-quarter of the world's countries share air quality data in a fully open manner. Each instance of not meeting a key criterion reduces the practical value of the data as described below.

Limitations of Sharing Data Only as an Air Quality Index

Countries that share but do not satisfy Criterion A [Physical Units] typically share the data in the form of an air quality index (AQI). AQIs are excellent communication tools—they summarize air quality in a simple way for easy public consumption. But they should supplement, not replace, the sharing of data in physical units. Actual physical measurements for each pollutant are required to analyze the complexity and nuances of air pollution and to develop corrective actions. Furthermore, AQIs are not calculated in a standardized way and vary significantly across the world. For more information, visit OpenAQ's Air Quality Index Hub, which decodes the methodologies different countries use to develop their AQI.

Limitations of Not Sharing Exact Locations of Monitoring Stations

Countries that share but do not satisfy Criterion B [Station-Specific] often share the data in the form of regional aggregates or averages. Some share data per station, but provide no information on the station location (*e.g.*, exact geolocation, accurate representation on a map). Location-specific information on physical air quality parameters is crucial to understand the spatial variability as well as pollution sources and to use this information to design and enforce appropriate regulations.

Limitations of Delaying Release of the Data

Countries that share but do not satisfy Criterion C [Real-Time] may not gather data in real-time,[23] may undertake certain processes that slow the release of the data, or may simply choose to report less often. Although historical data are useful, real-time data are needed for such applications as air quality forecasting.

Limitations of Not Sharing Data Programmatically

Countries that share but do not satisfy Criterion D [Programmatic Access] either share the data in a static, non-machine readable format or otherwise make it difficult for anyone intending to use computer software to access and use the data. Although sharing data as a PDF or graphic is a good first step, when data are provided in a machine-readable, analysis-ready and standardized form, many more use cases—and ultimately, impact—can be derived from the data.

Barriers and Opportunities

Even amongst countries that exhibit the capacity to generate and share data, a significant number of them have not implemented relatively low-cost measures that will make their air quality data fully transparent and useful.

On the one hand, they may not realize the value of making the data fully and easily accessible. As noted in Key Insight #2, there are many organizations working with governments to demonstrate the value of open data and to help them on their open data journey. This report is one tool to help raise awareness of the value of open air quality data.

On the other hand, the information-technology infrastructure that can provide programmatic access requires financial and technological resources that some countries cannot afford. For the funding community, this is an excellent example of where a small investment to support countries that are keen to share their air quality data programmatically, but are hampered by resource constraints, would go a long way.

[23] Some countries may use offline methods, such as 24-hour filter-based gravimetric methods for particulate matter or cartridge-based sampling for gases, which require laboratory analysis post-collection and thus are not reported in "real-time."

Key Insight #4: Greater data transparency would benefit billions of people.

The burden due to non-communicable disease resulting from air pollution is high and growing in many regions around the world; populations from low- and middle-income countries are exposed to 1.3 - 4 times higher levels of ambient $PM_{2.5}$.[24] While many populous countries have partially shared their air quality data, an increase in transparency could benefit over 4.5 billion people through continued capacity strengthening and knowledge building.

Countries with populations over 50 million in which real-time air quality data are produced in some format, but not in a fully open manner on a national level by the national government, are shown in Table 4.

Table 4. Most populous countries and the Four Key Open Data Criteria they have yet to meet.

Country	Population (in millions)[a]	Key Open Data Criteria Not Met			
		Physical Units	Station-Specific Coordinates	Timely Fine-Scale Data	Programmatic Access
India	1,428.6				×
China	1,410.7				×
Indonesia	277.5		×		×
Pakistan[b]	240.5		×		×
Brazil	216.4		×		×
Russian Federation	143.8	×			×
Philippines	117.3				×
Egypt	112.7	×			×
Viet Nam	98.9	×			×
Türkiye	85.3				×
Thailand	71.8				×

[a] World Bank figures as of 2023.

[b] Pakistan's national-level ambient air quality reports are released on a monthly basis; however, the Punjab province releases daily AQI reports (https://epd.punjab.gov.pk/aqi). Both do not have station-specific coordinates and are not programmatically accessible.

