Trouble In The Air

Millions of Americans breathed polluted air in 2020

Environment Iowa Reasearch & Policy Center

Iowa PIRG Education Fund

Frontier Group

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Errata: The original version of this report contained an error regarding EPA's characterization of the impacts of a "Moderate" level of air pollution. The error has been corrected in this version.

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Executive summary

Despite much progress in reducing levels of air pollution in the U.S., millions of Americans are exposed to unhealthy levels of pollution every year.[1] Ozone and small particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), among other pollutants, are widespread in the U.S. and have serious health effects.

Currently, the U.S. Environmental Protection Agency (EPA) considers safe and acceptable levels of air pollution that many American public health groups and international agencies consider unhealthy. This report examines EPA air quality data from 2020 and shows how often Americans living in large urban areas, small urban areas and rural counties were exposed to air pollution that could damage their health.[2]

Fossil fuel combustion is the primary human-caused source of air pollution – and the main driver of global warming, which threatens to make air quality even worse in the years to come.

Policymakers must move quickly to reduce air pollution, including by electrifying every sector of the economy and transitioning to clean, renewable sources of electricity.

TABLE ES-1. TEN MOST POPULOUS LOCATIONS THAT EXPERIENCED MORE THAN 100 DAYS OF ELEVATED OZONE AND/OR $PM_{2.5}$ IN 2020

Location	Number of days with ozone and/or $PM_{2.5}$ AQI over 50	Population
Los Angeles-Long Beach-Anaheim, CA	209	13,109,903
Phoenix-Mesa-Chandler, AZ	149	5,059,909
Riverside-San Bernardino-Ontario, CA	203	4,678,371
San Diego-Chula Vista-Carlsbad, CA	232	3,332,427
Denver-Aurora-Lakewood, CO	129	2,991,231
San Antonio-New Braunfels, TX	101	2,590,732
Sacramento-Roseville-Folsom, CA	122	2,374,749
Austin-Round Rock-Georgetown, TX	103	2,295,303
Cincinnati, OH-KY-IN	103	2,232,907
Indianapolis-Carmel-Anderson, IN	112	2,091,019

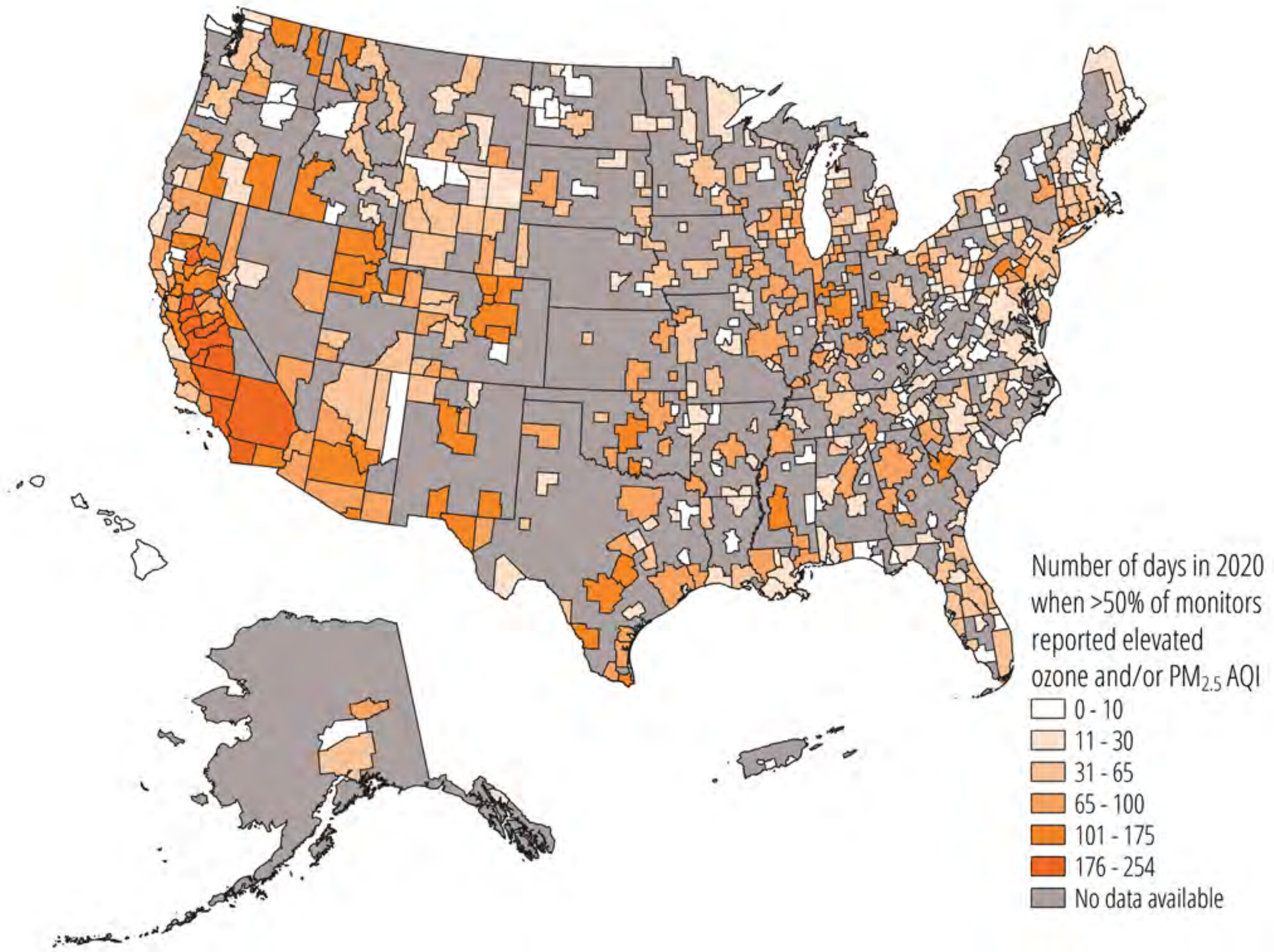


Figure ES-1. Both urban and rural areas experienced frequent elevated air pollution levels in 2020

Millions of Americans across the country experienced elevated levels of air pollution in 2020

- More than one in six Americans – 58.4 million – living in 53 large and small urban areas and rural counties experienced over 100 days of air pollution at levels above what the EPA considers "good" during 2020.[3]
- 179.2 million additional Americans – or more than half the country – living in 257 large and small urban areas and rural counties experienced between 31 and 100 days of elevated air pollution.[4]
- The 237.6 million people that experienced more than a month of elevated air pollution represents over 70% of the U.S. population.[5]

Ozone pollution

- 13.6 million Americans living in 11 large and small urban areas and rural counties experienced over 100 days of ozone pollution at levels above what the EPA considers "good" in 2020.
- An additional 57.3 million Americans living in 90 large and small urban areas and rural counties experienced between 31 and 100 days of elevated ozone pollution.

Particulate pollution

- 30.7 million Americans living in 26 large and small urban areas and rural counties experienced over 100 days of particulate pollution at levels above what the EPA considers "good."
- An additional 175.4 million Americans living in 194 large and small urban areas and rural counties experienced between 31 and 100 days of elevated particulate pollution.

TABLE ES-2. TEN MOST POPULOUS LOCATIONS THAT EXPERIENCED MORE THAN 100 DAYS OF ELEVATED OZONE IN 2020

Location	Number of days with ozone AQI over 50	Population
Phoenix-Mesa-Chandler, AZ	103	5,059,909
Riverside-San Bernardino-Ontario, CA	162	4,678,371
Fresno, CA	110	1,000,918
Bakersfield, CA	142	901,362
Colorado Springs, CO	104	753,839
Visalia, CA	158	468,680
Boulder, CO	106	327,171
Madera, CA	132	157,761
Hanford-Corcoran, CA	125	152,692
Carlsbad-Artesia, NM	110	58,418

TABLE ES-3. TEN MOST POPULOUS LOCATIONS THAT EXPERIENCED MORE THAN 100 DAYS OF ELEVATED $PM_{2.5}$ IN 2020

Location	Number of days with $PM_{2.5}$ AQI over 50	Population
Los Angeles-Long Beach-Anaheim, CA	178	13,109,903
Riverside-San Bernardino-Ontario, CA	118	4,678,371
San Diego-Chula Vista-Carlsbad, CA	225	3,332,427
Indianapolis-Carmel-Anderson, IN	101	2,091,019
Fresno, CA	171	1,000,918
Bakersfield, CA	119	901,362
Dayton-Kettering, OH	102	809,248
Stockton, CA	153	767,967
Jackson, MS	116	589,082
Spokane-Spokane Valley, WA	102	574,585

Air pollution harms our health, even at low levels.

- Exposure to ozone and particulate pollution has been linked to premature death; damage to the respiratory and cardiovascular systems; worsened mental health and neural functioning; problems with fertility, conception, pregnancy and birth; increased risk of many types of cancer; and harm to children. (See section "Air pollution threatens public health.")
- Air pollution, including ozone and particulate pollution, can weaken the immune system and help airborne pathogens spread. Air pollution has been linked to increased risk of infection from, and worse health outcomes due to, many infectious diseases, including influenza, pneumonia, the common cold, HIV-AIDS, Ebola and COVID-19. (See section "Air pollution threatens public health.")
- Levels of air pollution that meet current federal air quality standards can be harmful, especially with prolonged exposure. The World Health Organization, the American Thoracic Society, the American Lung Association and other groups recommend lower thresholds for what are considered acceptable pollution levels than those set by the U.S. Environmental Protection Agency. In fact, according to a 2021 literature review by an Australian government-funded air pollution research organization, "… current evidence suggests there is no 'safe' level of air pollution," including both $PM_{2.5}$ and ozone.[6] (See section "Air pollution is harmful at levels the EPA considers safe.")

Global warming and air pollution are intimately connected.

- Extracting, transporting and burning fossil fuels produces not just the greenhouse gases that drive global warming, but also many of the air pollutants that damage our health.
- Air pollutants that damage our health can also worsen global warming, and the increasing temperatures and changing weather patterns associated with global warming are likely to make air pollution, and its health effects, worse.
    - Higher temperatures have resulted in increased ozone levels in multiple years in the last decade.
    - Changes in weather patterns due to the changing climate are likely to increase concentrations of air pollution and to trap that air pollution near the ground, increasing exposure to unhealthy levels of pollution.
- Global warming will likely continue to increase the frequency of wildfires and droughts in the U.S. and make wildfires more severe while extending the fire season. That means more smoke and dust polluting the air. Global warming will also increase the rate at which the earth and plants emit pollutants naturally, which could make air pollution even worse. (See section "Global warming will make air pollution worse.")

To protect Americans against health-threatening air pollution, policy makers need to take swift action to curb emissions, including:

- Electrifying buildings and equipment that currently burn fossil fuels directly. This includes switching fossil fuel-powered building systems and industry to electric alternatives and reducing emissions from transportation by accelerating the switch to electric cars and trucks.
- Further transforming the way we move by improving access to and the quality of public transportation systems and infrastructure for walking, biking and other non-driving forms of transportation.
- Increasing the use of renewable energy like wind, solar and geothermal and incentivizing improved energy efficiency.
- Protecting and building upon the Clean Air Act by strengthening air quality standards to levels fully protective of public health and by ensuring strong and consistent enforcement.

Introduction

The year 2020 shut the world down. As COVID-19 spread, cars, trucks, planes, trains and ships stopped moving. People across the U.S. isolated and distanced themselves from one another, and many noticed that their skies were clearer.[7]

Just a few months later, however, the skies over much of America were as polluted as ever as the nation endured one of the worst fire seasons on record. Millions of acres of land were burned and lives from California to Washington to Colorado were upended.[8] The skies in the American West turned red and orange, a horrifying reflection of the conflagrations. The effects of the fires didn't stay contained to the West Coast and the Rockies, however: Americans across the country noticed their summer skies darkened and smelled the smoke from far-off wildfires.[9]

There are many lessons that can be learned from 2020, including about air pollution. We had the lesson burned into us that the greenhouse gases we produce today will have repercussions for the air our children and grandchildren breathe – just as the carbon pollution pumped into the atmosphere over the last century helped fuel 2020's devastating wildfires. But we also learned the hopeful lesson that if we reduce pollution today, we can enjoy noticeably cleaner skies almost overnight.[10]

These lessons share the same takeaway: Cutting air pollution now – including by transitioning away from burning fossil fuels in our homes, businesses and vehicles – can help us and future generations enjoy healthier lives.

America has the tools and the technology to make our air cleaner and reduce our global warming emissions. It's time to put them into practice.

Air pollution threatens public health

Americans breathe air polluted with a variety of contaminants, including particulate matter (PM), ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, volatile organic compounds (VOCs), and many other toxic or hazardous substances. This pollution, which comes from burning fossil fuels, agricultural activity, wildfires, and other sources, creates significant risks to public health. Each year, millions of Americans suffer from adverse health impacts linked to air pollution, and tens of thousands have their lives cut short.

Two pollutants of special concern are **particulate matter** and **ozone**. Fine particulate pollution smaller than 2.5 micrometers ($PM_{2.5}$) poses especially high health risks because it can be deposited deep in the lungs.[11] Ozone that forms near the ground is the main ingredient in smog and can damage human health in a variety of ways.

Air pollution – including, but not limited to, $PM_{2.5}$ and ozone pollution – damages many aspects of health and wellbeing, from lung function to mental health.

Premature death. Air pollution is the "greatest environmental health risk factor in the United States," according to a recent study published in *Environmental Science & Technology Letters*, and is associated with 100,000-200,000 excess deaths each year.[12] Globally, particulate matter and ozone pollution are responsible for millions of deaths each year. A recent study in the journal *Environmental Research* modeled premature deaths due to $PM_{2.5}$ from fossil fuel combustion and found that such pollution was responsible for as many as 10.2 million excess deaths worldwide in 2012, and as many as 8.7 million in 2018.[13] A separate study in *Environmental Health Perspectives* estimated the global premature death toll of long-term ozone exposure to be as high as 1.23 million in 2010 just among adults over 30 years old.[14]

Small changes in pollution levels affect death rates. A 2019 study published in the *New England Journal of Medicine* found that when the concentration of fine particulate matter ($PM_{2.5}$) increased by 10 micrograms per cubic meter ($\mu g/m^3$), daily mortality in the U.S. increased by 1.58%, the equivalent of an additional 122 deaths every day.[15] In addition, studies on pollution reduction in the United States showed that every 10 $\mu g/m^3$ improvement in a city's annual average air quality reduced relative risk of death by 27%, and that mortality benefits of air pollution reduction extend down to extremely low concentrations of pollutants, indicating that any amount of air pollution can cause damage.[16] Similarly, a study of the health effects of air pollution found that in the U.S., "exposure to $PM_{2.5}$ increased all-cause mortality rates at concentrations below the present national limits."[17]

Damage to respiratory and cardiovascular systems. In weeks with elevated ozone or particulate matter pollution, hospital emergency rooms see more patients for breathing problems.[18] A 2019 study published in *JAMA: The Journal of the American Medical Association* found that higher levels of pollutants including ozone and particulate matter in the air are associated with increased risk of emphysema.[19] Air pollution, especially traffic-related air pollution, not only worsens asthma but may also cause more people to actually become asthmatic.[20] Air pollution can cause chronic obstructive pulmonary disease (COPD) and increase the likelihood of dying from COPD, as well as increase the risk of chronic bronchitis.[21]

Research also shows strong associations between air pollution and cardiovascular diseases. Air pollution may cause arteries to calcify, may reduce levels of "good cholesterol," may increase the risk of hypertensive disorders in pregnant women, and may increase risk of stroke.[22] Particulate pollution in particular is associated with increased risk of ischemic heart disease mortality, cerebrovascular mortality, stroke and myocardial infarction.[23]

Worsened mental health and neural functioning. Recent studies have found that air pollution can affect mental health and cognition in many ways and at all ages. Two 2019 studies published in *PLOS Biology* found that poor air quality, including higher levels of particulate matter and ozone, was associated with increased risk of bipolar disorder.[24] Long-term exposure to particulate pollution has also been associated with increased risk of Alzheimer's disease and other forms of dementia.[25] Air pollution has been linked to accelerated cognitive decline in older adults; to worse performance on tests of memory, cognition and IQ in young children; to increased risk for attention disorders, anxiety and depression in children; to lower academic performance in students; and to brain inflammation and tissue damage in children.[26] Recent studies show an association between air pollution and feelings of nervousness, powerlessness and restlessness, as well as common mental disorders, physical symptoms of mental distress, and even psychotic experiences.[27] And more and more evidence indicates that air pollution can increase the risk of depression and rates of outpatient psychiatric hospitalizations.[28]

Decreased fertility and harm to pregnancies. Exposure to air pollution has been associated with decreased male and female fertility, lower rates of conception and worse pregnancy outcomes. A 2018 literature review found that higher levels of air pollution, particularly particulate matter, are associated with lower female fertility.[29] And in 2020, a meta-analysis revealed that air pollution significantly impacted male fertility in a variety of ways.[30] A separate meta-analysis, published in *Environmental Health*, found that increased air pollution levels, particularly levels of particulate pollution, are associated with lower rates of pregnancy, both clinically aided and not.[31]

Beyond effects on fertility, air pollution can also affect pregnancies and births. Maternal exposure to either $PM_{2.5}$ or ozone is associated with pre-term birth and low birth weight – which can increase the risk of death or adverse health outcomes – as well as stillbirth, especially among vulnerable populations.[32] $PM_{2.5}$, including at levels far lower than the EPA standard, was estimated by one study estimated to be responsible for up to 42,800 preterm births in the U.S. and Canada in 2010, or 10% of all preterm births in those countries in that year.[33] Particulate matter exposure has also been associated with reduced female fertility, reduced pregnancy rates and higher rates of miscarriage.[34]

Increased cancer risk. Exposure to air pollution can cause lung cancer and other cancers.[35] The International Agency for Research on Cancer (IARC), part of the World Health Organization, has found that outdoor air pollution generally, and particulate matter specifically, are carcinogenic to humans.[36] The IARC determined that "exposures to outdoor air pollution or particulate matter in polluted outdoor air are associated with increases in genetic damage that have been shown to be predictive of cancer in humans." In 2010, 223,000 lung cancer deaths globally were attributed to exposure to $PM_{2.5}$.[37]

A meta-analysis of studies of lung cancer and air pollution found that an increase in annual average $PM_{2.5}$ concentration of 10 $\mu g/m^3$ can increase the risk of lung cancer incidence and mortality by as much as 14%.[38] Some studies have also shown that exposure to air pollution can reduce the likelihood of surviving lung cancer.[39] Additionally, there is mounting evidence that air pollution – including that from fuel combustion indoors, traffic, and general outdoor air pollution – can increase the risk of oral, cervical, esophageal and bladder cancer, and may also be linked to brain, meningeal, kidney, liver, and colorectal cancer incidence and mortality.[40] There is even suggestion that traffic-related air pollution may be connected to childhood leukemia and to adult breast cancer.[41] A different meta-analysis suggests that an increase of 10 $\mu g/m^3$ of $PM_{2.5}$ may increase risk of cancer mortality by almost 20%.[42]

Children at risk

Children are particularly vulnerable to air pollution because their bodies are developing, and also because they tend to spend more time outside.[43] Children are also exposed to higher levels of air pollution because they walk or are pushed in strollers closer to the height of vehicle exhaust pipes.[44] In addition to the health effects detailed elsewhere, children are particularly vulnerable to impaired lung development and impaired long-term lung functioning from particulate pollution.[45] Even prenatal exposure to air pollution can impair lung function and lung development in childhood.[46]

Increase risk of infectious diseases. By weakening immune systems and helping pathogens spread, air pollution can increase the risk of contracting infectious diseases and the risk of dying from them.[47] Common air pollutants, including $PM_{2.5}$ and ozone, have been associated with an increased risk of infection from, and of worse outcomes due to: influenza and influenza-like illnesses, diseases caused by the respiratory syncytial virus, pneumonia, diseases caused by rhinovirus, and other severe acute respiratory infections.[48] Additional evidence suggests that exposure to air pollutants weakens the immune system, which can increase the risk of infection by viruses such as HIV, Nipah, Ebola, severe acute respiratory syndrome coronaviruses (SARS-CoV), and metapneumoviruses.[49] In particular, many recent studies have shown that increased levels of air pollution, including particulate matter and ozone, increase the risk of infection by SARS-CoV-2, the virus that causes COVID-19, and increase the likelihood of death after infection.[50] A study published in August 2021 in *Scientific Advances* found that the particulate pollution in the western U.S. that resulted from wildfires significantly increased the COVID-19 infection rate and the rate of severe disease and death due to COVID-19.[51]

Air pollution is harmful even at levels the EPA considers safe

In order to communicate the potential health risks of air pollution to the public, the EPA uses the Air Quality Index (AQI), which classifies levels of different pollutants into the color-coded risk categories of "Good," "Moderate," "Unhealthy for Sensitive Groups," "Unhealthy," "Very Unhealthy," and "Hazardous." (See Table 1 for details and colors.)

