



**Adapt, Flee, or Perish:
Responses to Climate Change for California's Water Sector**

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Water Education Foundation Water 101

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Sacramento, California

Today's Topics

- Climate change mitigation (“water-energy nexus”)
- Historical and current indications of climate change
- Projected climate change impacts to water resources
- Adapting to climate change



DWR's Roles & Responsibilities

Mission statement:

“To manage the water resources of California in cooperation with other agencies, to benefit the State’s people, and to protect, restore, and enhance the natural and human environments.”

- Plan, design, construct, operate, and maintain California’s State Water Project, the nation’s largest state-built water and power development and conveyance system
- Improve and maintain Central Valley flood management systems and provide statewide flood management financial assistance
- Protect and restore the Sacramento-San Joaquin Delta
- Educate the public about the importance of water and its proper use
- Regulate the safety of 1200 dams
- Regional water management, focusing on technical & financial assistance to local agencies to advance Integrated Regional Water Management
- Statewide planning, focusing on data and updating the California Water Plan (Bulletin 160 Series)





Mitigation

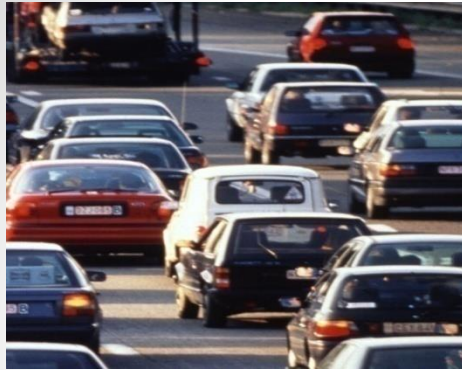
Climate Change Mitigation: to reduce, remove or prevent emission of greenhouse gases.

Mitigation can be accomplished by:

- Using new technologies
- Using renewable/ or reducing energy use
- Increasing efficiency
- Changing management practices
- Carbon sequestration

