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ISSUE BRIEF

CLIMATE CHANGE AND HEALTH IN COLORADO

Have you noticed that Colorado summers are getting hotter? Does it seem like wildfire season is lasting longer? Are you finding the air hazier and harder to breathe during fire season?

It's not your imagination. Climate change is altering seasonal patterns, making hot days more intense, and contributing to the rising number of disasters in Colorado like the 2012 High Park Fire.[1] As a result, we face a variety of health impacts like more heat-related illnesses, breathing and heart troubles, food and water contamination, traumatic injuries during extreme weather, mental health threats, and increased exposure to infectious diseases.[2] These threats will only increase as big polluters and our transportation systems continue to pump climate-changing pollution from burning coal, oil, and natural gas into the air.

The good news is that we can protect ourselves from these impacts by moving to cleaner and more efficient energy strategies and preparing more effectively for future climate-fueled disasters.[3]

CLIMATE CHANGE WILL MAKE IT HARDER FOR COLORADANS TO BREATHE

More than 3.5 million people live in 11 Colorado counties that experience one or more unhealthy ground-level ozone (i.e., smog) days per year (Figure 1).[4] Smog forms when pollution from power plants, vehicles, oil and gas operations, and other sources reacts with sunlight to create ground-level ozone.[5] Higher temperatures driven by carbon pollution can speed up this process and lead to more smog.[6]

Climate change and increasing urban development in fire-prone areas are exposing Coloradans to more wildfire smoke, which contains unhealthy particle pollution and other contaminants.[7] In the western United States, higher temperatures increase the severity of droughts, which reduce water availability and dry out vegetation. These conditions in turn fuel larger and more frequent fires.[8] Drier forests have contributed to an increasing number of large fires across the West, where the total area burned by wildfire doubled from 1984 to 2015.[9] On state and private lands in Colorado, the average annual acreage burned increased more than tenfold from the 1960s to the 2010s.[10] By the middle of this century, the combination of high carbon emissions and population growth could expose more than 5.5 million Coloradans to wildfire smoke as many as three times from 2040 to 2059—increasing the likelihood of negative health effects.[11]

Smog and fine particulate matter (i.e., small particles, like soot) are powerful asthma triggers and have also been linked to preterm births, birth defects, developmental delays in children, strokes, heart attacks, dementia in older adults, lung cancer, autoimmune diseases, type 2 diabetes, and other health problems.[12] High smog and particle pollution levels contributed to an estimated 73 excess deaths and 153 excess illnesses in Colorado between 2013 and 2015.[13] During Colorado's historic fire season of

