

# California's Fourth Climate Change Assessment

## Overall Description

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Team Lead for Climate Change and Environmental Research  
California Energy Commission

Workshop on  
Integrating Climate Change in California Extension

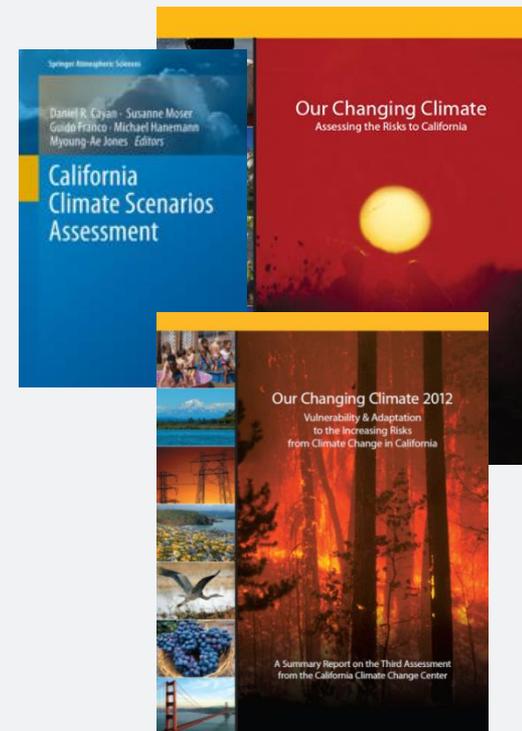
# Outline

- Background Information
- Overall Organization
- Products & Schedule
- Q&As

# BACKGROUND INFORMATION

# California's Climate Change Assessments

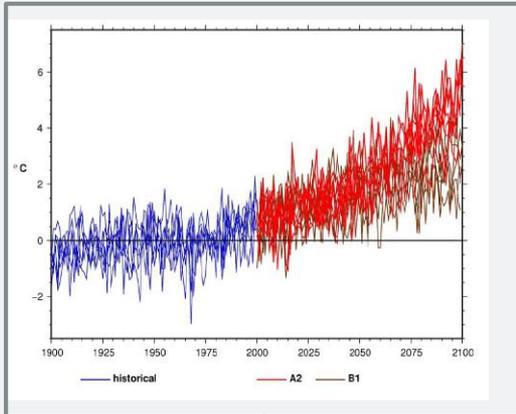
- California has been supporting regional climate science for more than two decades.
- Starting in the early 1990's, CEC produced three "first-generation" reports on impacts of climate change on California.
- Since California's landmark Executive Order (S-3-05) in 2005, the state has conducted periodic scientific assessments of regional climate change impacts.
- **"First"** California Climate Change Assessment (2006)
  - Documented the severity of potential impacts
  - Helped support passage of AB 32
- **"Second"** California Climate Change Assessment (2009)
  - Concluded adaptation to be an essential complement to mitigation
  - Informed first California Climate Adaptation Strategy (2009)
- **"Third"** California Climate Change Assessment (2012)
  - Explored regional and local studies, barriers to adaptation, and improved understanding of interactions of local vulnerabilities and climate risks...



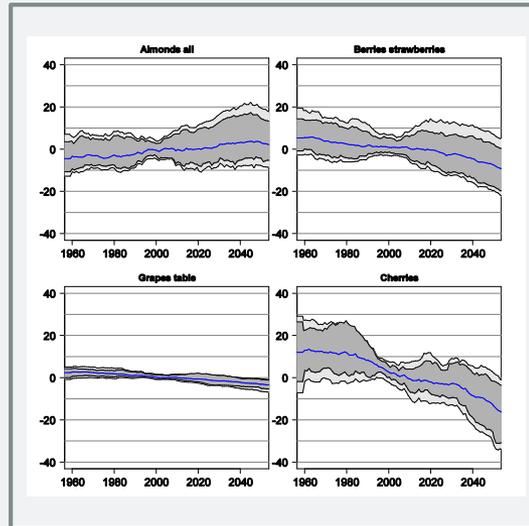
# Using an integrated framework with common climate and socio-economic scenarios

