Los Angeles Times

Extreme heat is one of the deadliest consequences of climate change.

But California undercounts the human toll...

...even as heat waves become more frequent and more deadly.

By Anna M. Phillips, Tony Barboza, Ruben Vives **and** Sean Greene

Photography by Genaro Molina

October 7, 2021

It was the hottest August on record in California.

For more than three weeks in 2020, back-to-back heat waves settled over the Southwest, claiming dozens of lives and leaving tens of millions of people sweltering in triple-digit temperatures. The days brought suffering and the nights offered little relief. On maps of the record heat, Southern California glowed like an ember, its normally temperate coast shaded orange, its inland cities and desert towns a deep, smoldering purple.

Seventy-three-year-old Jorge Valerio-Santiago went to work on Aug. 20 digging cable trenches at a mobile home park outside Desert Hot Springs in Riverside County. After several hours, he began to feel ill and returned home to a trailer that lacked air conditioning. His nephew found him that evening, lying still in the dirt driveway where he had gone into cardiac arrest. The paramedics pronounced him dead at the scene.

When a second heat wave bore down roughly two weeks later, Anne Gacambi Methu's family hoped she would be safe inside her assisted living facility in Riverside. But on that 117-degree day, she was outside for hours, according to a coroner's report, and last seen by staff while walking around the facility's courtyard. It was only after a shift change that employees found her lying on the ground.

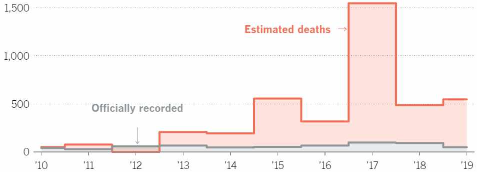
Extreme heat is one of the deadliest consequences of global warming. But in a state that prides itself as a climate leader, California chronically undercounts the death toll and has failed to address the growing threat of heat-related illness and death, according to a Los Angeles Times investigation.

Between 2010 and 2019, the hottest decade on record, California's official data from death certificates attributed 599 deaths to heat exposure.

But a Times analysis found that the true toll is probably six times higher. An examination of mortality data from this period shows that thousands more people died on extremely hot days than would have been typical during milder weather. All told, the analysis estimates that extreme heat caused about 3,900 deaths.

Extreme heat causes more deaths than official records show

A Times analysis found extreme heat caused 3,900 deaths in California over a decade, six times the official count of heat-related fatalities.



Times analysis, Tracking California

LOS ANGELES TIMES

California's undercount is one of the ways it overlooks the threat posed by heat waves, even as climate change delivers them more frequently, more intensely and with deadlier consequences. Other states are moving with greater urgency to confront this public health challenge that disproportionately imperils the elderly and vulnerable.

Extreme heat did not suddenly become a threat to Californians' lives. The Times found that state leaders have ignored years of warnings from within their own agencies that heat was becoming more dangerous. Data reviewed by The Times show heat-related hospital visits increasing in some parts of California, including Los Angeles County, for at least the last 15 years.

Experts interviewed by The Times said an effective state response would include identifying and assisting vulnerable populations, and putting in place a surveillance system to track when and where heat-related deaths and injuries are occurring. But the California Department of Public Health doesn't collect that kind of real-time data. It can't say how many people died in last year's heat waves because it does not examine death records during severe heat waves — as authorities in Oregon and Washington did this summer after days of record-breaking temperatures.

Each year, extreme heat kills more Americans than any other climate-fueled hazard, including hurricanes, floods and wildfires, but it gets far less attention because it kills so quietly.

As heat waves intensify, access to air conditioning can mean life or death

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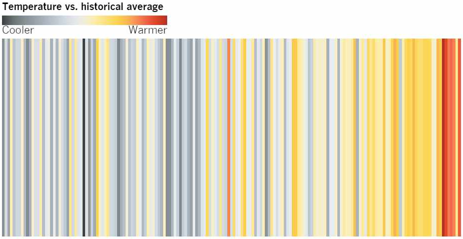
Like other effects of climate change, its harms fall most heavily on the poor, the infirm, the very young and the elderly. State data also show that Black Californians are more likely than those of any other race to die from heat, and people over the age of 65 are especially at risk.