Recap & Recommendations

The need for air quality data: Governments have a responsibility to address air pollution—a leading health concern across the world that disproportionately impacts low- and middle-income countries. Reliable data on air pollution are fundamental for informing actions to improve air quality and tracking progress over time.

Our findings: Unfortunately, we found no recent evidence of government-operated/sponsored air quality monitoring in 71 of the 198 countries we reviewed. In other words, 36% of countries are not monitoring air pollution, one of the greatest global health risks.

36% of countries are not monitoring air pollution, one of the greatest global health risks.

The need to share air quality data: Air quality data are a public good. When air quality data are shared in a fully open manner (in real-time, in physical units, with specific coordinates, and programmatically accessible) it unlocks the full potential of these data to support the data-driven applications needed to solve the air pollution crisis. Clean air action is maximized and accelerated because everyone across civil society, the public sector and the private sector can use the data, applying their knowledge, skills and experience.

Our findings: We found that among countries with evidence of air quality monitoring, a majority (86%) are sharing data with the public in some format. Furthermore, all countries that share their air quality data fulfill at least one of the Four Key Open Data Criteria. However, only 50% of these countries that monitor and share meet all four criteria. Applying this to all countries surveyed, slightly over half (55%) share air quality data publicly, and barely more than one quarter (27%) share the data in a way that maximizes potential uses.

Barely over ¼ of the world's countries provide open access to maximally useful air quality data.

This assessment points to a critical need to support countries in filling air quality data gaps and encourage them to apply open data principles to the data they generate.

To accelerate clean air progress, we recommend:

1. **All governments measure and track air quality.** Recognizing that resources are limited, a government just beginning to monitor should start by installing a reference-grade PM2.5 monitor as described in Our Common Air's 2024 report, "*Accelerating Country-led Air Quality Reporting to Achieve Clean Air*."
2. **All governments share the air quality data they generate in a fully transparent and accessible manner**: in physical units, with station-specific coordinates, in daily or sub-daily frequency, and in a format that is machine-readable.
3. **Funders, such as development banks and philanthropies, support less-resourced governments**. Countries where a relatively small investment would close a serious data gap and effect positive national-level change are identified in the EPIC report, "*The Case for Closing Global Air Quality Data Gaps with Local Actors: A Golden Opportunity for the Philanthropic Community*."
4. **Funders include conditions for data transparency in funding agreements**. One example of an open data sharing requirement is the EPIC Air Quality Fund.

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Additional Resources

Full list of countries and their category tags: https://link.openaq.org/2024-ReportWorksheet

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Appendix A. Detailed Methodology

The research methodology for the 2024 edition of Open Air Quality Data: The Global Landscape adheres to the methodology we formalized in 2022. Changes to search and query methods were adapted as necessary.

We surveyed 193 United Nations member states and 5 dependencies or disputed territories with populations greater than one million.

We used the methodological framework of 'scoping review' used in academic literature. This formal methodology was first developed in Arksey & O'Malley (2005) as distinct from the already well-established 'systematic review' methodology [1]. Scoping review is more useful than the latter in the case of questions with broader scopes, and where review does not plan to eliminate a wide variety of study methodologies with strict selection criteria. Scoping studies are also more useful when the review concerns an emerging field. Our study uses a scoping review framework to answer a broad question about the status of government-supported air quality monitoring in countries across the world. We allow for diverse types of monitoring technologies and different types of programs. We account for the evolving landscape of air quality monitoring with new technologies being featured in government programs. Scoping review methodology is increasingly being used in the field of air quality science and management to assess emerging sub-fields [2, 3, 4, 5]. While scoping review methodology was developed for primarily reviewing academic literature, its scope can be expanded to include gray literature as well [6].

The Arksey and O'Malley methodology includes five stages:

1. identifying research questions,
2. identifying relevant studies,
3. study selection,
4. charting the data, and
5. collating, summarizing, and reporting the results.

In addition, we incorporate two important extensions suggested to this framework. First, Levac et. al (2010) recommends adding the sixth stage of "incorporating consultation with stakeholders as a required knowledge translation component of scoping study methodology" [7]. This extension adds significant value by enabling us to use air quality professionals as a credible resource with firsthand knowledge of air quality monitoring and data in different countries across the world. Additionally, Peters et. al (2020) deliberated another detail for stage 2—'identifying relevant studies'—suggesting that the search strategy can be iteratively refined as the researchers become more familiar with the evidence base and potentially learn new keywords, sources, and search terms [8].