California's GHG Emissions

cars and trucks = 40%



energy = 33%



industrial = 20%



agriculture = 6%

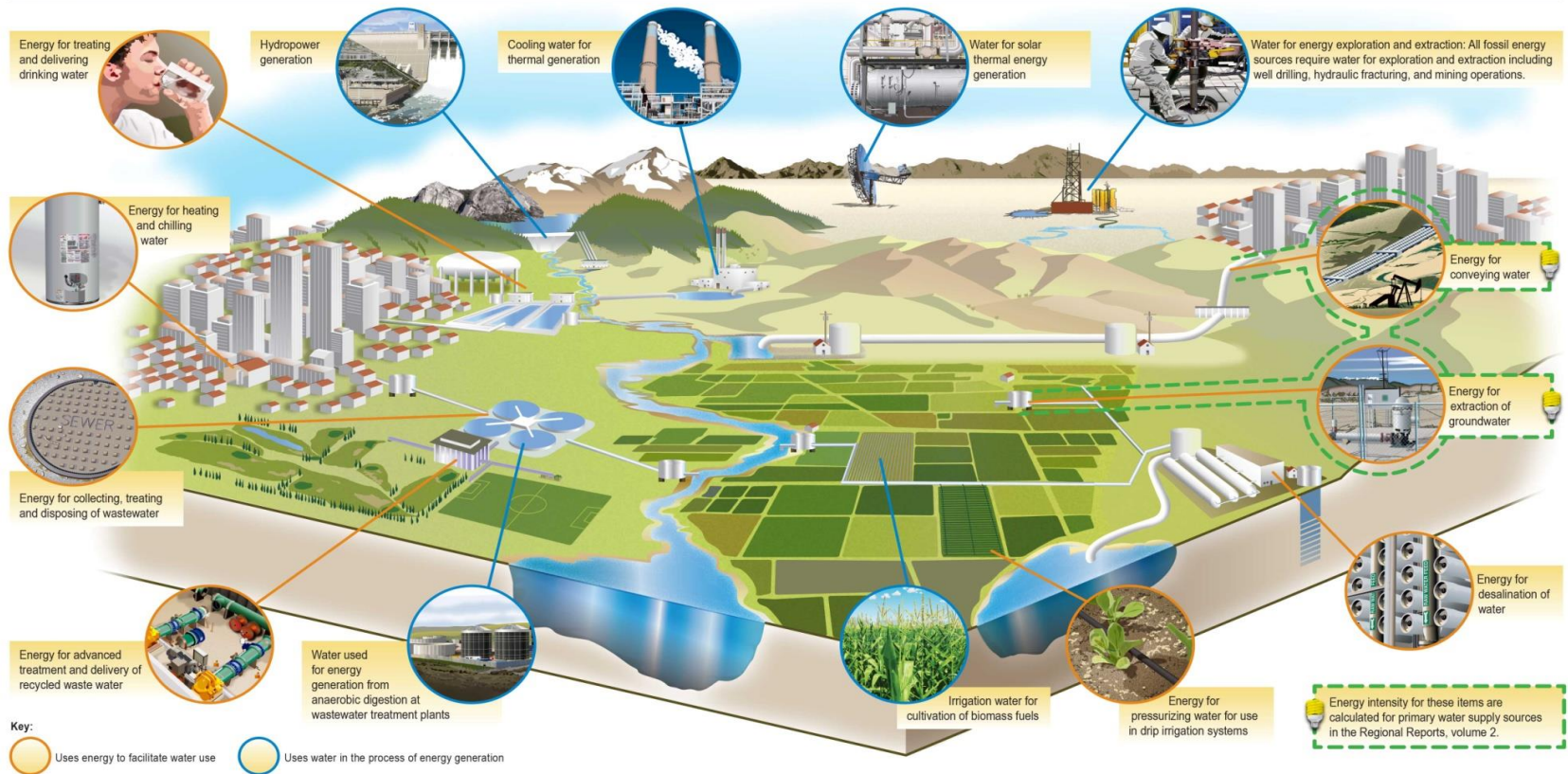


waste = 1%



Water and Energy

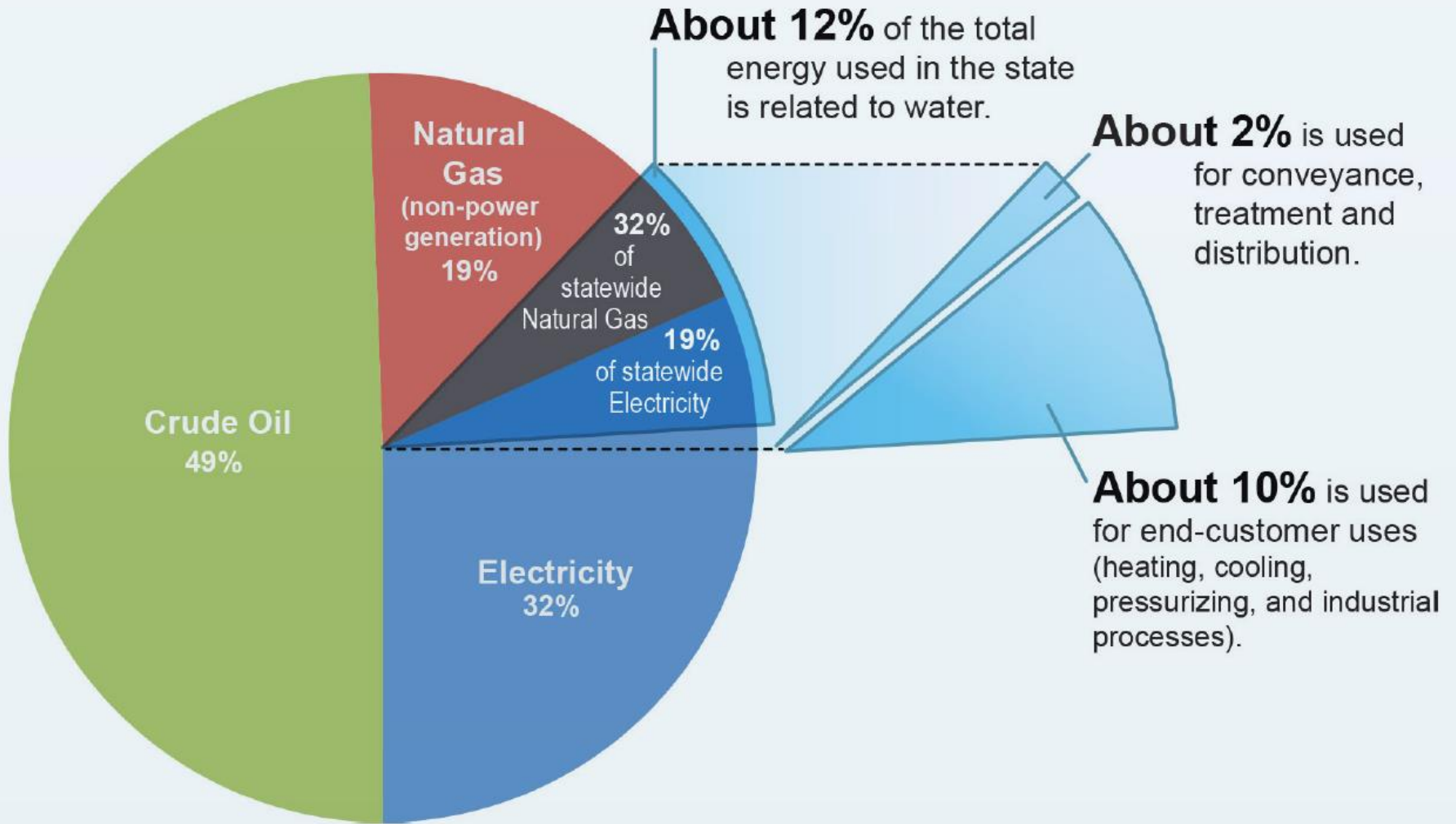
Figure X-x The Water and Energy Connection



**Everyone is entitled to his own opinion,
but not to his own facts.**

--Daniel Patrick Moynihan

Energy Use Related to Water



Climate Action Plan

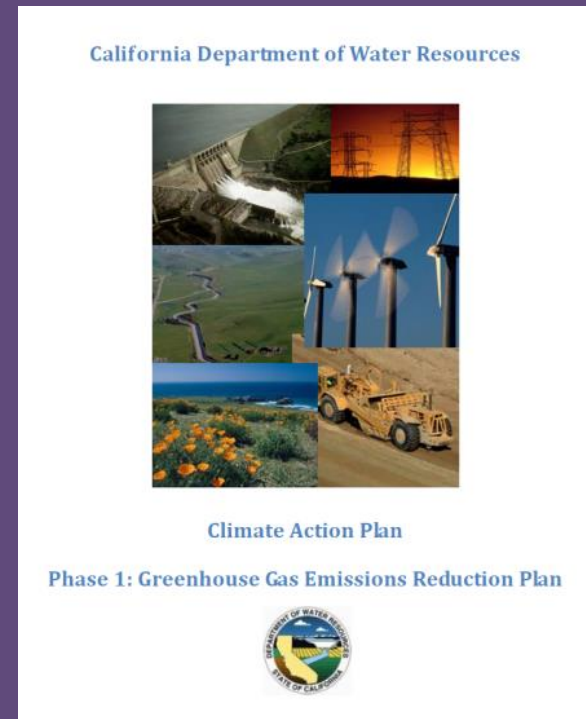
Phase 1: GHG Emissions Reduction Plan (GGERP)

Near-Term (2020) Goal:

Reduce GHG emissions to
50% below 1990 levels by 2020

Long-Term (2050) Goal:

Reduce GHG emissions to
80% below 1990 levels by 2050



Strong on climate, California is notoriously weak on weather.

--Carey McWilliams (1949)

In the Past 100 years...

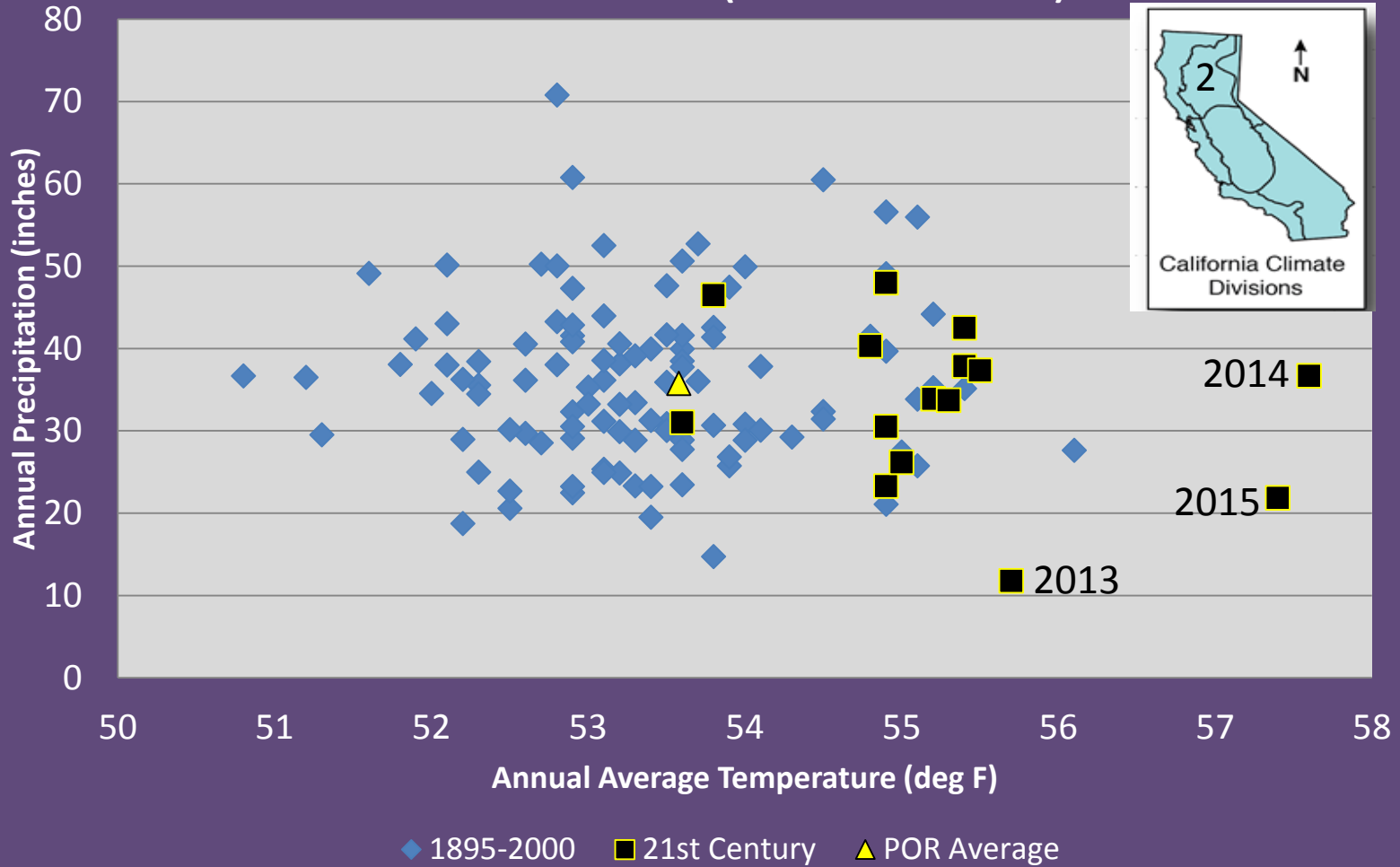
- ❖ 1°F rise in average temperatures
- ❖ 10% overall loss of snowpack in the Sierra Nevada
- ❖ Changes in runoff timing
- ❖ An average sea level rise of 7" along the California coast



