



# Climate Change Research Plan for California

*Climate Action Team: Report Brief*





*Report Brief*

# **Climate Change Research Plan for California**

*Climate Action Team*

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# Report Brief

*Over the past 25 years, the State of California has been a national and international leader in addressing climate change. Essential to its leadership has been a strong base of research to improve our understanding of the regional impacts of climate change, inform innovative strategies for reducing greenhouse gas emissions, and for safeguarding California from climate change. Similarly, successfully meeting future climate change challenges will require building on this foundation, filling in critical gaps in our knowledge, and integrating sound scientific bases into all of our planning and policy needs.*

The Climate Action Team has generated a Climate Change Research Plan for developing a scientific foundation for addressing these climate challenges. The purpose of this Report Brief is to summarize and present highlights from that plan.

...the first comprehensive climate change research plan developed by any state.

## Framework

California has a comprehensive and integrated approach to address climate change. The approach, articulated in the Governor's Environmental Goals and Policy Report (EGPR), includes the following three interconnected elements:

**Reducing emissions:** Assembly Bill (AB) 32, the California Global Warming Solutions Act of 2006, requires a reduction of greenhouse gas emissions in California to 1990 levels by 2020. Executive Order S-3-05 specifies further reductions to 80 percent below 1990 levels by 2050. AB 32 also requires the State to draft a Scoping Plan that guides California's emission reduction efforts and provides a comprehensive overview of the broad suite of state policies and programs designed to reduce greenhouse gas (GHG) emissions.

**Preparing for impacts:** The Safeguarding California Plan updates the 2009 California Climate Adaptation Strategy in light of advances in climate science and risk management options. The Safeguarding California Plan describes climate risks, work done to date, and recommendations for actions still needed across nine different sectors.

**Research to inform policy:** A strong research program is needed to inform climate policy, advance climate change science, and support the development of tools that will effectively reduce emissions and safeguard California.

### EGPR: Vision and Crosscutting Goals

Reducing emissions

Preparing for impacts

Research to inform policy

AB 32  
Scoping Plan

Safeguarding  
California

Climate  
Change  
Research Plan



## Research Plan

The Climate Change Research Plan for California provides a comprehensive cross-sector look at near-term climate research priorities in California.

Developed by the Climate Action Team Research Working Group, it delineates California's most critical climate-related research needs over the next three to five years. This is an unprecedented effort resulting in the first comprehensive climate change research plan developed by any State.

An important goal of the Research Plan is improved coordination among state agencies and with our partners at the local, regional, federal, and international levels. The plan will help avoid duplication of research efforts, identify opportunities to leverage funding, and encourage collaboration among governmental agencies at all levels.

The recent enhanced support for actionable climate research at the federal level provides an excellent opportunity to align California's research planning with the national plan developed by the U.S. Global Change Research Program. The Research Plan will allow California to address critical knowledge gaps without duplicating federal research activities.

## Guiding Questions

The Research Plan identifies critical areas of research that must be supported in order to inform climate-related policy. The guiding questions are:

**Monitoring:** How is climate changing in California? What monitoring strategies and capabilities will be necessary to track variations and changes in climate, including extreme events? What improvements in climate modeling are needed to support vulnerability assessments that lead to better adaptation planning at multiple levels and across sectors?

**GHG Accounting:** What new emissions accounting methods can help validate estimates of GHG emissions, especially for non-CO<sub>2</sub> gases such as short-lived climate pollutants and in difficult-to-quantify sectors such as agriculture, waste, and forestry? What are the areas of greatest uncertainty?

**Reducing GHG Emissions:** What are the most effective strategies and technological innovations to significantly reduce GHG emissions in all sectors of the economy? What are their economic, public health, and environmental impacts and co-benefits?

**Addressing Climate Change Risks:** How vulnerable are the people, resources, and infrastructure of California to climate change impacts? How is this vulnerability distributed among groups and geography?