## Climate and Sea Level Rise Scenarios

Cayan et al., (Scripps, Santa Clara University)

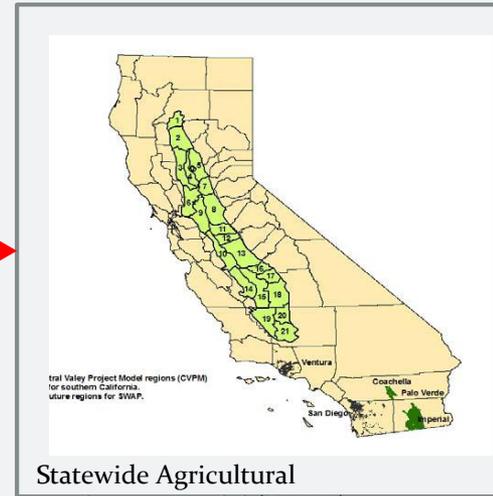


## Physical Impacts



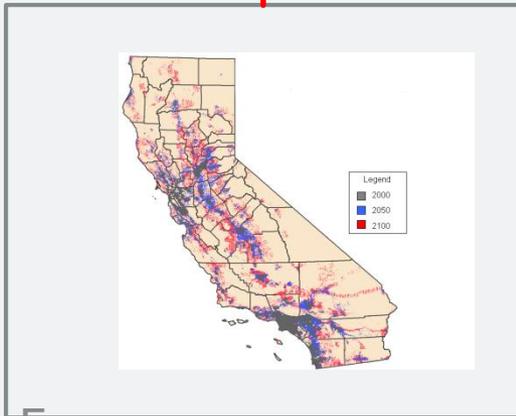
Lobell and Field (Stanford)

## Economic Outcomes



Statewide Agricultural Production Model (SWAP)  
Howitt et al. (UC Davis)

Sanstad et al., (LBNL, PPIC, LLLN, CEC)



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## Demographic and Urban Projections