People die in stifling homes, apartments and trailers they can't afford to air-condition. They collapse while working in the sun at jobs they can't afford to lose. What for some is a nuisance is for others a threat to survival.

"Heat in particular is something that people with more resources and privilege can insulate themselves from — literally," said Elizabeth Rhoades, who directs the L.A. County health department's climate change and sustainability program. "People who have air conditioning, people who have jobs that don't require them to be outside or in a hot warehouse can view a heat wave a little more like a mild inconvenience rather than the life-threatening event it could be."

California temperatures 1850-2020

The average temperature in the state has been steadily climbing.



Stripes are colored based on deviations in degrees Celsius from the average temperature between 1951 and 1980.
Berkeley Earth

LOS ANGELES TIMES

In 2013, a group of state agencies, led by the Department of Public Health and California Environmental Protection Agency, issued more than 40 recommendations to prepare for extreme heat. Years later, the state has taken little of its own advice, including that the health department “improve the timeliness” of death surveillance during heat waves.

A state health department spokesman said the agency is still working on those recommendations and has made progress on six of them.

When California’s worst heat wave in more than 50 years struck in 2006, killing an estimated 650 people and overwhelming hospitals, it should have been a wake-up call, said Paul English, who worked as an environmental epidemiologist for the state health agency for more than two decades before retiring this year. Instead, he said, requests from within the agency for funding to monitor heat-related deaths and illnesses in real time were denied.

The department is “mostly driven by the crisis of the moment,” said English, who now works for the Public Health Institute, a nonprofit group. “Timely information is really important, but the system to track statewide deaths and ER visits in real time has not been developed.”

California’s public health department declined to make its director, Dr. Tomás Aragón, available for an interview. In an email, agency spokesman Matt Conens wrote that the state health department, as well as county and city agencies, issues heat warnings and uses notification systems to protect the public. He said there is no requirement for the agency to collect real-time information on heat illness.

“Promoting awareness of and prevention of heat-related morbidity and mortality continues to be a priority,” he wrote.

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Gov. Gavin Newsom’s administration acknowledges that state agencies haven’t done enough to prepare for extreme heat.

Newsom’s senior climate advisor, Lauren Sanchez, said a lack of funding and urgency prevented the state from carrying out many of its 2013 recommendations. She said the administration is now working on a new strategy and has set aside hundreds of millions of dollars to respond to worsening heat waves.

Sanchez said the administration’s actions are informed by climate science “on heat that specifically means the state needs to be doing so much more to protect Californians,” adding that the deaths from recent heat waves have “definitely underscored our urgency.”

Extreme heat kills more Americans every year than any other climate-fueled hazard. People die in stifling homes, trailers and vehicles. They collapse while working in the sun at jobs they can't afford to lose or on hiking trails.

Yet more than a year after California was struck by two of the most severe heat waves in its history, there has been no official inquiry into how many people perished.

On Sept. 6, 2020, the temperature reached 121 degrees in Woodland Hills — a record high for L.A. County. Twenty-five miles away in Huntington Park, researchers measured the temperature of the living room in a family's non-air-conditioned duplex at 107.4 degrees, hotter than it was outside.

Emergency room visits soared to nearly 10 times their normal number, and deaths spiked, according to county health officials. Seven people in L.A. County were found dead from heat-related causes on sidewalks, in cars and on bus benches, according to coroner reports. Most had been living on the streets, including three men found within hours of one another in the skid row area of downtown L.A.

The day before, when the temperature in Malibu Creek State Park topped 103 degrees, a healthy 48-year-old woman collapsed while hiking and died of heatstroke.

After most natural disasters comes a reckoning. There are public displays of grief and impromptu memorials. Experts write accounts of what happened, and there is an official death toll. But after 2020's deadly heat waves, there was silence. If there is an accounting, it will be up to scientists to piece together — and it could take years.

California's lag in reporting data on heat-related illness and death is not just an administrative problem. It contributes to the loss of life by delaying effective, targeted responses during heat emergencies, said Edith B. de Guzman, a UCLA researcher who studies how to mitigate the effects of extreme temperatures on L.A. neighborhoods.

“Heat vulnerability is not the same in every neighborhood, and every heat wave is different,” De Guzman said.

“If we don't know which communities are dying or showing up at the hospital disproportionately, we cannot have an informed response, and we end up losing people,” she said. “Our hands are tied if we get the data three or five years later.”

