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IN FOCUS

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Extreme Heat and Climate Change

Scientific consensus supports a causal relationship between increasing global temperatures and the incidence of extreme heat. Extreme heat can have a range of serious consequences, with record-breaking temperatures and heatwaves occurring in recent years. For example, global temperature datasets from the National Aeronautics and Space Administration (NASA) and National Oceanic and Atmospheric Administration (NOAA) show that 2024 was the warmest year, and that 2015-2024 was the warmest decade, on record since 1880, and part of a global warming trend (**Figure 1**). In addition, the United States experienced record-breaking heatwaves in 2021 and 2023. These heatwaves brought extreme temperatures and life-threatening conditions in some areas. Historical studies of the United States have found increases in heatwaves regionally during the period 1981-2015 and for the continental United States (CONUS) during the period 1981-2018.

This In Focus describes some of the health, infrastructure, and productivity impacts of extreme heat; the relationship between extreme heat and human-caused climate change; and related policy considerations. Although the terms *extreme heat* or *heatwave* lack a consensus definition, studies have characterized extreme heat events by their frequency, intensity, and duration.

Extreme Heat Effects

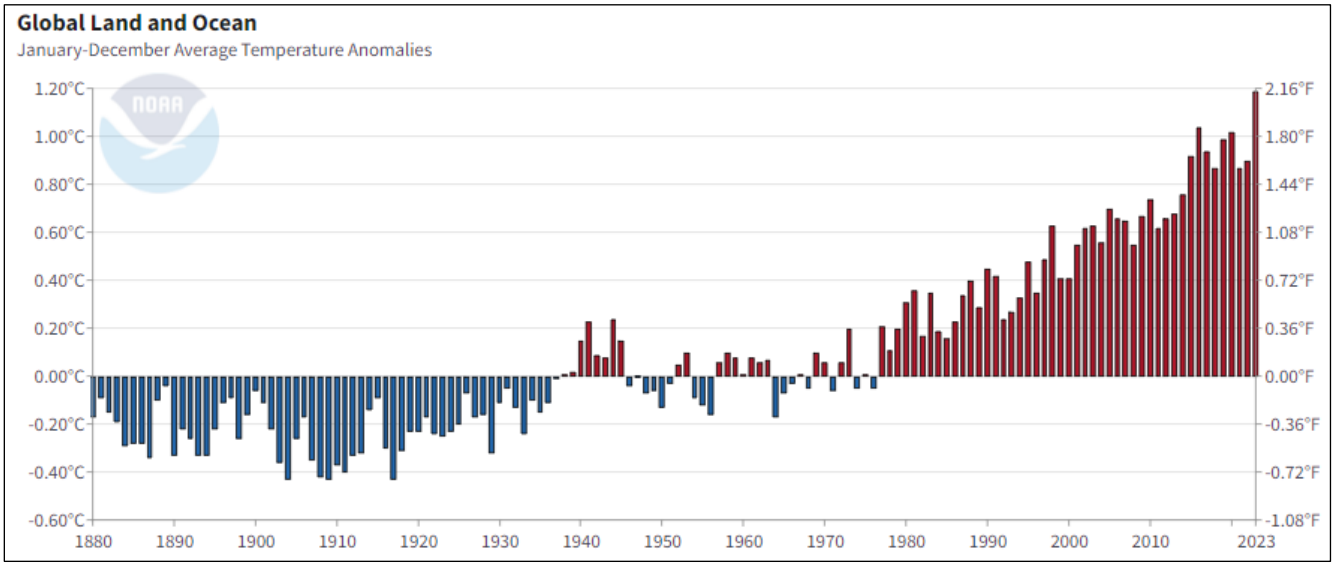
According to the Centers for Disease Control and Prevention (CDC), 1,600 heat-related deaths occurred in the United States in 2021. The CDC also states that extreme heat can cause various effects, including heat stroke, heat exhaustion, fainting, heat cramps, and heat rash. Extreme heat has affected U.S. communities, causing heat-related deaths and increases in heat-related medical conditions. These extreme heat events can place strain on health care systems.

Extreme heat can affect the health, safety, and productivity of workers. According to the CDC, extreme heat can put workers at increasing risk of workplace injuries.

Extreme heat can strain the power grid, potentially leading to high demand for air conditioning, refrigeration, and other power needs. It has been estimated that during the summer of 2023, about two-thirds of North America faced the potential for insufficient operating reserves of electricity from extreme heat. Extreme heat may accelerate the degradation of roads, bridges, and railroad tracks. According to the Department of Defense, extreme heat may degrade aircraft performance by reducing lift capacity that may require payload reductions and longer takeoff distances. Past extreme heat events caused flight delays and cancellations in Seattle, Portland, London, and Phoenix.

Extreme heat can stress plants, livestock, and poultry, reducing agricultural yields. Extreme heat exposure during critical growth stages may reduce yields in crops, such as corn and soybeans. Extreme heat events can stress livestock and may reduce meat and milk production.

Figure 1. Global Average Temperature Anomalies, 1880-2023



Source: NOAA, National Centers for Environmental information, Climate at a Glance: Global Time Series.

Note: Global average temperature anomalies calculated as deviations from the 1901-2000 baseline average.