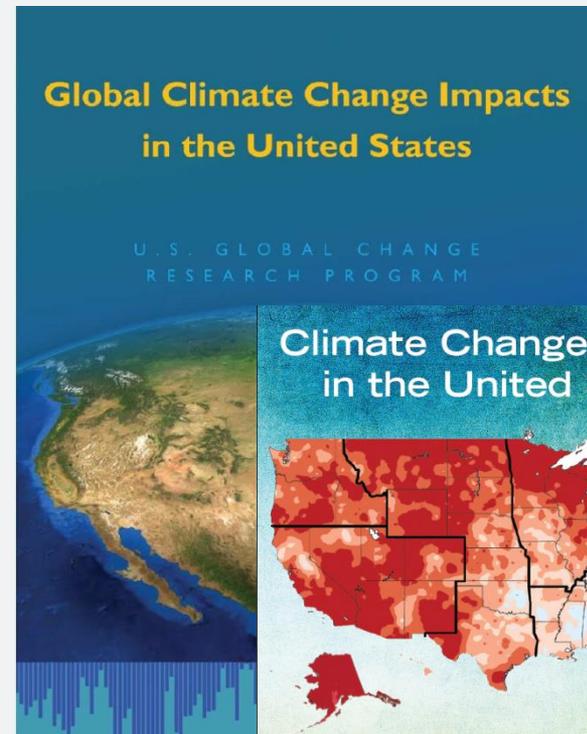
## Exploration of Economic Impacts

2009 Assessment

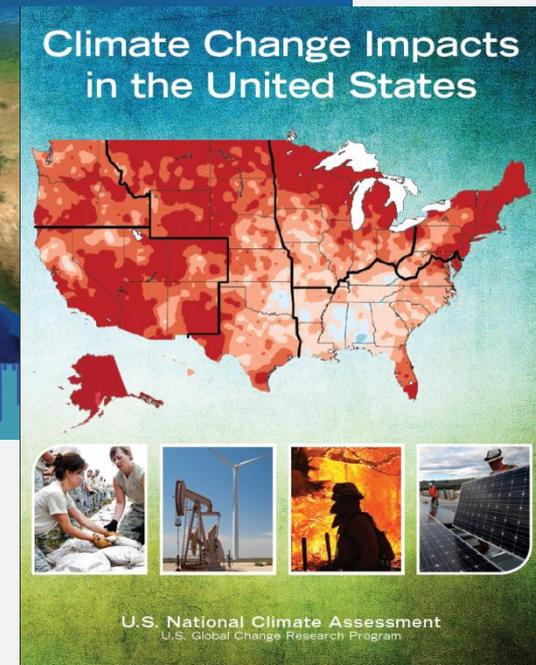
# Links to the National Assessments

- One-third of the references in the chapter for the Southwest (six states ) in the 2009 National Assessment came from CA-sponsored research
- CA-sponsored research was an important contributor to the 2014 National Assessment released on May 6th
- Informal coordination with the 2018 CA Assessment
  - National Assessment using the CA downscaling technique (LOCA)
  - We are using a US EPA product produced as input for the 2018 National Assessment (CIRA II)

2009



2014



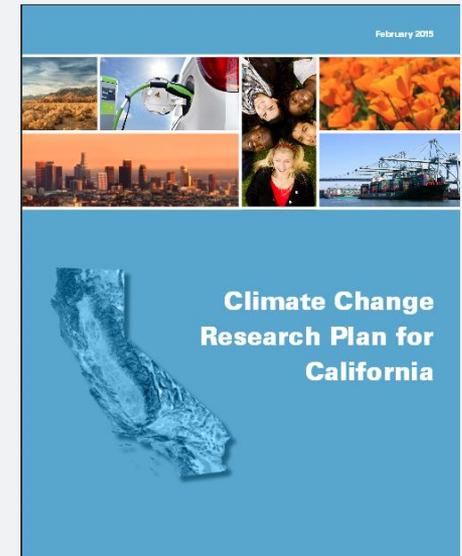
# California's Fourth Climate Change Assessment: **Scope and Funding**

## ○ **Scope** of research

- Shaped by input from CAT Research Working Group
- CAT RWG is a vehicle for coordinating and sharing research among ca. 20 state agencies representing public health, fish & wildlife, water resources, air resources, and many other areas
- Responsive to *California's Climate Change Research Plan* (February 2015)

## • **Distinct funding** streams:

- *Energy sector* research funded by EPIC (electricity sector), PIER (natural gas), and Petroleum Violation Escrow Account (petroleum)
- "Non-energy" research supported by California's Natural Resources Agency (CNRA)
  1. Climate change, habitat, and wildfires
  2. California's working lands
  3. Sea level rise, California's Coast, ecosystems, and the Delta
  4. Water security and long droughts
  5. Forecasting to support climate-resilience decision-making
  6. Emergency management
  7. Overcoming financial & institutional barriers to local government adaptation strategies



# Overall Organization

# California's Fourth Climate Change Assessment: **Coordination and Roles**

## Coordination

- Strong coordination between “energy” and “non-energy” research
  - Weekly management meetings
  - Quarterly technical meetings, peer review of all research, integration of projects’ results
- Coordination with local/regional efforts (ARCCA)

## Roles

- CNRA, Governor’s Office of Planning & Research ultimately responsible for the Assessment
- CAT Research Working Group, led by Chairman Weisenmiller, forms steering committee
- Technical management/support provided by the California Energy Commission, California’s Natural Resources Agency, and Department of Water Resources

