PLANNING IN THE FACE OF CLIMATE CHANGE:

INSIGHTS FROM A RECOVERING CLIMATE SCIENTIST

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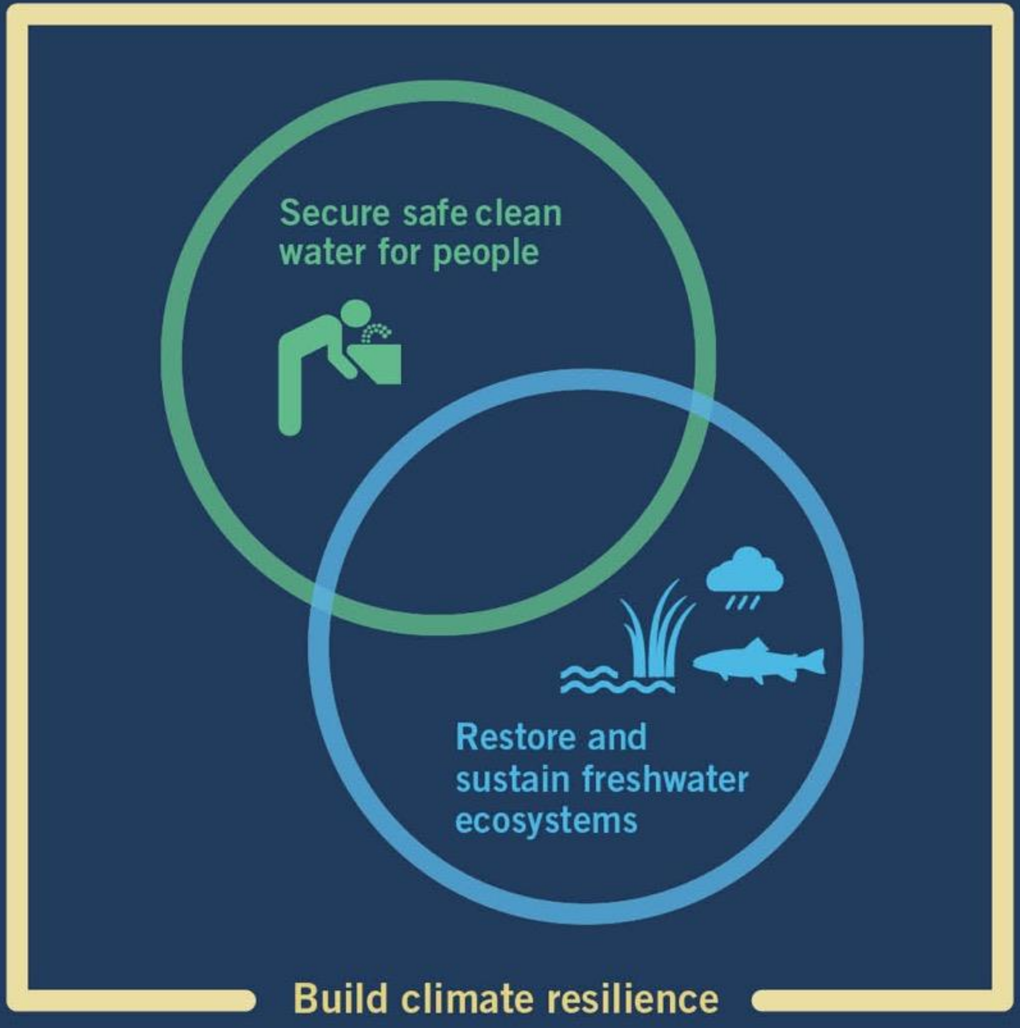
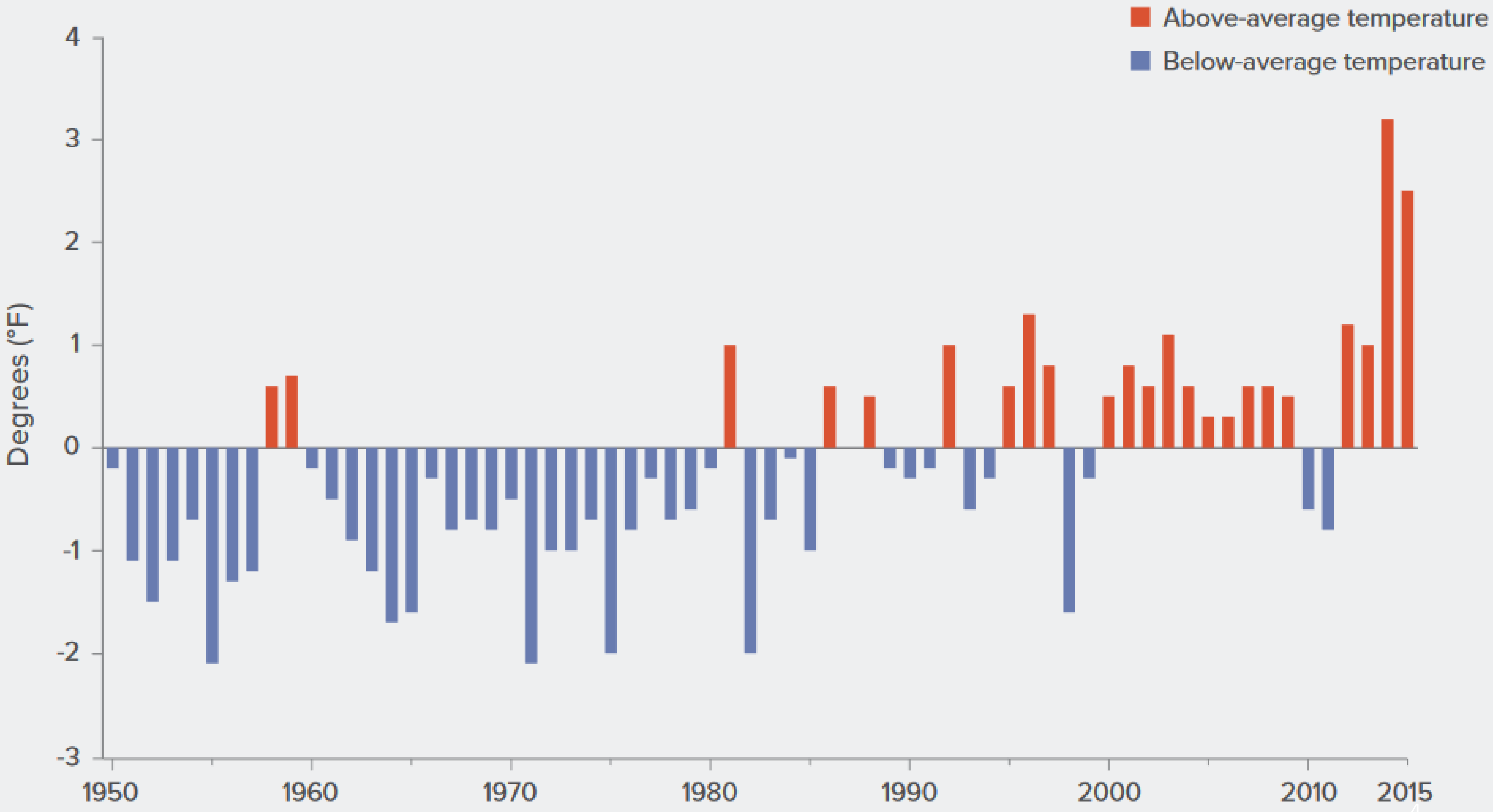
Our Goals