This methodology serves as a basic research framework and comparative analysis that can generate temporal insights about how the landscape of air quality data has evolved. It makes it easy to communicate transparently to readers the details of the research undertaken. It facilitates the crowd-sourcing component of this project, where background research is publicly shared for the broader community to use and possibly identify gaps in the collected data.

1. Identifying the Research Question

For every country, the overarching question this study addresses is: *What is the state of government-commissioned air quality monitoring?*

Some specific sub-questions include:

- Is there any evidence of an existing air quality monitoring program in the country that is implemented or sponsored by the government?
- Is there government monitoring at a national or sub-national (*e.g.,* major metropolitan area of the country) level?
- If the government is monitoring AQ, is the data being shared publicly?
- How are countries sharing their data?
- Why is air quality monitoring not a top priority for some countries?

2. Identifying Relevant Studies

We applied a search strategy that covers multiple types of resources available online. In our study, 'relevant studies' has a broader definition to include gray literature like reports by non-profit, intergovernmental organizations and official web pages of the departments of government concerned with air quality management in a country. Our search strategy was iteratively refined as new sources of information about air quality monitoring in different countries were identified.

An official government webpage with ongoing dissemination of information regarding a country's air quality was the target of this search strategy for each country. Using such web pages allowed us to assess the openness of the air quality data according to our criteria. In the absence of finding a webpage, we relied on other sources that describe the monitoring operations. The following describes the final iteration of the search strategy that was applied to all the countries:

- We searched for widely used air quality data aggregators—OpenAQ, aqicn/WAQI (World Air Quality Index Project), IQAir—if they are importing data from official government sources in the country. Additionally, we used the formula for search phrases: ***'<country name>'*** or ***'<capital city name>' + qualifier***, where qualifiers include "air", "air monitoring", "air quality" or "PM2.5". Google was used as a search engine to see if there are any other relatively less popular data aggregators that host official air quality data from the country.

- We located official web pages for three government departments (Environment, Meteorology, Statistics) for each country using Google as a search engine. Search phrases used were variations of the following: ***'<country name> ministry of environment', '<country name> department of environment', '<country name> department of statistics', '<country name> meteorological department', '<country name> department of health', '<country name> department of climate change', '<country name> open data portal***. These phrases were also translated to languages that were listed as official languages of the country as listed on Wikipedia. On each of these webpages, we searched through the reports and news archives for information on the country's air quality monitoring program. In the event that a website is unreachable, we tried various means of determining if the website is live, temporarily unavailable or is blocked outside of the region.

- We reviewed reports from non-profit and intergovernmental organizations: United Nations Environment Programme (UNEP), Clean Air & Climate Coalition, World Bank, Asian Development Bank, Economic Community of West African States (ECOWAS), etc. For example, UNEP in 2015 conducted a review of all countries for their air quality policies. The document for each country they reviewed has a section on the status of air quality monitoring.

- We searched for academic literature that could provide information about government-run air quality monitoring programs in the country. Using Google Scholar and these search phrases and their variations: ***'<country name> air quality', '<country name> air pollution', '<capital city name> air quality', '<capital city name> air pollution', '<country name> air monitoring'***. We filtered the results to show studies published after 2015, as we are primarily interested in ongoing air quality monitoring in the countries.

- We searched for social media of governmental institutions for air quality information as these pages may have regular uploads of air quality data from a given database, which is sourced from its original location and recorded for reference.

3. Study Selection

When applied to sources broader than academic literature or studies, including gray literature and government sources, this step translates to selecting satisfactory evidence that describes air quality monitoring in each country. In countries where the governments are actively sharing their air quality data, weblinks to those pages are the best available evidence. If the data is not being shared, we relied on descriptions about monitoring activities from official websites or gray literature. The minimum standard for a descriptive account to be considered as evidence of an existing monitoring program in a country is that specific information should be present about the operation. For example, the webpage of the department of environment of a country listing 'air quality monitoring' as one of its 'services' does not qualify as satisfactory evidence. Examples of minimum level of evidentiary accounts that can be considered satisfactory could look like "Ministry operates three monitoring stations in the region XYZ", "Ministry has collected regular daily data on PM_{10}, TSP, NO_x in the capital city since 2010". For the information to be considered current, the page needs to have an indication of the date and that the monitoring is currently ongoing.