Desert Edge, 100.4° F — Allan Wanner, 61, waits for a breeze to blow through the open door of his trailer near Desert Hot Springs. High temperatures can be dangerous for residents of the park including Wanner, who suffers from congestive heart failure, diabetes and other ailments. He suspects heat played a role in the death of his friend and neighbor Gerald Floyd Rice, 59, in 2020. He still mourns the loss.

A hidden toll

No one can say exactly how many Americans lose their lives to heat each year. Death certificates aren't perfect, and it's common for doctors and coroners to write that a person suffered a heart attack or kidney failure without knowing whether extreme heat played a part.

Using death records, the U.S. Centers for Disease Control and Prevention estimates that about 700 people nationwide die from heat-related causes annually. But scientists have established that the number of deaths attributable to heat is much higher. A study published last year in the journal Environmental Epidemiology found that in the 297 most populous counties in the U.S., at least 5,600 deaths annually might be caused by heat.

California stands apart because the death toll is climbing here at a time when it is either flat or falling in most of the U.S. A 2020 study in the journal Weather, Climate, and Society found that, over the last decade, heat-related deaths have increased in major metropolitan areas along the Pacific Coast among men and women over the age of 45. Several other cities in the South and Southwest have experienced a similar increase.

What's driving the surge is unclear. The study's authors suggest that while Americans are more aware of heat's dangers, and air conditioning is more common than it was a decade ago, an increase in the number of heat waves may have overtaken these advances.

H
High pressure
Humid air

Climate change is supercharging California heat waves, and the state isn't ready

Getting an accurate picture of extreme heat's toll requires a statistical approach that goes beyond simply tallying the number of death certificates that list heat as a cause of death.

In consultation with several experts, The Times used a similar approach to the methodology that public health researchers turn to when official statistics appear to undercount deaths.

Instead of looking at fatalities directly attributed to heat, The Times analyzed state records of deaths from all causes from 2010 to 2019. The analysis compared the total number of people who died in California on days when temperatures were at their highest — in the 95th percentile or above — to the number of deaths that would be expected given mortality trends over the same period of time. The difference between the number of deaths that occurred on extremely hot days and the number expected under normal conditions is what scientists call "excess deaths."

A spokesman for the California Department of Public Health did not dispute The Times' results. He described the type of statistical analysis the newspaper used as one of two methods that "measure different outcomes and will yield different results."

Counting deaths is slow. It can take months for public health officials to verify the information in death records and longer still to finalize the data. Monitoring emergency department visits and hospitalizations for heat-related illnesses is a much faster way for state and local health officials to stay on top of dangerous heat waves.

Yet the state health department doesn't collect real-time data on heat illness from hospitals, as it does for influenza. It also doesn't mandate that county health departments track and report incidents of heat illness, though an agency spokesman said this is within its power. So at a time when local agencies are often underfunded and thinly staffed, many don't monitor hospital data for a known threat.

In Southern California, the counties that do pay attention don't like what they're seeing.

Numbers from the L.A. County Department of Public Health show heat-related emergency department visits have risen in every area of the county since it began measuring in 2005, with the greatest increases in the hottest places: the Antelope and San Fernando valleys.

The same trend holds in San Diego County, where health officials have documented a gradual increase in emergency visits for heat illness or injury since 2006.

Even some inland counties whose residents are used to triple-digit temperatures have not escaped the surge. Imperial County hospitals reported almost as many cases of heat-related illness over six weeks this summer as they recorded in all of 2015. In a county afflicted with poverty and high rates of diabetes, asthma and other chronic diseases, extreme heat had claimed the lives of 22 people by late September.

(Irfan Khan / Los Angeles Times)

Riverside, 91.4° F — Aimee Jones, left, Roy Kuria and Catherine Bedwell lost their mother during the oppressive heat wave that hit Southern California last September. Anne Gacambi Methu, 70, was in an assisted living facility, where her children say staff allowed her to wander outside in 118-degree weather.

Abandoned in the heat

In 2011, Cathy Bedwell noticed something was a little off with her mother, Anne Gacambi Methu. The proud and sometimes fearsome family matriarch had a reputation as a “perfect, perfect” driver, her daughter said. Yet she had somehow racked up about $3,000 in tickets from running red lights.