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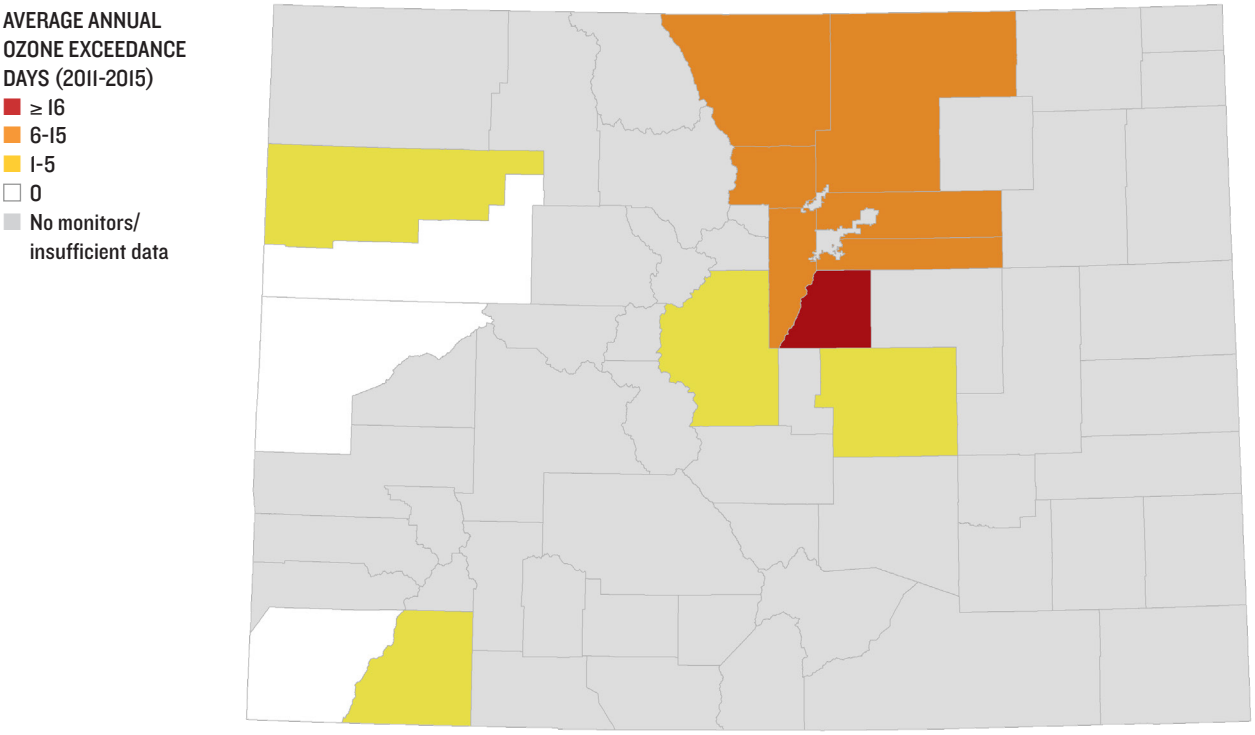
FIGURE I. COLORADO COUNTIES WITH AN AVERAGE OF ONE OR MORE UNHEALTHY GROUND-LEVEL OZONE (SMOG) DAYS FROM 2011 TO 2015

Ozone exceedances are days when an eight-hour average concentration of ozone exceeded the 2015 Ozone National Ambient Air Quality Standards (0.070 parts per million).



Source: NRDC.[14]

2012, one-hour maximum concentrations of fine particulate matter reached more than 5,000 micrograms per cubic meter.[15] (The U.S. Environmental Protection Agency's 24-hour standard for fine particulate matter is just 35 micrograms per cubic meter.)[16] During those fires, the risk of asthma-related emergency room visits increased by 7 percent for each 5 microgram per cubic meter increase in particle pollution.[17]

Climate change-fueled increases in smog and wildfire smoke are likely to increase health care costs for the estimated 107,000 children and 380,000 adults in Colorado who have been diagnosed with asthma, which is already an expensive condition to treat.[18] In 2012, the disease generated an estimated $2,484 in medical costs per Colorado asthma patient and a cumulative cost of $43.9 million in lost work and school days in the state.[19]

Children in poverty are particularly sensitive to declines in air quality because they are more likely to develop asthma in the first place and to be exposed to asthma triggers.[20] In Denver, an estimated 33,000 children under the age of 18—nearly a quarter of the city's children—were living in poverty in 2015.[21] Low-income households and communities of color in the Denver metropolitan region tend to be concentrated in areas with higher exposure to traffic pollution.[22]