4. Charting the Data

We reviewed each country's documents (reports, webpages, academic literature) and categorized countries as either with existing government air quality monitoring programs or with no evidence of one. For countries that conduct monitoring and share the data publicly, their data-sharing practices were reviewed, and whether they meet the four criteria of

openness set out in the report were assessed. Results were tabulated in a spreadsheet where each country is color-coded as matching one out of three categories:

- Green: The country has evidence of air quality monitoring and meets all four key criteria for full open data.
- Yellow: The country has evidence of air quality monitoring but only meets some of the four key criteria for full open data.
- Red: The country does not have proof of monitoring air quality.

In addition to the coloring system, descriptive sentences were added, as well as weblinks that point to evidence of air quality monitoring and publicly accessible platforms.

5. Collating, Reporting, and Summarizing the Results

After all countries were tagged for the existence of government air quality monitoring and openness of their data sharing practices, we derived a set of insights based on descriptive statistics. Some of the questions we asked were: What percent of countries have government air quality monitoring? How many countries that monitor also share the data? How many countries satisfy different openness criteria for how they share the data? How many countries share the data in a fully open manner? In what formats are countries sharing their data on air pollution? How many countries have up-to-date data on their websites? These insights are presented in the report.

6. Consultation and Validation of the Tally

We consulted with the OpenAQ community to find whether any gaps exist in our findings. This was especially important for countries where we were not able to find evidence of air quality monitoring through Steps 1-3. We confirmed our findings with air quality professionals or experts who work in these countries and are deemed trusted sources. We put out a call sharing an aggregate list of countries where we found no evidence of air quality monitoring (to seek what we may have missed), and conducted personal communications with these contacts. The OpenAQ community is made up of members across the world that may have used the OpenAQ platform to access air quality data, are subscribed to our newsletter or social media channels, are involved in the field of open air quality data, and/or directly affiliated with our organization in some capacity. We received inputs from contributors; these were incorporated in our findings and subsequent statistics.

References: Methodology

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Appendix B. Country Tally

As of September 2024. For the full table, see https://link.openaq.org/2024-ReportWorksheet

Country	Evidence of current government operated air quality monitoring in 2024?	Publicly accessible? (* = only in country)	A: Physical Data	B: Station Level and Coordinates	C: Timely fine scale	D: Programmatic access
Afghanistan	No	No	-	-	-	-
Albania	No	No	-	-	-	-
Algeria	Yes	No	-	-	-	-
Andorra	Yes	Yes	Yes	Yes	Yes	Yes
Angola	No	No	-	-	-	-
Antigua and Barbuda	No	No	-	-	-	-
Argentina	Yes	Yes	Yes	No	Yes	No
Armenia	Yes	Yes	Yes	No	Yes	No
Australia	Yes	Yes	Yes	Yes	Yes	Yes
Austria	Yes	Yes	Yes	Yes	Yes	Yes
Azerbaijan	Yes	Yes	Yes	No	No	No
Bahamas, The	No	No	-	-	-	-
Bahrain	Yes	No	-	-	-	-

Country	Evidence of current government operated air quality monitoring in 2024?	Publicly accessible? (* = only in country)	A: Physical Data	B: Station Level and Coordinates	C: Timely fine scale	D: Programmatic access
Bangladesh	Yes	Yes	No	No	Yes	No
Barbados	Yes	No	-	-	-	-
Belarus	Yes	Yes	Yes	Yes	Yes	No
Belgium	Yes	Yes	Yes	Yes	Yes	Yes
Belize	Yes	No	-	-	-	-
Benin	No	No	-	-	-	-
Bhutan	No	No	-	-	-	-
Bolivia	Yes	Yes	Yes	Yes	No	No
Bosnia and Herzegovina	Yes	Yes	Yes	Yes	Yes	Yes
Botswana	No	No	-	-	-	-
Brazil	Yes	Yes	Yes	No	Yes	No
Brunei Darussalam	Yes	Yes	No	No	Yes	No
Bulgaria	Yes	Yes	Yes	Yes	Yes	Yes
Burkina Faso	No	No	-	-	-	-
Burundi	No	No	-	-	-	-
Cabo Verde	Yes	Yes	Yes	Yes	Yes	Yes
Cambodia	Yes	Yes	No	No	Yes	No