A neurologist delivered the dreaded diagnosis: Methu, then in her 60s, was suffering from early-onset Alzheimer’s.

The disease came for her sense of balance first. Then it came for her self-control, provoking outbursts and aggression. Alzheimer’s eventually stole most of Methu’s English, and she began to address people in Swahili. If she didn’t have anything to say, she would sing, often in the Kikuyu language of Kiambu, the region of Kenya where she grew up.

Methu moved into the Gardens of Riverside, an assisted living facility that seemed like an ideal arrangement at first. But as time went on, her five children, most of whom have worked in healthcare, grew concerned that she wasn’t getting enough attention.

“How are you keeping the residents hydrated?” Bedwell recalls asking the staff at a meeting. “To me it seems like these people are not drinking enough water.”

Bedwell began bringing a liter of water with her on weekly visits, sitting by her mother’s side until Methu emptied the bottle. But her small interventions became impossible early in 2020, when the pandemic forced the facility to bar visitors.

On Sept. 5 of last year, Bedwell's phone rang just before 9 p.m. She had planned to see her mother that day — one of many fleeting window visits in which she sat outside and waved through the glass — but had been dissuaded by the oppressive heat wave that had descended on Southern California. Emergency alerts had gone out warning people to stay indoors. Now the facility's administrator was calling her.

"She told me they attempted to do CPR. I said, 'What are you saying? Are you saying my mom is dead?'"

Two of Bedwell's siblings raced to the center. They stood outside, unable to get any closer until staff from the coroner's office had completed their work. It was only later they learned, from a coroner's report, that their mother had died of heat exposure after the facility allowed her to wander for hours in an exposed courtyard on a 118-degree day. When questioned by police officers, the staff said they didn't know if she had consumed any water that day. "In addition," the investigation said, "staff reported they were unable to keep residents inside the facility at all times."

> *"It almost seems like she didn't matter. Like she's one of the forgotten people."*
>
> **Aimee Jones**

More than a year later, Methu's children still struggle to explain to relatives in Kenya how their 70-year-old mother died this way in America. The family is preparing to sue the Gardens of Riverside for negligence. A lawyer for the facility declined to comment on the case.

Methu's children are still trying to get over the shock of losing their mother. She had cared for others for most of her working life in this country, first as a home healthcare aide, then as a certified nurse's assistant. Her children said she doted on her elderly patients. Why, they wondered, did our mother have to suffer? How could someone so vulnerable be left to bake in the sun?

"It almost seems like she didn't matter," said Aimee Jones, Methu's youngest child. "Like she's one of the forgotten people."

S ANGELES CITY
FIRE
EPARTMENT
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Downtown L.A., 90° F — Firefighters treat a homeless woman gasping for air in front of the L.A. Mission along 5th Street on skid row in Los Angeles.

Invisible deaths

One sign that people are getting into serious trouble with heat is that they become confused.

That's one of the reasons heat is so insidious. It disables people's ability to sense that they are in danger.

To maintain a healthy temperature, the body redistributes blood flow so that heat moves from the core and the muscles to the skin and out of the body in the form of evaporated sweat. As long as someone drinks water to replace lost fluids, this system works well — until temperatures climb really high. But the heart must pump harder and faster, which is why most elderly people who die from heat exposure suffer heart attacks or other cardiovascular problems.

Heat exhaustion sets in when the body is still trying to keep cool, but is losing the battle. A person becomes dehydrated, nauseated and somewhat disoriented. Blood pressure falls because there's less fluid in the body, putting a strain on the kidneys and lungs.

Next comes heatstroke, the body's total failure to regulate internal temperature. Sweating stops; the skin becomes cool and clammy. A person might slur one's speech and behave unnaturally. Even if victims get help at this point, cognitive and organ dysfunction can last for years, leaving them at greater risk of death for decades after.

"The more we learn about heat, the more we realize it really is a general stress on the body and can make most medical conditions worse," said Dr. Aaron Bernstein, a pediatrician at the Harvard T.H. Chan School of Public Health.

Kylian Lopez, 2, cools off in a laundry basket filled with water with his mother, Jocelyn Lopez, off camera, as the temperature rises to 96 degrees in Pacoima.

Because heat affects so many organs, heat-related deaths are often recorded as heart failure, stroke or respiratory failure.

