

A photograph of a person drinking water from a plastic bottle. The person is in silhouette against a bright, sunny background. The sun is high in the sky, creating a lens flare effect. The water is splashing out of the bottle. The overall mood is one of relief and refreshment.

THE HIGH COST OF HOT

Image source: Air Force/Staff Sgt Sheila deVera

JULY 11, 2018

Climate Central
Jennifer Brady

The High Cost of Hot

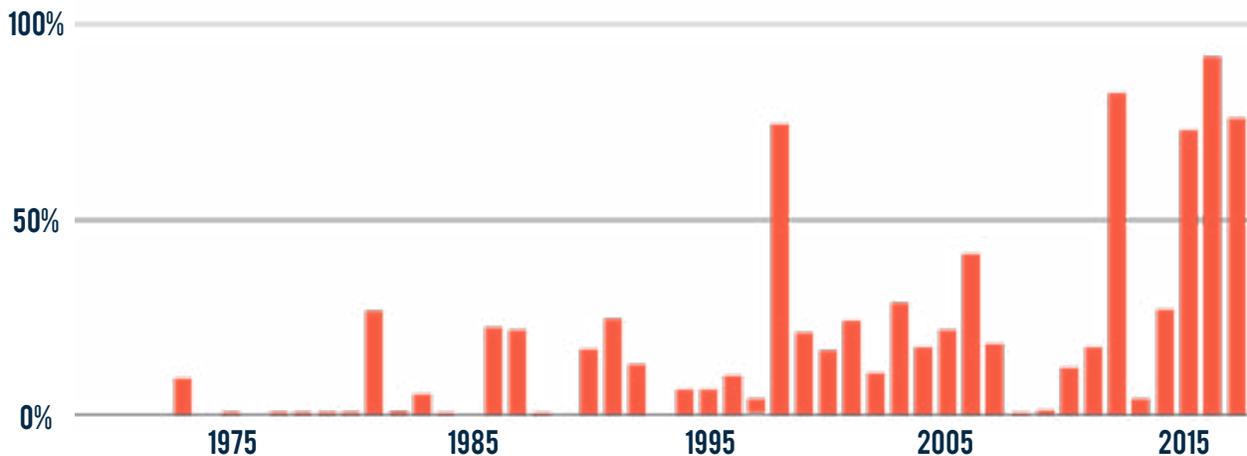
As additional carbon pollution continues to trap more and more heat in the atmosphere, the higher temperatures that result can come with a hefty price tag. Some of those costs hit our wallets in the form of higher energy bills from greater use of air conditioning. Warmer temperatures can also have major health impacts, increasing our vulnerabilities to allergies, asthma, heat stroke and even death. To better understand how this is impacting local communities, Climate Central analyzed trends in cooling degree days and minimum temperatures. Of the 244 cities analyzed, 93 percent had an increase in cooling degree days. Much of this warming occurs at night, demonstrated by the fact that of those same cities, 87 percent see an increase in the occurrence of overnight low temperatures above a threshold of either 55°F or 65°F.

WARM NIGHTS

According to the National Sleep Foundation, the optimal temperature for sleeping is [around 65°F](#). Unfortunately, daily minimum temperatures, which most often occur at night when our bodies rest and recover, have been increasing as a result of climate change. And in many places, those minimums [have been increasing at a faster rate](#) than the average temperature. The jump in overnight lows is driving much of the overall temperature increase in the United States. According to calculations by NOAA/NCEI, the rate of warming for overnight temperatures since 1900 is more than [20 percent higher](#) than the daytime rate.

Extremes in Minimum Temperatures

Percent of CONUS with minimum temperatures much above average



Source: Climate Extremes Index; NOAA/NCEI

Climate Central analyzed the trend in nights above 65°F for cities across the country. For a smaller set of cities that rarely experience nights above 65°F, we dropped that temperature to 55°F for this analysis. Overall, our analysis found that 87 percent of U.S. cities are experiencing more warm nights since 1970. El Paso, Las Cruces, and Fresno all see an increase of more than 50 nights over 65°F, while San Francisco had the biggest increase of 80 nights over 55°F.