Country	Evidence of current government operated air quality monitoring in 2024?	Publicly accessible? (* = only in country)	A: Physical Data	B: Station Level and Coordinates	C: Timely fine scale	D: Programmatic access
Cameroon	No	No	-	-	-	-
Canada	Yes	Yes	Yes	Yes	Yes	Yes
Central African Republic	No	No	-	-	-	-
Chad	No	No	-	-	-	-
Chile	Yes	Yes	Yes	Yes	Yes	Yes
China	Yes	Yes	Yes	Yes	Yes	No
Colombia	Yes	Yes	Yes	Yes	Yes	Yes
Comoros	No	No	-	-	-	-
Congo, Dem. Rep.	No	No	-	-	-	-
Congo, Rep	No	No	-	-	-	-
Costa Rica	Yes	No	-	-	-	-
Côte d'Ivoire	No	No	-	-	-	-
Croatia	Yes	Yes	Yes	Yes	Yes	Yes
Cuba	No	No	-	-	-	-
Cyprus	Yes	Yes	Yes	Yes	Yes	Yes
Czechia	Yes	Yes	Yes	Yes	Yes	Yes

Country	Evidence of current government operated air quality monitoring in 2024?	Publicly accessible? (* = only in country)	A: Physical Data	B: Station Level and Coordinates	C: Timely fine scale	D: Programmatic access
Denmark	Yes	Yes	Yes	Yes	Yes	Yes
Djibouti	Yes	Yes	Yes	Yes	Yes	No
Dominica	No	No	-	-	-	-
Dominican Republic	No	No	-	-	-	-
Ecuador	Yes	No	-	-	-	-
Egypt, Arab Rep.	Yes	Yes	No	Yes	Yes	No
El Salvador	Yes	Yes	Yes	Yes	Yes	No
Equatorial Guinea	No	No	-	-	-	-
Eritrea	No	No	-	-	-	-
Estonia	Yes	Yes	Yes	Yes	Yes	Yes
Eswatini	No	No	-	-	-	-
Ethiopia	Yes	No	-	-	-	-
Fiji	No	No	-	-	-	-
Finland	Yes	Yes	Yes	Yes	Yes	Yes
France	Yes	Yes	Yes	Yes	Yes	Yes
Gabon	No	No	-	-	-	-

Country	Evidence of current government operated air quality monitoring in 2024?	Publicly accessible? (* = only in country)	A: Physical Data	B: Station Level and Coordinates	C: Timely fine scale	D: Programmatic access
Gambia, Rep. of The	No	No	-	-	-	-
Georgia	Yes	Yes	Yes	Yes	No	No
Germany	Yes	Yes	Yes	Yes	Yes	Yes
Ghana	Yes	Yes	No	No	Yes	No
Greece	Yes	Yes	Yes	Yes	Yes	Yes
Grenada	No	No	-	-	-	-
Guatemala	Yes	Yes	Yes	No	Yes	No
Guinea	No	No	-	-	-	-
Guinea-Bissau	Yes	No	-	-	-	-
Guyana	Yes	Yes	Yes	Yes	Yes	No
Haiti	No	No	-	-	-	-
Honduras	Yes	Yes	Yes	No	No	No
Hong Kong SAR, China	Yes	Yes	Yes	Yes	Yes	Yes
Hungary	Yes	Yes	Yes	Yes	Yes	Yes
Iceland	Yes	Yes	Yes	Yes	Yes	Yes
India	Yes	Yes	Yes	Yes	Yes	No

