

California Legislature
Senate Committee on
Environmental Quality

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CHAIR



INFORMATIONAL HEARING OF THE
SENATE ENVIRONMENTAL QUALITY COMMITTEE
ROBERT WIECKOWSKI, CHAIR

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CALIFORNIA STATE CAPITOL
ROOM 3191

**California's Adaptation Efforts to Climate Change Impacts on
Environmental Quality and Public Health**

BACKGROUND INFORMATION

Climate Change Overview

Broad Impacts in California and Worldwide

There is broad scientific consensus that the climate is warming and that much of this warming is due to human activities, with serious implications for California.

The 5th assessment report from the Intergovernmental Panel on Climate Change (IPCC) notes that atmospheric concentrations of global warming pollutants have risen to levels unseen in the past 800,000 years. Carbon dioxide concentrations have increased by 40% since pre-industrial times. These increases have led to a rise of global average surface temperatures of approximately 1.4°F since 1900, with much of this increase occurring after 1970. Per the latest report by the National Oceanic and Atmospheric Administration (NOAA), 2014 was the 38th consecutive year that the global temperature increased. Research indicates that an increase in the global average temperature of 3.6°F above pre-industrial

levels, which is only 1.1°C (2.0°F) above present levels, poses severe risks to natural systems and human health and well-being. According to the U.S. Environmental Protection Agency, for every 2°F increase in global average temperature, we can expect to see 5-15% reductions in crop yields, 3-10% increases in rainfall during heavy precipitation events when flood risks are already high, and 200-400% increases in areas burned by wildfires in the western U.S.

Higher temperatures globally have already resulted in diminished snow and sea ice and have caused sea level to rise by nearly eight inches.

In California, the frequency of extreme events, including heat waves, wildfires, floods, and droughts, are expected to increase. Higher temperatures and more frequent and severe extreme events will have a range of consequences for public health through impacts to water quality, air quality, and the spread of infectious diseases.

As the evidence for anthropogenic climate change has mounted over the last few decades, the state has implemented a broad climate portfolio to mitigate global warming impacts by pursuing policies that reduce greenhouse gasses (GHGs).

And although deep and severe cuts in GHG emissions globally are still needed to avoid the most severe consequences of a changing climate, they will not be enough to stave off climate change. Even if all GHG emissions ceased today, many impacts of climate change would still be unavoidable because the climate system changes slowly.

The Costs of Climate Change and the Need for Adaptation

A major report from the University of College London's Institute for Global Health and the medical journal The Lancet has called climate change the "biggest global health threat of the 21st century." Climate change not only brings about new threats, it is a magnifier of existing natural hazards. The impacts to health, infrastructure, hazard response, etc. will come with a financial cost, as well. Additionally, the Pacific Institute estimates that \$100 billion worth of property is at risk of flooding during a 100-year flood with 1.4 m of projected sea level rise, including 55 healthcare facilities, over 330 hazardous waste facilities or sites, 30 coastal power plants, and 28 wastewater treatment plants.

Furthermore, recent extreme climate events revealed that the impacts from climate change are happening now and underscored the significant vulnerability in many human systems to climate variability.

For the protection of public health, environmental quality, natural resources and the state's financial interests, California must both continue the state's leadership in pursuing groundbreaking greenhouse gas emission reduction measures, as well as aggressively implement climate adaptation and resiliency measures to protect communities from the inevitable impacts to come.

Impacts to Environmental Quality and Public Health from Climate Change

Water Quality Impacts

In many regions, hydrological systems are being altered by changes in precipitation and snow pack, which leads to water availability and quality concerns. Reductions in the Sierra Nevada snowpack are

expected from higher temperatures, leading to diminished water reserves. Because of these dwindling water reserves, groundwater pumping may continue to increase and result in an increased concentration of pollutants in drinking water. For example, nitrate contamination of drinking water, already an acute problem in many areas in the Central Valley, may be further exacerbated by this scenario, resulting in a much higher fraction of residents who are not able to drink water safely from their tap. Though overall rain amounts will be reduced, rainfall events are expected to be more extreme, which can overwhelm sewage and water treatment facilities, resulting in decreased water quality. In coastal areas, rising sea levels can lead to increased salinity in coastal aquifers. Higher salinity of water has reduced usability for both drinking water and agricultural purposes, and desalination procedures are energy-intensive and costly. According to the Public Policy Institute of California's (PPIC) 2008 "Adapting California's Water Management to Climate Change" report, sea water intrusion in the Delta could disrupt the state's water supply for months to years (Hanak and Lund, 2008).