Lyell Glacier, Yosemite National Park, California, USA circa 1903 (upper) and 2003 (lower)

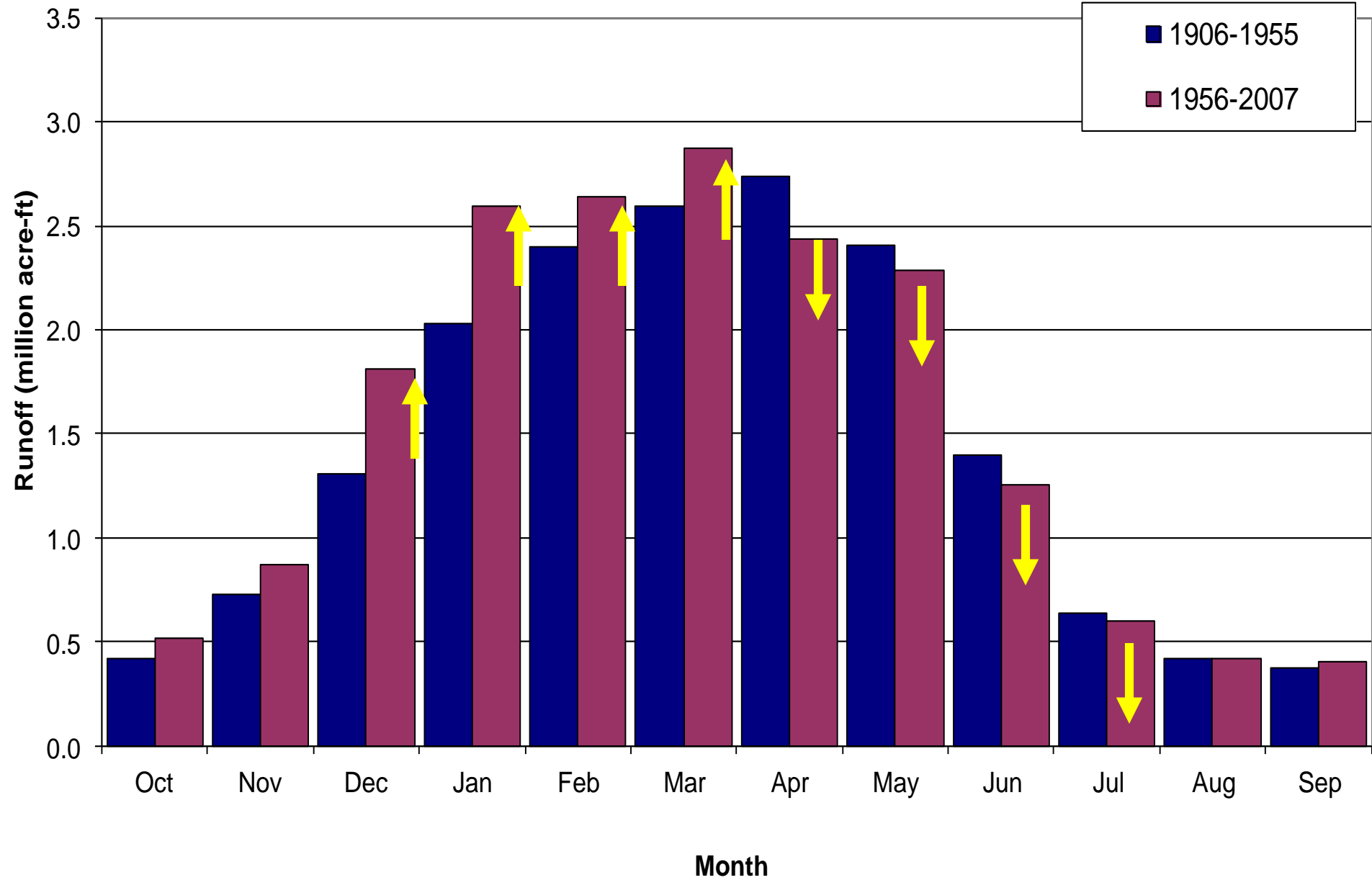
The Drought, This Time: Hot and Dry

Climate Division 2 (Sacramento Basin)