What are the most effective strategies and technological innovations to safeguard California from these impacts?

## Foundation

*California's innovative climate policies are built on a strong base of research about the impacts of climate change.*

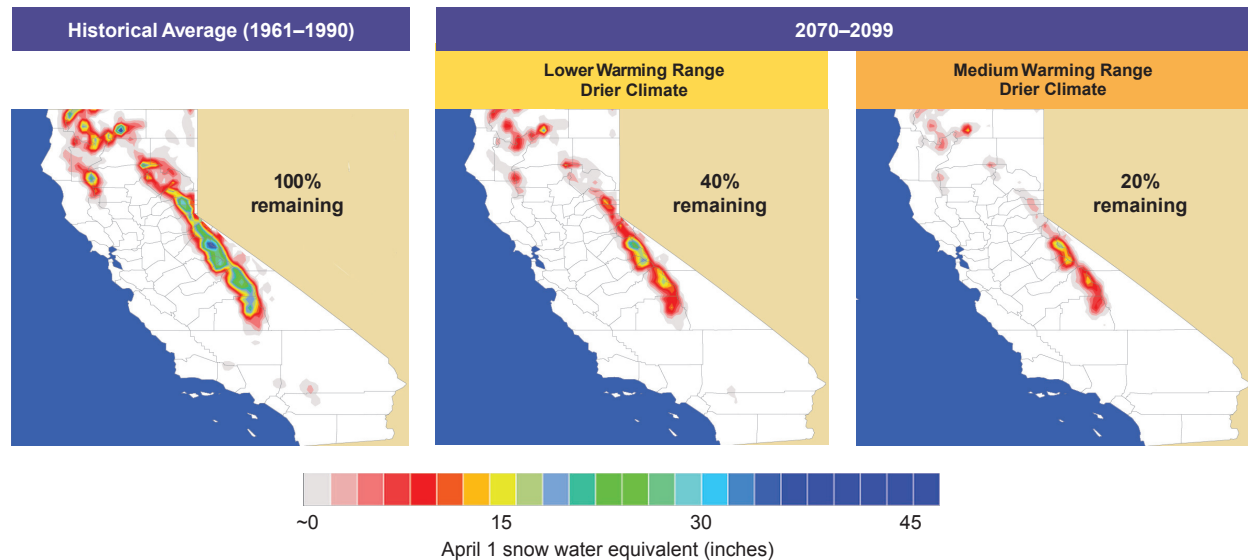
Our investments in California-specific research have proved uniquely important to policy development. For example, state-sponsored research associated with the First California Climate Assessment offered insights that were not available in 2006 from federal research products and that were instrumental to the passage of AB 32, California's groundbreaking climate law.

California-specific research has also been essential to inform policies aimed at safeguarding the state from climate change impacts. Research products like the iconic maps depicting loss of Sierra Nevada snowpack (Figure 1) have contributed to the will continue, as shown in Figure

4. Past studies suggest that wildfires and changes in vegetation patterns may result in net loss of biomass carbon to the atmosphere in this century. This has tremendous implications for mandates to reduce GHG emissions (e.g., AB 32) because even small fractional decreases of the carbon stock in our forests result in substantial carbon emissions.

# California-sponsored research was instrumental to the passage of AB 32.

Figure 1: Decreasing California Snowpack



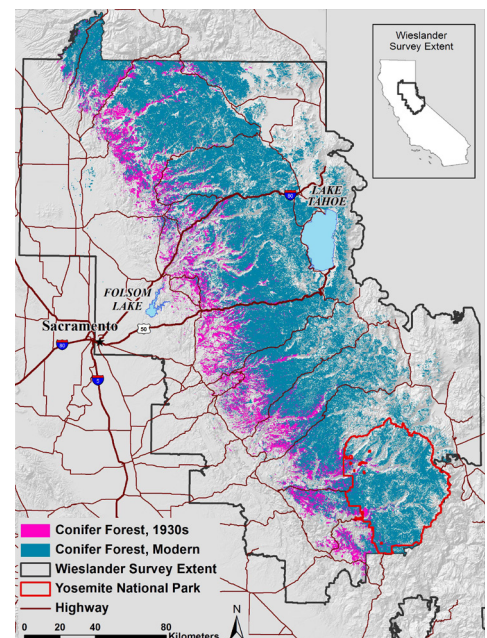
Projections show a 60-80% decrease in mountain snowpack, traditionally the primary reservoir of the State's fresh water supply.