Country	Evidence of current government operated air quality monitoring in 2024?	Publicly accessible? (* = only in country)	A: Physical Data	B: Station Level and Coordinates	C: Timely fine scale	D: Programmatic access
Indonesia	Yes	Yes	Yes	No	Yes	No
Iran, Islamic Rep. of	No	No	-	-	-	-
Iraq	No	No	-	-	-	-
Ireland	Yes	Yes	Yes	Yes	Yes	Yes
Israel	Yes	Yes	Yes	Yes	Yes	No
Italy	Yes	Yes	Yes	Yes	Yes	Yes
Jamaica	Yes	No	-	-	-	-
Japan	Yes	Yes	Yes	Yes	Yes	Yes
Jordan	Yes	Yes	No	Yes	Yes	No
Kazakhstan	Yes	Yes*	Yes	Yes	Yes	No
Kenya	Yes	Yes	Yes	Yes	Yes	Yes
Kiribati	No	No	-	-	-	-
Kosovo	Yes	Yes	Yes	Yes	Yes	Yes
Kuwait	Yes	Yes	Yes	Yes	Yes	No
Kyrgyz Republic	Yes	Yes	Yes	Yes	Yes	Yes
Lao People's Democratic Rep.	Yes	Yes	Yes	Yes	No	No

Country	Evidence of current government operated air quality monitoring in 2024?	Publicly accessible? (* = only in country)	A: Physical Data	B: Station Level and Coordinates	C: Timely fine scale	D: Programmatic access
Latvia	Yes	Yes	Yes	Yes	Yes	Yes
Lebanon	No	No	-	-	-	-
Lesotho	No	No	-	-	-	-
Liberia	No	No	-	-	-	-
Libya	No	No	-	-	-	-
Liechtenstein	Yes	Yes	Yes	Yes	Yes	No
Lithuania	Yes	Yes	Yes	Yes	Yes	Yes
Luxembourg	Yes	Yes	Yes	Yes	Yes	Yes
Madagascar	Yes	Yes	Yes	Yes	Yes	No
Malawi	No	No	-	-	-	-
Malaysia	Yes	Yes	No	Yes	Yes	No
Maldives	Yes	Yes	Yes	Yes	Yes	No
Mali	No	No	-	-	-	-
Malta	Yes	Yes	Yes	Yes	Yes	Yes
Marshall Islands	No	No	-	-	-	-
Mauritania	No	No	-	-	-	-

Country	Evidence of current government operated air quality monitoring in 2024?	Publicly accessible? (* = only in country)	A: Physical Data	B: Station Level and Coordinates	C: Timely fine scale	D: Programmatic access
Mauritius	Yes	Yes	No	Yes	Yes	No
Mexico	Yes	Yes	Yes	Yes	Yes	Yes
Micronesia, Fed. States of	No	No	-	-	-	-
Moldova, Rep. of	Yes	Yes	Yes	Yes	Yes	No
Monaco	Yes	Yes	No	No	Yes	No
Mongolia	Yes	Yes	Yes	Yes	Yes	No
Montenegro	Yes	Yes	Yes	Yes	Yes	No
Morocco	Yes	No	-	-	-	-
Mozambique	Yes	No	-	-	-	-
Myanmar	Yes	No	-	-	-	-
Namibia	No	No	-	-	-	-
Nauru	No	No	-	-	-	-
Nepal	Yes	Yes	Yes	Yes	Yes	No
Netherlands	Yes	Yes	Yes	Yes	Yes	Yes
New Zealand	Yes	Yes	Yes	Yes	Yes	Yes
Nicaragua	No	No	-	-	-	-

Country	Evidence of current government operated air quality monitoring in 2024?	Publicly accessible? (* = only in country)	A: Physical Data	B: Station Level and Coordinates	C: Timely fine scale	D: Programmatic access
Niger	No	No	-	-	-	-
Nigeria	Yes	Yes	No	Yes	Yes	No
North Korea (Korea, Dem. People's Rep.)	No	No	-	-	-	-
North Macedonia	Yes	Yes	Yes	Yes	Yes	Yes
Norway	Yes	Yes	Yes	Yes	Yes	Yes
Oman	Yes	Yes	Yes	No	No	Yes
Pakistan	Yes	Yes	Yes	No	Yes	No
Palau	No	No	-	-	-	-
Palestinian territories	No	No	-	-	-	-
Panama	No	No	-	-	-	-
Papua New Guinea	No	No	-	-	-	-
Paraguay	Yes	No	-	-	-	-
Peru	Yes	Yes	Yes	Yes	Yes	Yes
Philippines	Yes	Yes	Yes	Yes	Yes	No
Poland	Yes	Yes	Yes	Yes	Yes	Yes
Portugal	Yes	Yes	Yes	Yes	Yes	Yes
Puerto Rico	Yes	Yes	Yes	Yes	Yes	Yes