Air quality classified as "Good," for example, poses "little or no risk" according to the EPA.[53] "Moderate" pollution is described by the EPA as "acceptable," though the agency notes "there may be a risk for some people, particularly those who are unusually sensitive to air pollution."[54] Higher levels of pollution threaten much more of the population and can damage health after much shorter exposure times.

The AQI is linked to the National Ambient Air Quality Standards (NAAQS), which are periodically reviewed and adjusted based on the latest research on the links between pollution and public health. For example, currently the EPA has concluded that ozone levels above 70 parts per billion (ppb) for eight hours or more are unhealthy for sensitive people, and when ozone exceeds that level, the EPA warns that children, older adults, people with lung disease, people who are active outdoors, people with certain genetic variants and people who lack certain nutrients in their diets should consider limiting their exposure.[55] The EPA has concluded that sensitive people are at risk when levels of $PM_{2.5}$ average 35.5 micrograms per cubic meter of air ($\mu g/m^3$) over 24 hours.[56]

However, research suggests that even "moderate" air quality can, in fact, pose broad threats to public health, and a variety of medical and public health organizations have recommended tighter air quality standards that are more protective of public health.

The World Health Organization (WHO), for example, recommends lower ozone and particulate pollution standards than are currently in place in the United States. The WHO published air quality guidelines in 2006 that recommended an ozone pollution standard equal to

TABLE 1. U.S. EPA AIR QUALITY INDEX VALUES AND COLORS[52]

Air quality category	Air quality index values	Color	Ozone readings (ppb)	24-Hour $pm_{2.5}$ Readings (μg/m³)
Good	0-50	Green	0-54	0-12
Moderate	51-100	Yellow	55-70	12.1-35.4
Unhealthy for Sensitive Groups	101-150	Orange	71-85	35.5-55.4
Unhealthy	151-200	Red	86-105	55.5-150.4
Very Unhealthy	201-300	Purple	106-200	150.5-250.4
Hazardous	301-500	Maroon	201+	250.5+

51 ppb over eight hours.[57] By comparison, 15 years later, the current U.S. ozone standard is 70 ppb.[58] The WHO recommends that fine particulates be limited to 15 μg/m³ over 24 hours, which is more protective than the current U.S. standard of 35 μg/m³, though they have also noted that "there is little evidence to suggest a threshold below which no adverse health effects would be anticipated."[59] The American Thoracic Society, the American Lung Association and other health and advocacy groups support lowering the EPA standards to be more in line with the WHO recommendations, and some groups have petitioned to have the EPA standards reconsidered.[60] The EPA is currently revisiting the particulate standards because "available scientific evidence and technical information suggests that the current standards may not be adequate to protect public health and welfare."[61]

A particulate monitor in Brockton, Massachusetts. Credit: Massachusetts Department of Environmental Protection via Flickr, CC BY 2.0.

A growing body of evidence supports the conclusion that even very low levels of pollution can affect health. In fact, there may not be a minimum threshold at which air pollution should be considered safe.

- In response to new data about deaths linked to particulate pollution, a 2019 editorial in the *New England Journal of Medicine* noted that "Even high-income countries, such as the United States, with relatively good air quality could still see public health benefits from further reduction of ambient PM concentrations (i.e., below the current [pollution standards])."[62]
- In a 2017 study, researchers examined more than 22 million deaths in the Medicare population from 2000 to 2012 and found that a 10 ppb rise in warm-season ozone pollution increased the daily mortality rate by 0.5%, regardless of how low pollution levels had been initially.[63] The authors concluded that there is "no evidence of a threshold" below which ozone or particulate pollution is safe.
- Even when concentrations of ozone are at levels the EPA considers "good" or "moderate," a 2006 study found that an increase in ozone pollution results in more premature deaths.[64]
- In 2006, the WHO concluded that there is no documented safe level of exposure to particulate pollution.[65]
- A 2019 analysis of the effect of particulate pollution on all-cause mortality in 652 cities around the world concluded that there is no threshold below which particulate pollution is safe.[66]
- A 2021 literature review by an Australian air quality research organization to provide air pollution standards recommendations to the Australian government found that "...current evidence suggests there is no 'safe' level of air pollution," including both $PM_{2.5}$ and ozone.[67]

These results indicate that the current EPA standards may be insufficiently protective of health. The many serious health impacts of ozone and particulate pollution exposure detailed in the previous section, and the growing evidence that there *are* no safe levels of pollution, mean that federal and state leaders need to do more to improve air quality.

Fossil fuel combustion is a major source of air pollution

Air pollution comes from both human and natural sources. Gasoline, diesel, methane gas, coal and other fossil fuels burned for transportation, electricity generation, industrial processes, heating and other purposes are major sources of the nitrogen oxide (NO_x) and volatile organic compound (VOC) emissions that contribute to the formation of ground-level ozone and also can turn into particulate pollution. Fossil fuel combustion, fires and dust are major direct sources of particulate pollution and some of those sources also produce precursor chemicals that combine into particulates.

Ozone

Ozone, the main component of smog, is formed by chemical reactions between NO_x and VOCs in the presence of sunlight, and its formation is accelerated by higher temperatures.[68] The production and consumption of fossil fuels are major sources of NO_x and VOC emissions. Burning fossil fuels for transportation is responsible for the majority of NO_x emissions in the United States. (See Figure 1.)

- Transportation, which includes on-road vehicles, ships, trains, farm and construction equipment, and other vehicles, accounted for 59% of U.S. NOx emissions in 2017.[70] Cars, SUVs and other light-duty vehicles were responsible for 18% of total NOx emissions from human activities, while on-road diesel vehicles were responsible for 13%.
- In 2017, electricity generation by utilities at coal-fired power plants produced 9% of total human-related NOx emissions. Overall, electricity generation by utilities accounted for 11% of emissions.
- Industrial activities accounted for 14% of NO_x emissions from human activities.

Wildfires and transportation were the two biggest sources of VOC emissions in the United States in 2017 (excluding VOCs released by plants). (See Figure 2.)

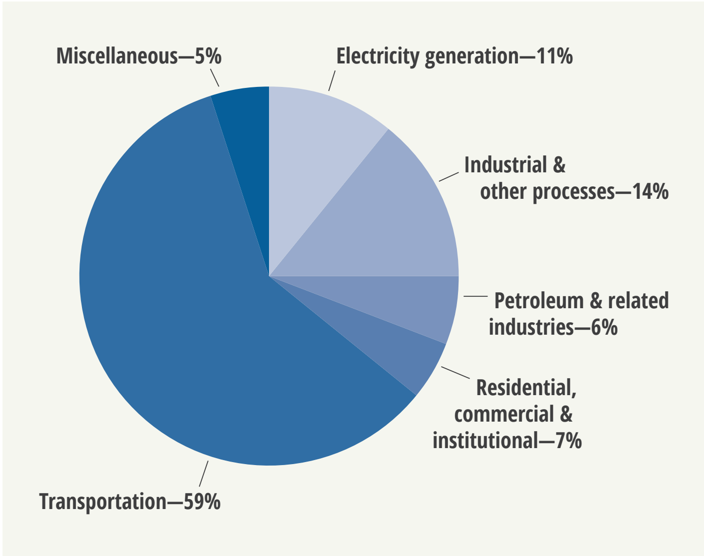


Figure 1. Anthropogenic sources of nitrogen oxide (NO_x) pollution in 2017, United States (rounded)[69]

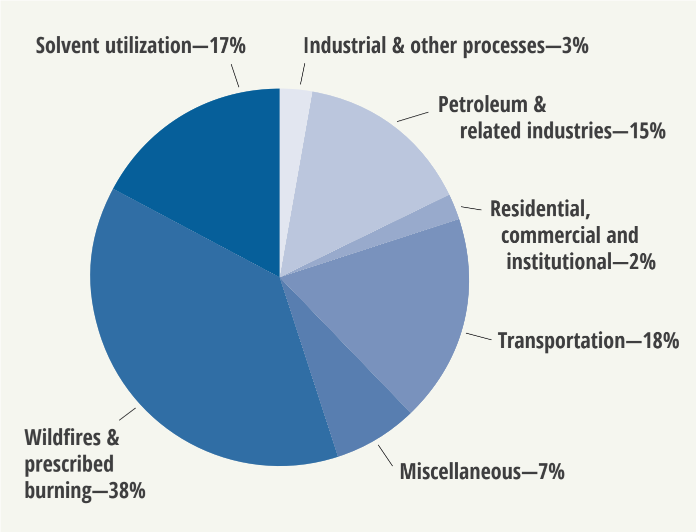


Figure 2. Anthropogenic sources of volatile organic compound (VOCs) pollution in 2017, United States[71]

- Wildfires and planned burns produced more than one-third of VOCs from human activities and fires in 2017.[72]
- Transportation was responsible for 18% of anthropogenic VOC emissions.
- Oil and gas production accounted for 15% of anthropogenic VOC emissions. In areas with oil and gas production, these emissions can have a significant influence on air quality. For example, along Colorado's Front Range, emissions from oil and gas operations account for 30%-40% of locally produced ozone.[73]
- Solvents such as those used in consumer products, pesticides, graphic arts, architectural applications and other activities created 17% of anthropogenic VOCs.
- Trees and other plants are also a major source of VOCs, which they naturally emit for a variety of reasons including as defense mechanisms, to attract pollinators and to communicate with other plants.[74] VOC emissions from plants can contribute to ground-level ozone when they react with pollution from human sources.[75] Additionally, VOC emissions from plants are likely to increase as global warming drives temperatures up.[76]

Particulate matter

Particulate matter consists of solid or liquid particles that can be emitted directly from a source (such as from a diesel engine) or that can form in the air from chemicals such as VOCs, sulfur dioxide, ammonia and NO_x.[77] Because of its size, $PM_{2.5}$ poses elevated health risks as it can be absorbed deep into the lungs.[78] The impact of $PM_{2.5}$ is further increased by the fact that it is so lightweight that it remains in the air for a long time and can travel hundreds of miles from its source.[79]

Primary particulate matter is created by a variety of sources, including fossil fuel combustion; dust from roads, agriculture and construction; wildfires; and wood burned for heating.[80] On average across the U.S., the majority of the particulate pollution in the atmosphere is secondary particulate pollution, which forms through chemical reactions of other pollutants in the air.[81] Secondary $PM_{2.5}$ can be created from sources including sulfur dioxide emitted by burning coal and other fossil fuels for electricity generation and industrial power; nitrogen oxides from fossil fuel combustion; and ammonia from fertilizer and manure.[82]

Mobile sources (including cars, trucks and other on-road and off-road vehicles) accounted for 20% of both primary and secondary $PM_{2.5}$ in one 2004 study.[83] Mobile sources may have disproportionately larger impacts on health compared to other sources, however, because mobile sources generally emit pollution in closer proximity to people. A 2019 study estimated that transportation emissions were associated with more than a quarter of U.S. deaths caused by fine particulate matter created by human activity.[84]

In addition to combustion emissions, cars, trucks and other on- and off-road vehicles play a role in producing other forms of particulate pollution. In 2017, dust from paved and unpaved roads accounted for 14% of primary fine particulate emissions.[85] Vehicle braking also produces particulate pollution potentially containing heavy metals such as zinc and copper that may create health risks.[86]

Electricity generation is another contributor to $PM_{2.5}$ pollution.[87] Power plants produce large amounts of sulfur dioxide, which can turn into $PM_{2.5}$. According to a 2019 study, sulfur dioxide from coal-fired power plants accounts for 11% of the total health damage from $PM_{2.5}$.[88]

Agriculture is another major source of particulate pollution. Dust from crop and livestock operations accounted for 14% of primary $PM_{2.5}$.[89] Agriculture is also responsible for 80% of national emissions of ammonia, which can react in the atmosphere to form secondary particulate matter.[90] Agricultural ammonia emissions, which come from sources including animal waste and fertilizer, are responsible for a significant percentage of human mortality attributed to $PM_{2.5}$.[91]

Air toxics

Fossil fuel combustion also releases toxic air contaminants such as benzene, formaldehyde and 1,3-butadiene that contribute to ozone and particulate pollution, and that are also hazardous on their own.[92] These pollutants can cause cancer, and some, such as formaldehyde, increase the risk of asthma.[93] Exposure to air toxics creates additional health threats above and beyond the threats highlighted in this report related to particulate matter and ozone.

Global warming will make air pollution worse

Pollution from cars, trucks, power plants, factories and fossil fuel infrastructure is the biggest immediate threat to air quality. But changes resulting from global warming threaten to make air quality even worse. Not only do some of the pollutants that damage our health also contribute to climate change, but the predicted changes in climate and the frequency and severity of natural disasters resulting from global warming are likely to fill the air we breathe with more pollutants. According to the U.S. Global Change Research Program's Fourth National Climate Assessment, "climate change will worsen existing air pollution levels" without additional efforts to improve air quality. The report continues, "[t]his worsened air pollution would increase the incidence of adverse respiratory and cardiovascular health effects, including premature death."[94]

The vicious cycle of air pollution and global warming is already impacting our daily lives.

- Higher temperatures have already resulted in increased ozone, despite lower emissions of the chemicals that create ozone. In the central U.S. in the summer of 2012, for example, higher temperatures caused higher levels of ozone than in the years before and after.[95] Yearly fluctuations in temperature occur naturally, but global warming drives up average temperature and the likelihood of extreme heat events. Recent years continue to be among the hottest in recorded history, and the American Lung Association warns that increasing temperatures – driven by global warming – will make ozone formation more likely and will make ozone removal more difficult.[96]
- Hotter, drier conditions increase the frequency and severity of wildfires, which create particulate pollution and the precursors to ozone and can spike air pollution to very dangerous levels.[97] By one estimate, global warming nearly doubled the total acreage that burned in western states from 1984 to 2015, compared to a scenario in which the climate had not changed.[98] (See Figure 3.) By 2018, summer wildfires in California burned areas eight times larger each year than they did in 1972.[99] In addition to creating the conditions for much larger fires, climate change has also extended the fire season in the western U.S. by at least 84 days, stretching out the period during which Americans may be exposed to the air pollution they create.[100] Wildfires also burn for longer, causing more prolonged and widespread exposure to pollutants. The typical large wildfire now burns for more than seven weeks, compared to less than a week in the 1970s.[101]

In the years to come, climate change will make air pollution even worse. In particular, the changing climate is likely to expose more people to ozone pollution more frequently, and to make the consequences of that exposure worse:

- Rising temperatures will result in more ozone formation.[103] According to an analysis by researchers at Harvard and the National Center for Atmospheric

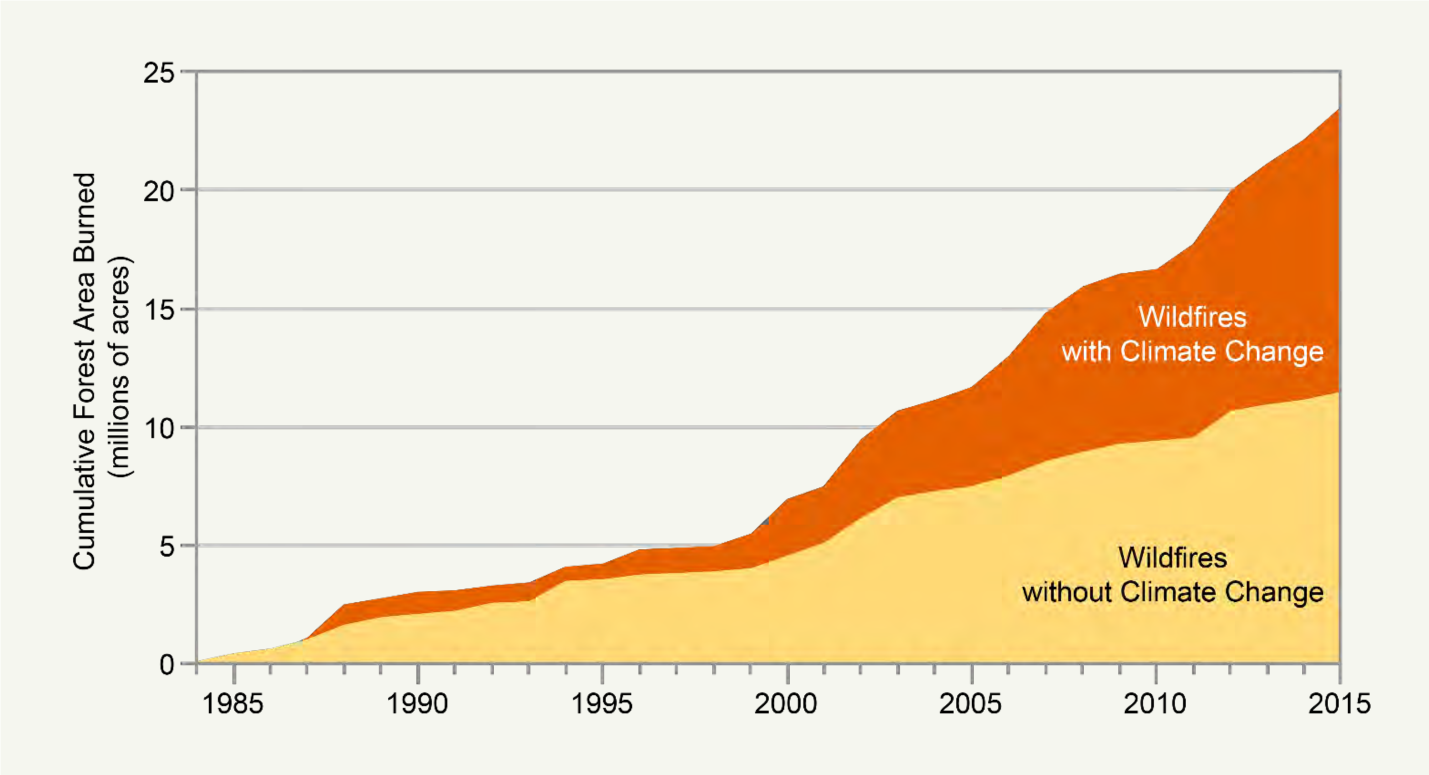


Figure 3. Climate change has increased the area burned in wildfires[102]