That’s not the fault of doctors or coroners, said Larry Kalkstein, a Florida-based researcher who studies how weather affects people’s health.

“There’s no way that they can tell that a heart attack, for example, or a respiratory failure was due to the heat,” Kalkstein said. “But we believe that heat is the stressor that puts people over the edge.”

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Los Angeles Times
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The Times requested six years of records from coroner’s or medical examiner’s offices in every county in California to understand how they investigate heat-related deaths. Some, including L.A., Riverside, San Bernardino and San Diego counties, tally and record them in detail. But many claimed not to have any such cases or said they don’t track them.

Hundreds of reports reviewed by The Times revealed stories of desperation and despair.

There were babies and young children left in cars, migrants discovered in the desert, and people living in tents and cars.

There were experienced hikers and runners, such as the 57-year-old San Diego County man who was “in excellent health and jogged daily,” according to a coroner’s report, and died after a mid-morning jog in 90-degree heat. High school students collapsed during football practice, and a young firefighter fell during a training hike and couldn’t get back up.

> *“Heat is the stressor that puts people over the edge.”*
>
> **Larry Kalkstein**

A 63-year-old U.S. Postal Service letter carrier was found dead in the driver’s seat of her mail truck in the San Fernando Valley on a 115-degree day. Others in their 30s, 40s and 50s succumbed while mowing lawns, fixing pools or installing sprinklers.

Diabetes, heart disease, obesity, hypertension and other conditions figured in many of the reports, as did the ravages of mental illness and drug addiction. Some families were told the cause of death was heatstroke or “exposure to excessive natural heat.”

Jorge Valerio-Santiago, 73, center. (Jorge Valerio)

Jorge Valerio-Santiago’s death in August of last year haunts his son, a construction foreman who often hired his father onto work crews with men half his age. When he saw his father just a few days before his death, Jorge Valerio was shocked. The father he knew — an indomitable man with a round belly and a thin, graying mustache — had lost a frightening amount of weight.

“You’re looking skinny. Is it too hot?” he recalls asking. But Valerio-Santiago batted away his concerns.

Valerio-Santiago had always worked outdoors at tough jobs. He had fathered three children, lost his wife to childbirth-related causes, raised one of his daughters largely on his own and immigrated to the U.S. from Mexico. After so many years of soldiering on, there wasn't much he couldn't bear.

Jorge Valerio looks at the hard hat that belonged to his father, Jorge Valerio-Santiago, who died of heatstroke last summer.

"My dad was a hard worker," Valerio said. "Even if it was hot, he needed to finish his eight hours. Even if he was sick, he would say, 'I'm not going to quit.'"

Still, the thought of his father working in blistering temperatures nagged at him. Authorities had extended an excessive-heat warning that had been issued days before. Even where Valerio was working in Escondido, where the weather was milder, conditions had become so unbearable that he sent his crew home early. There was no question things were worse for his father in Desert Hot

Springs.

Pacoima, 98.6° F — Felisa Benitez, 86, lives alone at San Fernando Gardens, a public housing complex. She has an AC unit, but usually relies on fans to cool herself, seeking to avoid an electrical bill she cannot afford to pay.

Behind on reducing risks

California's lack of action contrasts with other states and countries.

Arizona has been closely tracking a major increase in deaths from heat and holds regular statewide meetings to discuss trends in the data. New York City posts online, in near-real time, the number of heat-related emergency room visits and has given away tens of thousands of free air conditioners to protect seniors stuck indoors during the pandemic.

After a devastating 2003 heat wave killed more than 15,000 of its people, France launched an aggressive national heat wave plan with a color-coded alert system that, along with other measures, has been credited with dramatically reducing the death toll of subsequent heat waves.

California and the United States have taken some recent steps to better protect the public and workers.

The Biden administration in September launched a governmentwide effort to confront extreme heat that includes the development of federal workplace safety standards and the expansion of programs that help low-income families purchase and run air conditioners.

Jose Peña installs an AC unit in a family's home where the temperature reached 94 degrees. Apartments at San Fernando Gardens in Pacoima do not come with air conditioning. Residents must buy their own or use fans or swamp coolers.

In Sacramento, state lawmakers recently set aside $800 million for extreme heat in a $15-billion climate spending package. The money will be used over the next three years for projects such as modern cooling centers, tree planting, heat-reflecting roofs and pavement, and establishing a new grant program within the governor's office to help communities adapt.