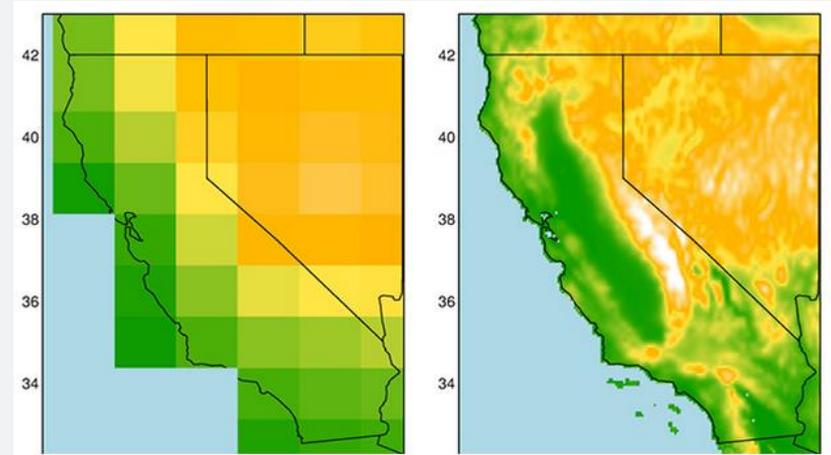


Figure: Global climate model (left) vs. LOCA downscaled (right) representation of climate changes in California and Nevada.

# Common set of scenarios

- Common set of climate scenarios developed by Scripps Institution of Oceanography
- Common set of sea level rise scenarios (Scripps)
- Socio-economic scenarios (CA Dept. of Finance)
- “Common” estimation of shoreline changes under sea level rise and storminess (USGS)
- Wildfire scenarios (UC Merced)

# Energy sector research supporting the Assessment: **Portfolio**

**SCENARIO DEVELOPMENT:** Climate, hydrological, and sea-level rise scenarios; and socioeconomic and land use projections.

**PROBABILISTIC FORECASTING:** Use of empirical data and regional climate modeling to enhance energy sector management.

**EXTREMES: WILDFIRE, INLAND AND COASTAL FLOODING, URBAN HEAT ISLANDS, PROLONGED DROUGHTS:** Investigation of how climate change will affect these issues in the context of the electricity, natural gas, and petroleum sectors.

**REGIONAL VULNERABILITY AND RESILIENCE:** Studies to clarify regional vulnerabilities related to natural gas and electricity systems.

**MAKING RESULTS ACTIONABLE:** Characterizing barriers to adaptation, visualizing and communicating results via Cal-Adapt (<http://cal-adapt.org/>) to support energy sector decision-making.

**RELATED WORK— LONG-TERM SCENARIOS FOR THE ENERGY SECTOR:** Study of resilient energy scenarios compatible with 2030, 2050 climate goals.

**California's Fourth Climate Change Assessment:  
Resources Research Portfolio**

| <i>Research Area</i>  | <i>Project Title</i>   | <i>Principal Investigator(s)</i> | <i>Institution</i>                  |
|---|--|----------------------------------|-------------------------------------|
| Climate Change, Habitat, and Wildfires                              | The Impact of Changing Wildfire Risk on the California Homeowners' Insurance Market  | Lloyd Dixon                      | RAND                                |
| Climate Change, Habitat, and Wildfires                              | Migration Corridors as Adaptation to Climate Change: Why, How, and What Next   | Adina Merenlander                | UCB                                 |
| Climate Change, Habitat, and Wildfires                              | Fuel Treatment for Forest Resilience and Climate Mitigation: Critical Review   | David Saah                       | Spatial Informatics Group           |
| California's Working Lands  | Increasing Soil Organic Carbon to Mitigate Greenhouse Gases and Increase Climate Resiliency for California   | Lorraine Flint                   | USGS                                |
| California's Working Lands  | Soil Water Dynamics, Carbon Sequestration, and Greenhouse Gas Mitigation Potential of Using Composted Manure and Food Waste on California's Rangelands | Whendee Silver                   | UCB                                 |
| California's Working Lands  | Innovations in Measuring and Managing Forest Carbon Stocks in California   | John Battles                     | UCB                                 |
| California's Working Lands  | Economic and Environmental Implications of California Crop and Livestock Adaptations to Climate Change and Climate Policy                              | Daniel Sumner, Josue Medellin    | UCD                                 |
| Sea Level Rise, California's Coast, Ocean Ecosystems, and the Delta | Assessing and Communicating the Impacts of Climate Change on the California Coast  | Patrick Barnard                  | USGS                                |
| Sea Level Rise, California's Coast, Ocean Ecosystems, and the Delta | Identification of Natural Infrastructure Options for Adapting to Sea Level Rise  | Sarah Newkirk                    | TNC                                 |
| Sea Level Rise, California's Coast, Ocean Ecosystems, and the Delta | California Mussels as Bio-Indicators of the Ecological Consequences of Global Change: Temperature, Ocean Acidification, and Hypoxia                    | Brian Gaylord                    | UCD                                 |
| Water Security and Long Droughts                                    | Advancing Hydro-Economic Optimization to Identify Vulnerabilities, Tradeoffs, and Adaptation Opportunities in California's Water System                | Jonathan Herman                  | UCD                                 |
| Water Security and Long Droughts                                    | Drought Planning and Climate Adaptation of Small Self-Sufficient Water Utilities in California   | Julia Ekstrom                    | UCD                                 |
| Water Security and Long Droughts                                    | Addressing Institutional Vulnerabilities to Climate Change: Drought as Stress Test for Water Allocation and Environmental Protection                   | Holly Doremus                    | UCB                                 |
| Forecasting to Support Climate-Resilient Decision-making            | Preparing Public Health Officials for Climate Change: A Decision Support Tool  | Emilie Mazzacurati               | Four Twenty Seven Climate Solutions |
| Emergency Management  | Assessing Vulnerability and Improving Resilience of Critical Emergency Management Infrastructure in California in a Changing Climate                   | Andrew Lauand                    | RAND                                |
| Making it Happen (Resilience)                                       | Overcoming Financial and Institutional Barriers to Implementing Local Government Adaptation Strategies   | Robert Kay                       | ICF                                 |