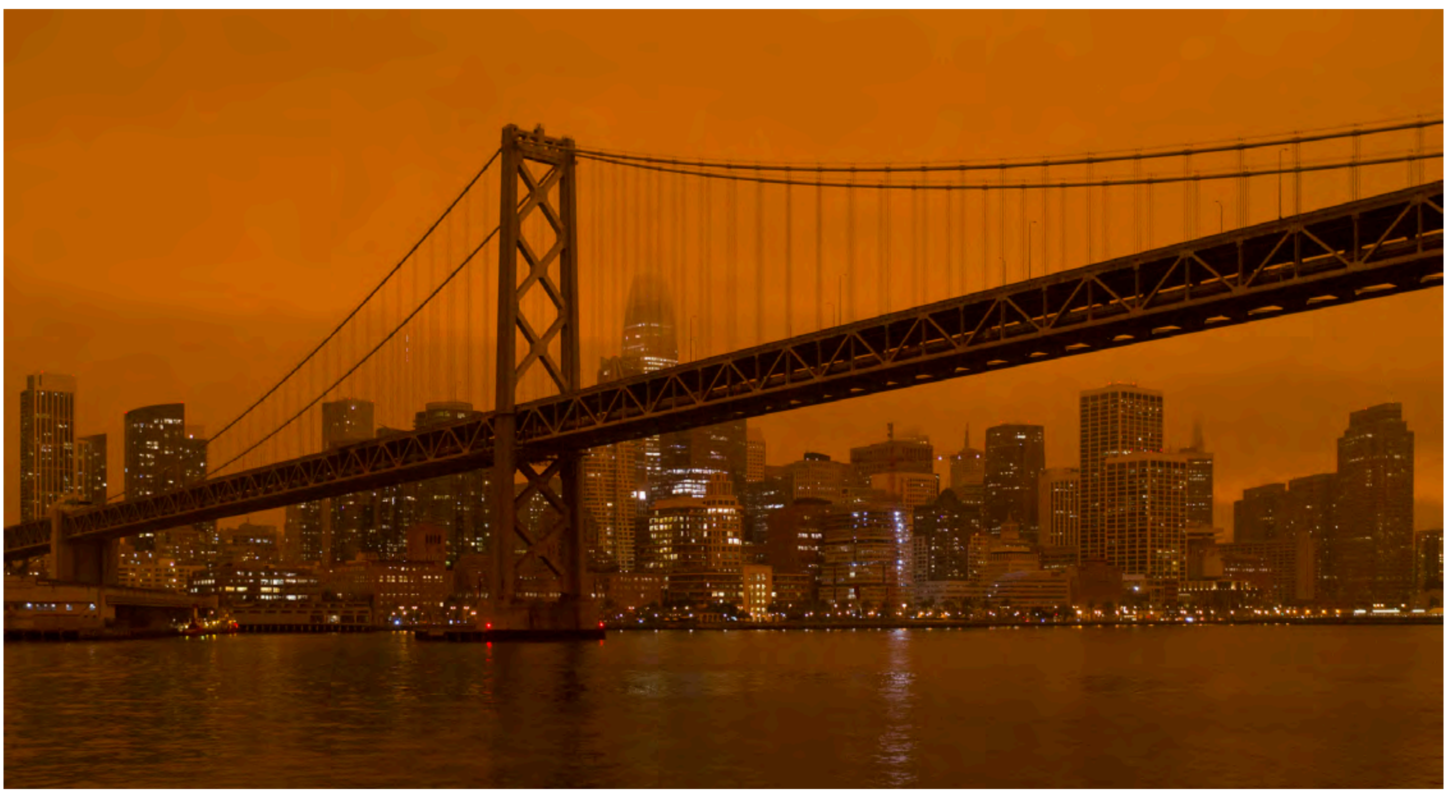
Research, people in the Northeast, Midwest and Southwest will experience an additional three to nine days of ozone pollution of above 75 parts per billion (ppb) annually by 2050 compared to 2000 because of higher temperatures predicted as a result of global warming.[104] Ozone concentrations at that level are in the range the EPA considers "unhealthy for sensitive groups."[105]

- With higher temperatures throughout the year, unhealthy levels of ozone may become more common in the spring and fall, in addition to the summer ozone problems that are common today.[106]
- Climate change is likely to increase the frequency and severity of events like wildfires that create ozone precursors and create conditions – including increased temperature – that increase the rate of ozone formation. It could also influence weather patterns that affect how ozone is transported.[107]
- The U.S. Global Change Research Program has concluded that global warming will make it more difficult to control ozone pollution, and that maintaining current pollution levels in a warmer world will require reduced emissions of the chemicals that form ozone.[108]
- Higher temperatures may also exacerbate the health effects of exposure to any given amount of ozone, as higher temperatures are associated with an increased risk of ozone-related premature death.[109]

The effects of climate change on air pollution are not limited to ozone. A study in the journal *Air Quality, Atmosphere & Health* found that global warming will likely increase $PM_{2.5}$ pollution levels, from both anthropogenic sources and natural ones, and that global warming-induced $PM_{2.5}$ pollution increases could cause almost 200,000 more premature deaths globally each year.[110] The increase in $PM_{2.5}$ pollution could come partly from increased emission of aerosols from plants, which emit more precursors to ozone and particulates with higher temperatures.[111] It could also come partly from faster reactions of particulate precursors in the atmosphere such that those precursors become particulate pollution more quickly.[112] A third possible cause for the increase in particulate pollution is an increase in the frequency and severity of droughts, which means less of the precipitation that removes particulates from the atmosphere.[113]

Additionally, global warming is likely to change wind, precipitation and fire patterns in ways that could increase exposure to air pollution:

- Climate-driven changes may increase the number of days with stagnant air, trapping and concentrating pollution near the ground. Decreased air circulation may already be worsening air quality by trapping pollution precursors and pollution near the ground.[114] Multiple days of stagnant air can lead to especially high levels of air pollution, including both ozone and $PM_{2.5}$, which can have severe health consequences.[115]
- Climate change will increase the frequency and severity of wildfires, as a result of hotter temperatures and more droughts.[116] According to the *Fourth National Climate Assessment,* resulting wildfires will "diminish air quality, increase incidences of respiratory illness from exposure to wildfire smoke, impair visibility, and disrupt outdoor recreational activities."[117] A review of the impacts of wildfires in the U.S. notes that wildfires can cause "extreme" concentrations of ozone and $PM_{2.5}$, and that wildfires alone may be responsible for the slowing or even reversal of pollution reduction trends in some parts of the country.[118]
- Global warming is projected to cause severe droughts in the southwestern U.S., increasing dust pollution. A 2019 study found that droughts could increase dust levels in the region, increasing deaths and hospitalizations attributable to fine dust by 230% and 360%, respectively.[119] Reduced rainfall caused by global warming may also increase air pollution levels because rainfall removes particulate matter from the atmosphere.[120]
- Higher temperatures change the metabolism of plants, which can increase evaporative emissions of volatile organic compounds, precursors to ozone and particulate matter.[121]



Smoke and ash blanket San Francisco in September 2020. Credit: Christopher Michel via Flickr, CC BY 2.0.

Increased ozone pollution is also likely to accelerate climate change. For instance, the Environmental Protection Agency (EPA) has found that there is strong evidence to suggest that surface level ozone damages plant life in many ways, and that among its effects is decreasing the amount of carbon that plants sequester.[122] The EPA also notes that tropospheric ozone (including the surface ozone that affects health) is a driver of global warming.[123] This is distinct from stratospheric ozone in the upper atmosphere, which protects us from ultraviolet radiation.[124]

The impact of $PM_{2.5}$ pollution on global warming is less clear. Some forms of $PM_{2.5}$, such as black carbon, absorb sunlight, which has a small warming effect.[125] Other forms of $PM_{2.5}$ can actually cool the atmosphere, such as aerosols in the upper atmosphere that reflect incoming sunlight.[126] According to the Intergovernmental Panel on Climate Change, the net effect of particulates given potential future scenarios is very likely to cause increased warming over the next few decades.[127] Additionally, future changes in particulate pollution and other short-lived climate forcers like ozone and methane are likely to continue to cause some warming, with the magnitude of that effect heavily influenced by the strength of our climate and pollution mitigation efforts.[128] This is partly because fire smoke is likely to become a larger portion of the $PM_{2.5}$ pollution concentration, and the forms of particulate matter in smoke drive warming in addition to causing health damage.[129]

In many cases, the activities that cause air pollution also contribute to global warming. Efforts to reduce our reliance on fossil fuels, which contribute to global warming, have the potential to help reduce ozone and particulate pollution as well.

Air pollution was widespread in the United States in 2020

About this analysis

Hundreds of air quality monitors in both urban and rural areas across the nation report air pollution levels hourly. Based on this information and computer modeling, the U.S. Environmental Protection Agency (EPA) communicates present and forecasted air quality conditions using its Air Quality Index (AQI).

This report estimates the number of days of elevated air quality experienced in 2020 by people across the country based on the number of days when air quality monitors reported an AQI of 51 or higher. This includes days that the EPA coded air quality as "moderate," "unhealthy for sensitive groups," "unhealthy," "very unhealthy," or "hazardous." Air pollution data were grouped locally, by metropolitan and micropolitan areas and rural counties. In areas that contain more than one monitoring location, days in which half or more of the monitoring locations in the area reported an air quality problem were included in the tally of days with degraded air quality.

Grouping air quality data across large geographies can mask local variations in air quality conditions with implications for public health. Because air quality varies over short distances based on weather conditions and sources of pollution, among other factors, the air people actually breathe could be of a different quality than the aggregate data for the area suggests. The EPA's AirNow website can be used to find the locations of monitors and to locate the closest monitor to you.[130] In addition, gaps in monitoring could result in air quality data failing to reflect actual conditions on the ground.

This report presents the number of days with elevated ground-level ozone pollution and with elevated particulate pollution, which pose different types of threats to health. It also presents the number of days in each area when ozone and/or particulate pollution were elevated, a measure of how often residents have to breathe polluted air. Air quality monitors report pollution levels at different time intervals, and not all of them report year-round. This analysis therefore likely presents an undercount of the number of days of elevated pollution experienced around the country.

Exposure to either ozone or particulate matter

Both ozone and particulate pollution are dangerous for human health. In 2020, more than 58.4 million people living in 53 large and small urban areas and rural counties experienced more than 100 days of either elevated ozone pollution, elevated $PM_{2.5}$ pollution or both. (See Table 2.) These Americans live all over the country, from Georgia to Ohio, and Pennsylvania to Texas and Washington.

Less frequent bad air conditions are even more widespread. In 2020, more than 179.2 million people – more than half the country's residents – living in 257 large and small urban areas and rural counties experienced between 31 and 100 days of elevated ozone and/or $PM_{2.5}$ pollution. (See Table 3.)

Overall, 237.6 million people experienced more than a month of elevated air pollution in 2020, representing over 70% of the U.S. population.[131]

TABLE 2. TEN MOST POPULOUS LOCATIONS THAT EXPERIENCED MORE THAN 100 DAYS OF ELEVATED OZONE AND/OR $PM_{2.5}$ IN 2020

Location	Number of days with ozone and/or $PM_{2.5}$ AQI over 50	Population
Los Angeles-Long Beach-Anaheim, CA	209	13,109,903
Phoenix-Mesa-Chandler, AZ	149	5,059,909
Riverside-San Bernardino-Ontario, CA	203	4,678,371
San Diego-Chula Vista-Carlsbad, CA	232	3,332,427
Denver-Aurora-Lakewood, CO	129	2,991,231
San Antonio-New Braunfels, TX	101	2,590,732
Sacramento-Roseville-Folsom, CA	122	2,374,749
Austin-Round Rock-Georgetown, TX	103	2,295,303
Cincinnati, OH-KY-IN	103	2,232,907
Indianapolis-Carmel-Anderson, IN	112	2,091,019

TABLE 3. TEN MOST POPULOUS LOCATIONS THAT EXPERIENCED 31-100 DAYS OF ELEVATED OZONE AND/OR $PM_{2.5}$ IN 2020

Location	Number of days with ozone and/or $PM_{2.5}$ AQI over 50	Population
New York-Newark-Jersey City, NY-NJ-PA	47	19,124,359
Chicago-Naperville-Elgin, IL-IN-WI	84	9,406,638
Dallas-Fort Worth-Arlington, TX	72	7,694,138
Houston-The Woodlands-Sugar Land, TX	96	7,154,478
Miami-Fort Lauderdale-Pompano Beach, FL	38	6,173,008
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	49	6,107,906
Atlanta-Sandy Springs-Alpharetta, GA	67	6,087,762
San Francisco-Oakland-Berkeley, CA	70	4,696,902
Detroit-Warren-Dearborn, MI	95	4,304,136
Seattle-Tacoma-Bellevue, WA	47	4,018,598

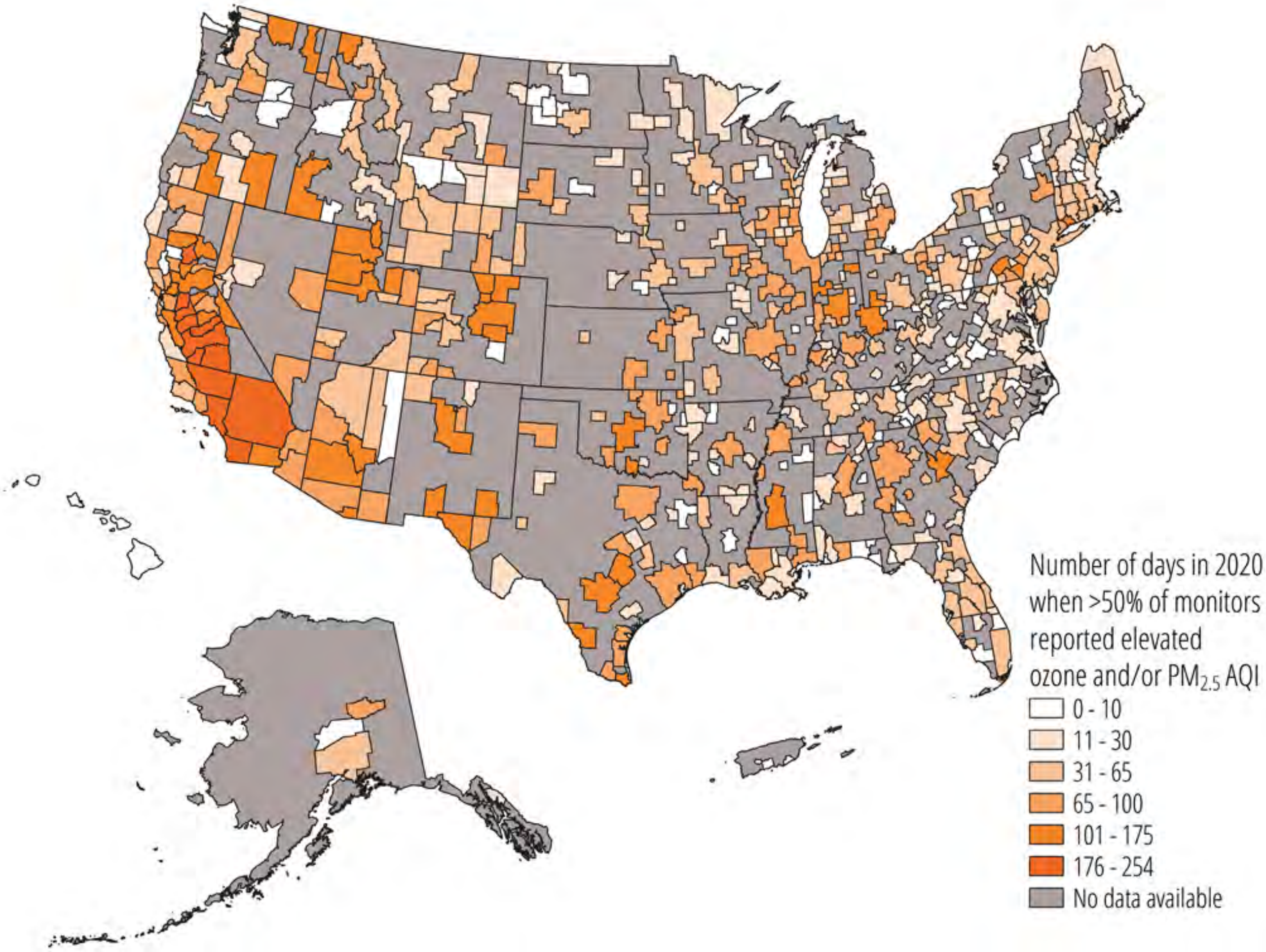


Figure 4. Number of days when half or more monitors reported ozone and/or $PM_{2.5}$ AQI over 50 in 2020

Exposure to ozone pollution

In 2020, almost 13.6 million people living in 11 large and small urban areas and rural counties were exposed to more than 100 days – well over three full months – of elevated ozone pollution. (See Table 4.) These Americans live in Western states: California, New Mexico, Arizona and Colorado.

Ozone is harmful even with less frequent exposure, however. In 2020, almost 57.3 million people living in 90 large and small urban areas and rural counties from every region of the country were exposed to between 31 and 100 days of elevated ozone pollution. (See Table 5.) This still represents a significant reduction in exposure relative to 2018, when up to 170 million Americans experienced between 31 and 100 days of elevated ozone.[132]

The drop in ozone exposure between 2018 and 2020 also appeared in the EPA's analysis of long-term ozone trends, in which the agency found a 34% decrease in the number of days of elevated ozone levels in 35 major cities around the country between 2018 and 2020.[133]

TABLE 4. TEN MOST POPULOUS LOCATIONS THAT EXPERIENCED MORE THAN 100 DAYS OF ELEVATED OZONE IN 2020

Location	Number of days with ozone AQI over 50	Population
Phoenix-Mesa-Chandler, AZ	103	5,059,909
Riverside-San Bernardino-Ontario, CA	162	4,678,371
Fresno, CA	110	1,000,918
Bakersfield, CA	142	901,362
Colorado Springs, CO	104	753,839
Visalia, CA	158	468,680
Boulder, CO	106	327,171
Madera, CA	132	157,761
Hanford-Corcoran, CA	125	152,692
Carlsbad-Artesia, NM	110	58,418

TABLE 5. TEN MOST POPULOUS LOCATIONS THAT EXPERIENCED 31-100 DAYS OF ELEVATED OZONE IN 2020

Location	Number of days with ozone AQI over 50	Population
Los Angeles-Long Beach-Anaheim, CA	100	13,109,903
Detroit-Warren-Dearborn, MI	32	4,304,136
San Diego-Chula Vista-Carlsbad, CA	42	3,332,427
Denver-Aurora-Lakewood, CO	98	2,991,231
San Antonio-New Braunfels, TX	47	2,590,732
Sacramento-Roseville-Folsom, CA	61	2,374,749
Las Vegas-Henderson-Paradise, NV	81	2,315,963
Cincinnati, OH-KY-IN	34	2,232,907
Milwaukee-Waukesha, WI	33	1,577,676
Oklahoma City, OK	37	1,425,375

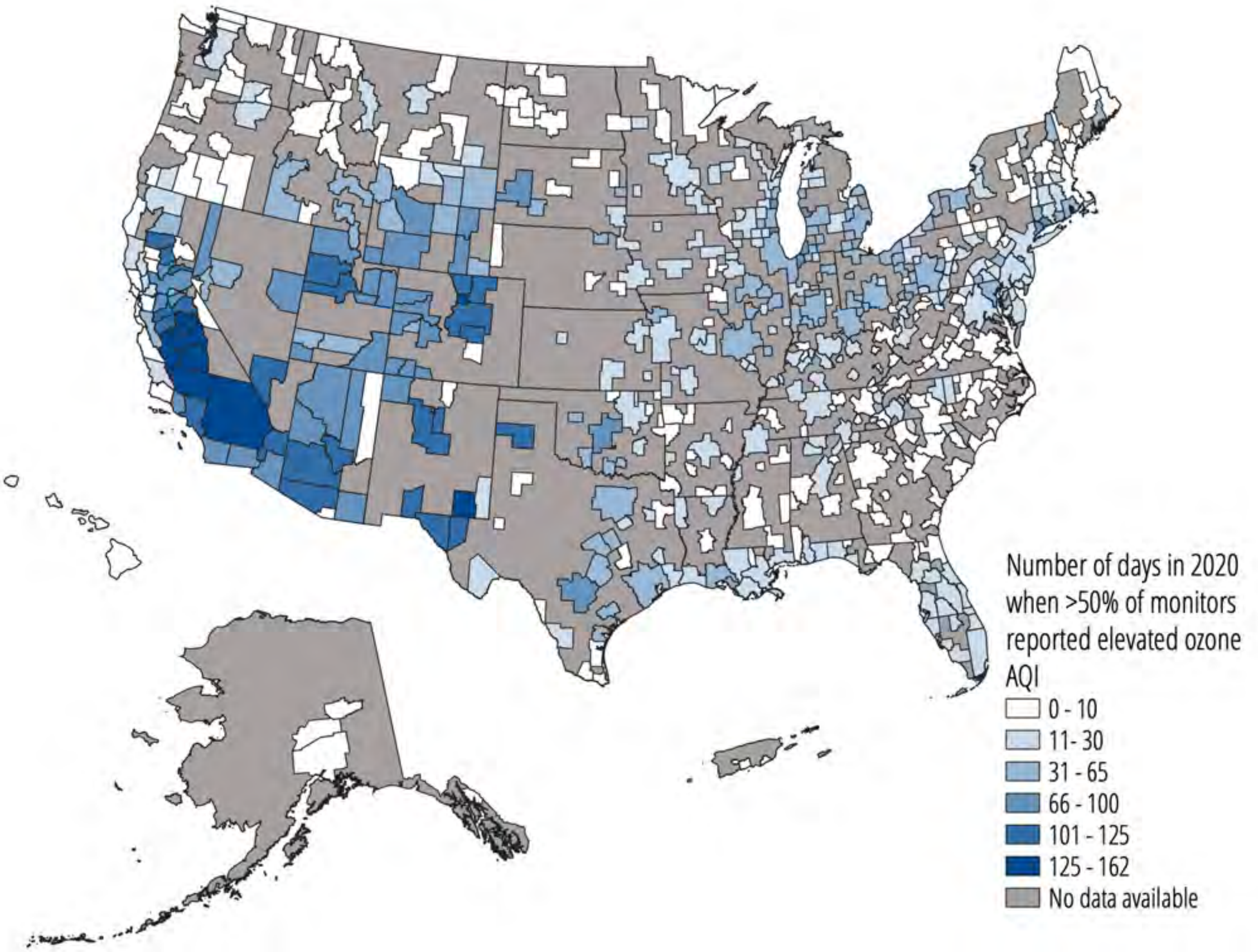


Figure 5. Number of days when half or more monitors reported ozone AQI over 50 in 2020

Exposure to particulate pollution

In 2020, almost 30.7 million people living in 26 large and small urban areas and rural counties were exposed to more than 100 days of elevated $PM_{2.5}$ pollution. (See Table 6.) These Americans were in states from California to Oregon and from Washington to Texas.

