

The Air Quality Index (AQI), Wood Smoke and Your Health - A Guide







What is the Air Quality Index (AQI) and What Are the Two Versions of the AQI?

The EPA AQI is an easy-to-use tool for expressing the quality of the air we breathe. The AQI can represent either the **daily air quality** for a specific air pollutant known as the U.S. Air Quality Index – daily index **or** the so called NowCast AQI that represents **current air quality** for a specific air pollutant **for the most recent available hour**.

State and local authorities may also issue AQI forecasts to predict the AQI for the next day for ozone and particulate matter (PM).

In General, What Values Apply to the AQI and What do They Mean?

AQI values range from 0 to 500 and indicate air quality and related health effects at each AQI category or color level from Good (Green) to Hazardous (Maroon):

AQI Numbers	AQI Category (Descriptor)	AQI Color	Hexadecimal Color Value	Category Number
0 - 50	Good		(00e400)	1
51 - 100	Moderate		(ffff00)	2
101 - 150	Unhealthy for Sensitive Groups		(ff7e00)	3
151 - 200	Unhealthy		(ff0000)	4
201 - 300	Very Unhealthy		(8f3f97)	5
301 - 500	Hazardous		(7e0023)	6

Courtesy of: <https://docs.airnowapi.org/aq101>

Higher values mean higher air pollution levels and greater health concerns. As the below illustration shows an AQI value of 50 or less means good air quality, while an AQI value greater than 50 means moderate to hazardous air quality dependent on the value of the Index.

Daily AQI Color	Levels of Concern	Values of Index	Description of Air Quality
Green	Good	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Yellow	Moderate	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Orange	Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Red	Unhealthy	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Purple	Very Unhealthy	201 to 300	Health alert: The risk of health effects is increased for everyone.
Maroon	Hazardous	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

<https://www.airnow.gov/aqi/aqi-basics/>

What do Specific AQI Values and Colors Mean?

Specifically, an AQI value of 100 means an ambient air concentration for a pollutant equal to its short-term national ambient air quality standard level for protection of public health. There is not necessarily a “safe” level of any particular pollutant such as PM_{2.5} the signature pollutant in wood smoke. AQI values at or below 100 indicate that public health may not be at risk save for sensitive or compromised individuals. AQI values over 100 imply that air quality is unhealthy to a varying extent for certain populations and for everyone as the AQI increases.

AQI	Air Pollution Level	Health Implications	Cautionary Statement (for PM _{2.5})
0 - 50	Good	Air quality is considered satisfactory, and air pollution poses little or no risk	None
51 -100	Moderate	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.	Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion.
101-150	Unhealthy for Sensitive Groups	Members of sensitive groups may experience health effects. The general public is not likely to be affected.	Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion.
151-200	Unhealthy	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects	Active children and adults, and people with respiratory disease, such as asthma, should avoid prolonged outdoor exertion; everyone else, especially children, should limit prolonged outdoor exertion
201-300	Very Unhealthy	Health warnings of emergency conditions. The entire population is more likely to be affected.	Active children and adults, and people with respiratory disease, such as asthma, should avoid all outdoor exertion; everyone else, especially children, should limit outdoor exertion.
300+	Hazardous	Health alert: everyone may experience more serious health effects	Everyone should avoid all outdoor exertion

<https://aqicn.org/calculator>

The AQI features six colors. Each color relates the pollutant standards to a different range of values or levels in the index and associated air quality and health concerns: Green (0-50) for “Good” air quality, Yellow (51-100) for “Moderate” air quality, Orange (101-150) for “Unhealthy” air quality “for sensitive groups”, Red (151-200) for “Unhealthy” air quality, Purple (201-300) for “Very Unhealthy” air quality and Maroon (301-500) for “Hazardous” air quality.

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
<i>When the AQI is in this range:</i>	<i>..air quality conditions are:</i>	<i>...as symbolized by this color:</i>
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

<https://cfpub.epa.gov/airnow/index.cfm?action=aqibasics.aqi>

What Air Quality Air Pollutants Does the AQI Track?