Air Quality Impacts

Worsening air quality is expected from numerous sources. Longer, hotter days will lead to increased amounts of ground-level pollutants such as ozone. Analysis of powerplants in California showed a 3% increase in NO_x emissions per degree F increase in daily temperature (Drechsler et al., 2006). Heat waves also directly lead to immediate public health concerns, particularly for those people without either access to air conditioning or enough money to pay for running an air conditioner even if they have access to one.

In Chicago's 1995 heat wave, temperatures reached 106°F, resulting in numerous blackouts, thousands of residents with dehydration, kidney failure, and respiratory distress, and over 600 deaths. In California in 2006, a 10-day heat wave caused 650 deaths, including a greater relative increase in deaths along the coast, where air conditioning is less common. Even with conservative emissions scenarios, major metropolitan areas in California, including Los Angeles, San Francisco, and Sacramento are projected to have 37-52 more extreme heat days (>90°F) each year by the end of the century (Miller et al. 2008).

Extreme events, such as wildfires, can affect air quality by leading to increased concentrations of particulate matter (PM), which has been linked to premature death in people with heart and lung disease, as well as aggravating asthma and respiratory symptoms. Scientific modeling has predicted 12-53% increase in large California wildfires by 2100 (Westerling and Bryant, 2006).

Infectious and Vector-borne Diseases and Public Health Impacts

Climate change can further lead to public health impacts by facilitating disease spread and exacerbating chronic health conditions. Already, California has seen an increase in the length of the growing season and pollen production amounts of ragweed, a common cause of severe seasonal allergies, due to increased CO₂ concentrations.

Increased temperatures can promote bacterial contamination in foods and lead to increases in harmful algal blooms that have been tied to skin, gastrointestinal, respiratory, and neurological signs and symptoms. Reductions in the number and sizes of recreational bodies of water due to decreased rainfall can further lead to increased concentration of pollutants and bacterial contaminants from more users in fewer and smaller areas.

Also, there is concern about the spread of vector-borne diseases, as the distribution of vectors (e.g. ticks, mosquitoes) carrying pathogens spread into new habitats as regional climates change. For example, previous research has shown that human outbreaks of Saint Louis encephalitis are correlated with periods of several days when the temperature exceeds 30°C (95°F), as has been the case in previous California epidemics (Githeko et al. 2000).

Hot temperatures also facilitate the spread of West Nile Virus (WNV) by speeding up both the replication of the virus and the development of the mosquito that carries it. Mosquitoes digest blood meals more rapidly at higher temperatures, leading them to feed more often. This leads to an overall increase in mosquito populations that are biting more often. The number of WNV cases in California more than doubled in 2014 compared to the previous year. Furthermore, higher temperatures along the coast could increase the risk of West Nile Virus in these areas, which have typically been at low risk. Somewhat counterintuitively, droughts, which will likely increase with climate change, can also favor mosquito breeding. Streams that would normally be flowing become a series of stagnant pools in which mosquitoes breed.

Disease spread to crops from vectors and pests is expected to threaten food production and quality, in addition to the effects of drought and severe weather events. Combating these threats to food security will likely require increased use of pesticides and fertilizers, which leads to increased GHG emissions and concerns about human health and water quality from runoff. In times of food insecurity and rising prices, people turn to nutrient-poor, calorie-rich foods with health impacts including malnutrition and obesity.

Climate Change and Environmental Justice Considerations

Climate change exacerbates existing environmental quality and public health concerns facing California, sometimes being referred to as a “threat multiplier.” This is particularly true for social inequity concerns in already socially and economically disadvantaged communities, which will be harder hit by, and less able to adapt to, the impacts of climate change. These communities already experience higher rates of chronic disease and lower life expectancy and have fewer resources available to respond and recover from impacts of climate change.

In their 2010 “Indicators of Climate Change in California: Environmental Justice Impacts” report, the Office of Environmental Health Hazard Assessment (OEHHA) developed indicators to describe the impacts of climate change on disadvantaged communities which included air conditioner ownership and cost, farm worker exposure to extreme heat, exposure to urban heat, and vulnerability to wildfires. For example, low-income households are less likely to either have air-conditioning or be able to pay for the costs of using an air-conditioner during extreme heat events, and impacts from heat are more intense in urban areas with less natural shade cover, which is also where low-income families and people of color are more likely to live.