Particulate pollution can cause health damage even with less frequent exposure, however. In 2020, almost 175.4 million people living in 194 large and small urban areas and rural counties experienced between 31 and 100 days of elevated $PM_{2.5}$ pollution. (See Table 7.) Particulate pollution affects every part of the country.

All told, more than 206 million Americans experienced more than a month of elevated particulate pollution in 2020, more than 62% of the U.S. population.[134]

TABLE 6. TEN MOST POPULOUS LOCATIONS THAT EXPERIENCED MORE THAN 100 DAYS OF ELEVATED $PM_{2.5}$ IN 2020

Location	Number of days with $PM_{2.5}$ AQI over 50	Population
Los Angeles-Long Beach-Anaheim, CA	178	13,109,903
Riverside-San Bernardino-Ontario, CA	118	4,678,371
San Diego-Chula Vista-Carlsbad, CA	225	3,332,427
Indianapolis-Carmel-Anderson, IN	101	2,091,019
Fresno, CA	171	1,000,918
Bakersfield, CA	119	901,362
Dayton-Kettering, OH	102	809,248
Stockton, CA	153	767,967
Jackson, MS	116	589,082
Spokane-Spokane Valley, WA	102	574,585

TABLE 7. TEN MOST POPULOUS LOCATIONS THAT EXPERIENCED 31-100 DAYS OF ELEVATED $PM_{2.5}$ IN 2020

Location	Number of days with $PM_{2.5}$ AQI over 50	Population
New York-Newark-Jersey City, NY-NJ-PA	36	19,124,359
Chicago-Naperville-Elgin, IL-IN-WI	64	9,406,638
Dallas-Fort Worth-Arlington, TX	50	7,694,138
Houston-The Woodlands-Sugar Land, TX	81	7,154,478
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	32	6,107,906
Atlanta-Sandy Springs-Alpharetta, GA	66	6,087,762
Phoenix-Mesa-Chandler, AZ	62	5,059,909
San Francisco-Oakland-Berkeley, CA	70	4,696,902
Detroit-Warren-Dearborn, MI	83	4,304,136
Seattle-Tacoma-Bellevue, WA	41	4,018,598

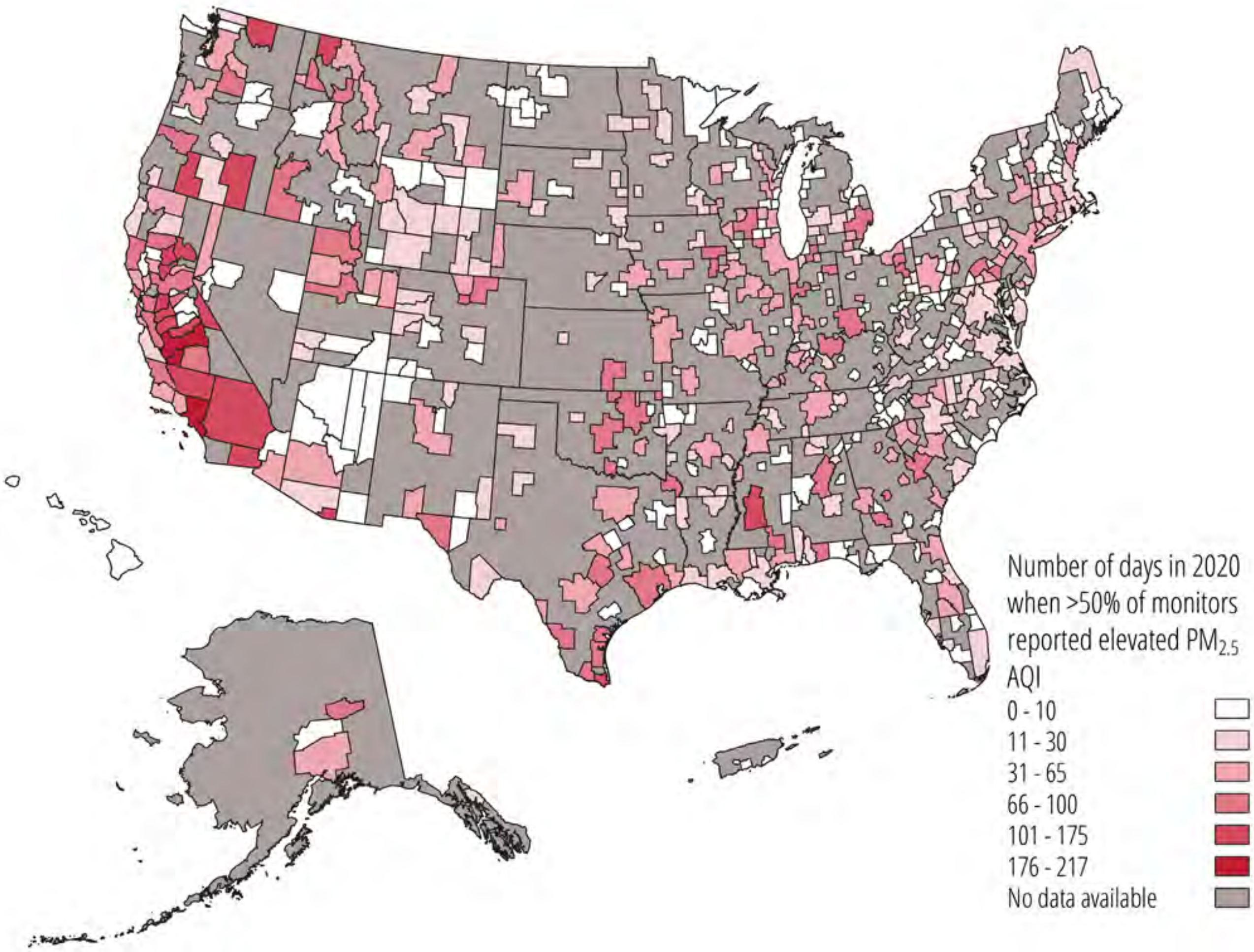


Figure 6. Number of days when half or more monitors reported $PM_{2.5}$ AQI over 50 in 2020

Wildfires caused very unhealthy levels of air pollution

Although by some metrics Americans' exposure to air pollution was better in 2020 than in years past, looking only at the number of days with air quality past a certain threshold masks the severity of the air pollution to which many Americans were exposed over the course of the year.

In 2020, many Americans were exposed to incredibly high levels of air pollution. Some of the pollution is due to the sources that cause bad air quality across the country: traffic, industry, dust, etc. But many of the worst air days were caused by the record-setting wildfire season in the western U.S. Because of the wildfires, most of the locations with the worst air quality measurements in 2020, and most of those with the largest number days with bad air quality, were in the western U.S., especially in California, Washington, Oregon, New Mexico and Colorado.

For instance, Mono County, California, on the California/Nevada border in the central part of the state, east of Yosemite, experienced the single worst $PM_{2.5}$ AQI measurement in 2020, according to EPA data. (See Table 8 and Figure 7.) Mono County saw the concentrations of pollutants in its air spike in September and October of 2020, reaching an AQI over 700 as the fires in California – including the nearby Creek Fire, which burned almost 380,000 acres – were exacerbated by an intense heat wave.[135] (See Figure 7.) Mono County's AQI reading of 714 is literally off the charts: it is what the EPA describes as "Beyond the AQI," and corresponds to a 24-hour $PM_{2.5}$ concentration of about 900 $\mu g/m^3$ which, according to one comparison tool, is like smoking approximately 41 cigarettes in a day.[136]

Similarly, the Portland-Vancouver-Hillsboro region in Oregon and Washington saw particulate matter concentrations in the air skyrocket in September when a series of fires exploded in the region.[137] (See Figure 8.) The area had never seen air quality as bad as it got during that stretch, according to a county official.[138] Exposure to wildfire smoke is particularly concerning because recent evidence indicates that the particulate matter in wildfire smoke may be many times more dangerous than ambient particulates.[139]

Particulate pollution concentrations reached extremely unhealthy levels all along the West Coast, from Washington to California. (See Table 8.) Even short exposures to this level of pollution can cause health damage.

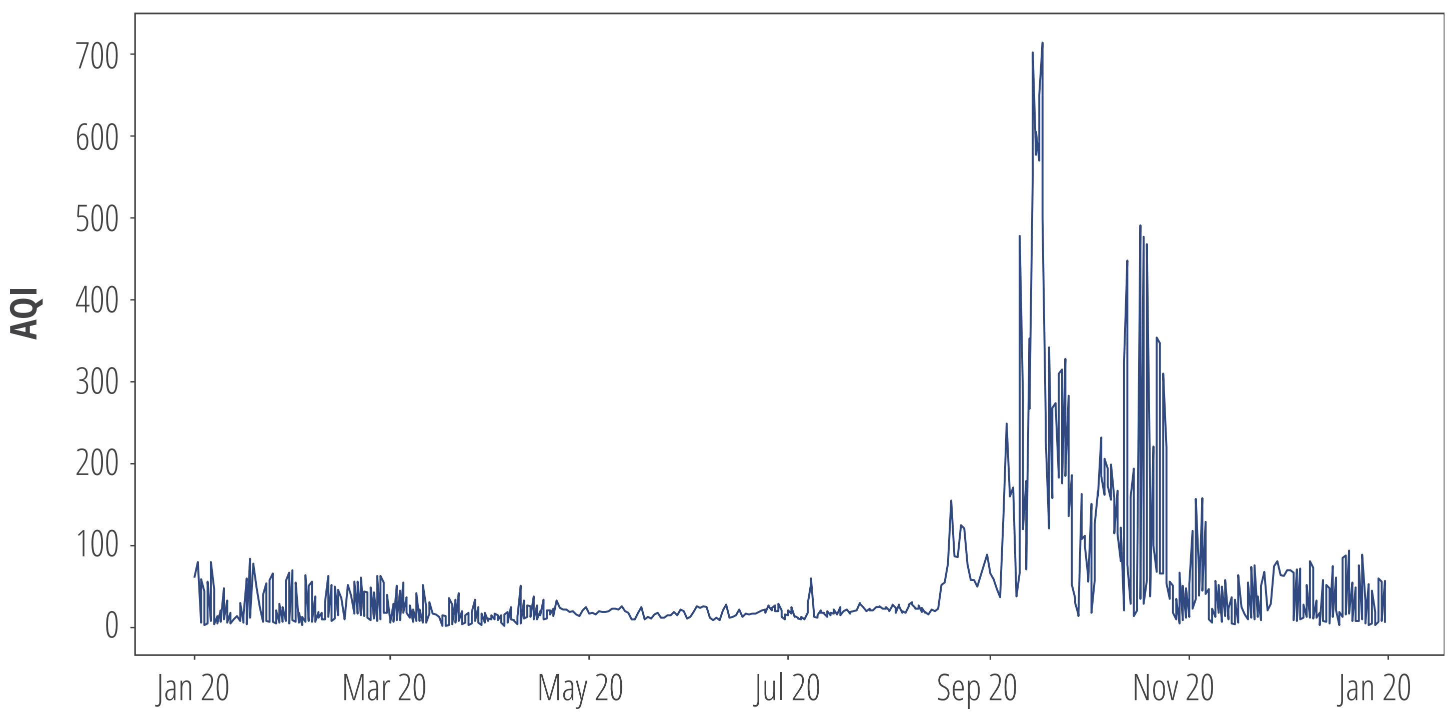


Figure 7. $PM_{2.5}$ AQI for Mono County, California in 2020

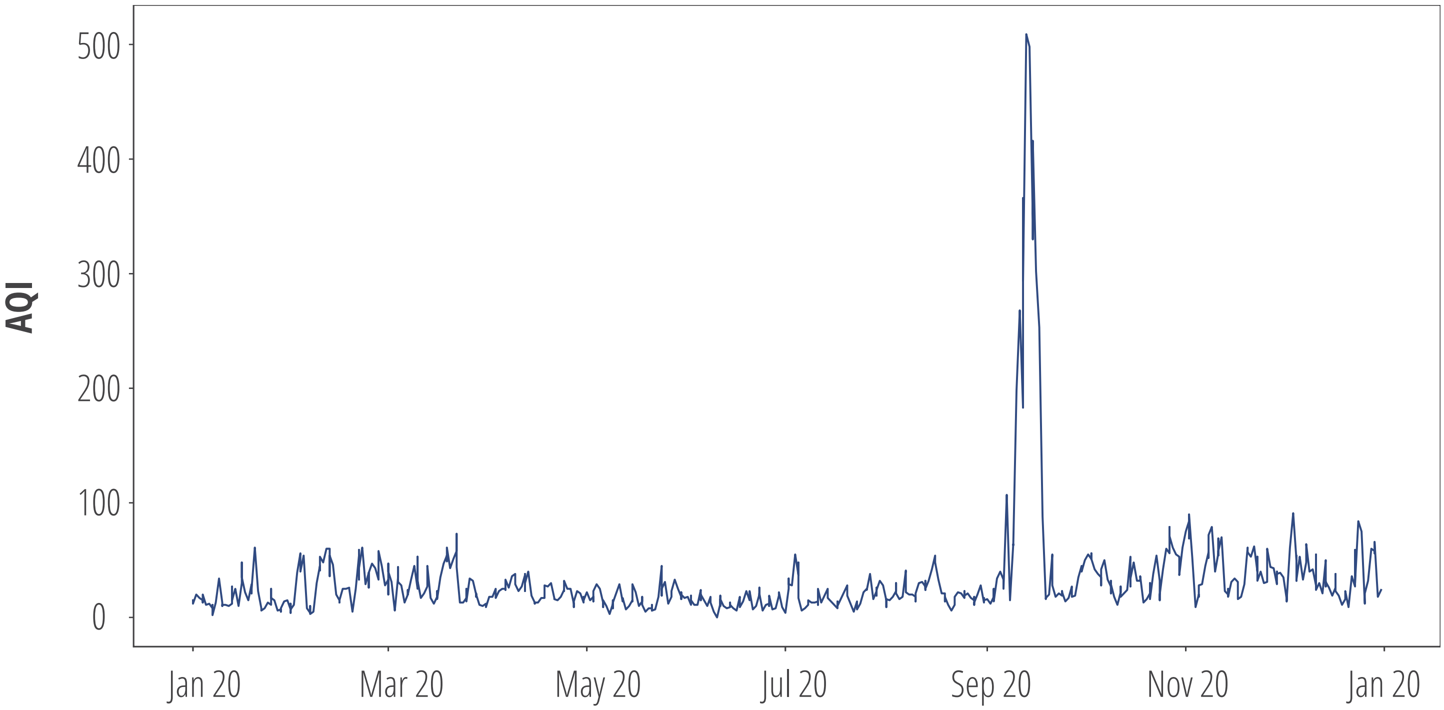


Figure 8. $PM_{2.5}$ AQI for the Portland-Vancouver-Hillsboro region, Oregon-Washington in 2020

TABLE 8. HIGHEST AQI READING FOR THE TOP 10 UNIQUE PLACES BY SINGLE MONITOR MAXIMUM $PM_{2.5}$ AQI READING IN 2020

Location	Monitor address	Date of reading	$PM_{2.5}$ AQI
Mono County, CA	330 Mattly Avenue, Lee Vining, California, 93541	9/17/20	714
Prineville, OR	251 S.E. Court St., Prineville, Oregon, 97754	9/12/20	561
Eugene, OR	47674 School St., Oakridge, Oregon, 97463	9/12/20	550
Medford, OR	711 Welch St., Medford, Oregon, 97501	9/12/20	517
Portland-Vancouver-Hillsboro, OR-WA	2722 N.E. 84th Ave., Vancouver, Washington, 98662	9/13/20	509
Klamath Falls, OR	4856 Clinton St., Klamath Falls, Oregon, 97603	9/12/20	472
Plumas County, CA	420 Gulling Street, Portola, California, 96122	9/12/20	469
Yakima, WA	141 Ward Rd., Toppenish, Washington, 98948	9/14/20	465
Ukiah, CA	125 E. Commercial St., Willits, California, 95490	9/9/20	456
Spokane-Spokane Valley, WA	261 E 1st St., Colville, Washington, 99114	9/13/20	432

Air pollution also affects rural areas

Though much of the data in this section is presented with the context of population to show how many people experience bad air quality, this masks the fact that air pollution is very much a threat to rural areas with fewer people in them. Though some sources of pollution, like road traffic, are less present in rural areas, industrial pollution, smoke and agricultural pollution can still be prevalent, and weather patterns can bring pollution in from other places. In 2020, many rural areas experienced many days of elevated air pollution (see Table 9). With a changing climate and increasingly long and severe fire seasons, being in the countryside no longer means the air is necessarily cleaner.

Unfortunately, in many areas of the country, especially in rural areas, there are few or no air quality monitors, which makes understanding the full extent of the pollution problem in the U.S. difficult.