The Research Plan recommends developing improved accounting methods for carbon stocks on California lands to determine if, as suggested by preliminary research, a less dense forest stores more carbon than the currently overgrown forest. If it is the case that thinning forests results in both increased carbon storage and reduced risk of catastrophic wildfires, it would be a win-win for climate mitigation and public health. The Research Plan places a priority on answering how to create healthier forests for both mitigation and adaptation purposes.

**Public Health Impacts:** Past State-sponsored research has also shown that increased temperatures will have detrimental effects on public health on both morbidity and mortality, with different regional manifestations. The Research Plan recommends exploring other ways in which climate change would affect public health, investigating options to ameliorate realization that climate change must be considered in long-term planning for State resources, such as water supply, energy generation, and ecosystem impacts. Recent research demonstrating that climate change is already happening and will accelerate in the rest of this century has contributed to a sense of urgency in policy development.

The Research Plan builds on these past research successes. It identifies critical gaps in our knowledge and recommends research designed to make projections more useful for local decision makers, such as through higher spatial and temporal resolutions. Consider a few examples:

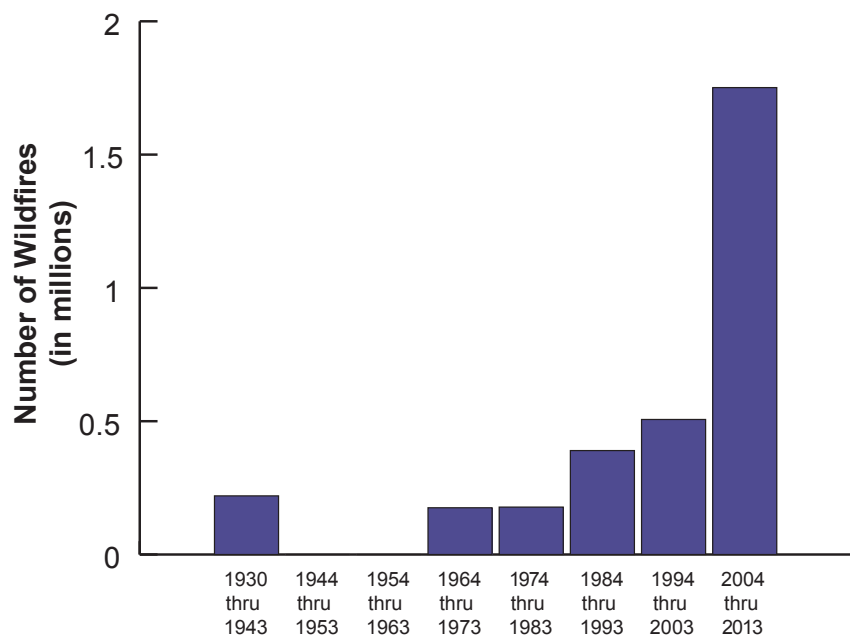
Figure 2: Ponderosa Pine Transition



The dark blue areas are the regions that still are dominated by conifer forests. The lower edge, shown in pink and historically marked by a mix of ponderosa pines, is contracting, consistent with predicted forest response to climate change.



**Figure 3: History of Wildfires in California**



This graph shows that the majority of California's twenty largest wildfires on record have occurred in the past twenty years.