Extreme Heat and Human-Induced Climate Change

According to the U.S. Global Change Research Program (USGCRP), human activity is warming the planet, leading to more frequent extreme high temperatures and heatwaves. The USGCRP *Fifth National Climate Assessment* (NCA5) of 2023 stated the following:

> The connection between warming and heatwaves is well understood: at the very basic level, as average temperatures warm, the risk of extreme temperatures and record-breaking temperatures goes up.

The Intergovernmental Panel on Climate Change *Sixth Assessment Report* stated that "human-induced greenhouse gas forcing is the main driver of the observed changes in hot and cold extremes on the global scale."

In addition to studies on the general connection between warming and extreme heat, climate attribution studies can examine the influence of human-caused climate change on individual extreme heat events. While not every extreme heat event is caused by climate change, some studies have found that human-caused climate change has increased the likelihood or severity of certain extreme heat events in the United States and other countries.

The NCA5 stated, based on modeling, that it is very likely that heatwaves will increase in frequency, severity, duration, and spatial extent as global warming continues. The NCA5 included estimates based on a Department of Energy-validated regional climate dataset of the increase in annual days above 95°F for the CONUS, Hawaii, and Puerto Rico, for global warming of 2.0°C (3.6°F) above preindustrial temperatures (**Figure 2**). A Department of Defense indicator of changes in heat risk exposure is the average number of days with maximum temperatures above 95°F. The NCA5 estimated that the number of days above 95°F is projected to increase, depending on the region, by between 0 and 49, and the largest increases are projected to occur in southern regions.

Considerations for Congress

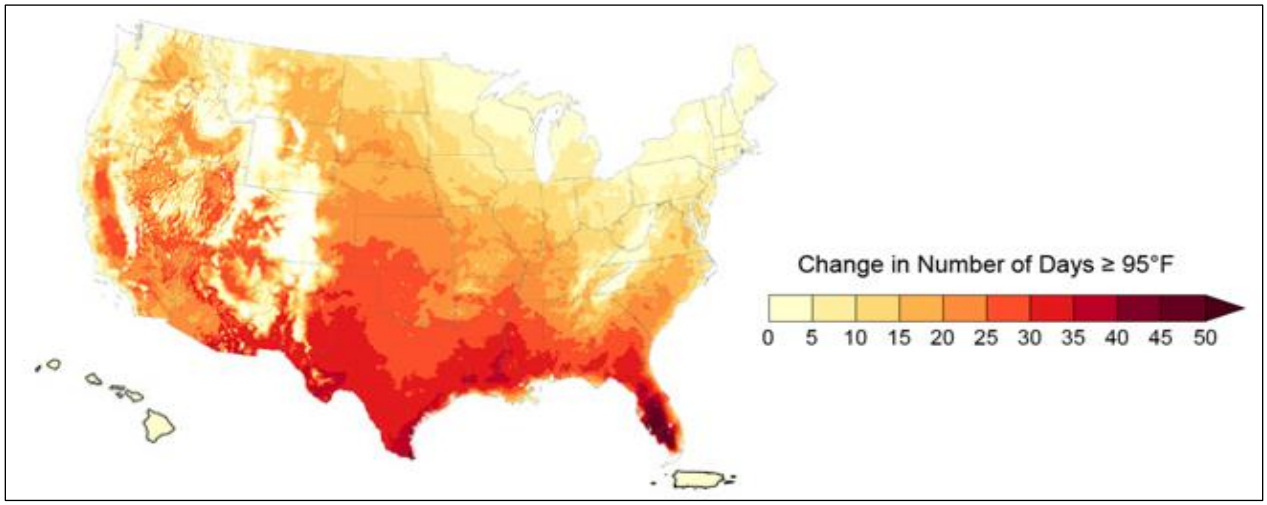
Congress has oversight of federal activities authorized in congressional legislation, including those for research, preparation, response, and mitigation of extreme heat risks. Congress may consider the level of funding for research on extreme heat. For example, NOAA has ongoing research to forecast extreme heat. Some scientists have suggested the need to better account for vegetation dynamics and aerosol effects, in order to improve modeling of heatwaves. Others have proposed interdisciplinary research on reducing vulnerabilities to extreme heat risk.

Federal actions to prepare and respond to heat extremes are subject to congressional oversight and include the efforts of the National Integrated Heat Health Information System. The system provides data and tools, such as Heat.gov, to the public.

In July 2024, the Occupational Safety and Health Administration (OSHA) announced a Notice of Proposed Rulemaking for Heat Injury and Illness Prevention in Outdoor and Indoor Work Settings. OSHA does not have specific heat exposure standards, and this rulemaking would develop a heat-specific workplace standard. Congress may engage in review of the proposed rule and its potential effects.

Some Members of Congress introduced legislation in the 118th Congress to prepare for and mitigate the effects of extreme heat. Issues under consideration include addressing the health and financial risks of extreme heat. Examples in the 118th Congress included mitigating extreme heat in urban areas (S. 1379) and planning for extreme heat events using scientific information (H.R. 6882).

Figure 2. Projected Increase in Annual Days with Temperatures at or Above 95°F at 2°C of Global Warming



Source: U.S. Global Change Research Program *Fifth National Climate Assessment* (NCA5); adapted by CRS from NCA5 Figure 2-11.

Notes: No change is projected for Alaska (not shown). Data were not available for the U.S.-affiliated Pacific Islands and the U.S. Virgin Islands.

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