Furthermore, minorities and low-income people are more likely to live close to facilities such as powerplants and refineries that can generate high local emissions, such as NO_x and PM (Boyce and Pastor, 2013). In the Salinas Valley, a largely agricultural region, some of the state’s worst air and water quality overlaps with areas of severe poverty, where per capita income is 26% lower than the state average (Fougeres, 2007). Local dust storms, field burning, farm machine use, and high numbers of shipping trucks can all contribute to high levels of local air pollutants. As well, industrial agriculture can

lead to contamination of water sources for local communities from the use of pesticides and fertilizers, as well as wastes from livestock facilities and food processing plants.

Adaptation Efforts

Adaptation and mitigation choices that are being made now will affect the risks to our communities from climate change throughout the 21st century.

Adaptation Efforts at the International Level

According to the IPCC's 5th report on adaptation and resiliency, countries across the world are beginning to develop adaptation plans and policies to make climate change considerations a part of their future development planning. In Africa, most national governments have initiated adaptation governance systems, though efforts tend to be isolated. In Europe, across levels of government, adaptation policy has been developed with some integration of adaptation planning in select sectors. In Asia, some areas have begun incorporating adaptation actions, as in subnational development planning, water management, and coastal reforestation of mangroves. In Australia, New Zealand, and New Guinea, planning for sea level rise and reduced water availability is being adopted broadly, less so for implementation. Central and South America have begun ecosystem-based adaptation, as well as adoption of resilient crop varieties and changes in water resources management in the agricultural sector. In North America, there has been an incremental approach to adaptation assessment and planning, especially at the municipal level, by governments with some longer-term investments in infrastructure.

Adaptation Efforts Across the U.S.

According to the U.S. EPA, 32 states have completed Climate Action Plans (CAPs). These range in scope from providing a list of recommendations to implementing policies, though more of the focus tends to be on reducing GHGs versus planning and implementing adaptation efforts.

According to the National Conference on State Legislature's recent climate change state policy update, more states are working on adaptation in response to extreme weather events. Per NCSL's database, since 2010, there have been 24 bills enacted in 9 states, including California, regarding climate adaptation. These have included legislation ranging from broad level coordination to planning for specific impacts, such as sea level rise.

For example, Hawaii enacted legislation last year to establish an interagency Climate Adaptation Committee and authorize the development of a statewide climate adaptation plan to address adaptation priorities and allocate funds. Hawaii has both statute to prioritize climate change adaptation in the state planning act (SB 2745, 2012) and resolutions to establish measures to increase climate resilience (HR 77, 2014 and HR 34, 2014).

Climate Action Plans in Major Metropolitan Areas

A number of cities across the U.S. have developed CAPs, including, but not limited to, San Francisco (adopted 2004), Boston, MA (2007), Denver, CO (2007), Philadelphia, PA (2007), Chicago, IL (2008),

Portland, OR (2009), Sacramento (2012), Minneapolis, MN (2013), Seattle, WA (2013), San Diego (Draft 2014).

In December 2014, 16 communities across the U.S. were recognized as leaders in climate change by the White House. Boston was the first city to add climate resilience to their large new construction review process. Dubuque, Iowa, in addition to GHG reduction targets of 50% by 2030, is focused on risk reduction and resilience, particularly relating to development and infrastructure. In California, three communities were recognized, including 1) San Francisco for their climate and sustainability targets that cover a range of sectors and include broad goals to measure their progress; 2) the Blue Lake Rancheria Tribe for implementing both climate resiliency and GHG reduction measures from their 2008 climate action plan, having already reduced energy consumption by 35%; and 3) the Sonoma County Regional Climate Protection Authority (RCPA), the first local government agency in the nation that was created to address climate change specifically and has formed partnerships across silos to work towards its GHG reduction goals.

California's State Efforts in Climate Assessment & Adaptation Planning

Executive Orders and Legislation Regarding Adaptation

While there have been a number of laws, regulations, and executive orders regarding climate change and GHG emission reduction efforts, there are far fewer that specifically address adaptation and resiliency.

Executive Order S-03-05 in 2005 established GHG reduction targets, created the Climate Action Team, and directed the Secretary of Cal/EPA to coordinate efforts to meet the targets. The EO further required the Secretary to report back to the Legislature and Governor every two years concerning the progress on these goals, as well as GHG impacts to California and mitigation and adaptation plans.

Executive Order S-13-08 in 2008 directed state agencies to plan for climate impacts specifically from sea level rise and to coordinate the California Climate Adaptation Strategy by June 2009, noting that "California must begin now to adapt and build our resiliency to coming climate changes through a thoughtful and sensible approach with local, regional, state and federal government using the best available science."