**Forests and Wildfires:** The conifer forests of the Sierra Nevada have been retreating upslope over the past several decades (Figure 2). And warmer temperatures and longer summers are also already affecting the frequency and severity of wildfires. Since 1930, nine of the twenty largest wildfires in California occurred in the last decade, and 14 of the largest occurred in the last two decades (Figure 3). This trend or eliminate negative impacts. For example, in addition to causing ecological and economic disruption, wildfires can cause negative public health outcomes. Particulate matter from wildfire smoke can reduce lung function, lead to bronchitis, and exacerbate asthma. The Research Plan therefore recommends studying forecast-based interventions that could be used to reduce the health and economic impacts of wildfires.

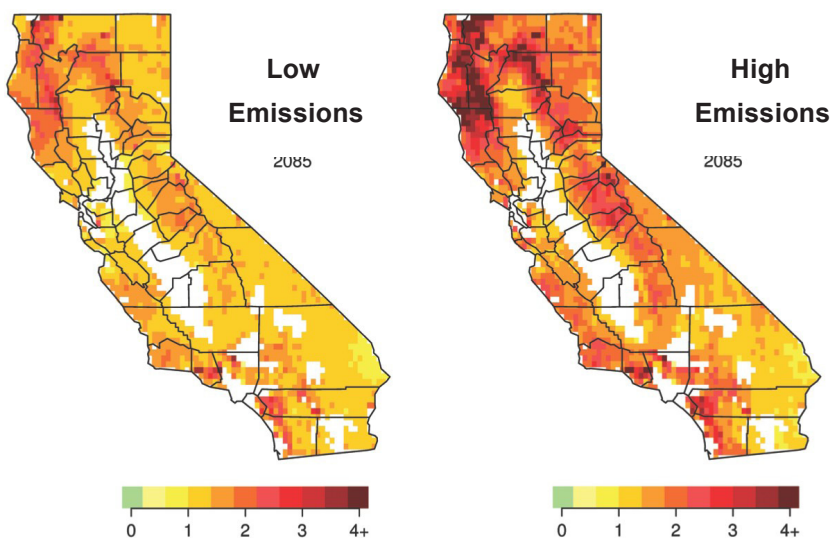
## Crosscutting Issues

The Research Plan identifies several crosscutting areas of research that touch on multiple sectors or would benefit from strong interdisciplinary approaches. Below is a sampling of these issues:

**Social science research:** The Research Plan recommends enhancing social science research on issues for which human behavior plays an important, if not a dominant, role. For example, past research shows that there are significant social, regulatory, institutional, and legal barriers that may impede or delay the implementation of technically sound adaptation options. Recognizing that foundational work has been done, the Research Plan suggests that more work is needed to identify barriers across sectors and to understand, in practical terms, how to overcome those barriers across multiple regions and economic sectors. Finally, holistic research on the non-economic costs and benefits of integrated mitigation and adaptation strategies must be supported for the well-being of California.

**The economics of climate change:** In studies of the economic impact of climate change, there has been a tendency to project only large-scale impacts, for example, on the state's entire economy. But, just as the physical impacts of climate change vary across the state, so too do the related economic benefits and burdens. "On the ground" interdisciplinary studies are needed to allow in-depth estimation of economic costs and benefits related to the implementation of risk management strategies.

**Figure 4: 2085 Wildfire Projections**



Projections for areas burnt by wildfire by 2085. Darker oranges and red suggest 2- to 4-fold increases in risk.

**Environmental justice:** Environmental justice is a universal crosscutting issue that deserves more attention in climate change studies. In the climate change context, research indicates that disadvantaged communities and certain racial/ethnic groups could experience disproportionate public health risks and economic burdens.

**Extreme events:** These events affect both the economy and public health resulting in a cascade of issues that, in turn, exacerbate impacts. Planning for extreme weather-related events must be investigated through integrated research on California's best options to prepare for, respond to, and recover from these events.