Source: NOAA Climate Division 2 Calendar Year Data

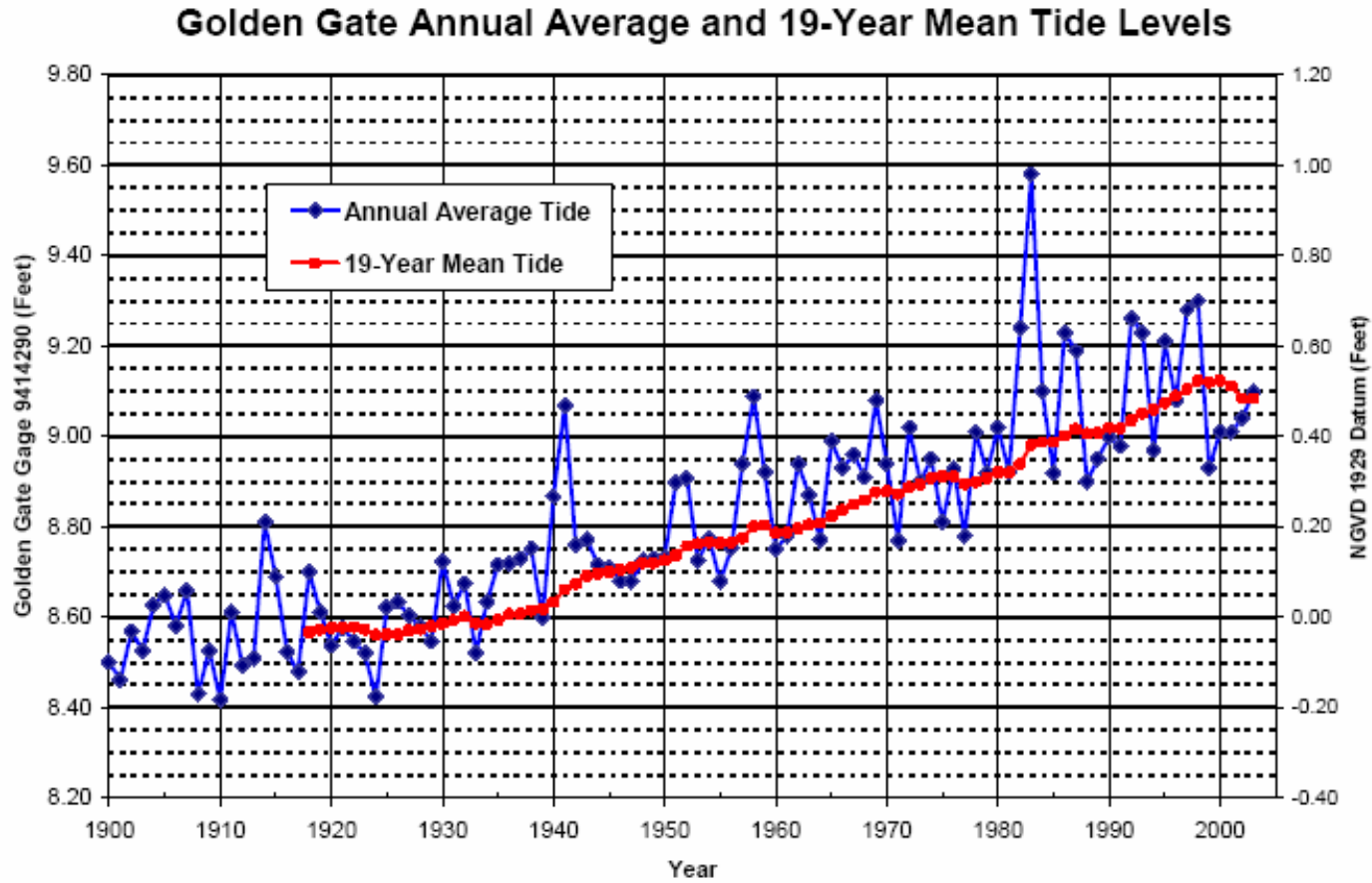
Monthly Average Runoff of Sacramento River System



Sea Level Rise



Sea Level Rise



Source: Roos, 2003

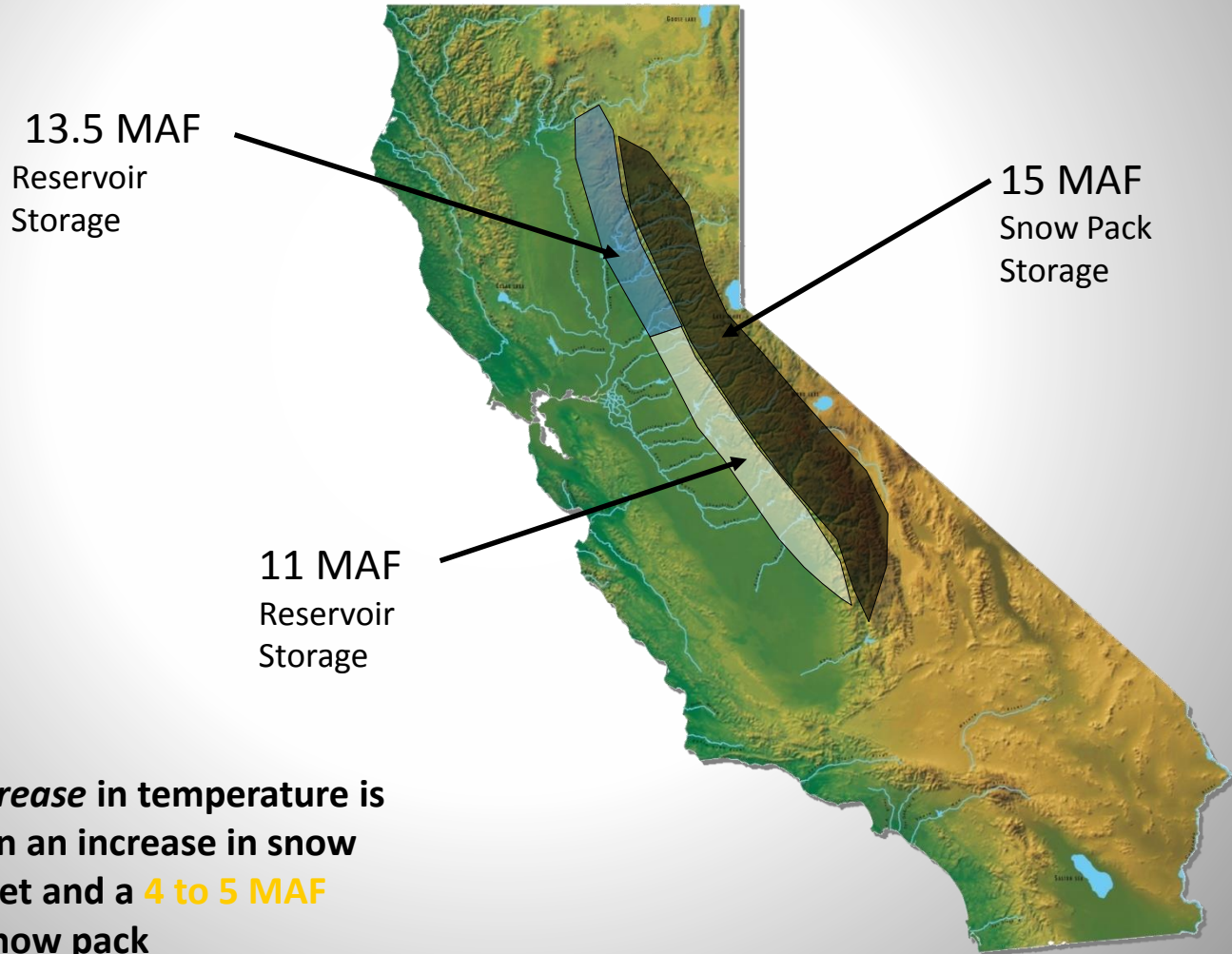
It's tough to make predictions, especially about the future.

--Yogi Berra

In the Next 35 years...