TABLE 9. TEN LEAST POPULOUS LOCATIONS THAT EXPERIENCED MORE THAN 100 DAYS OF OZONE AND/OR $PM_{2.5}$ AQI ABOVE 50 IN 2020

Location	Number of days in 2020 with ozone and/or $PM_{2.5}$ AQI above 50	Population
Harney County, OR	111	7,373
Mono County, CA	139	14,534
Mariposa County, CA	116	17,160
Plumas County, CA	118	18,967
Lincoln County, MT	148	20,343
Okanogan County, WA	109	42,620
Calaveras County, CA	102	46,308
Nogales, AZ	117	46,808
Carlsbad-Artesia, NM	110	58,418
Red Bluff, CA	117	64,494

Progress on air pollution is stalling

Though air quality in the U.S. has improved over the decades, in recent years that progress has slowed. The U.S. Environmental Protection Agency calculates that the average level of ozone pollution dropped by 20% from 2000 to 2020 and that fine particulate pollution levels and 1-hour NO_2 levels dropped by 30% and 39% respectively over the same period.[140]

However, the agency's analysis of elevated ozone and particulate pollution in 35 major cities shows that the progress that had been made in reducing air pollution around the country in past decades has seemingly stalled out since about 2013.[141] The EPA's analysis shows mixed results in pollution reduction for the studied cities, with some continuing to reduce the number of days residents are exposed to elevated pollution levels and others, especially in the western U.S., dealing with more and more polluted air.[142]

As explained previously, fossil fuel combustion is the main sources of both air pollution and the greenhouse gases that drive global warming. Transitioning away from fossil fuels can therefore both reduce air pollution and help mitigate the worst effects of climate change. Since the changing climate, as previously discussed, is likely to worsen air pollution without other interventions, cutting fossil fuel use and thereby limiting the extent of global warming would have the indirect effect of reducing the negative effects of global warming on air quality.

Conclusion and recommendations

As more research is conducted on air pollution and its effects on human health and well-being, we are learning that the scale and magnitude of those effects is much larger than we knew even a few years ago. We are learning that air pollution can cause and/or worsen everything from heart disease to cancer, depression to COVID-19, and that exposure to particulate and ozone pollution at any level increases the risk of death from all causes.

We are also learning more and more about the scale of the air pollution problem and its interconnections with many aspects of our society and environment. It is clear that fossil fuel combustion is one of the main sources of air pollution. And it is increasingly clear that global warming will both exacerbate the air pollution problem and be accelerated by many forms of air pollution.

The single biggest tool to improving air quality and reducing climate pollution to protect Americans' health and avoid the worst impacts of climate change is to rapidly shift away from fossil fuels throughout the economy. In addition, policymakers should strengthen standards for air quality to levels that are more protective of public health. Opportunities to achieve significant and lasting reductions in air pollution include:

Electrifying buildings, equipment and transportation. Using fossil fuels in our homes, businesses, industry and transportation necessitates emitting air pollution – including greenhouse gases – at every step of the process, from pumping the fuel out of the ground to piping it around the country and then to burning it where we live and work. Policymakers should be working to support and accelerate:

- **Switching to electricity for building and industry systems.** Heating, cooling and hot water systems can be replaced by heat pump systems, which are much more efficient than fossil fuel-powered systems and previous generations of electric equipment.[143] Many industrial processes that require less heat – such as paper production and recycling, plastic recycling, and aluminum casting – can already be electrified and increasing the efficiency of industrial processes can also cut emissions.[144] With further research and development, new electrification technologies could replace equipment even in harder-to-decarbonize fields such as steel and cement production.[145]

- **Electrifying transportation.** Highway vehicles are a major source of air pollution. Pollution from vehicles is also especially harmful, as vehicle emissions often occur in densely populated urban areas and directly into the air people breathe. Specifically, policymakers should:

    - **Hasten the transition to electric cars, SUVs and light-duty trucks.** Fourteen states – California, Colorado, Connecticut, Maine, Maryland, Massachusetts, Minnesota, New Jersey, New York, Oregon, Rhode Island, Vermont, Virginia and Washington – already have electric vehicle sales requirements.[146] Elected officials in other states should seek to adopt such requirements and set goals to have all new passenger vehicles be electric vehicles by 2035 at the latest. In addition, states should also support the development of infrastructure needed to recharge those vehicles.

- **Establish strong federal fuel economy and global warming pollution standards for light-duty vehicles.** On August 5, 2021, President Biden signed an executive order setting a goal that 50% of new light-duty vehicles sold in 2030 be zero-emission vehicles.[147] To accomplish this goal, federal agencies will need to set more ambitious limits on tailpipe pollution for the next decade to push the auto industry to develop more electric vehicles.

- **Replace diesel buses with electric buses.** Transit agencies and school districts should replace buses powered by fossil fuels with electric buses over their next replacement cycle. Both New York City and the state of California have committed to replacing all transit buses with electric buses by 2040.[148]

- **Reduce pollution from all forms of transportation,** including medium- and heavy-duty vehicles, airplanes, railroads and marine vessels by establishing incentives and mandates for zero- and reduced-emissions technologies. Already, 15 states and the District of Columbia have committed to a goal of having 30% of new medium- and heavy-duty trucks be zero-emission vehicles by 2030, and 100% by 2050.[149] Separately, California is developing tougher standards to cut NO_x pollution from heavy-duty diesel trucks.[150] Other states should adopt California's standard once it is finalized.

Reform the way we move by enabling people to drive less and walk, bike and use transit more. Such a change would cut air pollution and global warming pollution and give more people access to the health benefits of increased physical activity. Street and community designs that make walking and biking both safe and pleasant can help encourage people to drive less. Frequent, reliable transit service can attract more riders. Providing people with more options for getting out of their cars will require policymakers to increase funding for walking, biking and transit (which could be done by shifting funds away from new road construction) and supporting development patterns that allow people to travel easily without a car.

Increasing the use of clean, renewable energy. Renewable energy sources such as wind and solar power can reduce air pollution and climate pollution by cutting the need for production, transportation and burning of fossil fuels. Policymakers should commit to obtaining 100% of electricity from clean and renewable sources. This will be easier to accomplish with improved energy efficiency and reduced energy use. Already, eight states and many cities and counties have adopted commitments to obtain all of their energy from clean sources in the coming decades.[151]

Protecting and building upon progress achieved under the Clean Air Act. The Clean Air Act has reduced air pollution and improved public health across the nation since its enactment five decades ago.[152] With the challenge that climate change presents to air quality, the nation will need to take further action to maintain current air quality levels, much less improve air quality. To protect public health, political leaders and regulators should:

- **Strengthen ozone and particulate matter standards.** Ozone and particulate matter standards should be brought in line with the best available scientific understanding of what is necessary to minimize adverse effects on human health. Groups including the World Health Organization, the American Lung Association and the American Thoracic Society all recommend standards tighter than the EPA's.[153] The EPA should make a careful review of the latest research on the dangers of air pollution and should tighten pollution standards to be maximally protective of public health.

- **Ensure strong enforcement of the Clean Air Act**, including by requiring enforcement agencies to:

  - Issue timely, health-based air quality permits that are maximally protective of public health.

  - Take timely, aggressive enforcement action to hold polluters accountable.

  - Expand and improve air quality monitoring.

Methodology

This report estimates the number of days of degraded air quality experienced in 2020 by people living across the U.S. based on the number of days when air quality monitors for $PM_{2.5}$ or ozone reported an AQI of 51 or higher. Particulate matter and ozone are among the air pollutants that the World Health Organization reports as having the "strongest evidence for public health concern."[154] (See "Air pollution threatens public health.") The report also presents the number of days with elevated ozone and/or particulate pollution, a measure of how often residents have to breathe polluted air, and presents some of the highest single-monitor AQI measurements from 2020.

Data from air pollution monitors were grouped regionally by metropolitan and micropolitan areas and rural counties. In areas that contain more than one monitoring location, days in which half or more of the monitoring locations in the area reported an air quality problem were included in the tally of days with degraded air quality.

Air pollution data for 2020 are from U.S. Environmental Protection Agency, *Air Data: Pre-Generated Data Files*, accessed at https://aqs.epa.gov/aqsweb/airdata/download_files.html, 30 June 2021. This analysis uses the daily summary data for ozone and the daily summary data for $PM_{2.5}$ measured with FRM/FEM mass methods, which includes a daily EPA-calculated Air Quality Index (AQI) score for each monitoring station and for each pollutant. Only the $PM_{2.5}$ data calculated as 24-hour averages or 24-hour block averages in the "Sample Duration" column were used.

The geographic units included in this analysis were core-based statistical areas (CBSA) – metropolitan and micropolitan areas identified by the federal Office of Management and Budget – and counties that are not part of a CBSA but that include one or more air quality monitoring locations. Each CBSA or county may have more than one monitoring location, and each location may have multiple monitors.

Due to a discrepancy in the names of 38 geographic areas between the U.S. Environmental Protection Agency's air quality data CBSA names and those in the U.S. Census Bureau's population data, CBSAs with the same primary city were assumed to be the same in the EPA and Census datasets, and the Census names and population data were used.

The method for each pollutant was as follows:

1. Count the number of single-monitor eight-hour AQI scores for ozone and 24-hour AQI scores for $PM_{2.5}$ with an AQI above 50 for each CBSA and county.
2. Divide that by the total number of monitoring locations within each CBSA/county that reported an AQI for that pollutant on that day.
3. Tally the number of days on which half or more reporting locations in each CBSA or county reported an AQI above 50 for each pollutant.
4. Tally the number of days with elevated AQI for either pollutant by counting each day in which a CBSA or county had elevated AQI for either pollutant, classifying a day with elevated AQI for both ozone and $PM_{2.5}$ as a single day with elevated pollution levels.

2020 population data for CBSAs came from U.S. Census Bureau, *Metropolitan and Micropolitan Statistical Areas Totals: 2010-2020*, downloaded 7 July 2021 from https://www.census.gov/programs-surveys/popest/technical-documentation/research/evaluation-estimates/2020-evaluation-estimates/2010s-totals-metro-and-micro-statistical-areas.html. 2020 population for counties came from U.S. Census Bureau, *County Population Totals: 2010-2020*, downloaded 7 July 2021 from https://www.census.gov/programs-surveys/popest/technical-documentation/research/evaluation-estimates/2020-evaluation-estimates/2010s-counties-total.html.

The populations for 13 geographic areas were not included in these two sources, and alternate sources — some with 2018 or 2019 data — were used:

- The estimated 2020 population presented in this report for the Bishop, California, CBSA is that of Inyo County, California, from U.S. Census Bureau, QuickFacts, *Inyo County, California*, accessed 20 September 2021 at https://www.census.gov/quickfacts/fact/table/inyocountycalifornia/POP010220.
- The estimated 2020 population presented in this report for the Macon, Georgia, CBSA is that of Macon-Bibb County, Georgia, obtained from U.S. Census Bureau, QuickFacts, *Macon-Bibb County, Georgia*, accessed 20 September 2021 at https://www.census.gov/quickfacts/fact/table/maconbibbcountygeorgia/POP010220.
- The estimated 2020 population presented in this report for the Rockland, Maine, CBSA is that of Knox County, Maine, obtained from U.S. Census Bureau, QuickFacts, *Knox County, Maine*, accessed 20 September 2021 at https://www.census.gov/quickfacts/fact/table/knoxcountymaine/POP010220.
- The estimated 2019 population presented in this report for the Greenfield Town, Massachusetts, CBSA is that of Greenfield Town, MA Micropolitan NECTA, obtained from Census Reporter, *Greenfield Town, MA Micropolitan NECTA*, accessed 12 August 2021 at https://censusreporter.org/profiles/35000US73300-greenfield-town-ma-micropolitan-necta/.
- The estimated 2020 population presented in this report for the Oxford, North Carolina, CBSA is that of Vance County, North Carolina, obtained from U.S. Census Bureau, QuickFacts, *Vance County, North Carolina*, accessed 20 September 2021 at https://www.census.gov/quickfacts/fact/table/vancecountynorthcarolina/POP010220.
- The estimated 2020 population for Adjuntas, Puerto Rico, was obtained from U.S. Census Bureau, QuickFacts, *Adjuntas Municipio, Puerto Rico*, accessed 29 July 2021 at https://www.census.gov/quickfacts/fact/table/adjuntasmunicipiopuertorico/POP010220.
- The estimated 2019 population for Guayama, Puerto Rico, is that of Guayama, Puerto Rico, Metro Area, obtained from Census Reporter, *Guayama, PR Metro Area*, accessed 12 August 2021 at https://censusreporter.org/profiles/31000US25020-guayama-pr-metro-area/.
- The estimated 2020 population for Mayagüez, Puerto Rico, is that of Mayagüez and Hormigueros municipios, Puerto Rico, obtained from U.S. Census Bureau, QuickFacts, *Mayagüez Municipio, Puerto Rico* and *Hormigueros Municipio, Puerto Rico*, accessed 20 September 2021 at https://www.census.gov/quickfacts/fact/table/mayaguezmunicipiopuertorico,hormiguerosmunicipiopuertorico/POP010220.
- The estimated 2020 population for Ponce Municipio, Puerto Rico, is that of Guánica, Yauco, Guayanilla, Ponce, Juana Díaz and Villalba municipios, Puerto Rico, obtained from U.S. Census Bureau, QuickFacts, *Guánica Municipio, Puerto Rico, Yauco Municipio, Puerto Rico, Guayanilla Municipio, Puerto Rico, Ponce Municipio, Puerto Rico, Juana Díaz Municipio, Puerto Rico* and *Villalba Municipio, Puerto Rico* accessed 20 September 2021 at https://www.census.gov/quickfacts/fact/table/guanicamunicipiopuertorico,yaucomunicipiopuertorico,guayanillamunicip

iopuertorico,poncemunicipiopuertorico,juanadiaz municipiopuertorico,villalbamunicipiopuertorico/ POP010220.

- The estimated 2019 population presented in this report for the San Juan-Carolina-Caguas, Puerto Rico, CBSA was obtained from Data USA, *San Juan-Carolina-Caguas, PR Metropolitan Statistical Area (MSA)*, accessed 29 July 2021 at https://datausa.io/profile/geo/san-juan-carolina-caguas-pr#about.
- The estimated 2019 population presented in this report for the Marshall, Texas, CBSA is that of Harrison County, Texas, obtained from Census Reporter, *Harrison County, Texas*, accessed 12 August 2021 at https://censusreporter.org/profiles/05000US48203-harrison-county-tx/.
    - Because the Longview, Texas CBSA includes Harrison County, the population of Harrison County was subtracted from the population of Longview, Texas.
- The estimated 2018 population for St. Croix County, U.S. Virgin Islands, was obtained from Government of the Virgin Islands, *USVI Proposed Executive Budget FY 2022 & FY 2023: Building a Better Tomorrow*, 2021, p. 24, archived at https://web.archive.org/web/20210803161540/https://www.vi.gov/wp-content/uploads/2021/06/FY-2022-FY-2023-PROPOSED-EXECUTIVE-BUDGET-FINAL-Reduced.pdf.
- The estimated 2018 population for St. Thomas County, U.S. Virgin Islands, was obtained from Government of the Virgin Islands, *USVI Proposed Executive Budget FY 2022 & FY 2023: Building a Better Tomorrow*, 2021, p. 24, archived at https://web.archive.org/web/20210803161540/https://www.vi.gov/wp-content/uploads/2021/06/FY-2022-FY-2023-PROPOSED-EXECUTIVE-BUDGET-FINAL-Reduced.pdf.

Finally, the EPA air quality data was summarized to provide counts for each CBSA and county of the number of ozone monitors, the number of $PM_{2.5}$ monitors, the number of days on which an ozone AQI was reported, and the number of days on which a $PM_{2.5}$ AQI was reported.

The data assessed may miss certain threats that air pollution poses to public health. For example, averaging pollution data over eight hours for ozone and 24 hours for particulate pollution, as is the case for the AQI data used in this report, may mask short-term spikes in pollution that can damage health.[155] Additionally, this analysis would be affected if different monitors in the same area are targeted towards different forms of the same pollutant (i.e. background vs. high pollution). Some results not counted as indicating degraded air quality in this analysis also likely pose a threat to health. (See "Air pollution is harmful at some levels the EPA considers safe.") Attributing elevated air quality to full counties or CBSAs may mask variations on a smaller geographic level. Additionally, this analysis is affected both by the number of monitors in a given location (which determines the threshold at which we classify a day with elevated air pollution) and the frequency of reporting. Finally, this assessment does not include analysis of other pollutants, which can also be harmful to human health and the environment.

Sources of air pollution

Data on sources of pollution comes from U.S. Environmental Protection Agency, *2017 National Emissions Inventory*, 12 May 2020, downloaded from ftp://newftp.epa.gov/air/nei/2017/tier_summaries/.

For purposes of categorization in Appendix B and Figures 1 and 2, pollutant sources were aggregated based on the EPA's "Tier 1" source categorization as follows:

Tier 1 category	New categorization
Chemical & Allied Product Mfg	Industrial and other processes
Fuel Comb. Elec. Util.	Electricity generation
Fuel Comb. Industrial	Industrial and other processes
Fuel Comb. Other	Residential, commercial and institutional
Highway Vehicles	Transportation
Metals Processing	Industrial and other processes
Miscellaneous	Miscellaneous
Off-Highway	Transportation
Other Industrial Processes	Industrial and other processes
Petroleum & Related Industries	Petroleum & related industries
Solvent Utilization	Miscellaneous
Storage & Transport	Miscellaneous
Waste Disposal & Recycling	Miscellaneous

For VOCs, additional categorizations were applied as follows:

- Sources with an original Tier 1 source category of "solvent utilization" were categorized with the same name.
- Sources with original Tier 3 source categories of "prescribed burning" or "forest wildfires" were categorized as "wildfires and prescribed burning."

Appendix A: Days with elevated ozone, particulates and total pollution, by geographic area, 2020

This count includes air pollution at or above the level the EPA labels "moderate," and indicated in yellow or worse in its Air Quality Index. N/A indicates the location does not have a monitor for the type of pollution in question.

Air pollution data are listed by state. Results for urban areas are listed first, in alphabetical order, followed by results for rural counties that are not part of a metropolitan or micropolitan area. Many rural counties do not have any air pollution monitors and therefore do not appear here. Metropolitan and micropolitan areas that extend into more than one state are listed multiple times, once for each state.

Included with the counts of days of elevated pollution are counts of monitors for that pollutant and the number of days on which an AQI for that pollutant was reported.

