Understanding How the Air Quality Index Works

Air quality levels have received a lot of attention in recent years.

In the wake of COVID-19 lockdowns, many places reported a marked increase in air quality. Northern India captured the world's attention when it was reported that the Himalayan mountain range was visible for the first time in decades.

On the flipside, later that summer, wildfires swept over the Pacific Northwest, British Columbia and California, blanketing entire regions with a thick shroud of smoke that spanned hundreds of miles.

How is air quality measured, and what goes into the health scores we see'

Measuring the Air Quality Index

When we see that air quality is 'good' or 'unhealthy', those public health categories are derived from the Air Quality Index (AQI).

In North America, the AQI is calculated using five major air pollutants:

- Ground-level ozone
- Carbon monoxide
- Sulfur dioxide
- Particle pollution, also known as particulate matter
- Nitrogen dioxide

Some countries have a slightly different way of calculating their scores. For example, India also measures levels of ammonia and lead in the air.

To make these readings more accessible, the AQI has a scoring system that runs from 0 to 500, using data collected from air monitoring stations in cities around the world. Scores below 50 are considered good, with very little impact to human health. The higher the score gets, the worse the air quality is.

To make communicating potential health risks to the public even easier, ranges of scores have been organized into descriptive categories.

AQI Score Range	AQI Category	PM2.5 (‘g/m’)	Health Risks
0-50	Good	0-12.0	Air quality is satisfactory and poses little or no risk.
51-100	Moderate	12.1-35.4	Sensitive individuals should avoid outdoor activity.
101-150	Unhealthy	35.5-55.4	General public and sensitive individuals in particular are at risk to experience irritation and respiratory problems.
151-200	Unhealthy	55.5-150.4	Increased likelihood of adverse effects and aggravation to the heart and lungs among general public.
201-300	Very Unhealthy	150.5-250.4	General public will be noticeably affected. Sensitive groups should restrict outdoor activities.
301+	Hazardous	250.5+	General public is at high risk to experience strong irritations and adverse health effects. Everyone should avoid outdoor activities.

Particulate Matter

While all the forms of atmospheric pollution are a cause for concern, it’s the smaller 2.5’m particles that get the most attention. For one, we can see visible evidence in the form of haze and smoke when PM2.5 levels increase. As well, these fine particles have a much easier time entering our bodies via breathing.

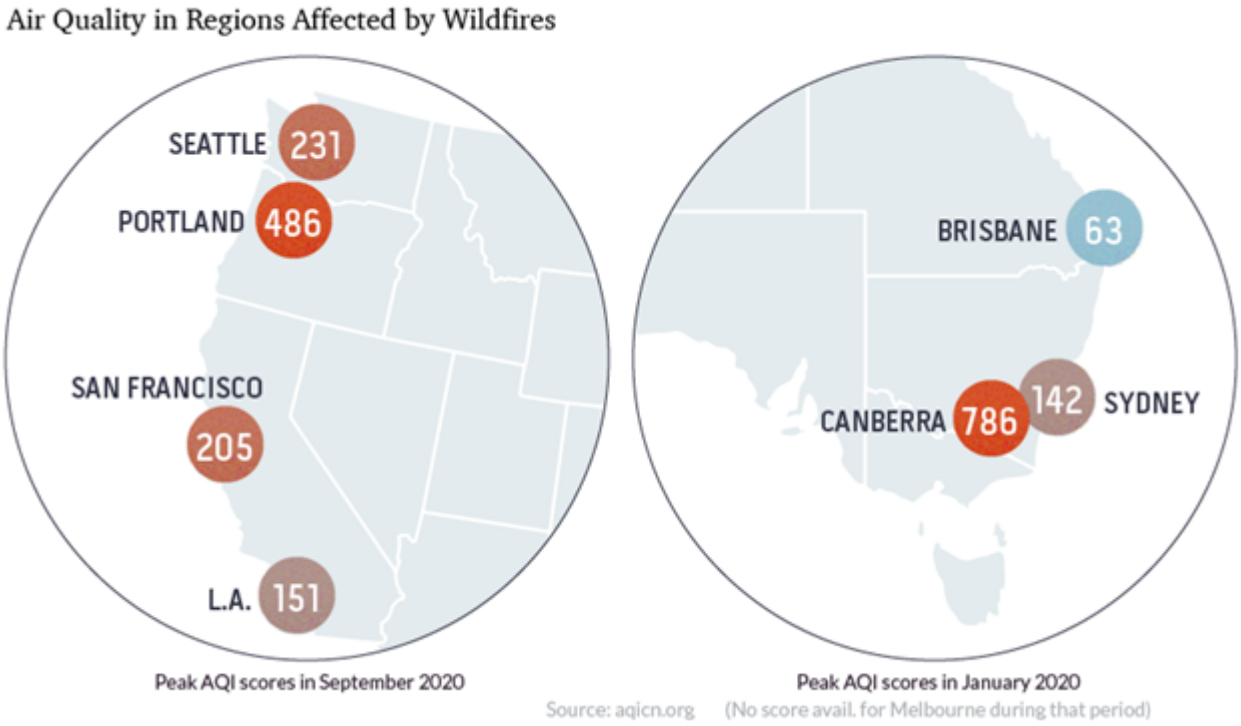
There are a number of factors that can increase the concentration of a region’s particulate matter. Some common examples include:

- Coal-fired power stations
- Cooking stoves (Many people around the world burn organic material for cooking and heating)
- Smoke from wildfires and slash-and-burn land clearing

Wildfires and Air Quality

Air quality scores can fluctuate a lot from season to season. For example, regions that are reliant on coal for power generation tend to see AQI score spikes during peak periods.

One of the biggest fluctuations occurs during wildfire season, when places that typically have scores in the ‘good’ category can see scores reach unsafe levels. In 2020, Eastern Australia and the West Coast of the U.S. both saw massive drops in air quality during their respective wildfire seasons.



In June 2023, a storm system sent a thick blanket of smoke from Canadian wildfires down to Northeastern states, blocking out the sun and turning the sky over Manhattan into a dull shade of orange.

Luckily, while these types of fluctuations are extreme, they are also temporary.

The air we breathe is made up of the gases that form Earth's atmosphere.

Primarily nitrogen and oxygen.

Composition of Earth's atmosphere

78% NITROGEN

21% OXYGEN

1% ARGON, CARBON DIOXIDE, ETC

Of course, other particles are present in the atmosphere as well.

SPORES SOOT POLLEN DUST FINE DUST WILDFIRE SMOKE

The concentration of these particles, along with other pollutants such as ozone and sulfur dioxide, is what dicates air quality.

AQI Air Quality Index

Used by government agencies to communicate to the public how polluted the air is in a given location.

In the United States, the AQI is calculated using five major air pollutants regulated by the Clean Air Act:

1. Ozone (Ground-level)
2. Sulfur dioxide
3. Particulate matter
4. Nitrogen dioxide
5. Carbon monoxide

Two measures of particulate matter are commonly used: <10 microns, <2.5 microns. Particles less than 2.5 microns in diameter are considered the most dangerous.

The AQI scale runs from 0 to 500...

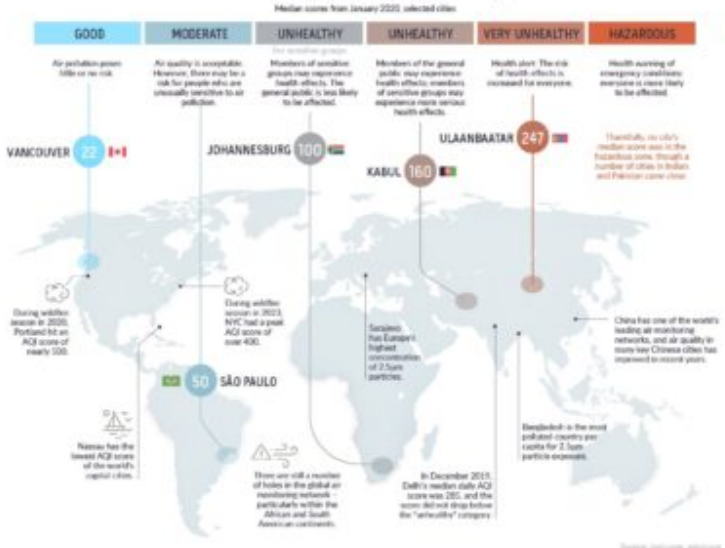
0 100 200 300 400 500

...and segments of that scale are divided into six categories related to health impact.

Here are some real-world examples from January, 2020.

Median scores from January 2020, selected cities

GOOD	MODERATE	UNHEALTHY	UNHEALTHY	VERY UNHEALTHY	HAZARDOUS
Air pollution poses little or no risk.	Air quality is acceptable. However, there may be a risk for people who are unusually sensitive to air pollution.	Members of sensitive groups may experience health effects. The general public is less likely to be affected.	Members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.	Health alert: The risk of health effects is increased for everyone.	Health warning of emergency conditions: everyone is more likely to be affected.



Correction: Graphics and article updated to include nitrogen dioxide.

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