State Assemblywoman Luz Rivas (D-North Hollywood), who pushed for those changes, grew up in one of the hottest areas of L.A., the northeast San Fernando Valley, and worked in Chicago during the historic 1995 heat wave that killed hundreds. She lamented that as a California lawmaker she has no solid numbers on how many people in her district fell ill or died from extreme temperatures this year.

"Heat is one of climate change's most urgent and deadliest impacts," Rivas said. "We need to make sure that we're prepared."

How to protect yourself and your loved ones from extreme heat

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Sanchez, Newsom's climate advisor, said the governor will continue to prioritize the threat in his budget, public statements and regulatory action. She said the state's track record of work on climate change and air pollution demonstrates "we can mobilize pretty quickly and advance this agenda."

Despite those pledges, researchers and public health advocates say California could be taking more concrete steps to prevent heat deaths and hospitalizations, enhance public warnings and better protect those who work in hot settings.

A state-commissioned study being released later this year by UCLA's Luskin Center for Innovation found significant gaps in California's policies. It described the state's regulation of extreme heat exposure as "fragmented across numerous state agencies" and "with no centrally-responsible authority."

Though California has a heat illness prevention regulation for outdoor workers, and rules designed to limit heat exposure in assisted-living and child-care facilities, the extent of compliance and monitoring is unclear. Assisted living facilities and child-care centers are subject to temperature limits established by the state and are inspected regularly, but UCLA researchers who reviewed publicly available inspection reports couldn't find consistent documentation of temperature readings.

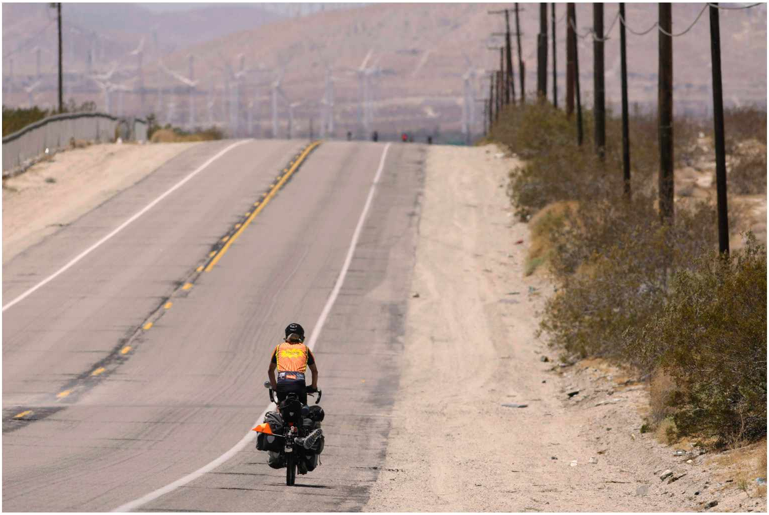
> *“My dad was a hard worker. Even if it was hot, he needed to finish his eight hours.”*
>
> Jorge Valerio

To date, California has not adopted heat exposure rules for people in other situations, such as in schools, jails or prisons. Landlords in California are required to make rental housing units “habitable” by providing heating, but there is no requirement for cooling.

On the local level, L.A. is trying to cool neighborhoods with trees, has adopted standards for reflective roofs and is experimenting with lighter-colored pavement on some streets.

Yet such local projects are sporadic, and they occur separately from any state or national strategy to reduce fatalities from high temperatures. Overall, California spends far less on heat protection than it does on less deadly threats, including wildfires, floods and water shortages.

“The progress has been opportunistic and patchwork,” said Kurt Shickman, executive director of the Global Cool Cities Alliance, a nonprofit that advocates for measures to alleviate extreme heat. “Heat is an area where California can be a leader again. It just hasn’t materialized yet.”



Desert Hot Springs, 89.6° F — A man who goes by the nickname Popcorn rides his bike down Dillon Road. Popcorn, 68, said he was leaving his home in Borrego Springs and heading to Washington state, where summers are cooler. “I want to get out of this heat for the summer,” he said.

Brutal heat forecast to intensify

In late June, a mass of hot air planted itself over British Columbia and the Pacific Northwest, producing the highest temperature ever recorded in Canada — 121.3 degrees. After the "heat dome" dissipated, authorities reported a death toll of nearly 800 people in Canada and the United States.