- ❖ 1 – 3.6°F temperature rise
- ❖ 25 - 40 % reduction in snowpack
- ❖ Sea level rise: 5"-24"
- ❖ Less summer/fall runoff
- ❖ More intense wet and dry periods

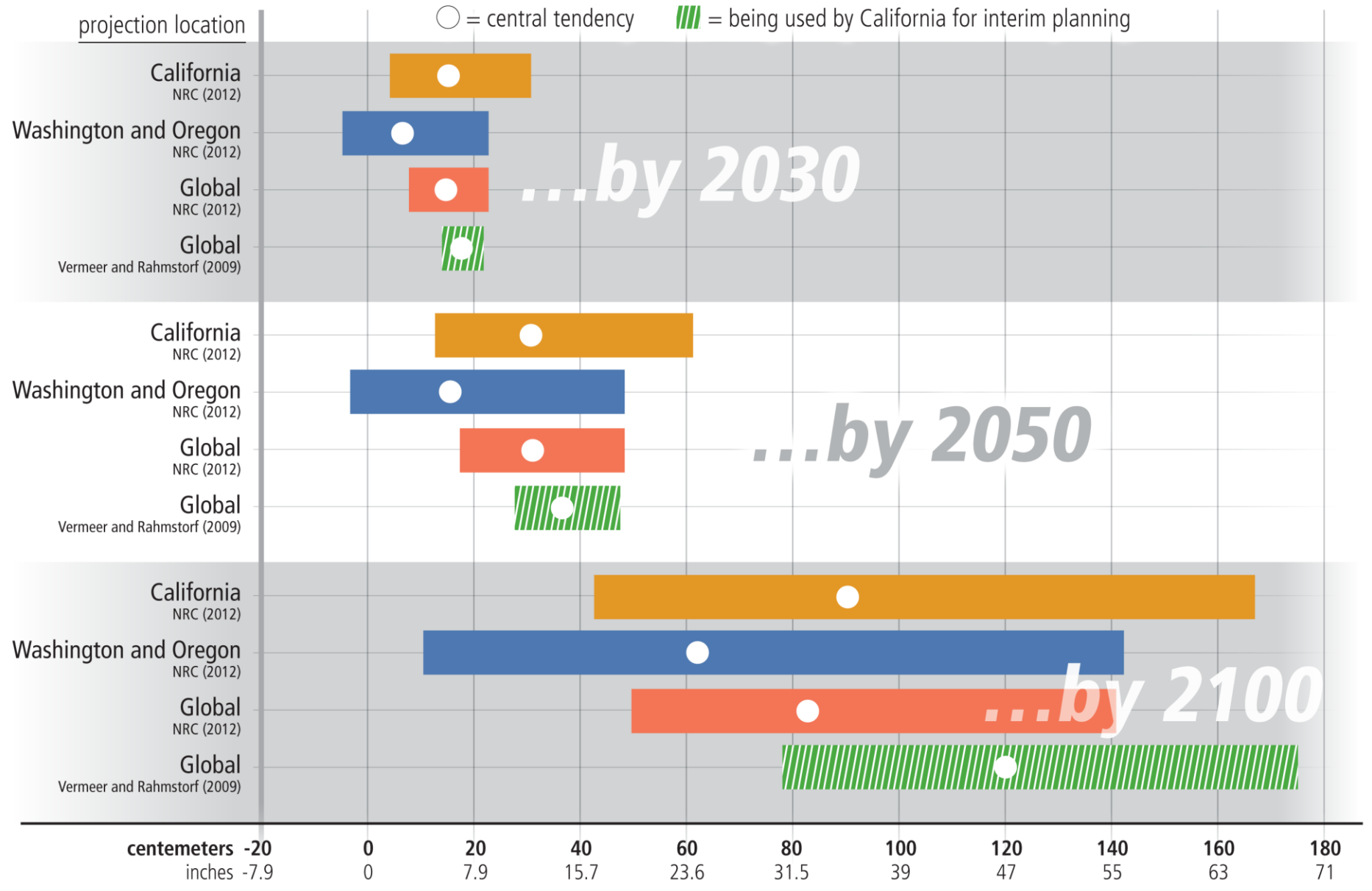
Expected Storage Capacity Impacts from Runoff Changes



A moderate 3°C increase in temperature is projected to result in an increase in snow elevation of 1500 feet and a **4 to 5 MAF decrease** in Sierra snow pack



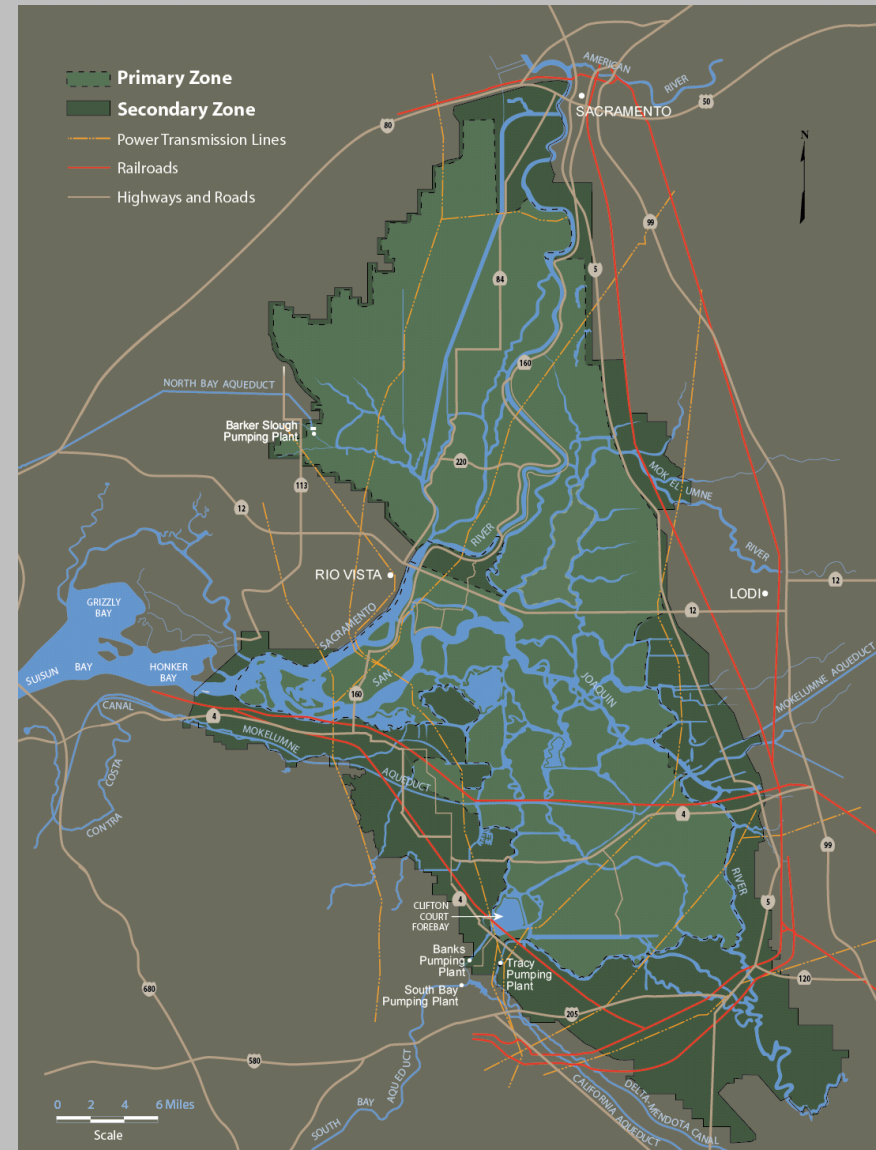
Regional and Global Sea Level Rise Projections (relative to the year 2000)



Adapted from NRC (2012), Sea Level Rise for the Coasts of California, Oregon and Washington. http://www.nap.edu/catalog.php?record_id=13389

Implications of Sea Level Rise in the Delta

- Salinity intrusion degrades water quality, requires additional water to repel the sea
- Habitat changes, losses
- Levee failure
- Inundation
- Interruption of water supplies statewide





**Adapt or perish, now as ever, is nature's
inexorable imperative.**

--H.G. Wells (1945)