TABLE A1. DAYS WITH ELEVATED OZONE, PARTICULATES AND TOTAL POLLUTION, BY GEOGRAPHIC AREA, 2020

		Ozone			Particulate				
State or territory	Urban area or rural county	Number of days with elevated ozone	Number of days with reported ozone AQI	Number of ozone monitors	Number of days with elevated particulate	Number of days with reported particulate AQI	Number of particulate monitors	Number of days with elevated ozone and/or particulate	Population
Alabama									
	Birmingham-Hoover, AL	16	365	7	86	366	5	94	1,091,921
	Columbus, GA-AL	3	246	2	62	363	4	63	322,658
	Daphne-Fairhope-Foley, AL	7	234	1	12	113	1	19	229,287
	Decatur, AL	10	234	1	30	219	1	39	152,740
	Fort Payne, AL	7	366	1	8	109	1	14	71,658
	Gadsden, AL	3	239	1	15	115	1	18	102,371
	Huntsville, AL	11	246	2	13	122	1	24	481,681
	Mobile, AL	4	228	2	11	111	1	15	428,692
	Montgomery, AL	1	241	2	13	117	1	14	372,583
	Tuscaloosa, AL	1	243	1	10	118	1	11	253,211
	Clay County, AL	N/A	N/A	N/A	9	108	1	9	13,112
	Sumter County, AL	0	242	1	N/A	N/A	N/A	0	12,225

State or territory	Urban area or rural county	Ozone			Particulate			Number of days with elevated ozone and/or particulate	Population
		Number of days with elevated ozone	Number of days with reported ozone AQI	Number of ozone monitors	Number of days with elevated particulate	Number of days with reported particulate AQI	Number of particulate monitors		
Alaska									
	Anchorage, AK	N/A	N/A	N/A	35	366	2	35	397,308
	Denali Borough, AK	1	355	1	0	N/A	N/A	1	2,081
	Fairbanks, AK	0	190	1	89	362	3	89	95,651
	Juneau, AK	N/A	N/A	N/A	18	355	1	18	31,849
Arizona									
	Flagstaff, AZ	48	366	2	N/A	N/A	N/A	48	142,481
	Nogales, AZ	N/A	N/A	N/A	117	364	1	117	46,808
	Payson, AZ	100	366	1	N/A	N/A	N/A	100	54,303
	Phoenix-Mesa-Chandler, AZ	103	366	28	62	366	13	149	5,059,909
	Prescott Valley-Prescott, AZ	66	332	1	N/A	N/A	N/A	66	240,226
	Show Low, AZ	49	366	1	N/A	N/A	N/A	49	112,112
	Sierra Vista-Douglas, AZ	60	365	1	N/A	N/A	N/A	60	127,450
	Tucson, AZ	68	366	8	20	366	2	77	1,061,175
	Yuma, AZ	47	366	1	59	358	1	87	217,824
	Apache County, AZ	N/A	N/A	N/A	2	60	1	2	71,875
	La Paz County, AZ	68	366	1	6	361	1	70	21,480
Arkansas									
	Arkadelphia, AR	1	346	1	N/A	N/A	N/A	1	22,103
	El Dorado, AR	N/A	N/A	N/A	15	121	1	15	38,219
	Fayetteville-Springdale-Rogers, AR	6	366	2	7	119	1	13	548,634
	Fort Smith, AR-OK	2	288	1	12	120	1	14	250,434
	Harrison, AR	5	364	1	N/A	N/A	N/A	5	45,227
	Hot Springs, AR	N/A	N/A	N/A	16	121	1	16	99,789
	Little Rock-North Little Rock-Conway, AR	11	366	2	65	359	2	71	746,564
	Memphis, TN-MS-AR	17	366	5	61	366	5	77	1,348,678
	Texarkana, TX-AR	N/A	N/A	N/A	88	362	1	88	148,838
	Arkansas County, AR	N/A	N/A	N/A	11	119	1	11	17,383
	Ashley County, AR	N/A	N/A	N/A	11	122	1	11	19,339
	Jackson County, AR	N/A	N/A	N/A	13	122	1	13	16,636
	Polk County, AR	9	359	1	12	120	1	21	19,707
California									
	Bakersfield, CA	142	366	9	119	366	6	197	901,362
	Bishop, CA	45	366	3	68	366	3	90	18,039
	Chico, CA	84	366	2	116	363	1	158	212,744
	Clearlake, CA	7	359	1	6	61	1	10	64,479
	El Centro, CA	57	366	4	115	356	3	148	180,267
	Eureka-Arcata, CA	0	361	1	24	106	1	24	134,977
	Fresno, CA	110	366	7	171	366	6	218	1,000,918
	Hanford-Corcoran, CA	125	366	2	217	366	2	254	152,692

State or territory	Urban area or rural county	Ozone			Particulate			Number of days with elevated ozone and/or particulate	Population
		Number of days with elevated ozone	Number of days with reported ozone AQI	Number of ozone monitors	Number of days with elevated particulate	Number of days with reported particulate AQI	Number of particulate monitors		
	Los Angeles-Long Beach-Anaheim, CA	100	366	17	178	366	12	209	13,109,903
	Madera, CA	132	366	2	154	366	1	223	157,761
	Merced, CA	97	365	1	142	363	2	195	279,252
	Modesto, CA	97	366	2	153	366	2	204	550,081
	Napa, CA	14	362	1	63	363	1	67	135,965
	Oxnard-Thousand Oaks-Ventura, CA	57	366	5	50	366	5	78	841,387
	Red Bluff, CA	71	366	2	80	358	1	117	64,494
	Redding, CA	31	366	4	20	82	1	49	179,027
	Riverside-San Bernardino-Ontario, CA	162	366	23	118	366	11	203	4,678,371
	Sacramento-Roseville-Folsom, CA	61	366	12	94	366	7	122	2,374,749
	Salinas, CA	2	366	3	27	366	3	28	430,906
	San Diego-Chula Vista-Carlsbad, CA	42	366	9	225	366	6	232	3,332,427
	San Francisco-Oakland-Berkeley, CA	5	366	12	70	366	11	70	4,696,902
	San Jose-Sunnyvale-Santa Clara, CA	23	366	5	92	366	3	99	1,971,160
	San Luis Obispo-Paso Robles, CA	14	366	7	71	366	4	74	282,249
	Santa Cruz-Watsonville, CA	2	365	1	61	366	2	62	269,925
	Santa Maria-Santa Barbara, CA	6	366	9	42	366	4	43	444,766
	Santa Rosa-Petaluma, CA	2	366	2	42	363	1	43	489,819
	Sonora, CA	76	360	1	N/A	N/A	N/A	76	54,515
	Stockton, CA	49	366	2	153	366	2	167	767,967
	Truckee-Grass Valley, CA	78	321	1	44	342	2	86	99,606
	Ukiah, CA	8	362	1	86	366	2	86	86,061
	Vallejo, CA	19	366	3	102	364	1	104	446,935
	Visalia, CA	158	366	4	78	128	1	203	468,680
	Yuba City, CA	65	364	2	133	355	1	151	176,545
	Amador County, CA	32	361	1	N/A	N/A	N/A	32	40,083
	Calaveras County, CA	63	366	1	73	356	1	102	46,308
	Colusa County, CA	2	366	1	61	166	2	61	21,558
	Glenn County, CA	5	361	1	N/A	N/A	N/A	5	28,283
	Mariposa County, CA	116	366	2	N/A	N/A	N/A	116	17,160
	Mono County, CA	N/A	N/A	N/A	139	364	2	139	14,534
	Plumas County, CA	N/A	N/A	N/A	118	248	2	118	18,967
	Siskiyou County, CA	10	366	1	59	365	1	61	43,245

State or territory	Urban area or rural county	Ozone			Particulate			Number of days with elevated ozone and/or particulate	Population
		Number of days with elevated ozone	Number of days with reported ozone AQI	Number of ozone monitors	Number of days with elevated particulate	Number of days with reported particulate AQI	Number of particulate monitors		
Colorado									
	Boulder, CO	106	351	1	82	365	2	151	327,171
	Colorado Springs, CO	104	366	2	28	365	1	111	753,839
	Denver-Aurora-Lakewood, CO	98	366	9	66	366	8	129	2,991,231
	Durango, CO	62	366	3	N/A	N/A	N/A	62	56,564
	Fort Collins, CO	79	366	3	53	358	1	114	360,428
	Glenwood Springs, CO	46	366	3	29	339	1	55	78,260
	Grand Junction, CO	46	366	1	29	366	1	64	155,603
	Greeley, CO	88	363	2	82	366	2	147	333,983
	Pueblo, CO	N/A	N/A	N/A	4	71	1	4	169,823
	Archuleta County, CO	62	334	1	N/A	N/A	N/A	62	14,196
	Delta County, CO	24	267	1	17	272	1	34	31,067
	Gunnison County, CO	55	337	1	N/A	N/A	N/A	55	17,593
	Montezuma County, CO	43	366	3	N/A	N/A	N/A	43	26,408
	Rio Blanco County, CO	42	366	2	21	347	1	53	6,342
Connecticut									
	Bridgeport-Stamford-Norwalk, CT	45	215	4	60	366	2	95	942,426
	Hartford-East Hartford-Middletown, CT	17	359	3	40	366	2	53	1,201,483
	New Haven-Milford, CT	47	363	2	61	366	2	100	851,948
	Norwich-New London, CT	33	214	1	25	366	1	55	264,999
	Torrington, CT	21	350	1	21	363	1	35	179,610
	Worcester, MA-CT	12	366	3	36	361	1	46	945,752
Delaware									
	Dover, DE	15	358	1	17	312	2	30	183,643
	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	17	366	13	32	366	15	49	6,107,906
	Salisbury, MD-DE	13	366	2	25	361	1	37	423,481
District of Columbia									
	Washington-Arlington-Alexandria, DC-VA-MD-WV	9	366	15	19	366	9	28	6,324,629
Florida									
	Cape Coral-Fort Myers, FL	15	366	2	21	324	1	36	790,767
	Crestview-Fort Walton Beach-Destin, FL	7	364	1	N/A	N/A	N/A	7	289,468
	Deltona-Daytona Beach-Ormond Beach, FL	8	366	2	27	359	1	35	679,948
	Gainesville, FL	10	364	1	33	366	1	41	332,317
	Jacksonville, FL	4	366	4	46	366	3	49	1,587,892
	Lake City, FL	0	278	1	N/A	N/A	N/A	0	72,654
	Lakeland-Winter Haven, FL	12	366	2	44	350	1	54	744,552
	Miami-Fort Lauderdale-Pompano Beach, FL	8	366	8	30	366	9	38	6,173,008

State or territory	Urban area or rural county	Ozone			Particulate			Number of days with elevated ozone and/or particulate	Population
		Number of days with elevated ozone	Number of days with reported ozone AQI	Number of ozone monitors	Number of days with elevated particulate	Number of days with reported particulate AQI	Number of particulate monitors		
	Naples-Marco Island, FL	10	366	1	N/A	N/A	N/A	10	392,973
	North Port-Sarasota-Bradenton, FL	8	366	6	28	314	1	36	854,684
	Ocala, FL	12	366	2	N/A	N/A	N/A	12	373,513
	Orlando-Kissimmee-Sanford, FL	11	366	5	35	364	2	45	2,639,374
	Palm Bay-Melbourne-Titusville, FL	12	366	2	31	356	1	42	608,459
	Panama City, FL	8	365	1	N/A	N/A	N/A	8	171,322
	Pensacola-Ferry Pass-Brent, FL	12	366	3	79	357	1	87	511,503
	Port St. Lucie, FL	9	366	2	N/A	N/A	N/A	9	499,274
	Sebastian-Vero Beach, FL	15	350	1	N/A	N/A	N/A	15	162,518
	Sebring-Avon Park, FL	15	363	1	N/A	N/A	N/A	15	106,639
	Tallahassee, FL	6	366	2	10	117	1	15	389,599
	Tampa-St. Petersburg-Clearwater, FL	9	366	9	32	366	4	41	3,243,963
	Holmes County, FL	4	346	1	N/A	N/A	N/A	4	19,594
	Liberty County, FL	2	362	1	N/A	N/A	N/A	2	8,364
Georgia									
	Albany, GA	N/A	N/A	N/A	89	365	1	89	145,206
	Americus, GA	3	246	1	N/A	N/A	N/A	3	34,478
	Atlanta-Sandy Springs-Alpharetta, GA	2	366	6	66	365	5	67	6,087,762
	Brunswick, GA	2	246	1	10	107	1	12	119,157
	Chattanooga, TN-GA	13	246	2	66	366	3	77	569,931
	Columbus, GA-AL	3	246	2	62	363	4	63	322,658
	Dalton, GA	10	242	1	N/A	N/A	N/A	10	143,869
	Douglas, GA	N/A	N/A	N/A	5	120	1	5	51,611
	Gainesville, GA	N/A	N/A	N/A	55	363	1	55	206,591
	Macon, GA	3	246	1	40	366	2	43	153,159
	Savannah, GA	2	246	1	50	366	1	52	395,983
	Summerville, GA	1	246	1	N/A	N/A	N/A	1	24,843
	Valdosta, GA	N/A	N/A	N/A	19	167	1	19	148,364
	Warner Robins, GA	N/A	N/A	N/A	75	364	1	75	188,060
	Athens-Clarke County, GA	4	246	1	51	365	1	54	214,759
	Augusta-Richmond County, GA-SC	3	341	3	99	346	2	101	614,312
	Washington County, GA	N/A	N/A	N/A	56	357	1	56	20,150
Hawaii									
	Hilo, HI	N/A	N/A	N/A	1	366	6	1	203,340
	Kahului-Wailuku-Lahaina, HI	N/A	N/A	N/A	2	345	2	2	167,902
	Kapaa, HI	N/A	N/A	N/A	0	330	1	0	71,851
	Urban Honolulu, HI	0	366	2	0	366	4	0	963,826

State or territory	Urban area or rural county	Ozone			Particulate			Number of days with elevated ozone and/or particulate	Population
		Number of days with elevated ozone	Number of days with reported ozone AQI	Number of ozone monitors	Number of days with elevated particulate	Number of days with reported particulate AQI	Number of particulate monitors		
Idaho									
	Boise City, ID	31	362	2	91	348	2	104	770,353
	Idaho Falls, ID	23	366	1	N/A	N/A	N/A	23	155,361
	Jackson, WY-ID	25	366	2	37	364	2	48	35,998
	Logan, UT-ID	27	366	1	89	366	2	107	144,219
	Pocatello, ID	27	179	1	N/A	N/A	N/A	27	96,438
	Twin Falls, ID	N/A	N/A	N/A	0	213	1	0	112,989
	Benewah County, ID	N/A	N/A	N/A	61	339	1	61	9,430
	Idaho County, ID	3	328	1	N/A	N/A	N/A	3	16,823
	Lemhi County, ID	N/A	N/A	N/A	43	114	1	43	8,054
	Shoshone County, ID	N/A	N/A	N/A	86	366	1	86	12,911
Illinois									
	Bloomington, IL	25	246	1	59	366	1	78	171,256
	Champaign-Urbana, IL	28	365	2	41	366	2	64	225,547
	Chicago-Naperville-Elgin, IL-IN-WI	30	366	20	64	366	24	84	9,406,638
	Davenport-Moline-Rock Island, IA-IL	16	366	3	62	366	3	74	377,759
	Decatur, IL	14	246	1	56	365	1	64	103,015
	Effingham, IL	10	168	1	N/A	N/A	N/A	10	34,065
	Fort Madison-Keokuk, IA-IL-MO	N/A	N/A	N/A	13	118	1	13	57,732
	Mount Vernon, IL	22	230	1	61	352	1	78	37,235
	Paducah, KY-IL	16	245	2	56	363	1	68	96,090
	Peoria, IL	22	246	2	48	338	1	63	396,781
	Quincy, IL-MO	24	246	1	N/A	N/A	N/A	24	74,593
	Rockford, IL	18	229	1	72	365	1	82	334,072
	Springfield, IL	25	246	1	33	360	1	52	205,950
	St. Louis, MO-IL	24	366	14	59	366	12	75	2,805,473
	Clark County, IL	16	364	1	N/A	N/A	N/A	16	15,268
	Jo Daviess County, IL	17	357	1	N/A	N/A	N/A	17	21,239
	Randolph County, IL	16	246	1	52	362	1	64	31,351
Indiana									
	Bloomington, IN	22	359	1	44	363	2	58	169,052
	Chicago-Naperville-Elgin, IL-IN-WI	30	366	20	64	366	24	84	9,406,638
	Cincinnati, OH-KY-IN	34	366	10	85	366	11	103	2,232,907
	Columbus, IN	23	364	1	26	360	1	43	84,447
	Elkhart-Goshen, IN	14	359	1	42	359	1	52	206,161
	Evansville, IN-KY	17	366	5	52	362	2	66	315,731
	Fort Wayne, IN	30	366	2	95	363	2	111	416,565
	Indianapolis-Carmel-Anderson, IN	20	366	8	101	366	8	112	2,091,019
	Jasper, IN	N/A	N/A	N/A	19	121	1	19	54,920

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	Kokomo, IN	27	366	1	22	360	1	47	82,732
	Lafayette-West Lafayette, IN	12	365	1	93	360	1	103	233,278
	Michigan City-La Porte, IN	42	366	2	14	110	1	55	109,663
	Muncie, IN	23	366	1	15	122	1	35	113,454
	New Castle, IN	N/A	N/A	N/A	13	118	1	13	48,033
	South Bend-Mishawaka, IN-MI	27	366	4	78	349	1	92	323,068
	Terre Haute, IN	23	366	2	61	358	2	72	185,632
	Vincennes, IN	23	360	1	N/A	N/A	N/A	23	36,522
	Wabash, IN	27	366	1	N/A	N/A	N/A	27	30,784
	Louisville/Jefferson County, KY-IN	18	366	7	77	366	7	88	1,268,993
	Perry County, IN	14	366	1	N/A	N/A	N/A	14	19,154
	Spencer County, IN	N/A	N/A	N/A	16	122	1	16	20,225
Iowa									
	Cedar Rapids, IA	16	246	2	81	356	1	90	273,885
	Clinton, IA	18	245	1	22	124	2	39	46,392
	Davenport-Moline-Rock Island, IA-IL	16	366	3	62	366	3	74	377,759
	Des Moines-West Des Moines, IA	12	246	2	49	366	2	58	707,915
	Fort Madison-Keokuk, IA-IL-MO	N/A	N/A	N/A	13	118	1	13	57,732
	Iowa City, IA	N/A	N/A	N/A	92	364	1	92	175,732
	Muscatine, IA	N/A	N/A	N/A	52	358	3	52	42,394
	Omaha-Council Bluffs, NE-IA	11	357	4	43	364	5	53	954,270
	Sioux City, IA-NE-SD	15	360	1	25	363	2	38	144,996
	Waterloo-Cedar Falls, IA	12	246	1	15	122	1	26	168,314
	Montgomery County, IA	6	246	1	11	121	1	17	9,935
	Palo Alto County, IA	15	246	1	11	118	1	23	8,845
	Van Buren County, IA	8	240	1	9	121	1	17	7,069
Kansas									
	Kansas City, MO-KS	16	366	6	51	366	6	58	2,173,212
	St. Joseph, MO-KS	20	246	1	49	359	1	60	122,556
	Topeka, KS	8	366	1	66	328	1	69	230,878
	Wichita, KS	15	366	3	69	366	2	77	643,768
	Neosho County, KS	7	366	1	58	366	1	61	15,929
	Trego County, KS	16	361	1	21	312	1	35	2,758

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Kentucky									
	Bowling Green, KY	11	366	2	48	366	1	55	180,751
	Cincinnati, OH-KY-IN	34	366	10	85	366	11	103	2,232,907
	Clarksville, TN-KY	12	366	2	32	364	2	44	314,364
	Elizabethtown-Fort Knox, KY	14	240	1	27	366	1	38	154,356
	Evansville, IN-KY	17	366	5	52	362	2	66	315,731
	Huntington-Ashland, WV-KY-OH	6	246	4	34	366	3	38	354,085
	Lexington-Fayette, KY	11	245	2	34	366	1	42	520,391
	Middlesborough, KY	2	245	1	5	61	1	7	25,482
	Owensboro, KY	14	245	2	48	366	1	58	119,795
	Paducah, KY-IL	16	245	2	56	363	1	68	96,090
	Somerset, KY	9	245	1	10	122	1	18	65,530
	Carter County, KY	0	245	1	2	119	1	2	26,542
	Louisville/Jefferson County, KY-IN	18	366	7	77	366	7	88	1,268,993
	Morgan County, KY	3	365	1	N/A	N/A	N/A	3	13,142
	Perry County, KY	4	235	1	26	365	1	29	25,456
	Pike County, KY	2	242	1	12	366	1	14	57,057
	Simpson County, KY	4	223	1	N/A	N/A	N/A	4	18,635
	Washington County, KY	12	366	1	N/A	N/A	N/A	12	12,147
Louisiana									
	Alexandria, LA	N/A	N/A	N/A	10	121	1	10	150,821
	Baton Rouge, LA	17	366	7	55	366	3	68	858,571
	Hammond, LA	N/A	N/A	N/A	11	121	1	11	136,765
	Houma-Thibodaux, LA	16	359	1	10	120	1	26	207,455
	Lafayette, LA	26	366	2	17	119	1	43	489,759
	Lake Charles, LA	16	350	2	12	115	1	25	210,313
	Monroe, LA	8	361	1	11	119	1	19	198,836
	New Orleans-Metairie, LA	10	366	3	19	135	4	29	1,272,258
	Shreveport-Bossier City, LA	9	366	2	27	120	1	35	392,404
Maine									
	Augusta-Waterville, ME	1	202	1	2	59	1	3	122,955
	Bangor, ME	5	222	1	7	358	1	11	151,655
	Lewiston-Auburn, ME	1	225	1	16	355	1	16	108,547
	Portland-South Portland, ME	4	366	5	39	362	2	40	543,221
	Rockland, ME	6	149	1	N/A	N/A	N/A	6	39,772
	Aroostook County, ME	0	366	2	16	365	3	16	66,804
	Hancock County, ME	23	366	2	1	360	1	24	55,088
	Oxford County, ME	1	260	1	10	321	1	11	58,132
	Washington County, ME	2	351	2	N/A	N/A	N/A	2	31,473