The deadly heat demonstrated that nearly any place is vulnerable — from the rainforests of Washington's Olympic National Park to California's temperate coastal areas. Scientists studying the event found it would have been "virtually impossible" without human-induced climate change and warned that catastrophic heat spells like it, which used to be extraordinarily rare, will become more commonplace as global warming accelerates.

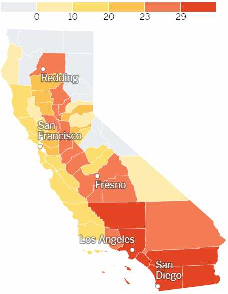
Fueling these fiercer heat waves are rising greenhouse gas emissions, which have increased temperatures in California by 1 to 2 degrees since the beginning of the 20th century.

By 2050, researchers project the number of days above 95 degrees in L.A. and other cities could double, triple or even quadruple. How bad it gets ultimately depends on how much more greenhouse gas pollution humans spew into the atmosphere.

Projected heat-related deaths

Southern California and the Central Valley are expected to see the largest increases in temperature-related deaths by mid-century.

Deaths per 100,000 residents in 2040-2060



Projection based on a moderate emissions scenario.

Climate Impact Lab

LOS ANGELES TIMES

Projections by researchers with the Climate Impact Lab rank California behind only Arizona and Texas in how deadly an overheating planet will probably be for its population by mid-century. People living in L.A., Orange, Riverside and Imperial counties could find themselves in the center of a worsening crisis, as the analysis puts these places in the top 2% of counties nationally for projected increases in heat-related deaths.

Even under a moderate emissions scenario, where global emissions peak around 2040 then start to decline, rising temperatures from climate change could cause thousands of additional deaths annually in California by mid-century, according to the analysis by the Climate Impact Lab, which is made up of more than 30 scientists, economists and researchers from UC Berkeley and other institutions.

That effect would be deadlier than diabetes — currently the state's seventh leading cause of death — and nearly as high as the death rate from lung disease at No. 6, according to the analysis.

Whenever extreme temperatures take a life, loved ones are left to ponder what they did, and what they could have done.

Jorge Valerio-Santiago's sudden death last summer devastated his son, who had reminded his father to drink plenty of water and take precautions when working outdoors. But sometimes the old man wouldn't listen. He had bragged about how younger workers couldn't keep up with him.

At home in Desert Hot Springs, Jorge Valerio recalled the day his father died. His voice trailed off as he fought the urge to cry. Occasionally, he would glance at the corner of the living room where his father's ashes sat atop a bookshelf, next to an orchid.

Valerio feels he did everything he could to warn his father, but he's more vigilant now. He makes sure his employees take breaks and drink water. He recently pulled aside an older worker to tell him the story of his father's death.

Then he cautioned the man's son: "You better be careful with your dad."

About this story

The Times conducted its analysis of excess deaths with consultant Logan Arnold, a health data analyst. Data from California Department of Public Health's public-use death index files, the state Department of Finance and Oregon State University's PRISM Climate Group formed the basis of the analysis. The estimates include deaths from California's 26 most populous counties, representing about 91% of the total population. The Times' analysis was reviewed by four independent experts in epidemiology and bioclimatology. The code and underlying data are available as open-source software, along with a more detailed methodology.

Temperature values presented in photo captions were obtained from the University of Utah's Department of Atmospheric Sciences MesoWest project for the date, time and nearest weather station of each image.

Lead images: 1) Dennis Johnson, 60, pours water over himself as the temperature reaches 92 degrees on skid row in downtown Los Angeles. 2) Diane McLindon, 63, with her dog Frankie, cools off with a wet towel and fan in their trailer in Desert Hot Springs. 3) The sun sets over windmills as seen along Dillon Road in Desert Hot Springs.

This story was designed by Sean Greene and Phi Do. Additional production by Javier Panzar, Adrienne Shih, Louisa Frahm, Lora Victorio and Christian Orozco. It was edited by Stuart Leavenworth, Monte Morin and Laura Wides-Muñoz and copy edited by Sam-Omar Hall and John Penner. The photographs were edited by Mary Cooney. In print, the story was designed by Allison Hong and Ross May.