Coordinating Bodies

Climate Action Team (CAT): Created in 2005 by EO S-03-05, the CAT is comprised of 17 members from state agencies, boards, and departments, headed by the Secretary of Cal/EPA. The CAT is tasked with coordinating statewide efforts to implement GHG reduction programs, as well as the state's Climate Adaptation Strategy. Within CAT, there are 10 Working Groups, including Agriculture, Land Use and Infrastructure, Public Health, State Government, and Intergovernmental.

Strategic Growth Council (SGC): The Strategic Growth Council was created through SB 732 (Steinberg) Chapter 729, Statutes of 2008. SGC is a cabinet level committee of state agencies, including the Office of Planning and Research (Chair), California State Transportation Agency (CalSTA), California Natural Resources Agency (CNRA), Business, Consumer Services and Housing Agency (BCSH), California Environmental Protection Agency (Cal/EPA), California Health and Human Services Agency (CHHS), and California Department of Food and Agriculture (CDFA). The CAT has a

broad range of tasks, including assisting state and local entities in planning sustainable communities and meeting AB 32 goals. The latest 2015 Draft Program Guidelines for the Affordable Housing and Sustainable Communities Program note, “The applicant must demonstrate that where applicable climate adaptation measures are integrated into their Project” and contains an appendix on climate resiliency.

Climate Change Assessments

A number of assessment and planning documents have been developed by state agencies to better understand risks from climate change to California. These include:

- **First Assessment (2006):** The first California climate change assessment used global models to provide more regionally scaled information on climate impacts to the state. This assessment provided support for passage of AB 32 and the development of the California Air Resources Board’s 2008 Scoping Plan for GHG reductions.
- **Second Assessment (2009):** The second California climate change assessment provided initial economic impact estimates from climate risks in the state. This assessment provided support for the 2009 California Climate Change Adaptation Strategy document, which was the first plan for climate risks developed across sectors.
- **Third Assessment (2012):** The third California climate change assessment was completed after requests for additional information about state vulnerabilities to climate change, including institutional barriers to preparation efforts, sector-specific risks, and local risks. This assessment provided support for the Safeguarding California Plan, which was an update to the 2009 Adaptation Strategy document.
- **Fourth Assessment:** The fourth California climate change assessment is being completed and is intended to provide information to support adaptation decisions. It is the first inter-agency effort to implement much of the Climate Change Research Plan and is ultimately intended to serve as the basis for the request for proposal (RFP) for a portfolio of projects developed by the CNRA, along with OPR and the CAT Research Working Group and to be released during the 2015-16 Fiscal Year. The 4th assessment identifies key research themes and projects for each theme, and indicates funding for non-energy sectors (energy-related studies will support the assessment but identify different funding sources).

Adaptation Resource & Guidance Documents

In addition to assessing the risks, state agencies have created documents to aid state, regional, and local efforts in climate resiliency and adaptation. These include:

- **California Climate Change Adaptation Strategy (CAS, 2009):** The CAS is a statewide strategy that includes a summary of impacts from climate change and provides recommendations for adaptation strategies in seven sectors, including public health, water, agriculture, transportation

and energy, forestry, biodiversity and habitat, and oceans and coastal resources. Overall, it provides guidance for establishing adaptation and resiliency actions.

- California Climate Adaptation Strategy First Year Report (2010): This document provided a first-year update to the 2009 CAS.
- California Adaptation Planning Guide (APG, 2012): Prepared by the CNRA and the Office of Emergency Services, this document is designed to provide guidance and support for local governments and regional collaboratives in addressing the impacts of climate change.
- Safeguarding California (CAS update, 2013): This update to the 2009 Climate Adaptation Strategy by the CNRA in coordination with other state agencies augments previous strategies based on new climate science and risk management options.
- Cal-Adapt: This is a web-based climate adaptation planning tool intended to benefit local planning efforts by downscaling climate change scenarios and research so that users can identify risks from climate change by specific regions within California. This is a project of the CNRA, the California Energy Commission and their Public Interest Energy Research (PIER) Program, along with numerous private and public partners.

As noted in the Little Hoover Commission's 2014 "Governing California Through Climate Change" report, the efforts to understand challenges and vulnerabilities from climate change have been encouraging. However, according to the report, there is still a need "for a more unified approach to adaptation on the part of state government." They note that currently, there is no single, comprehensive administrative structure in California for creating adaptation policy. They further state that most adaptation strategies at the state level are still advisory and have been developed without coordination with local governments and the private sector, which have been largely planning and implementing projects on their own or as part of regional collaboratives.