Jamie Anderson, Ph.D., P.E., of the Department of Water Resources manages this portfolio (Jamie.Anderson@water.ca.gov).

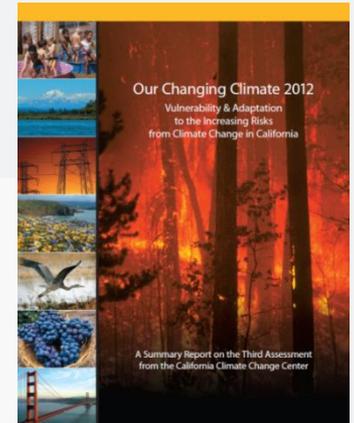
**California's Fourth Climate Change Assessment:  
External Collaborator Portfolio**

| <i>Research Area</i>          | <i>Project Title</i>  | <i>Principal Investigator(s)</i> | <i>Institution</i>                  |
|-------------------------------|---|----------------------------------|-------------------------------------|
| Coastal Resilience Strategies | Multi-Scale Infrastructure Interactions with Intermittent Disruptions: Coastal Flood Protection Infrastructure, Transportation, and Government Networks | Mark Stacey, Bruce Riordan       | UCB, Climate Readiness Institute    |
| Coastal Resilience Strategies | Strategies for Adapting to Long-term Sea Level Rise in the San Francisco Bay Area   | Kristina Hill, Bruce Riordan     | UCB, Climate Readiness Institute    |
| Coastal: Overcoming Barriers  | The Role of California State Agencies in Facilitating Local Adaptation to Sea Level Rise  | Hilda Blanco                     | USC                                 |
| Coastal: Overcoming Barriers  | Assessment of the State of Coastal Adaptation in California-- The 2016 Update   | Susanne Moser                    | Susanne Moser Research & Consulting |
| Making It Happen (Resilience) | The Role of Visualization in Community Engagement   | Susanne Moser                    |                                     |
| Ecology                       | San Diego County: A Bio-diversity Hotspot's Vulnerability to Climate Change   | Julie Kalansky                   | UCSD                                |
| Ecology                       | <i>Lake Warming in California: Observed and projected trends with regard to a changing climate</i>  | Simon Hook                       | NASA JPL                            |
| Ecology                       | CASCaDE: Ecological Modeling of Future Scenarios in the Delta   | Noah Knowles                     | USGS                                |
| Ecosystem Carbon              | Integrated Projections of Land Changes and Ecosystem Carbon Dynamics  | Ben Sleeter                      | USGS                                |
| Ecosystem Carbon              | Land Acquisition and Ecosystem Carbon in Coastal California   | David Ackerly, Bruce Riordan     | Climate Readiness Institute         |
| Energy                        | Impacts of Climate Change on Residential Natural Gas Consumption  | Max Auffhammer                   | UCB                                 |
| Extremes, EJ, UHI             | Urban Heat Project, Bay Area  | Andy Jones, Bruce Riordan        | Climate Readiness Institute         |
| Extremes, EJ, UHI             | Investigating Optimal Urban Heat Mitigation Strategies for Vulnerable Populations in a Changing Climate   | George Ban-Weiss                 | USC                                 |
| Water Resources, Drought      | Groundwater Strategy for Southern California  | Hilda Blanco                     | USC                                 |
| Water Resources, Drought      | Adapting to Climate Change and Drought in Selected California Groundwater Basins: Local Achievements and Challenges                                     | Ruth Langridge                   | UCSC                                |
| Water Resources, Drought      | SJV Case Study of Social Vulnerability to California Drought in Rural Communities   | Christina Greene                 | University of Arizona               |
| Water Resources, Drought      | <i>How Do Different Sizes and Types of Utilities Perceive and Address Climate Change?</i>   | Julia Ekstrom                    | UC Davis                            |