The U.S. Air Quality Index – daily index portrays air quality on the basis of any one of five of the six major air pollutants or “criteria” pollutants (five of which excluding ozone are in wood smoke as per above). These are the pollutants that the Clean Air Act (CAA) regulates to protect public health under the National Ambient Air Quality Standards (NAAQS):

- Particle pollution/particulate matter (PM), including PM_{2.5} (PM2.5 microns or less in diameter) and PM₁₀ (PM 10 microns or less in diameter)
- Carbon monoxide
- Sulfur dioxide
- Nitrogen dioxide
- Lead (the AQI does not record Lead)
- Ozone

The AQI for each pollutant is based on the specific health – based standard for that pollutant. The illustrations below denote the 24-hour average range in ug/m³ and its equivalent AQI values for PM_{2.5} the signature pollutant in wood smoke. Note that the PM_{2.5} 24-hour average standard in ug/m³ is 35.4 ug/m³. That corresponds to an AQI value of 100.

The NowCast AQI covers just two pollutants – ozone and PM_{2.5}. It’s a convenient barometer as to timing of outdoor activities. The NowCast AQI is the AQI you see as “current air quality” and on the AirNow website.

24-Hour PM_{2.5} Levels (ug/m³)

Air Quality Index		PM _{2.5} Health Effects	Precautionary Actions
0 to 12.0	Good 0 to 50	Little to no risk.	None
12.1 to 35.4	Moderate 51 to 100	Unusually sensitive individuals may experience respiratory symptoms.	Unusually sensitive people should consider reducing prolonged or heavy exertion.
35.5 to 55.4	Unhealthy for Sensitive Groups 101 to 150	Increasing likelihood of respiratory symptoms in sensitive individuals, aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly.	People with respiratory or heart disease, the elderly and children should limit prolonged exertion.
55.5 to 150.4	Unhealthy 151 to 200	Increased aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; increased respiratory effects in general population.	People with respiratory or heart disease, the elderly and children should avoid prolonged exertion; everyone else should limit prolonged exertion.
150.5 to 250.4	Very Unhealthy 201 to 300	Significant aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; significant increase in respiratory effects in general population.	People with respiratory or heart disease, the elderly and children should avoid any outdoor activity; everyone else should avoid prolonged exertion.
250.5 to 500.4	Hazardous 301 to 500	Serious aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; serious risk of respiratory effects in general population.	Everyone should avoid any outdoor exertion; people with respiratory or heart disease, the elderly and children should remain indoors.

Source: [U.S. Environmental Protection Agency](#)

EPA's Air Quality Index (AQI) for 24-hour Fine Particle Pollution (PM_{2.5})

24-hr PM _{2.5} (µg/m ³)	AQI Categories	AQI Values	AQI Cautionary Statements	AQI Health Effects Statements
0 – 12.0	Good	0 - 50	None	None
12.1 – 35.4	Moderate	51 - 100	Unusually sensitive people should consider reducing prolonged or heavy exertion.	Respiratory symptoms possible in unusually sensitive individuals, possible aggravation of heart or lung disease in people with cardiopulmonary disease and older adults.
35.5 – 55.4	Unhealthy for Sensitive Groups	101 - 150	People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.	Increasing likelihood of respiratory symptoms in sensitive individuals, aggravation of heart or lung disease and premature mortality in people with cardiopulmonary disease and older adults.
55.5 – 150.4	Unhealthy	151 - 200	People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion; everyone else should reduce prolonged or heavy exertion.	Increased aggravation of heart or lung disease and premature mortality in people with cardiopulmonary disease and older adults; increased respiratory effects in general population.
150.5 – 250.4	Very Unhealthy	201 - 300	People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.	Significant aggravation of heart or lung disease and premature mortality in people with cardiopulmonary disease and older adults; significant increase in respiratory effects in general population.
Greater than 250.5	Hazardous	Over 300	Everyone should avoid all physical activity outdoors; people with heart or lung disease, older adults, and children should remain indoors and keep activity levels low.	Serious aggravation of heart or lung disease and premature mortality in people with cardiopulmonary disease and older adults; serious risk of respiratory effects in general population.