URBAN HEAT ISLANDS

Because surfaces like streets and buildings absorb the sun's heat more readily than do trees and grasses, [cities](#) typically become "urban heat islands". Researchers have estimated that the urban

FUTURE WARMING

Since some level of future warming is inevitable from the greenhouse gases that have already been released into the atmosphere, the critical way to mitigate some of the increased demand for cooling is through energy efficiency improvements of appliances. Despite additional usage demands, [EIA estimates](#) a decline in cooling electricity consumption of nearly 20 percent by 2040, based on the currently mandated energy efficiency standards.

Table 1. Cities with the largest increase in nights above 65°F since 1970

City	Increase in warm nights	City	Increase in warm nights
El Paso, TX	63	Sarasota, FL	43
Las Cruces, TX	54	Tampa, FL	43
Fresno, CA	51	Greenville, NC	43
Las Vegas, NV	46	Salt Lake City, UT	38
Albuquerque-Santa Fe, NM	45	Phoenix, AZ	37

heat island effect can increase overnight temperatures in cities by [as much as 22°F](#). And while the temperature on the thermometer in rural areas may not be quite as high as the cities, the long-term trend is the same — temperatures are rising. So cities alone are not driving the overall rising temperatures nationally and globally.

Adding vegetation in cities can help lessen the heat island effect. Researchers estimate that shaded surfaces can be a remarkable [20–45°F](#) cooler than the peak temperatures of unshaded materials— which means lower air-conditioning costs and relief for those working in the heat. However, a recent [analysis](#) found that many urban areas in multiple states are losing tree cover, sometimes dramatically so. For example, between 2009 and 2014, [Rhode Island and Georgia](#) respectively lost 44 and 40 percent of their urban and community tree cover.

COOLING DEGREE DAYS

The concept of cooling degree days (CDD), and their counterpart heating degree days (HDD), are primarily used to estimate the amount of artificial cooling or heating needed to maintain a comfortable indoor temperature.

In fact, [degree days](#) aren't actually days at all. They represent the number of degrees the daily average temperature is above or below 65°F. In this report, we are focusing on heat and the corresponding cooling degree days, which follow this equation:

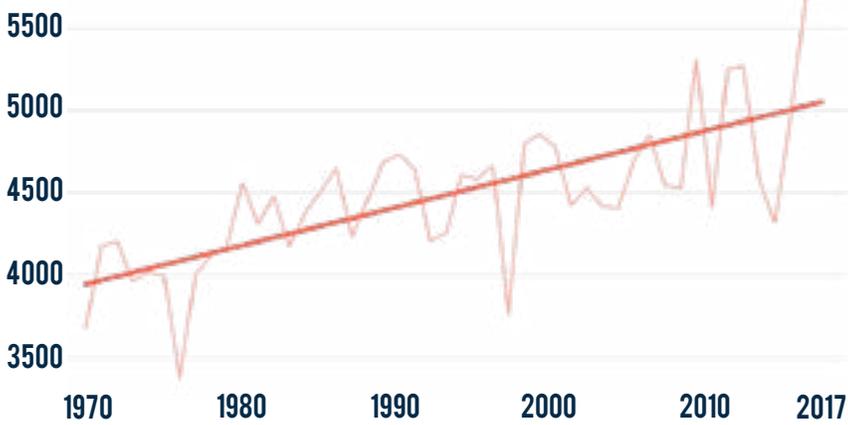
$$\text{Daily Average Temperature} - 65^{\circ}\text{F} = \text{Number of Cooling Degree Days}$$

It's important to note, an increase in the number of cooling degree days is a result of an increase in the *number of days* above 65°F, an increase in the *number of degrees* above 65°F, or both.