# Products & Schedule

# Products

- 50+ Scientific Reports
- Statewide Report
- 9 Regional Reports
- 3 Topical Reports
  - EJ/Disadvantaged communities
  - Tribal and indigenous communities
  - Coastal issues
- Glossy brochure(s)
- Outreach activities
  - CA Climate Adaptation Forum (August 2018)
  - Governor's Summit (September 2018)
  - Potential for regional workshops



# Article in *Nature*

## COMMENT

**ASTROBIOLOGY** A profile of the indomitable woman at the helm of SETI p.596



**HEALTH** Documentary traces the roots and legacy of a pioneering aid agency p.598

**ENERGY** Call for caution following China's gas-hydrate extraction p.599

**TAXONOMY** Rebuttals on bureaucracy, hypotheses, conservation and more p.600



Decarbonizing the world economy will require renewable energy generation from vast solar farms, such as this one in Nevada.

## Three years to safeguard our climate

Christiana Figueres and colleagues set out a six-point plan for turning the tide of the world's carbon dioxide by 2020.

In the past three years, global emissions of carbon dioxide from the burning of fossil fuels have levelled after rising for decades. This is a sign that policies and investments in climate mitigation are starting to pay off. The United States, China and other nations are replacing coal with natural gas and boosting renewable energy sources. There is almost a unanimous international agreement that the risks of abandoning the planet to climate change are too great to ignore.

The technology-driven transition to low-carbon energy is well under way, a trend that made the 2015 Paris climate agreement possible. But there is still a long way to go to decarbonize the world economy. The political winds are blustery. President Donald Trump

has announced that the United States will withdraw from the Paris agreement when it is legally able to do so, in November 2020.

The year 2020 is crucially important for another reason, one that has more to do with physics than politics. When it comes to climate, timing is everything. According to an April report<sup>1</sup> (prepared by Carbon Tracker in London, the Climate Action Tracker consortium, the Potsdam Institute for Climate Impact Research in Germany and Yale University in New Haven, Connecticut), should emissions continue to rise beyond 2020, or even remain level, the temperature goals set in Paris become almost unattainable. The UN Sustainable Development Goals that were agreed in 2015 would also be at greater risk.

That's why we launched Mission 2020—a collaborative campaign to raise ambition and action across key sectors to bend the greenhouse-gas emissions curve downwards by 2020 ([www.mission2020.global](http://www.mission2020.global)).

As 20 leaders of the world's largest economies gather on 7–8 July at the G20 summit in Hamburg, Germany, we call on them to highlight the importance of the 2020 climate turning point for greenhouse-gas emissions, and to demonstrate what they and others are doing to meet this challenge. Lowering emissions globally is a monumental task, but research tells us that it is necessary, desirable and achievable.