## Local and Regional Issues

**The impacts of climate change vary across the state.**

Regions, cities, and communities face challenges specific to their geography, resources and history. In order to meet the varied needs of different geographies, the Research Plan stresses coordination across scales, leveraging research and funding at the federal level while working in concert with local and regional stakeholders.

For example, the California Air Resources Board is using data from NASA on GHG monitoring in the Los Angeles Basin to improve emissions accounting efforts. In addition, partners like the San Francisco Bay and Conservation Development Commission and Caltrans have received federal

**Figure 5: A child enjoying a drink of cool water on a hot day.**

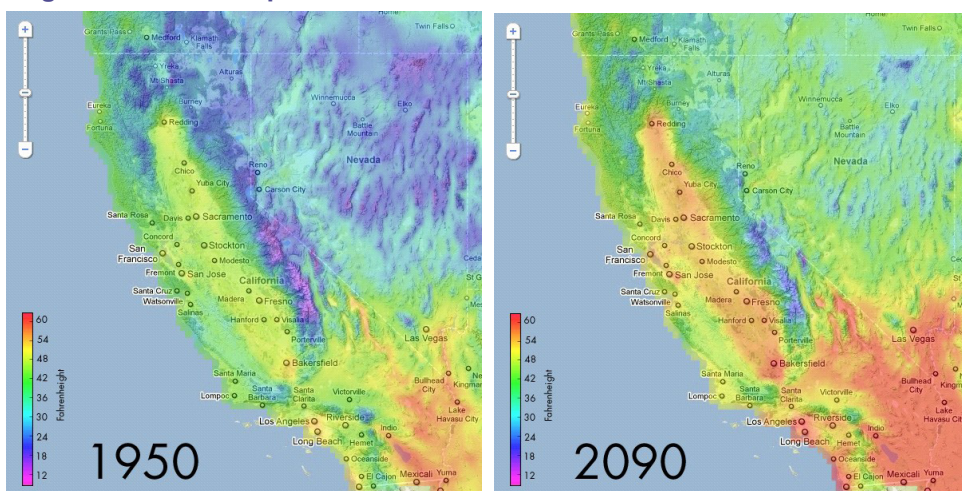


The Research Plan stresses coordination across scales, leveraging research and funding at the federal level while working in concert with local and regional stakeholders.

funds for climate vulnerability research at the local and regional level that fits within the Research Plan. Similarly, private foundations and non-governmental organizations are also supporting much-needed locally and regionally focused climate science.

Local and regional groups are both consumers and producers of California climate research, with diverse and at times overlapping needs and interests. To share resources and coordinate needs, the state's major urban regions (San Francisco Bay Area, the Los Angeles region, San Diego, and the Sacramento area) have developed collaborative efforts around adaptation and preparedness—bridging gaps between State ARCCA was a key contributor to establishing the specific regional research needs that are compatible with the *Research Plan*.

**Figure 6: 2090 Temperature Simulation**



Simulated decadal average temperatures under a high emissions (A2) scenario show that the vast majority of California is expected to warm, on average, by more than 5°F by 2090, with inland areas warming more than coastal areas. Source: [www.cal-adapt.org](http://www.cal-adapt.org)

## Box A

### **Cal-Adapt, Leveraging the State's Climate Change Research to Prepare for Climate Risks**

In 2011, Cal-Adapt (<http://cal-adapt.org/>) was launched to address the scarcity of readily accessible scientific information to illuminate local climate risks in support of adaptation initiatives and planning efforts. Drawing on the wealth of California's peer-reviewed, State-sponsored climate change research, Cal-Adapt is an interactive website that enables exploration of climate risks associated with low- and high-emission scenarios. Custom visualizations allow users to explore projected temperature changes, wildfire risks, sea level rise, and snow pack at the local level. All data presented on the site are freely available for download to support further analysis. California's recently released Adaptation Planning Guide directs users to Cal-Adapt, which has established itself as a primary tool enabling resource managers; city, county, and tribal governments; and other public and private decision-makers to find locally relevant information to facilitate planning for climate risks. The Climate Action Team has also created science and technical catalogs documenting prior, current, and planned climate change research studies supported by state agencies in California.