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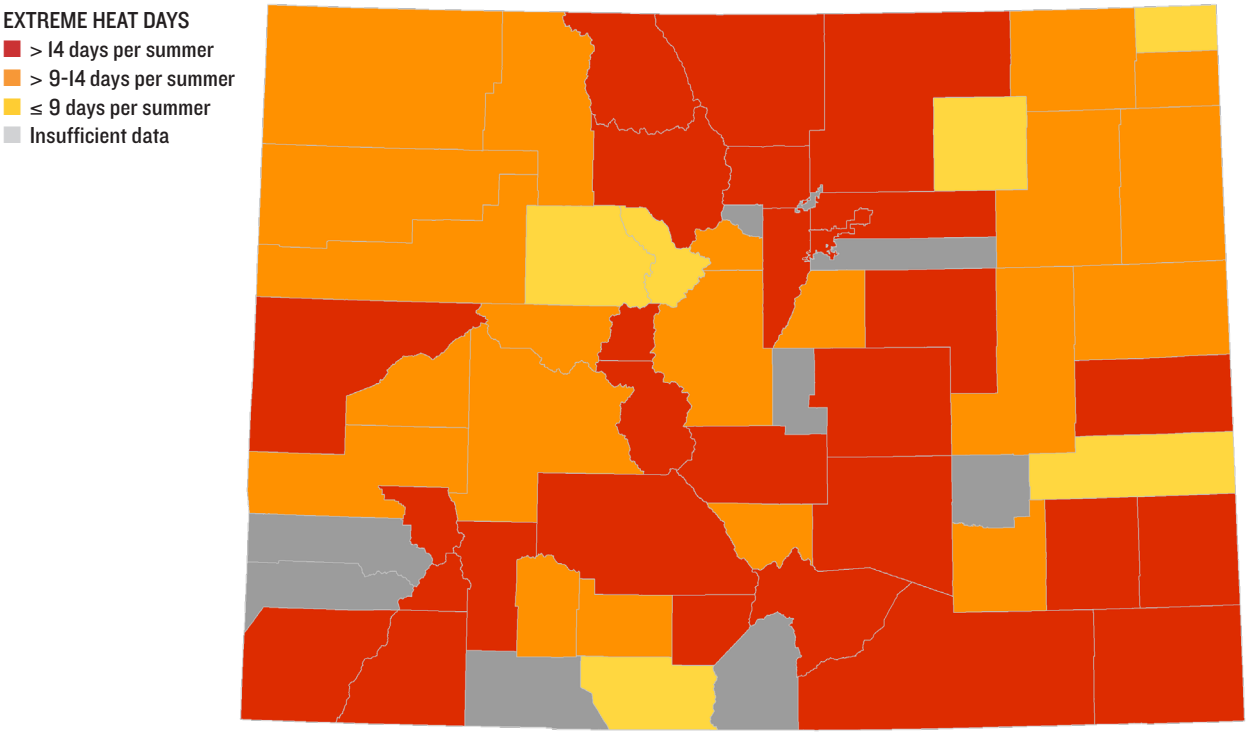
FIGURE 2. AVERAGE NUMBER OF EXTREME HEAT DAYS EACH YEAR IN COLORADO COUNTIES, 2007-2016

"Extreme heat days" are defined here as days from June 1 to August 31 on which the maximum temperature at a given station fell within the top 10 percent of maximum readings at that station from 1961 to 1990.



Source: NRDC.[23]

EXTREME HEAT IS BAD FOR COLORADANS' HEALTH

Colorado summers are getting hotter—and could become downright dangerous in just a few decades. One way to define extreme heat is to look at maximum temperatures, which have climbed more than 2 degrees Fahrenheit in Colorado since 1895.[24] From 2007 to 2016, 84 percent of Coloradans lived in counties that experienced more than nine extreme heat days per year, more than expected from local historical averages (Figure 2).[25] From 2000 to 2016, Fort Collins averaged nine days each year that were 95°F or above; from 1900 to 1999, there were an average of just two such days per year.[26]

Heat already poses a range of threats to Colorado residents, from minor illnesses like heat cramps to deadly conditions like heat stroke or heat-related heart attacks.[27] From the beginning of June through August 2017, 25 of 33 general hospitals in Boulder, Denver, Jefferson, Adams, Arapahoe, and Douglas counties reported a total of 104 emergency room visits for heat-related illnesses.[28]

Anyone can get sick from extreme heat, but older adults are particularly vulnerable to heat-related illnesses because the ability to regulate internal temperature declines with age.[29] Colorado's population is aging at one of the fastest rates in

the country because of migration from other states and the aging of baby boomers.[30] The number of residents 65 years old or more is expected to climb from about 555,000 in 2010 (11 percent of the population) to more than 1.4 million in 2040 (19 percent of the population).[31]

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Extreme heat can also make strenuous outdoor activity more dangerous.[32] This is especially relevant in Colorado, where nearly 61 percent of residents engage in at least 150 minutes of moderate aerobic activity per week (compared with just under 51 percent nationally), and an estimated 71 percent of residents participate in outdoor recreation each year.[33] In July 2017, a 49-year-old mother of two died from heat stroke complications while hiking in Black Canyon of the Gunnison National Park.[34] And in 2017, Colorado ranked last in the country for implementing safety guidelines to protect high-school athletes from heat stroke and other health threats.[35]