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Maryland									
	Baltimore-Columbia-Towson, MD	20	361	7	24	365	5	43	2,800,189
	Cambridge, MD	13	366	2	1	358	1	14	31,853
	Hagerstown-Martinsburg, MD-WV	18	246	2	29	362	2	45	291,144
	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	17	366	13	32	366	15	49	6,107,906
	Salisbury, MD-DE	13	366	2	25	361	1	37	423,481
	Washington-Arlington-Alexandria, DC-VA-MD-WV	9	366	15	19	366	9	28	6,324,629
	Garrett County, MD	7	362	1	3	360	1	10	28,852
	Kent County, MD	12	243	1	2	360	1	14	19,192
Massachusetts									
	Barnstable Town, MA	11	351	1	N/A	N/A	N/A	11	213,164
	Boston-Cambridge-Newton, MA-NH	4	366	10	16	366	10	19	4,878,211
	Greenfield Town, MA	2	359	1	48	363	1	50	37,262
	Pittsfield, MA	3	362	1	36	366	2	39	124,571
	Providence-Warwick, RI-MA	22	366	6	20	366	7	40	1,623,890
	Springfield, MA	11	366	2	28	366	3	38	695,654
	Vineyard Haven, MA	9	355	1	N/A	N/A	N/A	9	17,461
	Worcester, MA-CT	12	366	3	36	361	1	46	945,752
Michigan									
	Adrian, MI	23	256	1	51	366	1	70	97,808
	Ann Arbor, MI	30	366	2	48	366	1	74	366,473
	Bay City, MI	N/A	N/A	N/A	15	366	1	15	102,387
	Cadillac, MI	17	364	2	34	338	1	48	48,895
	Detroit-Warren-Dearborn, MI	32	366	5	83	366	10	95	4,304,136
	Flint, MI	23	266	2	24	366	1	44	404,794
	Grand Rapids-Kentwood, MI	34	359	3	19	122	2	52	1,081,372
	Holland, MI	36	269	1	13	361	1	48	118,927
	Kalamazoo-Portage, MI	31	262	1	16	117	1	46	265,988
	Lansing-East Lansing, MI	17	366	2	12	118	1	29	548,248
	Ludington, MI	22	255	1	N/A	N/A	N/A	22	29,164
	Muskegon, MI	38	251	1	N/A	N/A	N/A	38	173,883
	Niles, MI	41	259	1	N/A	N/A	N/A	41	153,025
	South Bend-Mishawaka, IN-MI	27	366	4	78	349	1	92	323,068
	Traverse City, MI	18	264	1	N/A	N/A	N/A	18	151,190
	Huron County, MI	20	266	1	N/A	N/A	N/A	20	30,653
	Manistee County, MI	3	72	1	3	89	1	6	24,738
	Schoolcraft County, MI	12	271	1	4	287	1	16	8,104
	Tuscola County, MI	13	356	1	N/A	N/A	N/A	13	52,289

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Minnesota									
	Bemidji, MN	N/A	N/A	N/A	11	364	1	11	47,442
	Brainerd, MN	3	212	1	13	366	2	16	95,572
	Duluth, MN-WI	2	363	3	10	366	4	12	288,648
	Fargo, ND-MN	6	365	1	21	357	1	27	248,594
	La Crosse-Onalaska, WI-MN	8	211	1	52	366	1	60	137,134
	Marshall, MN	11	230	1	20	363	1	30	25,271
	Minneapolis-St. Paul-Bloomington, MN-WI	7	366	7	34	366	8	41	3,657,477
	Red Wing, MN	9	211	1	N/A	N/A	N/A	9	46,318
	Rochester, MN	17	247	1	26	366	1	41	223,062
	St. Cloud, MN	12	247	1	21	366	1	30	202,996
	Becker County, MN	12	243	1	11	366	1	23	34,456
	Cook County, MN	N/A	N/A	N/A	2	351	1	2	5,417
	Lake County, MN	4	243	1	4	365	1	7	10,639
Mississippi									
	Cleveland, MS	13	257	1	56	365	1	68	30,142
	Gulfport-Biloxi, MS	9	242	3	54	360	3	61	418,963
	Hattiesburg, MS	N/A	N/A	N/A	87	363	1	87	169,554
	Jackson, MS	3	365	2	116	366	2	117	589,082
	Memphis, TN-MS-AR	17	366	5	61	366	5	77	1,348,678
	Meridian, MS	0	255	1	N/A	N/A	N/A	0	98,571
	Tupelo, MS	1	245	1	N/A	N/A	N/A	1	166,201
	Yalobusha County, MS	3	352	1	N/A	N/A	N/A	3	11,982
Missouri									
	Columbia, MO	9	246	1	N/A	N/A	N/A	9	210,094
	Fort Madison-Keokuk, IA-IL-MO	N/A	N/A	N/A	13	118	1	13	57,732
	Jefferson City, MO	11	246	1	N/A	N/A	N/A	11	150,198
	Joplin, MO	12	246	1	N/A	N/A	N/A	12	180,099
	Kansas City, MO-KS	16	366	6	51	366	6	58	2,173,212
	Quincy, IL-MO	24	246	1	N/A	N/A	N/A	24	74,593
	Springfield, MO	9	246	2	38	351	1	43	475,220
	St. Joseph, MO-KS	20	246	1	49	359	1	60	122,556
	St. Louis, MO-IL	24	366	14	59	366	12	75	2,805,473
	Cedar County, MO	11	246	1	23	353	1	32	14,322
	Monroe County, MO	6	366	1	N/A	N/A	N/A	6	8,672
	Perry County, MO	14	246	1	N/A	N/A	N/A	14	19,194
	Ste. Genevieve County, MO	16	246	1	N/A	N/A	N/A	16	17,924

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Montana									
	Billings, MT	N/A	N/A	N/A	35	366	1	35	183,799
	Bozeman, MT	N/A	N/A	N/A	17	358	1	17	116,806
	Butte-Silver Bow, MT	N/A	N/A	N/A	47	366	1	47	35,180
	Helena, MT	12	366	1	47	366	2	55	82,589
	Kalispell, MT	0	365	1	39	362	1	39	105,851
	Missoula, MT	4	361	1	68	366	2	72	121,630
	Fergus County, MT	8	363	1	18	366	1	23	11,104
	Lincoln County, MT	N/A	N/A	N/A	148	364	1	148	20,343
	Phillips County, MT	1	366	1	54	334	1	54	3,919
	Powder River County, MT	11	316	1	61	347	1	64	1,681
	Ravalli County, MT	N/A	N/A	N/A	42	364	1	42	45,002
	Richland County, MT	3	365	1	10	365	1	12	11,043
	Rosebud County, MT	5	341	1	27	304	1	28	8,836
Nebraska									
	Grand Island, NE	N/A	N/A	N/A	24	350	2	24	75,325
	Lincoln, NE	3	245	1	7	120	1	10	337,836
	Omaha-Council Bluffs, NE-IA	11	357	4	43	364	5	53	954,270
	Scottsbluff, NE	N/A	N/A	N/A	53	291	2	53	37,285
	Sioux City, IA-NE-SD	15	360	1	25	363	2	38	144,996
	Knox County, NE	24	366	1	N/A	N/A	N/A	24	8,304
Nevada									
	Carson City, NV	49	324	1	44	366	1	64	56,034
	Fallon, NV	27	364	1	N/A	N/A	N/A	27	25,363
	Fernley, NV	23	351	1	N/A	N/A	N/A	23	58,319
	Gardnerville Ranchos, NV	N/A	N/A	N/A	55	366	1	55	49,088
	Las Vegas-Henderson-Paradise, NV	81	366	13	32	366	10	96	2,315,963
	Reno, NV	45	366	7	53	366	4	75	481,289
	White Pine County, NV	62	363	1	N/A	N/A	N/A	62	9,466
New Hampshire									
	Berlin, NH	24	366	2	N/A	N/A	N/A	24	31,174
	Boston-Cambridge-Newton, MA-NH	4	366	10	16	366	10	19	4,878,211
	Concord, NH	4	215	1	N/A	N/A	N/A	4	152,622
	Keene, NH	1	366	1	26	363	1	27	76,228
	Laconia, NH	2	215	1	4	360	1	6	61,551
	Lebanon, NH-VT	1	366	2	10	364	1	11	217,783
	Manchester-Nashua, NH	7	363	2	1	366	1	8	418,735

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New Jersey									
	Allentown-Bethlehem-Easton, PA-NJ	9	366	3	44	366	3	51	846,399
	Atlantic City-Hammonton, NJ	8	346	1	23	349	2	29	262,945
	New York-Newark-Jersey City, NY-NJ-PA	15	366	17	36	366	20	47	19,124,359
	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	17	366	13	32	366	15	49	6,107,906
	Trenton-Princeton, NJ	23	366	2	34	362	2	55	367,239
	Vineland-Bridgeton, NJ	9	360	1	39	360	1	46	147,008
New Mexico									
	Albuquerque, NM	78	366	5	41	366	5	100	923,630
	Carlsbad-Artesia, NM	110	364	2	N/A	N/A	N/A	110	58,418
	Espanola, NM	48	365	1	0	N/A	N/A	48	38,521
	Farmington, NM	48	366	5	N/A	N/A	N/A	48	123,312
	Hobbs, NM	19	366	1	19	361	1	32	71,830
	Las Cruces, NM	93	366	5	45	366	4	122	221,262
	Santa Fe, NM	68	365	1	9	363	1	69	151,946
	Taos, NM	N/A	N/A	N/A	22	363	1	22	32,593
New York									
	Albany-Schenectady-Troy, NY	6	336	2	58	364	2	60	878,550
	Buffalo-Cheektowaga, NY	34	366	2	7	123	3	38	1,125,637
	Corning, NY	2	366	1	8	353	1	9	94,657
	Ithaca, NY	5	366	1	N/A	N/A	N/A	5	101,058
	Jamestown-Dunkirk-Fredonia, NY	24	364	1	3	116	1	25	126,032
	New York-Newark-Jersey City, NY-NJ-PA	15	366	17	36	366	20	47	19,124,359
	Rochester, NY	23	365	2	24	366	2	42	1,067,486
	Syracuse, NY	12	366	2	21	365	1	32	646,038
	Watertown-Fort Drum, NY	15	366	1	N/A	N/A	N/A	15	108,095
	Essex County, NY	6	364	3	0	58	1	6	36,891
	Hamilton County, NY	3	365	1	N/A	N/A	N/A	3	4,345
North Carolina									
	Asheville, NC	15	247	4	9	363	1	24	466,634
	Charlotte-Concord-Gastonia, NC-SC	4	366	7	26	366	5	30	2,684,276
	Cullowhee, NC	N/A	N/A	N/A	4	113	1	4	58,212
	Durham-Chapel Hill, NC	2	245	2	28	358	1	30	652,542
	Fayetteville, NC	6	245	2	29	364	1	34	529,252
	Greensboro-High Point, NC	9	246	2	23	364	1	32	776,363
	Greenville, NC	4	243	1	13	361	1	17	182,924
	Hickory-Lenoir-Morganton, NC	2	246	2	45	361	1	46	370,266

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	Kinston, NC	6	241	1	N/A	N/A	N/A	6	55,720
	Morehead City, NC	3	366	1	N/A	N/A	N/A	3	69,558
	Myrtle Beach-Conway-North Myrtle Beach, SC-NC	0	218	1	N/A	N/A	N/A	0	514,488
	Oxford, NC	1	239	1	N/A	N/A	N/A	1	44,535
	Raleigh-Cary, NC	6	362	2	27	365	3	33	1,420,376
	Roanoke Rapids, NC	N/A	N/A	N/A	14	334	1	14	68,567
	Rocky Mount, NC	3	234	1	N/A	N/A	N/A	3	145,688
	Virginia Beach-Norfolk-Newport News, VA-NC	1	246	3	12	366	2	12	1,779,824
	Wilmington, NC	3	242	1	10	346	1	13	301,284
	Winston-Salem, NC	11	246	3	44	366	3	55	679,731
	Avery County, NC	12	366	2	N/A	N/A	N/A	12	17,571
	Caswell County, NC	4	244	1	N/A	N/A	N/A	4	22,443
	Graham County, NC	13	244	1	N/A	N/A	N/A	13	8,474
	Macon County, NC	2	365	1	N/A	N/A	N/A	2	35,994
	Martin County, NC	0	242	1	N/A	N/A	N/A	0	22,178
	Mitchell County, NC	N/A	N/A	N/A	9	363	1	9	14,881
	Montgomery County, NC	0	363	1	24	359	1	24	27,238
	Swain County, NC	4	248	2	18	360	1	22	14,179
	Yancey County, NC	30	247	1	N/A	N/A	N/A	30	18,099
North Dakota									
	Bismarck, ND	4	366	2	31	366	2	34	129,641
	Dickinson, ND	2	366	1	5	363	1	6	32,997
	Fargo, ND-MN	6	365	1	21	357	1	27	248,594
	Minot, ND	0	366	1	9	363	1	9	76,444
	Burke County, ND	2	361	1	12	362	1	13	2,118
	Dunn County, ND	1	366	1	5	362	1	6	4,465
	McKenzie County, ND	1	365	1	5	363	1	6	15,242
	Mercer County, ND	2	362	1	8	364	1	9	8,174
Ohio									
	Akron, OH	31	245	2	73	361	3	87	701,449
	Ashtabula, OH	17	242	1	N/A	N/A	N/A	17	96,513
	Athens, OH	N/A	N/A	N/A	3	86	1	3	65,481
	Canton-Massillon, OH	31	246	3	77	360	2	92	396,669
	Cincinnati, OH-KY-IN	34	366	10	85	366	11	103	2,232,907
	Cleveland-Elyria, OH	22	366	8	43	365	10	56	2,043,807
	Columbus, OH	25	246	6	33	360	3	56	2,138,946
	Dayton-Kettering, OH	29	366	4	102	366	2	117	809,248
	Huntington-Ashland, WV-KY-OH	6	246	4	34	366	3	38	354,085
	Lima, OH	29	240	1	14	359	1	42	101,980

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		Number of days with elevated ozone	Number of days with reported ozone AQI	Number of ozone monitors	Number of days with elevated particulate	Number of days with reported particulate AQI	Number of particulate monitors		
	Marietta, OH	12	246	1	N/A	N/A	N/A	12	59,652
	Mount Vernon, OH	19	246	1	N/A	N/A	N/A	19	62,423
	Portsmouth, OH	N/A	N/A	N/A	4	97	2	4	74,347
	Springfield, OH	34	246	2	39	346	1	69	133,593
	Toledo, OH	24	246	4	16	101	3	36	641,549
	Washington Court House, OH	23	343	1	N/A	N/A	N/A	23	28,579
	Weirton-Steubenville, WV-OH	29	246	2	17	126	4	43	115,184
	Wheeling, WV-OH	24	231	1	6	124	3	29	137,217
	Wilmington, OH	24	232	1	N/A	N/A	N/A	24	41,921
	Youngstown-Warren-Boardman, OH-PA	17	366	4	32	366	2	46	531,420
	Harrison County, OH	N/A	N/A	N/A	0	43	1	0	15,014
	Noble County, OH	21	358	1	N/A	N/A	N/A	21	14,364
Oklahoma									
	Ardmore, OK	36	295	1	77	328	1	98	58,583
	Bartlesville, OK	13	318	1	39	338	1	45	52,222
	Fort Smith, AR-OK	2	288	1	12	120	1	14	250,434
	Lawton, OK	32	310	1	33	366	1	60	126,775
	McAlester, OK	9	365	1	54	366	1	62	43,679
	Miami, OK	1	227	1	75	335	1	76	30,879
	Oklahoma City, OK	37	366	4	83	366	4	108	1,425,375
	Ponca City, OK	4	224	1	69	344	1	73	43,274
	Tulsa, OK	13	366	6	70	366	2	78	1,006,411
	Adair County, OK	2	321	1	N/A	N/A	N/A	2	21,955
	Dewey County, OK	33	307	1	30	366	1	58	4,815
	Johnston County, OK	21	292	1	N/A	N/A	N/A	21	10,824
	Mayes County, OK	3	264	1	N/A	N/A	N/A	3	41,152
Oregon									
	Eugene-Springfield, OR	4	149	2	69	366	4	73	382,986
	Grants Pass, OR	N/A	N/A	N/A	12	60	1	12	88,053
	Hermiston-Pendleton, OR	7	147	1	N/A	N/A	N/A	7	89,452
	Klamath Falls, OR	N/A	N/A	N/A	154	359	1	154	68,739
	Medford, OR	13	150	1	31	120	1	41	221,844
	Portland-Vancouver-Hillsboro, OR-WA	4	366	6	51	362	4	55	2,510,259
	Prineville, OR	N/A	N/A	N/A	24	115	1	24	25,105
	Salem, OR	6	146	2	N/A	N/A	N/A	6	436,948
	Harney County, OR	N/A	N/A	N/A	111	358	1	111	7,373
	Lake County, OR	N/A	N/A	N/A	20	110	1	20	7,949

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Pennsylvania									
	Allentown-Bethlehem-Easton, PA-NJ	9	366	3	44	366	3	51	846,399
	Altoona, PA	18	341	1	36	364	1	51	121,007
	Chambersburg-Waynesboro, PA	0	365	1	N/A	N/A	N/A	0	155,637
	DuBois, PA	2	349	1	N/A	N/A	N/A	2	78,612
	East Stroudsburg, PA	2	360	1	N/A	N/A	N/A	2	170,154
	Erie, PA	15	350	1	20	363	1	34	268,426
	Gettysburg, PA	20	366	2	29	284	1	46	102,742
	Harrisburg-Carlisle, PA	16	366	2	88	366	2	97	581,943
	Indiana, PA	21	355	1	5	44	1	26	83,664
	Johnstown, PA	13	344	1	49	366	1	57	128,672
	Lancaster, PA	19	366	2	94	366	2	107	546,192
	Lebanon, PA	0	8	1	26	172	1	26	141,663
	New Castle, PA	9	365	1	N/A	N/A	N/A	9	85,083
	New York-Newark-Jersey City, NY-NJ-PA	15	366	17	36	366	20	47	19,124,359
	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	17	366	13	32	366	15	49	6,107,906
	Pittsburgh, PA	26	366	10	40	366	15	57	2,309,246
	Reading, PA	22	364	2	64	359	1	82	421,017
	Sayre, PA	3	351	1	19	361	1	21	60,221
	Scranton--Wilkes-Barre, PA	5	366	3	29	366	2	33	552,528
	Somerset, PA	8	366	1	N/A	N/A	N/A	8	72,916
	St. Marys, PA	2	366	1	N/A	N/A	N/A	2	29,607
	State College, PA	13	366	2	32	351	1	42	161,496
	Williamsport, PA	9	361	1	30	365	1	38	113,209
	York-Hanover, PA	11	366	2	56	350	1	65	450,448
	Youngstown-Warren-Boardman, OH-PA	17	366	4	32	366	2	46	531,420
	Greene County, PA	12	342	1	15	363	1	24	35,621
	Susquehanna County, PA	N/A	N/A	N/A	14	366	1	14	40,006
	Tioga County, PA	5	350	1	14	359	1	18	40,381
Puerto Rico									
	Adjuntas, PR	N/A	N/A	N/A	4	57	1	4	17,363
	Guayama, PR	N/A	N/A	N/A	7	52	1	7	69,845
	Mayaguez, PR	0	305	1	N/A	N/A	N/A	0	87,048
	Ponce, PR	N/A	N/A	N/A	7	61	1	7	264,513
	San Juan-Carolina-Caguas, PR	6	366	3	9	64	4	15	2,030,000
Rhode Island									
	Providence-Warwick, RI-MA	22	366	6	20	366	7	40	1,623,890