After their research, which included multiple hearings, an advisory committee meeting, and interviews with stakeholders and experts, the Little Hoover Commission made numerous proposals regarding climate change governance in California. In addition to enforcement and clarification of laws regarding private property and impacts from wildfires and sea level rise, the Commission recommended:

- That the Governor and Legislature create a new state entity or enhance the institutional capacity of an existing organization, which should include an independent science board, to help California's multitude of governments prepare for and react to climate change; and
- That the California Strategic Growth Council expands its focus beyond reduction of carbon emissions to include a greater emphasis on adaptation to the impacts of climate change.

Regional Efforts on Climate Adaptation

Regional collaboratives are an important part of the adaptation process by helping to coordinate local efforts by assisting with planning and implementation as well as being a voice at the state and federal levels.

The Alliance of Regional Collaboratives for Climate Adaptation (ARCCA) is a network of regional collaboratives across California, including five regions: San Diego, Los Angeles, San Francisco Bay, Capital, and Sierra Nevada. ARCCA was formed in 2012 by leaders from regional collaboratives focusing on climate change in conjunction with OPR in order to help urban centers throughout California prepare for the impacts of climate change. Member collaboratives include the San Diego Regional Climate Collaborative, Los Angeles Regional Collaborative for Climate Action and Sustainability (LARC), the Bay Area Joint Policy Committee, the Capital Region Climate Readiness Collaborative, and the Sierra Climate Adaptation & Mitigation Partnership.

Local Efforts on Climate Adaptation

In 2013, the Rockefeller Foundation selected five cities in California—Los Angeles, San Francisco, Oakland, Alameda, and Berkeley—to receive technical support and funding for climate resiliency planning through its Resilient Cities Centennial Challenge.

Aiding these and other cities and counties across California are a number of public and private organizations. One of the many examples is the Local Government Commission (LGC) in Sacramento, a nonprofit organization that assists local governments with policy development and implementation, and one of their main issue areas is climate change and adaptation. Climate Resolve is a founding member of the LARC in the Los Angeles area and focuses on building collaborations to communicate with the public about climate change and promoting resiliency and GHG reduction efforts. The Bay Area's Climate Readiness Institute is a partnership with universities, the regional collaborative, and leaders from the local government, non-profits developing climate science, adaptation strategies, and mitigation tools.

Throughout California, a number of cities and counties have developed plans for addressing climate change, including San Francisco, San Diego, Berkeley, Albany, Arcata, Chula Vista, Davis, Los Angeles, Santa Barbara, and Marin County. For adaptation specifically, Fresno and San Luis Obispo Counties have developed regionally specific climate adaptation strategies across socioeconomic and natural systems.

Summary

As the evidence for anthropogenic global warming has grown, California has been a leader on climate mitigation policy and continuing these greenhouse gas reduction strategies is critical in the ongoing efforts against global warming. However, to better address the magnitude of this challenge, and to

protect the state from climate effects that are happening now and will continue to become more severe, aggressive adaptation and resiliency building policies must be holistically incorporated into the state's overarching climate strategy to create a more comprehensive approach to addressing climate change.