Colorado's farmworkers face the double threats of poverty—which can limit access to air-conditioning—and strenuous working conditions, including prolonged exposure to extreme heat.[36] These threats are particularly acute for migrant and seasonal farmworkers, who may face language barriers or concerns about their immigration status, potentially hindering their access to information or their willingness to report illness.[37] A 2013 study of one health facility in Colorado found the likelihood of migrant farmworkers seeking health care increased 88 percent on very hot days.[38]

Finally, heat vulnerabilities associated with age, occupation, and socioeconomic factors are more pronounced in cities, where the urban heat island effect (produced by tall buildings that block airflow and by heat-absorbing surfaces like asphalt) amplifies carbon pollution-fueled warming.[39] In Denver, for instance, daily summer temperatures from 2004 to 2013 were an average of 4.9°F higher than in nearby rural areas.[40] Elyria-Swansea, a low-income, majority Hispanic neighborhood, is one of Denver's most heat-vulnerable areas.[41] Nearly 41 percent of the neighborhood is covered by buildings, parking lots, and other heat-absorbing surfaces, and more than 11 percent of households do not have vehicle access, which may make it difficult for residents to get to air-conditioned spaces during heat waves.[42]

HIGHER TEMPERATURES AND HEAVIER RAINSTORMS COULD MAKE COLORADO'S DRINKING WATER UNSAFE

No one wants to drink or swim in water that looks like it's covered by a layer of pea soup. But algae-filled water isn't just unappealing—it's also bad for our health. Harmful algal blooms form when some species of naturally-occurring algae rapidly accumulate in water bodies and produce toxins that cause symptoms ranging from skin irritation, diarrhea, and vomiting to liver or kidney damage.[43] Treatment facilities can remove algal toxins from drinking water, but the process is expensive and may not be completely effective.[44] To keep swimmers and boaters safe, municipalities will often close waterfronts or issue advisories.[45] However, Colorado does not currently require regular, statewide testing for algal toxins in drinking or recreational water.[46]

Algal blooms happen with or without climate change, but higher temperatures can speed up algal growth and promote toxic species over nontoxic ones.[47] Algal blooms are also more likely to occur when rain washes animal wastes, artificial fertilizers, and other nutrient-rich pollution into rivers and lakes.[48] Colorado is a major livestock producer: in 2016, the state ranked fifteenth in the nation for hog production, tenth for cattle production, and third for sheep production.[49] At the same time, climate change is expected to increase extreme rainfall in the state.[50] With continued high emissions of climate-changing pollution, Colorado and other Northern Plains states (Montana, North Dakota, South Dakota, and Nebraska) could see an average of about six more days each year with harmful algal blooms by 2050.[51]

Extreme rainfall can also cause floods that damage sewage treatment plants, oil and gas wells, and other hazardous facilities.[52] Nearly 70 percent of waterborne disease outbreaks in the United States between 1948 and 1994 happened after heavy precipitation.[53] In the Colorado Front Range, a historic week of rain in 2013—with more than 20 inches falling in some locations—led to severe flooding that killed eight people and caused more than $2 billion in damage.[54] By one estimate, climate change increased the amount of rain that week by 30 percent.[55] About 20 million gallons of untreated sewage and as much as 270 million gallons of partially treated sewage flowed into the floodwaters, leading to elevated levels of bacteria in Boulder Creek, the Big Thompson River, and the South Platte Basin.[56] Flooding also destroyed the water distribution system of the Town of Jamestown and contaminated local wells, making the area uninhabitable for months.[57] Jamestown Elementary School was closed for an entire school year partly because of a lack of drinking water. By 2080, the amount of rain falling during extreme 24-hour events could increase 15 to 20 percent across much of Colorado.[58]

SEVERE DROUGHTS WILL HARM THE HEALTH OF COLORADO RESIDENTS

In addition to heavier rainstorms, Colorado faces a future with more severe droughts.[59] Warming in the Western United States from 1955 to 2016 led to an estimated loss of 15 to 30 percent of the water stored in the region's April snowpack.[60] The amount of water flowing through the Colorado River—which serves 40 million people in Colorado and six other states—has also decreased because of warming. Between 2000 and 2014, the river's flow was 19 percent below the 1906 to 1999 average; this could decline another 20 to 30 percent by the 2050s.[61]