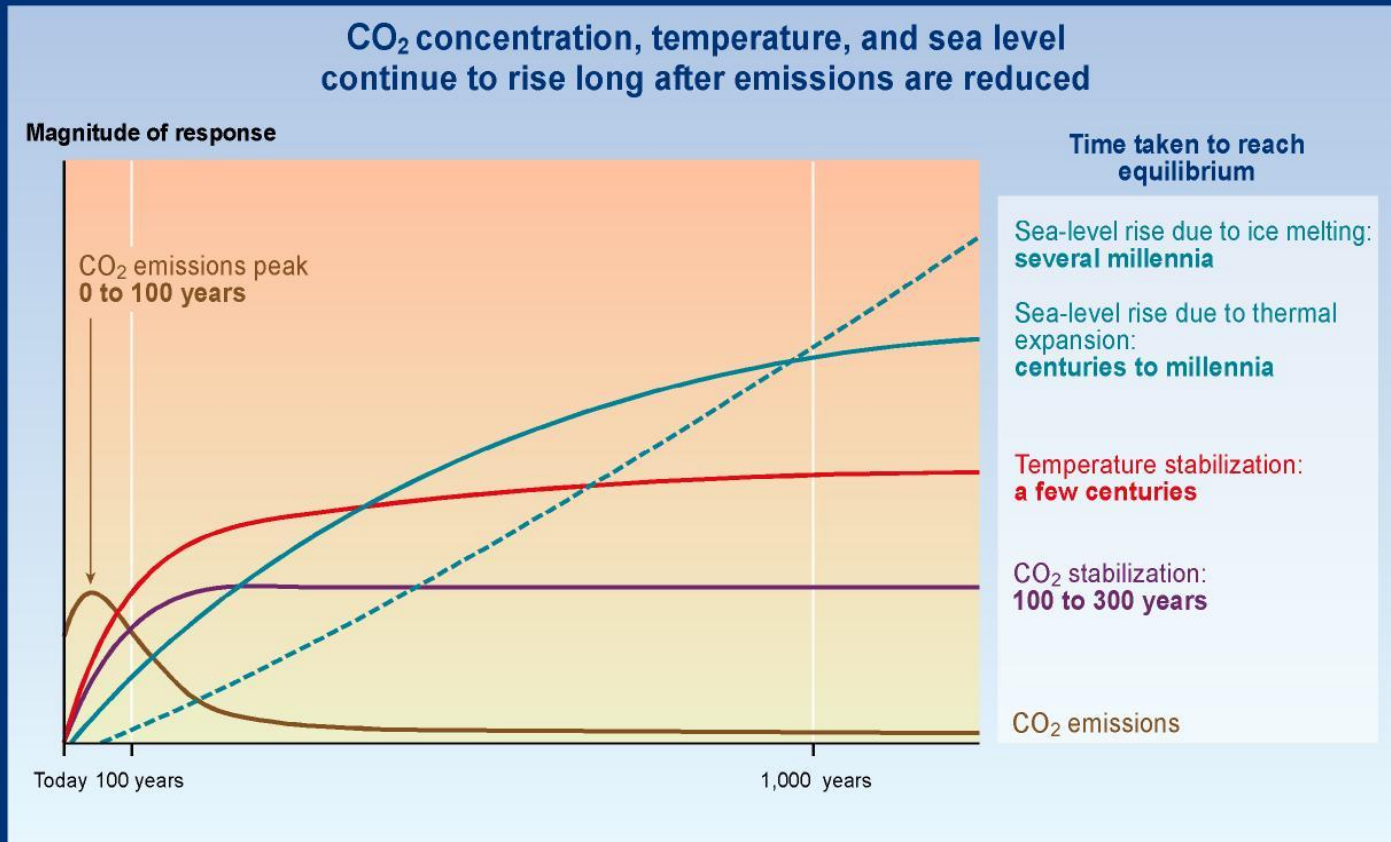
Climate Adaptation

'Climate adaptation' refers to efforts by society or ecosystems to prepare for or adjust to changes in the climate

- ❖ **Protective** – guarding against negative impacts of climate change
- ❖ **Opportunistic** – taking advantage of any beneficial effects of climate change