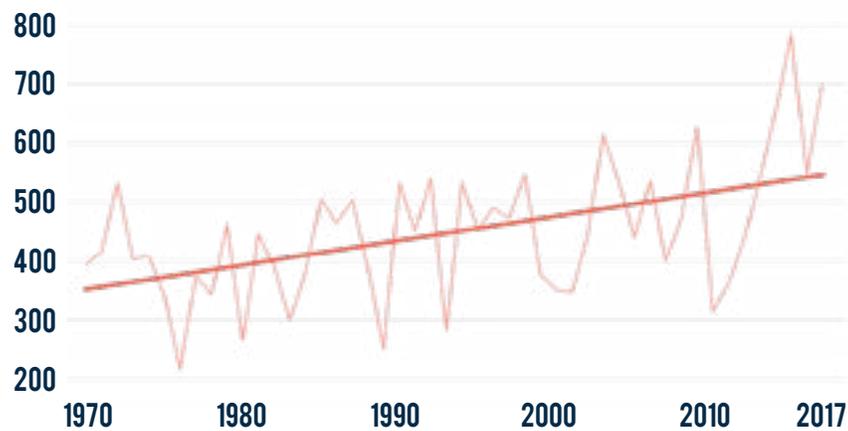
Climate Central analyzed 244 cities in the U.S. and determined that 93 percent have seen an increase in CDDs. Traditionally hot cities have seen the highest rise in CDDs. The largest increases are in McAllen, Texas, Phoenix and Las Vegas. However, many cooler cities that in the 1970s did not need widespread air conditioning are experiencing a large percentage increase in the past 10 years. For example, the number of CDDs in San Francisco and Portland, OR have almost doubled during the analysis period.

As temperatures continue to climb, so will the cost of associated electricity bills and the demand for air conditioning our homes and places of business increases. Air conditioning is already the largest share of residential electricity use ([17 percent](#)), according to the Energy Information Administration. In 2015, Americans spent over [\\$27 billion](#) cooling their homes.

Cooling Degree Days in McAllen, TX



Cooling Degree Days in Portland, OR



AIR CONDITIONING

Ironically, air conditioning helps to reduce climate change’s impacts by letting people get out of the heat, but it also worsens the underlying problem when air conditioners are powered by fossil fuels whose combustion releases heat-trapping carbon dioxide. Air conditioners also contribute to climate change if they are disposed of improperly, because the chemicals in air conditioners are themselves extremely potent heat-trapping gases. The U.S. Environmental Protection Agency’s voluntary Responsible Appliance Disposal (RAD) programs reduce climate pollution by disposing of air conditioners using the best environmental practices and technologies available. As EPA notes, “partners send appliances to recycling facilities capable of properly handling the environmentally harmful substances contained in the units.” A state-by-state roster of partners is available at <https://www.epa.gov/rad/find-rad-partner-programs>

Households in Texas, Oklahoma, Arkansas and Louisiana have the highest air conditioning use per household — almost six times more than in New England. The average annual cost for homes across the U.S. with air conditioning is approximately \$250. In the high use areas of the South, air conditioning costs are almost \$450 a year. A 2014 Climate Central analysis of projected future summer temperatures shows that by 2100 New England summers will be as hot as current summers in Florida, dramatically increasing the need for artificial cooling.

Table 2. Cities with the largest increase in cooling degree days since 1970

City	Increase in CDDs	City	Increase in CDDs
McAllen, TX	1,123	Tucson, AZ	965
Phoenix, AZ	1,080	Yuma, AZ	941
Las Vegas, NV	1,042	El Paso, TX	907
Laredo, TX	1,003	Odessa, TX	821
Reno, NV	1,003	Houston, TX	802

METHODOLOGY

Trends in minimum temperatures and cooling degree days were calculated using data from the Applied Climate Information System (rcc-acis.org). Both analyses excluded years with more than 60 days of missing data. For the analysis of days with a minimum temperature at or above 65°F (or 55°F for a smaller subset), we counted the total number of days with a minimum temperature each year at or above that threshold. Cooling degree days were calculated using the annual sum of the daily cooling degree days measure. All analyses were performed in R. Trends were estimated using R's simple linear regression model.