Drought can be a slow-moving disaster with the potential to affect human health by limiting supplies of clean water, reducing air quality, and imposing financial hardships on farmers and workers in other water-dependent industries.[62] In California, surveys of two counties in October and November 2015 suggested that drought-related losses in household finances increased the probability of negative health effects and acute stress.[63] From 2000 to 2013, the risk of mortality from all causes among Medicare recipients was 1.55 percent higher during periods of high-severity and worsening drought than during non-drought periods across the Western United States.[64] However, the exact link between drought and increased deaths among older adults is not yet established.

ACTING ON CLIMATE CAN PROTECT OUR HEALTH

The good news is that cleaning up power plants, vehicles, and other big carbon pollution emitters will help protect our health by limiting the dangerous effects of climate change and by cutting unhealthy smog, soot, and other air pollution.

For instance, from 2007 to 2017, Colorado's wind and solar power averted the production of nearly 36 million metric tons of carbon dioxide, the equivalent of what passenger vehicles traveling more than 87.8 million miles would produce. This also reduced emissions of sulfur dioxide and nitrogen oxides—building blocks of smog and particle pollution—by more than 25,000 metric tons and nearly 37,000 metric tons, respectively.[65]

But there's a lot more to do. Colorado only reduced its carbon dioxide emissions by about 5 percent from 2005 to 2015—well below the national average of 11.8 percent.[66] In July 2017, Colorado Governor John Hickenlooper signed an executive order directing the state to cut greenhouse gases 26 percent by 2025 (compared with 2005 levels), and to use energy efficiency to reduce electricity use by 2 percent per year through 2020.[67] This action represents a huge step forward for Colorado, but the state can and should increase its energy efficiency targets and accelerate the growth of clean energy in the power sector, buildings, and transportation.[68]

Transportation is the second largest source of carbon dioxide pollution in Colorado after power plants, accounting for nearly 31 percent of emissions in 2015.[69] In January 2018, state agencies finalized a plan mandated by the governor to reach nearly 1 million electric vehicles in the state by 2030.[70] If these efforts are realized, Colorado could cut up to 3 million tons of climate changing pollution and 800 tons of smog-forming nitrogen dioxides.[71]

Colorado should also consider a clean transportation plan that promotes diverse travel options beyond single-occupant vehicles. Such a plan could deliver numerous health benefits, including less traffic jam-induced stress, improved response times by paramedics, higher birth weights because of improved air quality, and fewer premature adult deaths resulting from increased physical activity and less road pollution.[72] Denver's long-term transportation plan is a good example of what the state should consider. The plan aims to cut per capita greenhouse gas pollution from surface transportation 60 percent from 2010 levels by 2040 through improved traffic flow, increased active transportation options (e.g., biking), and other measures. Denver's plan also aims to add rapid transit rail lines and improve local bus service (which could make it easier for low- and moderate-income workers to get to work) and to expand door-to-door transit options (which could help elderly people stay mobile).[73]

Colorado also needs to create and implement more detailed plans to address the health impacts of climate change that are already being felt today. The state's 2015 Climate Adaptation Plan recommended some health initiatives, including emphasizing climate change in disaster preparedness plans and working to better understand the relationship between climate change and mosquito- and tick-borne diseases.[74] However, the state has made little visible progress since then and seems to be considering a fairly narrow suite of climate-related health hazards.[75] The Colorado Department of Public Health and Environment should quickly develop a climate vulnerability assessment that combines data on socioeconomic and other health risk factors with information about the ability of communities, health providers, and other key institutions to cope with the health consequences of climate threats. Such an assessment will help the state make evidence-based choices about which climate impacts to emphasize in planning exercises and how to best help the people most vulnerable to those impacts.[76]

The bottom line is that Colorado residents have much to gain from climate action, and much to lose if we fail to clean up climate-changing pollution and build resilience to the changes that have already occurred.

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