

# Western boom cities see spike in harmful ozone

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The reduction of harmful ground-level ozone across most of the U.S. over the past several decades has been an air pollution success story. But in some parts of the country, especially in the heavily populated mountain valleys of the West, the odorless, colorless gas has remained stubbornly difficult to reduce to safe levels.

Meanwhile, a growing body of research shows that the levels considered

safe may still be too high and should be substantially lowered.

Cities with chronically hazardous levels of ozone include Salt Lake City, Phoenix and Albuquerque, New Mexico. But the levels in Colorado's Front Range, along the eastern edge of the Rockies, are among the highest in the country—and this summer were the worst on record there.

The spike in ozone, a smoke-filled wildfire season and the ongoing pandemic created a no-win situation for people living within the Front Range, the most populated area of Colorado, which stretches more than 130 miles from Fort Collins through the Denver area and Colorado Springs. Exercising indoors with others is a high risk for COVID-19 transmission, while high levels of ozone and particulate matter outdoors are dangerous to human health.

"What should you do? We don't really know," said James Crooks, an air pollution researcher at National Jewish Health, a hospital specializing in respiratory disorders. "Unfortunately, there's not a great body of research to figure out what the trade-off is."

Along the Front Range, a place where you might expect fresh mountain breezes, this past summer the levels of ozone routinely spiked above the federal limit of 70 parts per billion—a level that the Environmental Protection Agency lowered from 75 parts per billion in 2015. Officials issued "action alert" health warnings on 65 days there during the peak season from May 31 to Aug. 31, the highest since record-keeping began in 2011.

The World Health Organization suggests that, based on new research, the limit should be 60 parts per billion to better protect human health. The EPA said at the end of October it was reviewing the 70 ppb limit to see whether change was warranted.

Children, older adults and people with heart and lung problems and other preexisting conditions are warned not to spend extended time outdoors. For much of the summer, the indoors was the only safe place for many people.

"The last two years it has been really, really bad," said Crooks. Ozone is "the second-most dangerous widespread pollutant after particulate matter, and we know it impacts not just your lungs."

In some places, sporting events were canceled because of high levels of ozone and wildfire smoke. Schools in Provo, Utah, canceled football and soccer games in August because of ozone and other air pollution. The athletic department at the University of Utah in Salt Lake City has its own air quality monitor for tracking particulate and ozone levels to know when to cancel practice or games.

Ozone, which is chemically similar to chlorine, though less toxic, may be most often thought of as a gas in the upper atmosphere, or stratosphere, where it acts to shield the Earth from the sun's ultraviolet rays. Ground-level, or tropospheric, ozone is created when auto exhaust and emissions from oil and gas production get baked by the sun. Cities at higher elevations get more solar irradiance than cities lower in altitude and that increases the reactions that turn nitrous oxide and [volatile organic compounds](#) into ozone.

The gas is highly toxic to plants and animals, including humans. "Good up high, bad nearby" is the phrase some use to differentiate the protective, stratospheric ozone layer from ground-level ozone.

Ozone poses multiple serious threats to human health. "When our bodies breathe in ozone, it's like a sunburn of the lungs," said JoAnna Strother, senior director of advocacy for the American Lung Association. It can cause shortness of breath and stinging in the eyes, trigger asthma attacks,

and make people susceptible to pulmonary inflammation and coronary damage. It can increase the risk of other respiratory infections and trigger cardiac arrest. Exposure to ozone during pregnancy may result in lower birth weights.

It's also been shown to exacerbate COVID-19 symptoms and increase mortality from the disease, and to increase the prevalence of Type 2 diabetes in people who spend time outdoors. In a study published last year, researchers in Colorado detected a reduction in bacterial diversity in the microbiome of the human gut from ozone, which could increase the risk of numerous chronic illnesses.

More than a million premature deaths are caused globally each year by ozone. Experts also say the burden of air pollution falls disproportionately on low-income, nonwhite and otherwise disenfranchised people who often lack the resources to move.

A new type of research into the impacts of air pollution at the single-cell level has found that exposure to ozone and fine-particle pollution may cause lifelong health problems. In a study of predominantly Hispanic children 6 to 8 years old in California's ozone-plagued Central Valley, air pollution was found to impair the expression of genes that regulate the immune system, and can lead to increased levels of heart disease and other problems. These changes may even be passed on to offspring.

"It looks like even brief air pollution exposure can actually change the regulation and expression of children's genes and perhaps alter blood pressure, potentially laying the foundation for increased risk of disease later in life," said Dr. Mary Prunicki, director of air pollution and health research at Stanford University's Sean N. Parker Center for Allergy and Asthma Research.

Ground-level ozone is primarily human-caused. The smoke from

wildfires, which plague Colorado and the West every summer but were especially bad this year, add much to the problem of both ozone and fine-particle pollution. Ozone from Asia also crosses the Pacific and adds to the burden.

"We are not nearly as strict as other states—for example, California—and not nearly as strict as Europe for vehicle [emissions](#)," said Frank Flocke, an atmospheric chemist at the National Center for Atmospheric Research in Boulder, Colorado, who studies air pollution.

The other major factor is volatile organic compounds—methane, ethane, benzene and other substances—emitted by the burning and production of natural gas and oil and gas operations, he said.

"The meteorology here is also part of the problem," said Flocke. "You have prolonged high-pressure systems and the air gets really stagnant and the effects get amplified."

Climate change is a major contributor. "If you are under polluted conditions as the climate warms, you get more ozone," said Daniel Jacob, a professor of atmospheric chemistry at Harvard University.

While the air quality on the Front Range improved through the past decade, it grew worse the past two years. State officials say they are moving to address sources of pollution; critics say they are not taking it seriously enough as the Front Range continues to boom, adding people and pollution.

"I don't think there's an easy fix," said Flocke. "We need more aggressive regulation and shifting of our habits. We need to try to get people to use public transit."

Increasing the use of electric vehicles and renewable energy is key to the

strategy in Denver and other [ozone](#)-plagued cities, he and others said. "The things that we do to address [climate change](#) are the things that would clean up our air immediately," said Crooks. "We'd get two birds for one stone."

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