Who is "SENSITIVE" to PM_{2.5}? "People with heart or lung disease, older adults, children, and people of lower socioeconomic status are the groups most at risk." Also at higher risk: **prenatal children** (low birth weight, pre-term birth, and IQ reduction), **diabetics**, and people with higher exposures such as **athletes** exposed during exercise.

Sources: <http://cleanairfairbanks.files.wordpress.com/2013/01/aqi-chart-for-pm-2-5-pollution-2013.pdf>

2013 by Clean Air Fairbanks cleanairfairbanks@gmail.com <http://cleanairfairbanks.wordpress.com>

What Special Considerations does The AQI Address and What is The AQI Calculator?

EPA's AQI PM_{2.5} is an invaluable tool to visualize measured particulate levels i.e., PM_{2.5} levels in µg/m³ at a wood smoke affected site at or beyond the property line nearest the source. Those readings may be compared to the customary and ordinary ambient background particulate PM_{2.5} level at the same site as measured at or beyond the property line nearest the source at the corresponding time and location and/or to the ambient PM_{2.5} levels at an unaffected control site at the same time in terms of the AQI PM 2.5 and associated health concerns.

The AirNow website (<https://www.airnow.gov/aqi/aqi-calculator/>) features an AQI Calculator to convert PM_{2.5} levels due to wood smoke in µg/m³ to the AQI numbers. And, it does not only Concentration to AQI conversions but also AQI to Concentration conversions.

Note: The WHO guideline for PM_{2.5} is 10 µg/m³ (annual average) and 25 µg/m³ (24-hour average). The EPA guideline for PM_{2.5} is far less conservative at 12 µg/m³ (annual average) and 35.4 µg/m³ (24-hour average).

What are The Specific Health and Environmental Effects of the Wood Smoke Pollutants that the AQI Tracks?

The following is a concise discussion of the health effects of the above-mentioned “criteria” pollutants in wood smoke that the AQI addresses.

Particulate matter (PM) i.e., PM_{2.5}. The potential for PM causing health issues is in direct relationship to particle size. Small particles (e.g. PM_{2.5}) 2.5 micrometers (um) in diameter or less present the greatest health risks, because they can penetrate deeply into the lungs, and thence the bloodstream, the circulatory system and almost all organs. The International Agency for Research on Cancer (**IARC**) - part of the World Health Organization (WHO) - classifies air pollution and PM_{2.5} as carcinogens.

Scientific studies link particle pollution e.g. PM_{2.5} exposure – short and long term - to an array of very serious respiratory, cardiovascular and other health issues, including:

- Inflammation of lung cells and susceptibility to and severity of COVID-19
- premature death in people with heart or lung disease
- nonfatal heart attacks
- irregular heartbeat
- stroke
- heart failure
- aggravated [asthma](#)
- decreased lung function
- increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing, burning eyes, runny nose
- bronchitis
- emphysema
- lung cancer
- COPD
- Respiratory infections including pneumonia
- Reproductive issues
- Dementia
- Reduced cognitive function
- An increase in Alzheimer admissions
- Parkinson’s
- Reduced intellectual performance
- Autism

“Particle pollution can be harmful even if it is inhaled over just a few hours or days, even if the year-round averages are low. "Short-term levels" refers to just such spikes. These represent levels averaged over a 24-hour period. Those days or weeks of high levels can be dangerous, even deadly” (<http://www.stateoftheair.org/key-findings/short-term-particle-pollution.html>).

The evidence links PM_{2.5} to airborne transmission of the SARS-COV-2 virus which causes COVID-19 disease where PM is the carrier of this pathogen. Thus, in addition to the polluting PM, one inhales the coronavirus as well (

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7345938/#:~:text=According%20to%20this%20analysis%2C%20a,more%20severe%20COVID%2D19%20results.>)

“Fine particles are also the main cause of reduced visibility (haze) in parts of the United States, including many of our treasured national parks and wilderness areas” (<https://www.epa.gov/pm-pollution/particulate-matter-pm-basics>).