## Implementation

Who's implementing it? Individual state agencies will be responsible for implementing the *Research Plan*. Many agencies have climate-related activities that support actionable climate science. However, few have dedicated climate research funding. The State will need to make choices about which specific research initiatives it will prioritize and how it will secure funding for those priorities. In order to foster communication between agencies and make the most out of limited funds, the Climate Action Team's Research Working Group will coordinate implementation of this Research Plan (see Box B). Coordinated implementation will advance a comprehensive research portfolio to support climate goals articulated by the Climate Change Scoping Plan, Safeguarding California, and the Governor's Environmental Goals and Policy Report.

What results can I expect? The Fourth California Climate Change Assessment (Fourth Assessment, see Box C), scheduled for release in 2018, will be the first step towards major cross-sectoral implementation of this Research Plan. The Fourth Assessment will involve collaboration with the State's external partners, as envisioned by the Research Plan, to address critical information needs articulated in Safeguarding California. Innovative public-private partnerships will build off of prior climate research contributions from non-governmental organizations and continue to advance vulnerability assessments and other climate-related research to support management actions.

The Research Plan articulates a strategy for implementation that will ensure internal consistency among a broad array of climate initiatives, while aligning climate policy and initiatives with California's broader goals. Although the climate challenges before the State are daunting, the required transformations present opportunities to foster communities that are more equitable, healthy, and food-secure, while protecting California's bountiful natural resources for future generations.

## Box B

### **The Climate Action Team's Research Working Group, Building a Foundation for Enhanced Collaborations**

The California's interagency Climate Action Team has established a Research Working Group (RWG) to bolster inter-agency coordination on state-sponsored climate change research. Monthly coordination meetings involving 22 agencies have established a forum for discussion of state research priorities, facilitated timely exchange of research results between agencies, and strengthened the ability of California's Climate Change Assessments to engage the concerns of a wide variety of stakeholders. Moving forward, the Climate Action Team RWG will continue to augment internal coordination while cultivating further coordination with external groups including federal agencies, the international community and private actors such as foundations, the business community, and NGOs.

## Box C

### **California's Climate Change Assessments, Vital Support for the State's Climate Leadership**

California's Fourth Climate Change Assessment will build on the success of three prior assessments, each of which was scoped to address California-specific policy questions and information needs. By filling gaps regarding climate vulnerability as well as management options, the Fourth Assessment enhances the capacity of diverse local and regional entities from a variety of sectors to anticipate and plan for projected climate risks including extreme events. Scientific studies will offer finer spatial resolution as to what impacts might be expected in the next 20 to 40 years without losing sight of end-of-century climate risks. Regional case studies will highlight specific examples of overcoming adaptation barriers and financing adaptation options. California's previous Climate Change Assessments are available at:

[http://climatechange.ca.gov/climate\\_action\\_team/reports/climate\\_assessments.html](http://climatechange.ca.gov/climate_action_team/reports/climate_assessments.html)



## Acknowledgements

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**Figure Credits**

Figure 1: Our Changing Climate (2006),  
CEC-500-2006-077.

Figure 2: Data from CEC-500-2006-107  
provided by Dr. James Thorne,  
University of California, Davis.

Figure 3: Data from the California Department  
of Fire and Forestry Protection (CAL-FIRE).

Figure 4: From A. LeRoy Westerling,  
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CEC-500-2009-046-F.

Figure 5: From the Department of Water  
Resources Photo Gallery  
([pixel.water.ca.gov](http://pixel.water.ca.gov)).

Figure 6: Images from Cal-Adapt  
([www.cal-adapt.org](http://www.cal-adapt.org)),

Plan and its appendices are available  
at the California Climate Change Portal:  
[www.climatechange.ca.gov](http://www.climatechange.ca.gov)

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