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

--Daniel Patrick Moynihan
Energy Use Related to Water

About 12% of the total energy used in the state is related to water.

About 2% is used for conveyance, treatment and distribution.

About 10% is used for end-customer uses (heating, cooling, pressurizing, and industrial processes).

- Crude Oil: 49%
- Electricity: 32%
- Natural Gas (non-power generation): 19%
  - 32% of statewide Natural Gas
  - 19% of statewide Electricity
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)

- Annual Precipitation (inches)
- Annual Average Temperature (deg F)

Source: NOAA Climate Division 2 Calendar Year Data
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
A moderate $3^\circ C$ 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)

projection location

California
NRC (2012)

Washington and Oregon
NRC (2012)

Global
NRC (2012)

Global
Vermeer and Rahmstorf (2009)

...by 2030

...by 2050

...by 2100

International
Vermeer and Rahmstorf (2009)

Regional
Washington and Oregon
NRC (2012)

California
NRC (2012)

Global
NRC (2012)

Global
Vermeer and Rahmstorf (2009)

Centimeters -20 0 20 40 60 80 100 120 140 160 180
Inches -7.9 0 7.9 15.7 23.6 31.5 39 47 55 63 71

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

CO₂ concentration, temperature, and sea level continue to rise long after emissions are reduced.

- Sea-level rise due to ice melting: several millennia
- Sea-level rise due to thermal expansion: centuries to millennia
- Temperature stabilization: a few centuries
- CO₂ stabilization: 100 to 300 years

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
CLIMATE IS AN ANGRY BEAST AND WE ARE POKING AT IT WITH STICKS
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.
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
Common Energy-Water Tradeoffs

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<th>Energy Use</th>
<th>Water Use or Environmental Impact</th>
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Jay Lund, UCD