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South Carolina									
	Charleston-North Charleston, SC	2	344	2	23	366	3	25	819,705
	Charlotte-Concord-Gastonia, NC-SC	4	366	7	26	366	5	30	2,684,276
	Columbia, SC	3	352	3	35	358	2	38	847,397
	Florence, SC	0	257	1	6	119	1	6	204,097
	Greenville-Anderson, SC	5	366	3	59	366	2	62	932,705
	Myrtle Beach-Conway-North Myrtle Beach, SC-NC	0	218	1	N/A	N/A	N/A	0	514,488
	Spartanburg, SC	18	265	1	40	328	1	55	326,205
	Augusta-Richmond County, GA-SC	3	341	3	99	346	2	101	614,312
	Chesterfield County, SC	10	290	1	15	285	1	25	45,606
South Dakota									
	Aberdeen, SD	N/A	N/A	N/A	20	366	1	20	42,555
	Brookings, SD	32	353	1	12	366	1	42	35,603
	Pierre, SD	N/A	N/A	N/A	10	363	1	10	20,457
	Rapid City, SD	37	366	2	40	366	2	61	144,514
	Sioux City, IA-NE-SD	15	360	1	25	363	2	38	144,996
	Sioux Falls, SD	19	353	1	25	361	1	39	273,566
	Watertown, SD	6	316	1	19	364	1	23	34,420
	Jackson County, SD	22	358	1	18	366	1	35	3,321
Tennessee									
	Athens, TN	N/A	N/A	N/A	31	362	1	31	54,208
	Chattanooga, TN-GA	13	246	2	66	366	3	77	569,931
	Clarksville, TN-KY	12	366	2	32	364	2	44	314,364
	Cookeville, TN	N/A	N/A	N/A	14	363	1	14	115,359
	Dyersburg, TN	N/A	N/A	N/A	19	359	1	19	36,693
	Jackson, TN	N/A	N/A	N/A	20	358	1	20	179,131
	Kingsport-Bristol, TN-VA	6	246	2	11	364	2	17	308,183
	Knoxville, TN	5	366	5	31	366	7	36	878,124
	Lawrenceburg, TN	N/A	N/A	N/A	12	363	1	12	44,432
	Memphis, TN-MS-AR	17	366	5	61	366	5	77	1,348,678
	Morristown, TN	8	244	1	N/A	N/A	N/A	8	143,982
	Nashville-Davidson--Murfreesboro--Franklin, TN	12	248	5	41	366	4	52	1,961,232
	Sevierville, TN	23	366	2	N/A	N/A	N/A	23	99,244
	Claiborne County, TN	2	354	1	N/A	N/A	N/A	2	32,023
	DeKalb County, TN	5	349	1	N/A	N/A	N/A	5	20,837

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Texas									
	Amarillo, TX	80	358	1	17	355	1	90	265,761
	Austin-Round Rock-Georgetown, TX	22	365	2	84	366	3	103	2,295,303
	Beaumont-Port Arthur, TX	11	364	7	61	364	3	68	391,310
	Brownsville-Harlingen, TX	2	321	1	128	365	2	129	424,180
	College Station-Bryan, TX	N/A	N/A	N/A	40	309	1	40	268,224
	Corpus Christi, TX	22	365	2	70	366	2	87	430,217
	Corsicana, TX	17	358	1	N/A	N/A	N/A	17	50,694
	Dallas-Fort Worth-Arlington, TX	29	366	16	50	366	7	72	7,694,138
	Eagle Pass, TX	N/A	N/A	N/A	55	360	1	55	58,378
	El Paso, TX	68	366	6	78	360	2	126	846,192
	Houston-The Woodlands-Sugar Land, TX	26	366	19	81	366	6	96	7,154,478
	Killeen-Temple, TX	33	366	2	42	362	1	73	468,453
	Kingsville, TX	N/A	N/A	N/A	90	353	1	90	30,717
	Laredo, TX	11	359	1	89	355	1	98	277,681
	Longview, TX[156]	6	358	1	N/A	N/A	N/A	6	220,552
	Lubbock, TX	N/A	N/A	N/A	23	361	1	23	326,364
	Marshall, TX	5	365	1	10	59	1	15	66,553
	McAllen-Edinburg-Mission, TX	6	308	1	92	364	2	96	875,200
	Odessa, TX	N/A	N/A	N/A	35	355	1	35	167,701
	San Antonio-New Braunfels, TX	47	366	3	57	366	4	101	2,590,732
	Texarkana, TX-AR	N/A	N/A	N/A	88	362	1	88	148,838
	Tyler, TX	14	366	1	N/A	N/A	N/A	14	235,806
	Victoria, TX	21	331	1	N/A	N/A	N/A	21	99,562
	Waco, TX	29	365	1	N/A	N/A	N/A	29	277,005
	Brewster County, TX	17	357	1	11	322	1	26	9,237
	Culberson County, TX	71	130	1	N/A	N/A	N/A	71	2,149
	Polk County, TX	9	360	1	N/A	N/A	N/A	9	52,995
Utah									
	Cedar City, UT	21	366	1	19	366	1	33	56,814
	Logan, UT-ID	27	366	1	89	366	2	107	144,219
	Ogden-Clearfield, UT	60	366	3	100	366	2	131	691,359
	Price, UT	43	351	1	N/A	N/A	N/A	43	20,760
	Provo-Orem, UT	78	366	2	83	366	2	128	663,181
	Salt Lake City, UT	71	366	8	62	366	7	108	1,240,029
	St. George, UT	65	366	2	22	359	1	73	184,913
	Vernal, UT	44	366	5	48	359	1	83	35,970
	Duchesne County, UT	61	366	2	55	366	1	100	19,894
	Garfield County, UT	32	366	1	N/A	N/A	N/A	32	5,050
	San Juan County, UT	45	363	1	N/A	N/A	N/A	45	15,278

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Vermont									
	Bennington, VT	2	366	1	16	366	1	18	35,338
	Burlington-South Burlington, VT	9	359	1	24	366	2	30	221,160
	Lebanon, NH-VT	1	366	2	10	364	1	11	217,783
	Rutland, VT	1	366	1	36	366	1	37	57,764
Virgin Islands									
	St Croix County, VI	N/A	N/A	N/A	6	59	1	6	45,980
	St Thomas County, VI	N/A	N/A	N/A	10	77	1	10	46,321
Virginia									
	Blacksburg-Christiansburg, VA	4	347	2	N/A	N/A	N/A	4	167,244
	Charlottesville, VA	4	242	1	12	366	1	16	219,910
	Harrisonburg, VA	1	244	1	5	118	1	6	135,550
	Kingsport-Bristol, TN-VA	6	246	2	11	364	2	17	308,183
	Lynchburg, VA	N/A	N/A	N/A	1	110	1	1	264,386
	Richmond, VA	1	366	5	23	366	5	24	1,303,469
	Roanoke, VA	3	244	1	26	366	2	28	313,784
	Virginia Beach-Norfolk-Newport News, VA-NC	1	246	3	12	366	2	12	1,779,824
	Washington-Arlington-Alexandria, DC-VA-MD-WV	9	366	15	19	366	9	28	6,324,629
	Winchester, VA-WV	3	240	1	14	152	1	17	142,009
	Madison County, VA	2	360	1	N/A	N/A	N/A	2	13,312
	Prince Edward County, VA	0	364	1	N/A	N/A	N/A	0	23,006
	Rockbridge County, VA	0	245	1	N/A	N/A	N/A	0	22,757
	Wythe County, VA	2	238	1	N/A	N/A	N/A	2	28,620
Washington									
	Bellingham, WA	2	142	1	12	366	1	12	231,016
	Bremerton-Silverdale-Port Orchard, WA	N/A	N/A	N/A	21	363	1	21	272,787
	Ellensburg, WA	N/A	N/A	N/A	38	322	1	38	49,204
	Kennewick-Richland, WA	10	145	1	N/A	N/A	N/A	10	303,501
	Mount Vernon-Anacortes, WA	0	17	1	0	142	1	0	130,789
	Olympia-Lacey-Tumwater, WA	7	142	1	N/A	N/A	N/A	7	294,074
	Port Angeles, WA	1	310	1	N/A	N/A	N/A	1	78,067
	Portland-Vancouver-Hillsboro, OR-WA	4	366	6	51	362	4	55	2,510,259
	Seattle-Tacoma-Bellevue, WA	8	366	5	41	366	9	47	4,018,598
	Spokane-Spokane Valley, WA	6	148	2	102	366	2	104	574,585
	Walla Walla, WA	0	57	1	N/A	N/A	N/A	0	61,292
	Yakima, WA	N/A	N/A	N/A	84	362	2	84	251,879
	Okanogan County, WA	N/A	N/A	N/A	109	366	1	109	42,620

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West Virginia									
	Charleston, WV	11	366	1	16	366	2	24	254,145
	Clarksburg, WV	N/A	N/A	N/A	8	118	1	8	91,937
	Fairmont, WV	N/A	N/A	N/A	5	74	1	5	55,962
	Hagerstown-Martinsburg, MD-WV	18	246	2	29	362	2	45	291,144
	Huntington-Ashland, WV-KY-OH	6	246	4	34	366	3	38	354,085
	Morgantown, WV	11	235	1	5	118	1	14	140,199
	Parkersburg-Vienna, WV	10	245	1	12	119	1	19	88,643
	Washington-Arlington-Alexandria, DC-VA-MD-WV	9	366	15	19	366	9	28	6,324,629
	Weirton-Steubenville, WV-OH	29	246	2	17	126	4	43	115,184
	Wheeling, WV-OH	24	231	1	6	124	3	29	137,217
	Winchester, VA-WV	3	240	1	14	152	1	17	142,009
	Gilmer County, WV	0	364	1	N/A	N/A	N/A	0	7,811
	Greenbrier County, WV	2	234	1	N/A	N/A	N/A	2	34,319
	Tucker County, WV	1	360	1	N/A	N/A	N/A	1	6,816
Wisconsin									
	Appleton, WI	15	216	1	44	366	1	59	238,975
	Baraboo, WI	15	204	1	38	366	1	53	64,449
	Beaver Dam, WI	18	365	1	52	366	1	68	87,336
	Chicago-Naperville-Elgin, IL-IN-WI	30	366	20	64	366	24	84	9,406,638
	Duluth, MN-WI	2	363	3	10	366	4	12	288,648
	Eau Claire, WI	9	208	1	45	366	1	54	169,997
	Fond du Lac, WI	11	209	1	N/A	N/A	N/A	11	102,902
	Green Bay, WI	18	213	2	41	366	1	58	323,379
	Janesville-Beloit, WI	18	211	1	N/A	N/A	N/A	18	163,084
	La Crosse-Onalaska, WI-MN	8	211	1	52	366	1	60	137,134
	Madison, WI	17	205	2	70	366	2	82	670,447
	Manitowoc, WI	23	192	1	N/A	N/A	N/A	23	78,757
	Milwaukee-Waukesha, WI	33	366	6	55	366	5	85	1,577,676
	Minneapolis-St. Paul-Bloomington, MN-WI	7	366	7	34	366	8	41	3,657,477
	Platteville, WI	N/A	N/A	N/A	56	365	1	56	51,021
	Racine, WI	37	200	1	N/A	N/A	N/A	37	195,802
	Sheboygan, WI	37	207	2	N/A	N/A	N/A	37	115,240
	Watertown-Fort Atkinson, WI	21	210	1	N/A	N/A	N/A	21	85,038
	Wausau-Weston, WI	6	199	1	N/A	N/A	N/A	6	163,159
	Whitewater, WI	18	200	1	N/A	N/A	N/A	18	103,953
	Ashland County, WI	3	366	1	9	364	1	12	15,415
	Door County, WI	21	205	1	N/A	N/A	N/A	21	27,889
	Forest County, WI	7	341	1	21	357	1	28	8,960
	Taylor County, WI	8	366	1	22	366	1	30	20,318
	Vilas County, WI	7	206	1	9	365	1	15	22,356

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Wyoming									
	Casper, WY	34	366	2	19	365	2	45	80,815
	Cheyenne, WY	25	338	2	25	366	3	39	100,595
	Evanston, WY	42	233	1	N/A	N/A	N/A	42	20,215
	Gillette, WY	26	362	1	6	240	1	28	61,012
	Jackson, WY-ID	25	366	2	37	364	2	48	35,998
	Laramie, WY	60	346	1	11	116	1	65	38,950
	Riverton, WY	40	366	3	18	366	4	51	39,317
	Rock Springs, WY	43	366	4	16	357	2	53	42,673
	Sheridan, WY	13	366	1	11	123	2	22	30,863
	Big Horn County, WY	10	360	1	N/A	N/A	N/A	10	11,575
	Converse County, WY	43	320	1	12	240	1	49	13,804
	Johnson County, WY	24	366	1	N/A	N/A	N/A	24	8,588
	Park County, WY	N/A	N/A	N/A	7	120	1	7	29,331
	Sublette County, WY	36	366	6	16	353	1	45	9,856
	Weston County, WY	27	357	1	N/A	N/A	N/A	27	6,743

Appendix B: Sources of pollutants that contribute to ozone and particulate pollution, by state, 2017

Data are from the EPA's 2017 National Emissions Inventory. "Transportation" includes on- and off-road vehicles. "Industrial and other processes" includes fuel combustion for industrial purposes, chemical and related product manufacturing, metals processing, and other industrial processes.

TABLE B1. SHARE OF NITROGEN OXIDES FROM VARIOUS EMISSION SOURCES, 2017

Percentages represent share of total emissions minus biogenic emissions. Selected emission sources are the top four national emission sources for nitrogen oxides. The category of "Other, from human activity" includes residential, commercial, institutional and miscellaneous sources, but excludes vegetation.

State	Transportation	Electricity generation	Industrial and other processes	Petroleum & related industries	Other, from human activity
Alabama	59%	10%	23%	2%	6%
Alaska	22%	14%	29%	1%	35%
Arizona	75%	12%	6%	0%	7%
Arkansas	52%	13%	19%	4%	12%
California	71%	1%	10%	1%	17%
Colorado	52%	15%	14%	12%	7%
Connecticut	66%	2%	6%	0%	25%
Delaware	75%	5%	11%	3%	7%
District of Columbia	69%	0%	2%	0%	29%
Florida	72%	14%	7%	0%	6%
Georgia	69%	9%	12%	0%	11%
Hawaii	48%	46%	3%	0%	2%
Idaho	59%	0%	11%	0%	29%
Illinois	64%	9%	10%	5%	12%

State	Transportation	Electricity generation	Industrial and other processes	Petroleum & related industries	Other, from human activity
Indiana	54%	23%	16%	2%	5%
Iowa	61%	14%	19%	0%	6%
Kansas	42%	6%	15%	22%	15%
Kentucky	51%	24%	13%	7%	5%
Louisiana	45%	9%	34%	7%	4%
Maine	53%	2%	31%	0%	14%
Maryland	74%	5%	8%	0%	13%
Massachusetts	65%	3%	10%	0%	23%
Michigan	53%	14%	18%	3%	11%
Minnesota	58%	9%	24%	0%	8%
Mississippi	55%	10%	27%	1%	7%
Missouri	61%	18%	9%	0%	11%
Montana	49%	12%	10%	2%	27%
Nebraska	67%	15%	13%	0%	5%
Nevada	69%	4%	10%	0%	17%
New Hampshire	57%	5%	20%	0%	17%
New Jersey	75%	3%	2%	1%	19%
New Mexico	46%	12%	14%	23%	4%
New York	66%	4%	8%	0%	23%
North Carolina	68%	15%	11%	0%	6%
North Dakota	39%	24%	22%	12%	3%
Ohio	61%	18%	12%	1%	7%
Oklahoma	37%	8%	27%	18%	10%
Oregon	63%	2%	8%	0%	27%
Pennsylvania	52%	11%	14%	13%	10%
Rhode Island	72%	5%	5%	0%	18%
South Carolina	68%	7%	18%	0%	6%
South Dakota	73%	2%	13%	0%	12%
Tennessee	69%	8%	16%	0%	6%
Texas	47%	10%	16%	22%	4%
Utah	51%	22%	8%	11%	7%
Vermont	70%	1%	9%	0%	19%
Virginia	69%	7%	15%	2%	8%
Washington	74%	4%	8%	1%	14%
West Virginia	28%	34%	10%	20%	7%
Wisconsin	60%	12%	17%	0%	11%
Wyoming	30%	25%	28%	14%	4%

TABLE B2. SHARE OF VOLATILE ORGANIC COMPOUNDS FROM VARIOUS EMISSION SOURCES, 2017

Percentages represent share of total emissions minus vegetation emissions. Selected emission sources are the top four national emission sources for volatile organic compounds. The category of "Other, from human activity" includes residential, commercial and institutional sources; industrial and other processes; electricity generation; and miscellaneous sources excluding vegetation emissions.

State	Wildfires and prescribed burning	Transportation	Petroleum & related industries	Solvent utilization	Other, from human activity
Alabama	37%	27%	4%	17%	16%
Alaska	96%	2%	0%	0%	1%
Arizona	47%	26%	0%	20%	7%
Arkansas	56%	12%	3%	13%	16%
California	65%	12%	2%	12%	9%
Colorado	19%	20%	37%	12%	13%
Connecticut	1%	41%	0%	43%	15%
Delaware	2%	59%	1%	20%	18%
District of Columbia	0%	39%	0%	55%	5%
Florida	29%	31%	0%	27%	12%
Georgia	9%	34%	0%	32%	25%
Hawaii	7%	41%	5%	30%	17%
Idaho	83%	6%	0%	5%	5%
Illinois	13%	27%	14%	31%	15%
Indiana	5%	29%	6%	40%	20%
Iowa	5%	27%	0%	34%	34%
Kansas	57%	7%	20%	10%	7%
Kentucky	18%	18%	14%	22%	27%
Louisiana	39%	13%	15%	10%	22%
Maine	4%	49%	0%	19%	28%
Maryland	3%	44%	0%	37%	16%
Massachusetts	0%	38%	0%	43%	19%
Michigan	4%	36%	6%	38%	16%
Minnesota	18%	32%	0%	24%	26%
Mississippi	30%	17%	6%	19%	27%
Missouri	56%	16%	0%	17%	10%
Montana	87%	3%	5%	2%	3%
Nebraska	22%	25%	2%	29%	22%
Nevada	42%	23%	0%	21%	13%
New Hampshire	3%	46%	0%	27%	24%
New Jersey	4%	37%	0%	38%	20%
New Mexico	20%	10%	56%	8%	7%

State	Wildfires and prescribed burning	Transportation	Petroleum & related industries	Solvent utilization	Other, from human activity
New York	1%	38%	2%	40%	19%
North Carolina	11%	32%	0%	35%	22%
North Dakota	5%	4%	83%	6%	3%
Ohio	2%	31%	6%	40%	21%
Oklahoma	42%	10%	30%	7%	12%
Oregon	84%	6%	0%	6%	4%
Pennsylvania	2%	24%	28%	33%	13%
Rhode Island	1%	36%	0%	49%	14%
South Carolina	27%	29%	0%	23%	21%
South Dakota	52%	13%	1%	24%	10%
Tennessee	15%	29%	1%	32%	22%
Texas	13%	12%	53%	12%	10%
Utah	37%	13%	33%	11%	5%
Vermont	2%	37%	0%	26%	36%
Virginia	13%	35%	4%	29%	20%
Washington	63%	15%	0%	15%	6%
West Virginia	12%	12%	52%	9%	15%
Wisconsin	7%	37%	0%	36%	20%
Wyoming	18%	8%	52%	3%	19%

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