Country	Evidence of current government operated air quality monitoring in 2024?	Publicly accessible? (* = only in country)	A: Physical Data	B: Station Level and Coordinates	C: Timely fine scale	D: Programmatic access
Qatar	Yes	No	-	-	-	-
Romania	Yes	Yes	Yes	Yes	Yes	Yes
Russian Federation	Yes	Yes	No	Yes	Yes	No
Rwanda	Yes	Yes	No	Yes	Yes	No
Samoa	No	No	-	-	-	-
San Marino	Yes	Yes	Yes	No	Yes	No
Sao Tome and Principe	No	No	-	-	-	-
Saudi Arabia	Yes	No	No	Yes	Yes	No
Senegal	Yes	Yes	No	No	Yes	No
Serbia	Yes	Yes	Yes	Yes	Yes	Yes
Seychelles	Yes	Yes	No	Yes	Yes	No
Sierra Leone	No	No	-	-	-	-
Singapore	Yes	Yes	Yes	No	Yes	No
Slovak Republic	Yes	Yes	Yes	Yes	Yes	Yes
Slovenia	Yes	Yes	Yes	Yes	Yes	Yes
Solomon Islands	No	No	-	-	-	-

Country	Evidence of current government operated air quality monitoring in 2024?	Publicly accessible? (* = only in country)	A: Physical Data	B: Station Level and Coordinates	C: Timely fine scale	D: Programmatic access
Somalia	Yes	No	-	-	-	-
South Africa	Yes	Yes	Yes	Yes	Yes	Yes
South Korea (Korea, Rep.)	Yes	Yes	Yes	Yes	Yes	Yes
South Sudan	No	No	-	-	-	-
Spain	Yes	Yes	Yes	Yes	No	Yes
Sri Lanka	Yes	Yes	No	No	Yes	No
St. Kitts and Nevis	No	No	-	-	-	-
St. Lucia	No	No	-	-	-	-
St. Vincent and the Grenadines	Yes	No	-	-	-	-
Sudan	No	No	-	-	-	-
Suriname	No	No	-	-	-	-
Sweden	Yes	Yes	Yes	Yes	Yes	Yes
Switzerland	Yes	Yes	Yes	Yes	Yes	Yes
Syrian Arab Republic	No	No	-	-	-	-
Taiwan	Yes	Yes	Yes	Yes	Yes	Yes
Tajikistan	Yes	Yes	No	No	Yes	No

Country	Evidence of current government operated air quality monitoring in 2024?	Publicly accessible? (* = only in country)	A: Physical Data	B: Station Level and Coordinates	C: Timely fine scale	D: Programmatic access
Tanzania, United Rep. of	No	No	-	-	-	-
Thailand	Yes	Yes	Yes	Yes	Yes	No
Timor-Leste	No	No	-	-	-	-
Togo	No	No	-	-	-	-
Tonga	No	No	-	-	-	-
Trinidad and Tobago	Yes	Yes	Yes	Yes	Yes	No
Tunisia	No	No	-	-	-	-
Türkiye	Yes	Yes*	Yes	Yes	Yes	No
Turkmenistan	No	No	-	-	-	-
Tuvalu	No	No	-	-	-	-
Uganda	Yes	Yes	Yes	Yes	Yes	Yes
Ukraine	No	No	-	-	-	-
United Arab Emirates	Yes	Yes	Yes	Yes	Yes	No
United Kingdom	Yes	Yes	Yes	Yes	Yes	Yes
United States	Yes	Yes	Yes	Yes	Yes	Yes
Uruguay	Yes	Yes	Yes	Yes	Yes	No

Country	Evidence of current government operated air quality monitoring in 2024?	Publicly accessible? (* = only in country)	A: Physical Data	B: Station Level and Coordinates	C: Timely fine scale	D: Programmatic access
Uzbekistan	Yes	Yes	Yes	Yes	Yes	No
Vanuatu	No	No	-	-	-	-
Venezuela, Bolivarian Rep. of	Yes	No	-	-	-	-
Viet Nam	Yes	Yes	No	Yes	Yes	No
Yemen, Rep. of	No	No	-	-	-	-
Zambia	No	No	-	-	-	-
Zimbabwe	Yes	Yes	Yes	Yes	Yes	No

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