Adaptation is a Necessity



SYR - FIGURE 5-2



“Politicians discussing global warming”
Isaac Cordal

Safeguarding California Update

Comprehensive State Strategies to Safeguard California

Social Systems and the Built Environment

Emergency Management

Energy

Land Use and Community Development

Public Health

Transportation

Natural and Managed Resource Systems

Agriculture

Biodiversity and Habitat

Forests

Ocean and Coast

Water

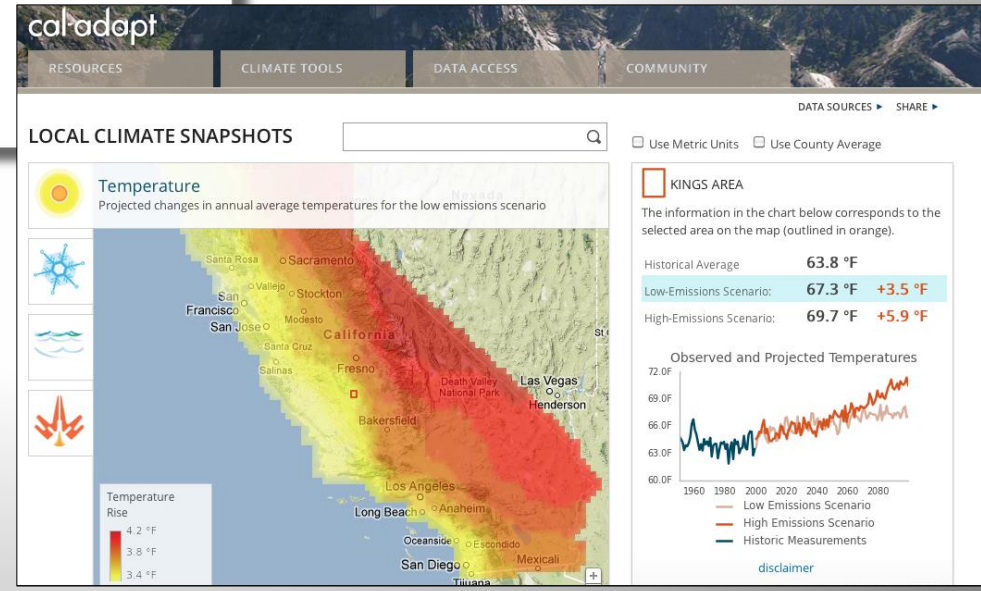
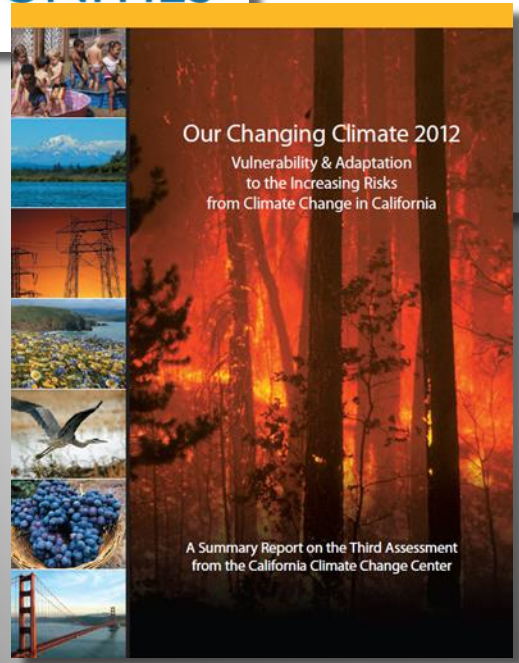
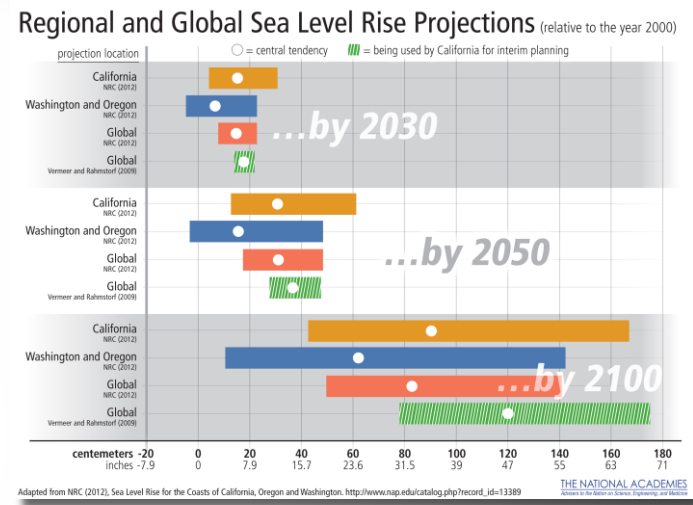
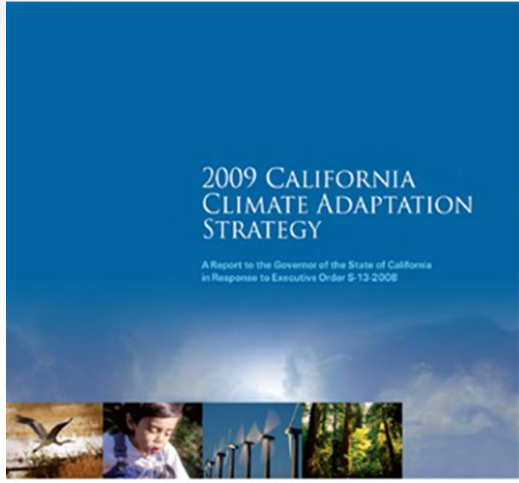
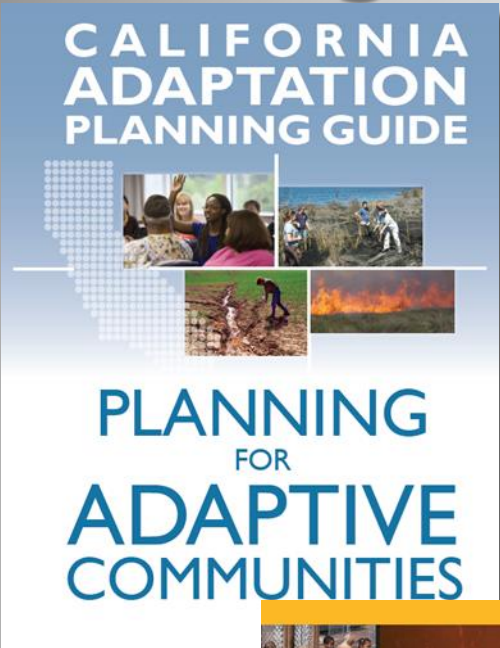
Integrated Regional Water Management

48 Regional Water Management Groups



- Foster partnerships & expand solution opportunities
- Diversify water portfolios & integrate supplies
- Leverage resources & economies of scale to reduce costs
- Integrate data, tools & resources management
- Implement multi-benefit actions with sustainable outcomes

Mitigation & Adaptation Efforts Statewide



State of California Climate Change Portal:
www.climatechange.ca.gov

DWR Climate Change Web Site:
www.climatechange.water.ca.gov

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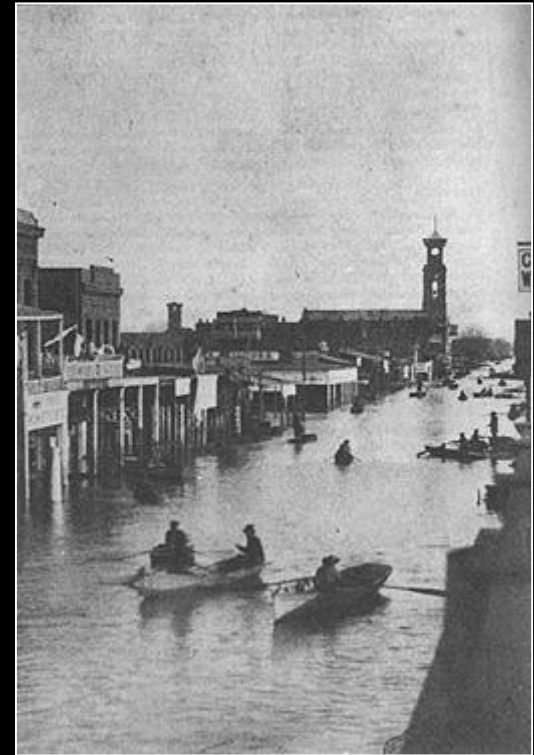
STICKS

WALLACE WARDEN
Director

California Water Management and Climate Change

- Climate change presents significant challenges for the management of California's water resources.
- California water managers must focus on mitigation and especially adaptation.
- Climate change responses must be thoughtfully integrated with water supply reliability, environmental protection, public safety, and public health actions.
- We must embrace an entirely new way of thinking about water resources planning and management.