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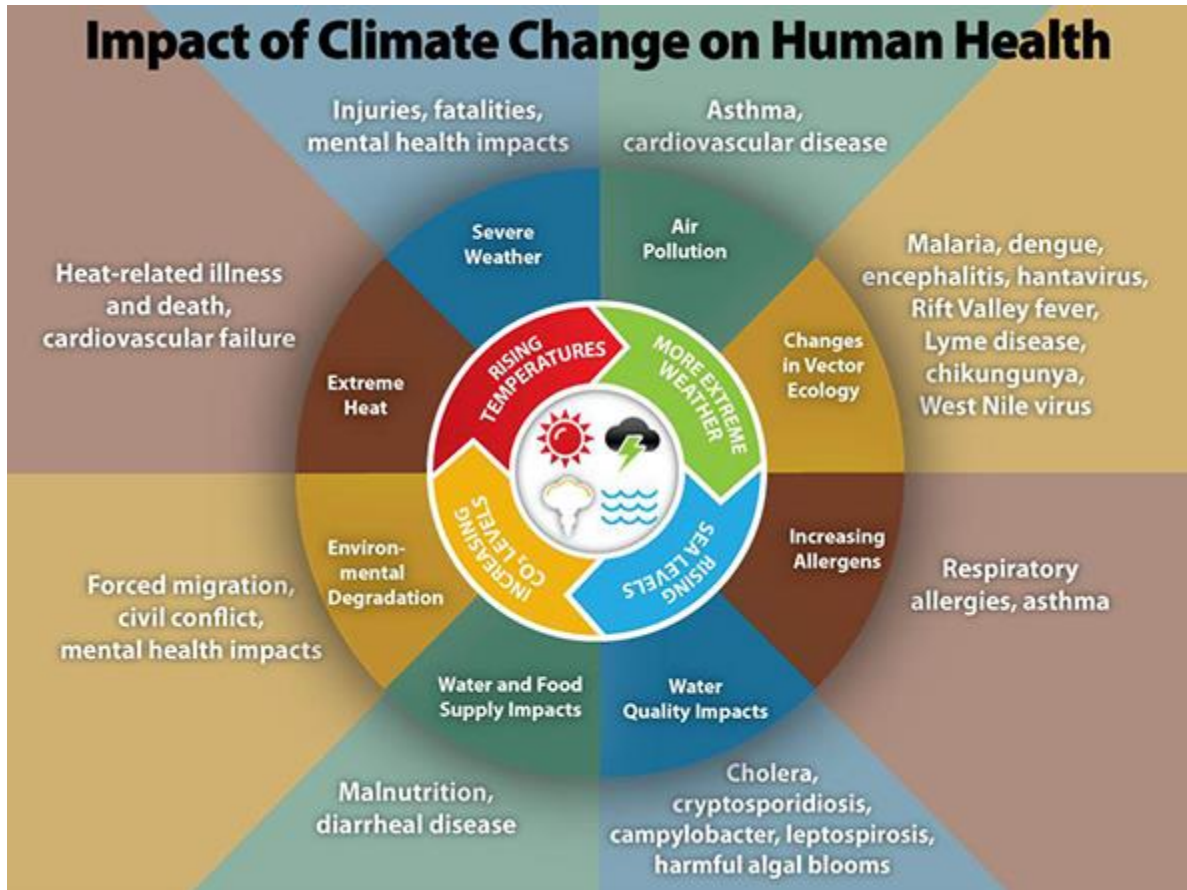
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Source: Centers for Disease Control and Prevention (CDC), Climate and Health Site – “Climate Effects on Health” with content from the National Center for Environmental Health. <http://www.cdc.gov/climateandhealth/effects/default.htm>

EXTREME HEAT DAYS ACROSS THE STATE



TEMPERATURE: EXTREME HEAT TOOL

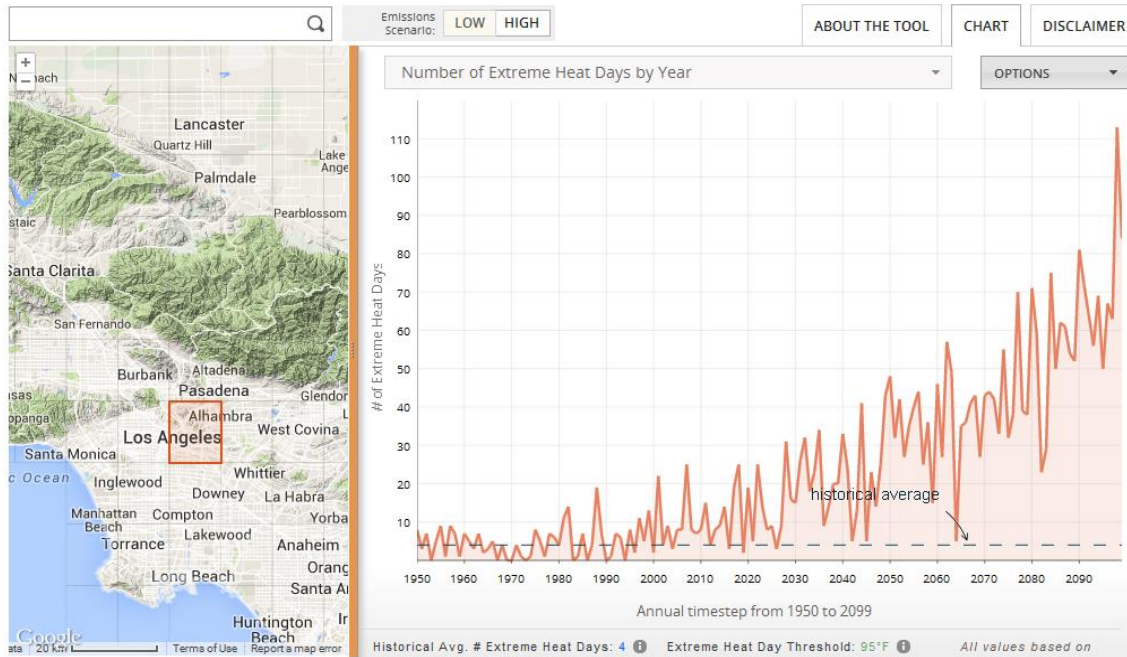


Figure 1. The number of projected extreme heat days (>95 °F) through 2100 in Los Angeles.*