Carbon Monoxide (CO) is a potentially deadly, odorless, colorless gas, produced in large amounts by combustion with insufficient air. “CO reduces the blood’s ability to supply oxygen to body tissues, and can cause stress on your heart and reduce your ability to exercise. Exposure to CO can cause long-term health problems, dizziness, confusion, severe headache, unconsciousness and even death. Those most at risk from CO poisoning are the unborn child, and people with anemia, heart, circulatory or lung disease”

http://www.foresthillmessenger.com/news/regional/burning-wood-produces-wood-smoke-and-air-pollution/article_53f030a0-c7fe-11e6-9e77-ef0f33726edb.html.”

Nitrogen Dioxide (NO₂) – “One of the “Oxides of Nitrogen (NO_x) - NO_x impairs the respiratory system and its ability to fight infection. NO_x also combines with VOCs to make ozone and with water vapor to form acid rain or acid fog”

(http://www.foresthillmessenger.com/news/regional/burning-wood-produces-wood-smoke-and-air-pollution/article_53f030a0-c7fe-11e6-9e77-ef0f33726edb.html).

“Nitrogen dioxide causes a range of harmful effects on the lungs, including: increased inflammation of the airways; worsened cough and wheezing; reduced lung function; increased asthma attacks; and greater likelihood of emergency department and hospital admissions. New research warns that NO₂ is likely to be a cause of asthma in children.”

(<https://www.lung.org/clean-air/outdoors/what-makes-air-unhealthy/nitrogen-dioxide>).

“NO₂ and other NO_x interact with water, oxygen and other chemicals in the atmosphere to form acid rain. Acid rain harms sensitive ecosystems such as lakes and forests.

The nitrate particles that result from NO_x make the air hazy and difficult to see though. This affects the many national parks that we visit for the view.

NO_x in the atmosphere contributes to nutrient pollution in coastal waters”

([https://www.epa.gov/no2-pollution/basic-information-about-no2#:~:text=Nitrogen%20Dioxide%20\(NO2\)%20is,from%20the%20burning%20of%20fuel](https://www.epa.gov/no2-pollution/basic-information-about-no2#:~:text=Nitrogen%20Dioxide%20(NO2)%20is,from%20the%20burning%20of%20fuel)).

Sulfur Dioxide (SO₂) – Sulfur dioxide (SO₂) is a colorless, reactive air pollutant with a strong odor. “Short-term exposures to SO₂ can harm the human respiratory system and make breathing difficult. People with asthma, particularly children, are sensitive to these effects of SO₂. SO₂ emissions that lead to high concentrations of SO₂ in the air generally also lead to the formation of other sulfur oxides (SO_x). SO_x can react with other compounds in the atmosphere to form small particles i.e. particulate matter (PM) pollution.

At high concentrations, gaseous SO_x can harm trees and plants by damaging foliage and decreasing growth.

SO₂ and other sulfur oxides can contribute to acid rain which can harm sensitive ecosystems” (<https://www.epa.gov/so2-pollution/sulfur-dioxide-basics>)

Note: Ozone (O₃) is not a wood smoke pollutant but rather a pollutant that forms as a result of chemical reactions between wood smoke pollutants namely oxides of nitrogen (NO_x) and volatile organic compounds (VOC). “Ozone is a gas composed of three atoms of oxygen (O₃) ... created by chemical reactions between oxides of nitrogen (NO_x) and volatile organic compounds (VOC). Ozone in the air we breathe can harm our health. People most at risk from breathing air containing ozone include people with asthma, children, older adults, and people who are active outdoors, especially outdoor workers. In addition, people with certain genetic characteristics, and people with reduced intake of certain nutrients, such as vitamins C and E, are at greater risk from ozone exposure.

Breathing ozone can trigger a variety of health problems including chest pain, coughing, throat irritation, and airway inflammation. It also can reduce lung function and harm lung tissue. Ozone can worsen bronchitis, emphysema, and asthma, leading to increased medical care.

Ozone affects sensitive vegetation and ecosystems, including forests, parks, wildlife refuges and wilderness areas. In particular, ozone harms sensitive vegetation during the growing season” (<https://www.epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics#effects>).

What Other References Can I Find as to the AQI?

The following sites may be of interest as to the AQI:

<https://www.airnow.gov/>

<https://www.epa.gov/sites/production/files/2014-05/documents/zell-aqi.pdf>

https://www3.epa.gov/airnow/aqi_brochure_02_14.pdf

<https://aqicn.org/faq/>