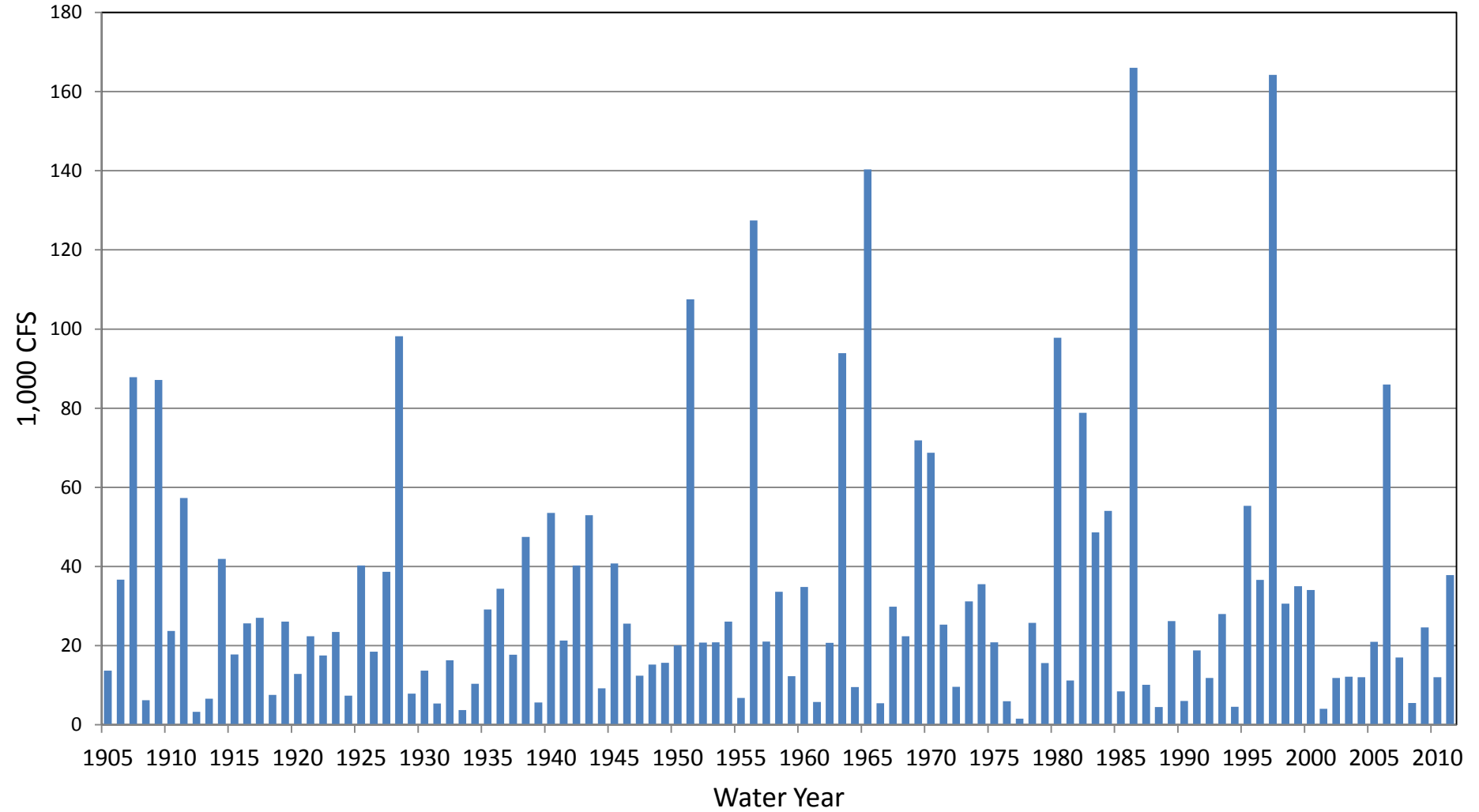
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American River Runoff

Annual Maximum 3-Day Flow

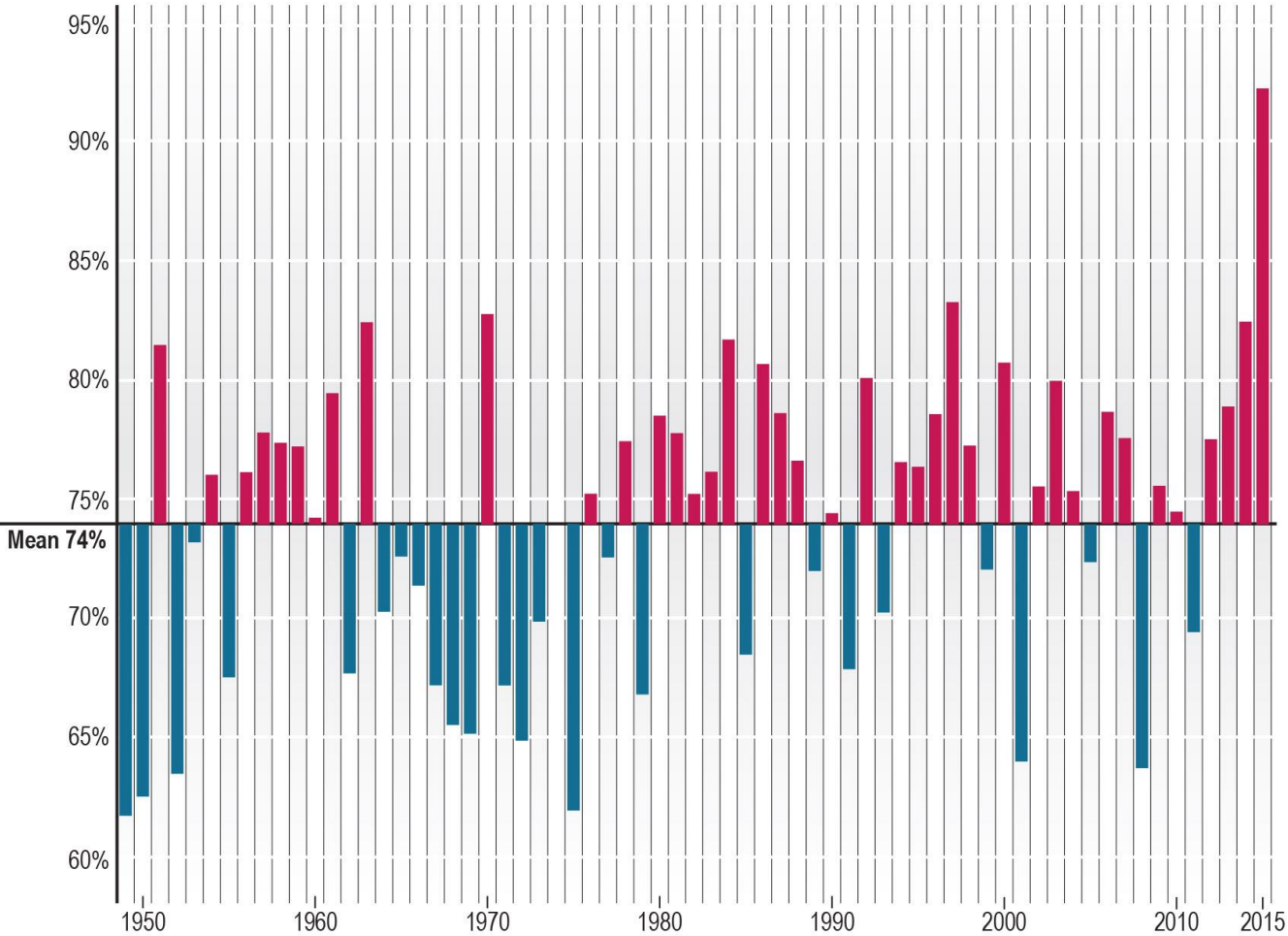
Unimpaired Runoff at Fair Oaks



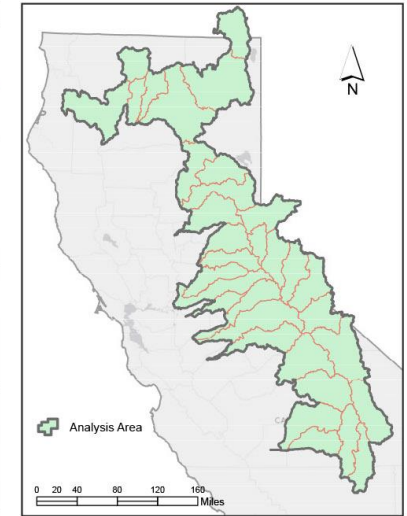
Data from Corps of Engineers Sacramento District

Changing Trend of Rain vs. Snow

Rain as Percentage of Total Precipitation



Location of 33 watersheds sampled



Common Energy-Water Tradeoffs