TEMPERATURE: EXTREME HEAT TOOL

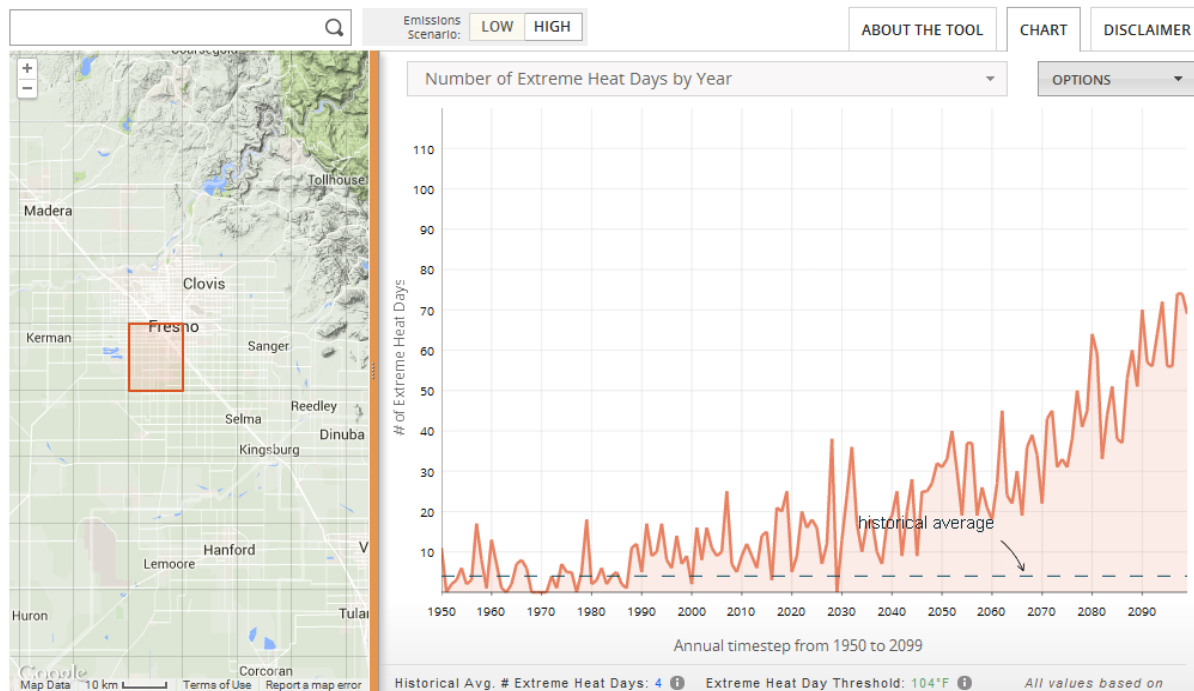


Figure 2. The number of projected extreme heat days (>104 °F) through 2100 in Fresno.*