After roughly 1°C of global warming driven by human activity, ice sheets in Greenland ▶

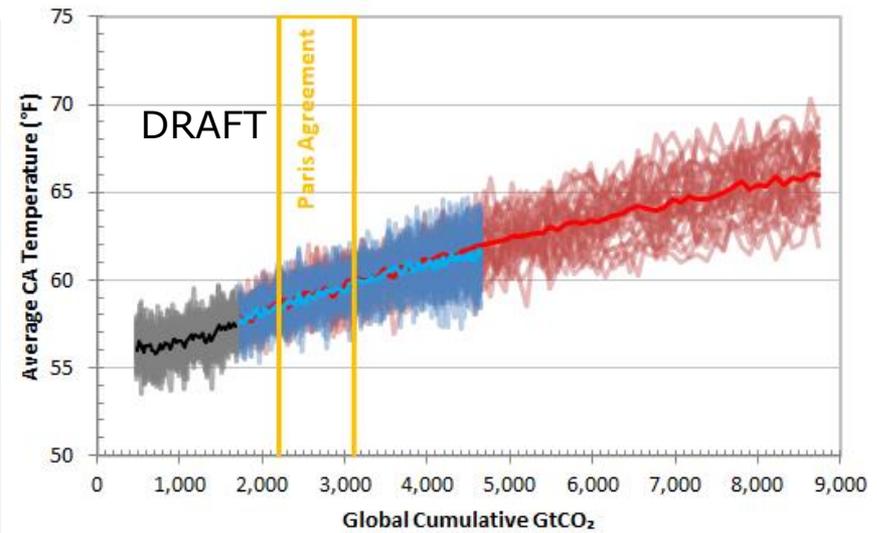
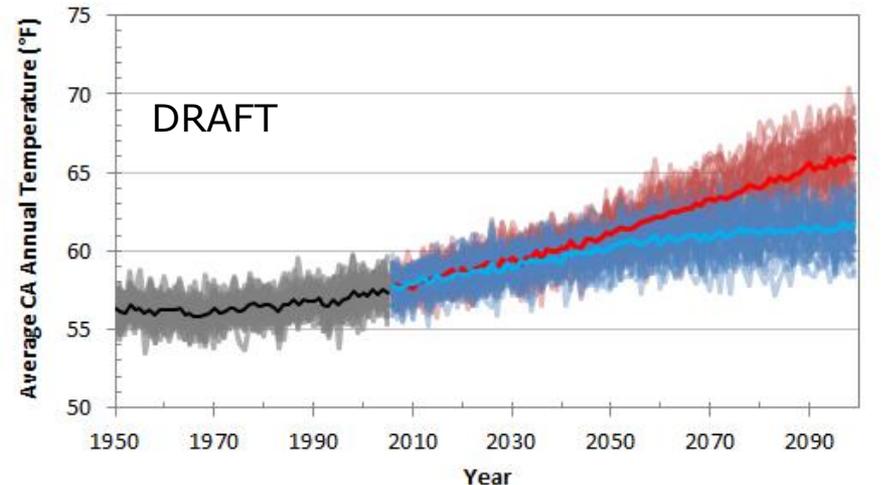
“After subtracting past emissions, humanity is left with a ‘carbon credit’ of between 150 and 1,050 gigatonnes of CO<sub>2</sub> to meet the Paris target of 1.5 °C or well below 2 °C.”

Note in *Nature* co-signed by Governor Brown

# Implications of the Paris Agreement

- To achieve the Paris goal of limiting global average temperature to between 1.5 °C and 2 °C (2.7 °F to 3.6 °F) from pre-industrial levels, total global CO<sub>2</sub> emissions could only increase by certain amounts from the cumulative emissions emitted since 1850.
- The “Paris” range of cumulative CO<sub>2</sub> is shown in the yellow rectangle.
- Temperatures in California would go up from 1.6°F to 2.8 °F from the 1976-2005 average temperature.
- California has already experienced an increase of average temperature of about 2°F since 1895.

## Statewide Average Temperature



California has decided that mitigation is not enough and that adaptation must complement mitigation

# Q&As

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