TEMPERATURE: EXTREME HEAT TOOL

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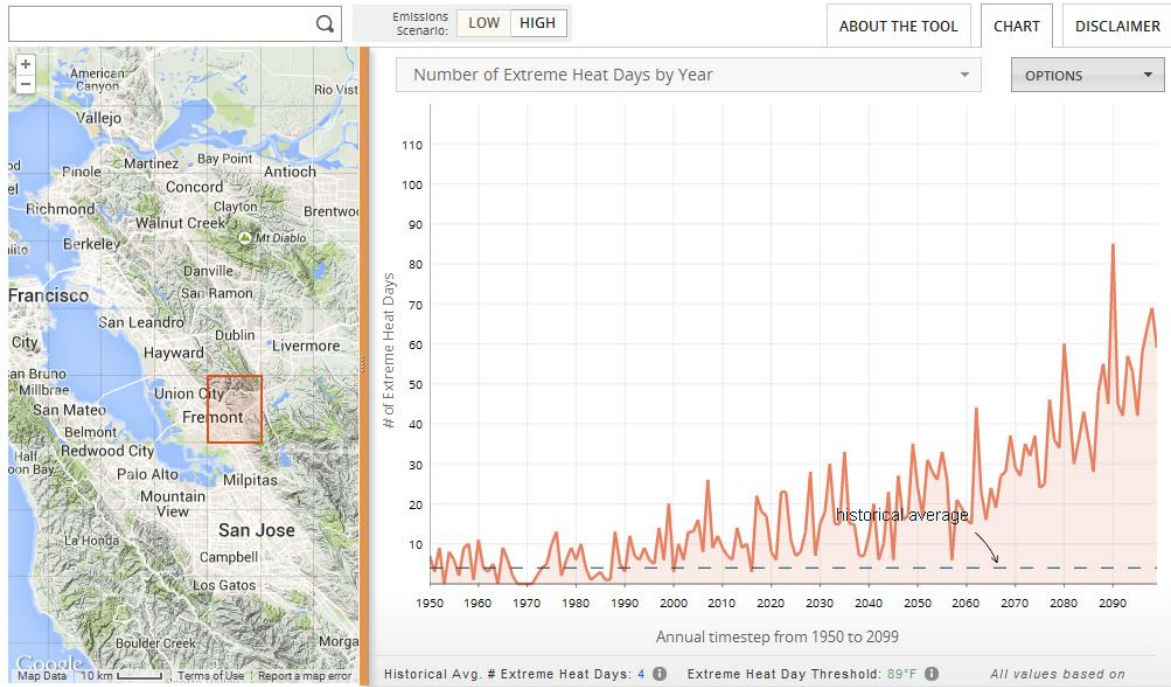


Figure 3. The number of projected extreme heat days (>89 °F) through 2100 in Fremont.*

TEMPERATURE: EXTREME HEAT TOOL

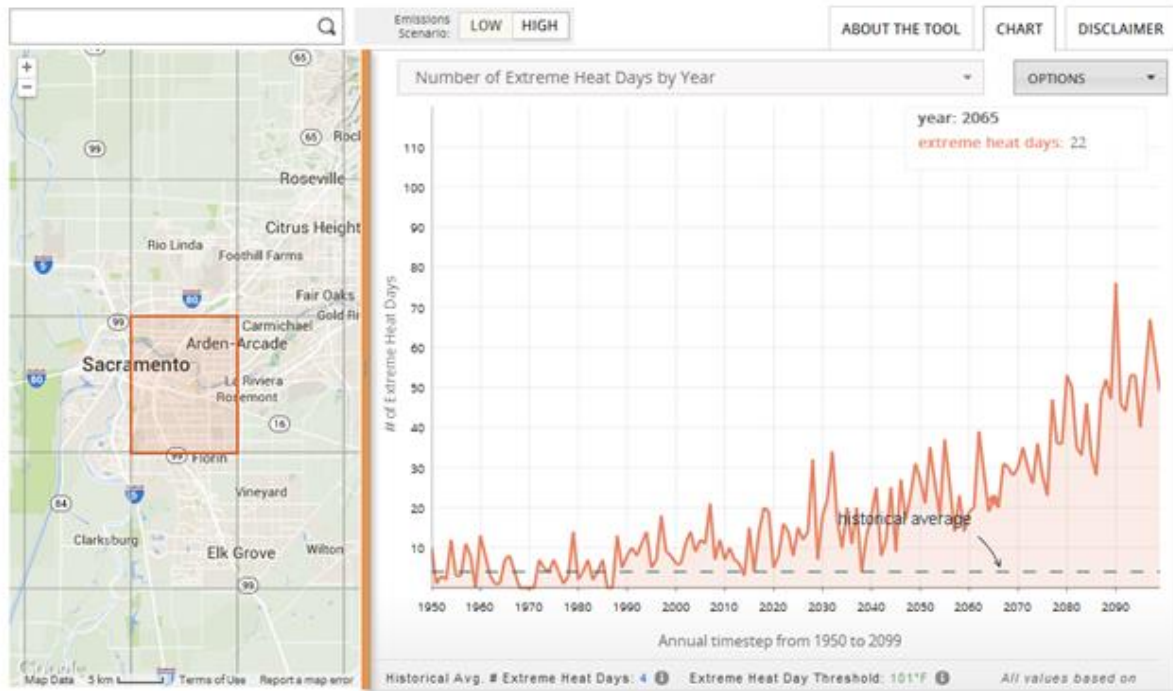


Figure 4. The number of projected extreme heat days (>100 °F) through 2100 in Sacramento.*

*All figures generated using the cal-adapt tool: <http://cal-adapt.org/temperature/heat/>