Secure safe clean water for people
Restore and sustain freshwater ecosystems
Build climate resilience

CHALLENGE

CALIFORNIA IS GETTING WARMER



THE SCIENCE IS CLEAR

1. Precipitation becomes more extreme
2. Wet and dry seasons intensify
3. Snowpack declines
4. Swings between extreme years increase

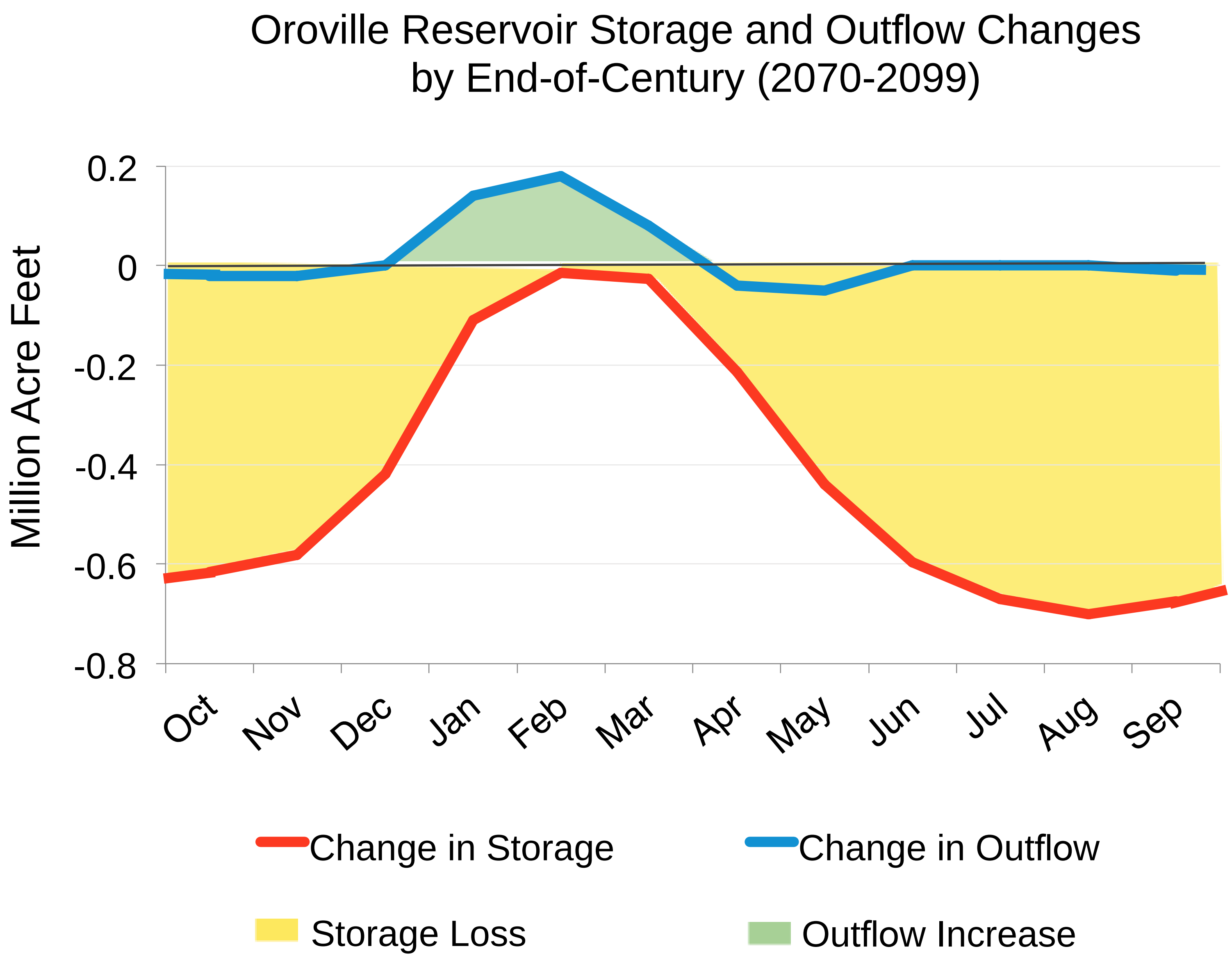
THE SCIENCE IS CONSISTENT

	Concentration into Extremes	Maximum 3-Day Precip.	Concentration into Nov-Mar	Evapotranspiration	Rain vs. Snow Ratio	Rain-on-Snow Events	Normalized R-o-S Events	Snow Water Equivalent	Wet Years	Dry Years	Wet-to-Dry Whiplash	Dry-to-Wet Whiplash
North 1	+7%	+17%	+4%	+10%	+12%	-68%	+15%	-88%	+63%	-13%	50%	-47%
North Coast 2	+8%	+14%	+4%	+16%	+1%	-89%	+7%	-91%	+83%	-10%	+70%	-25%
Central Coast 3	+12%	+27%	+5%	+11%	+1%	-87%	+7%	-80%	+97%	-17%	+100%	-47%
Sacramento Valley 4	+10%	+22%	+5%	0%	+1%	-88%	+2%	-57%	+73%	-10%	+80%	-53%
San Joaquin Valley 5	+13%	+20%	+6%	+1%	+1%	-84%	+9%	-84%	+105%	-2%		-30%
South Coast 6	+13%	+10%	+6%	+7%	+1%	-85%	+5%	-84%	+33%	+17%		-50%
South Central 7	+12%	+9%	+6%	+8%	+6%	-77%	+17%	-89%	+18%	+13%	+80%	-57%
Far South 8	+8%	+19%	+3%	-1%	+1%	-81%	+8%	-55%	+108%	-15%	+120%	-50%
Mojave 9	+8%	+6%	+6%	+1%	+4%	-72%	+15%	-77%	+47%	+3%	+70%	-53%
Sierra Nevada 10	+11%	+17%	+5%	+16%	+33%	-44%	+17%	-68%	+65%	-13%	+60%	-35%
Cascades 11	+8%	+21%	+5%	+16%	+23%	-53%	+19%	-79%	+87%	+2%		-10%

Full Model Agreement   Medium Model Agreement   Low Model Agreement

Source: Persad et al., 2020

THE SCIENCE HAS CONSEQUENCE



Source: Persad et al., 2020

WHAT DOES CLIMATE CHANGE MEAN FOR THE WATER INDUSTRY?

Wetter, more intense storms

- Design storms may be inaccurate, infrastructure may be inadequate

Rising sea levels

- Seawater intrusion into coastal aquifers

Hotter temperatures

- Increased water demand to cope, earlier snowmelt, less storage

Longer, more severe drought

- Existing water supplies may be insufficient, possible supply shortages

WHAT ARE WE DOING TO PREPARE FOR CHANGE?

AWWA *2017 State of the Industry Report*:

"45% of utility personnel reported their utilities do **not** include any potential impacts from climate variability in their risk management or planning processes."

WHAT ARE WE DOING TO PREPARE FOR CHANGE?

AWWA *2018 State of the Industry Report*:

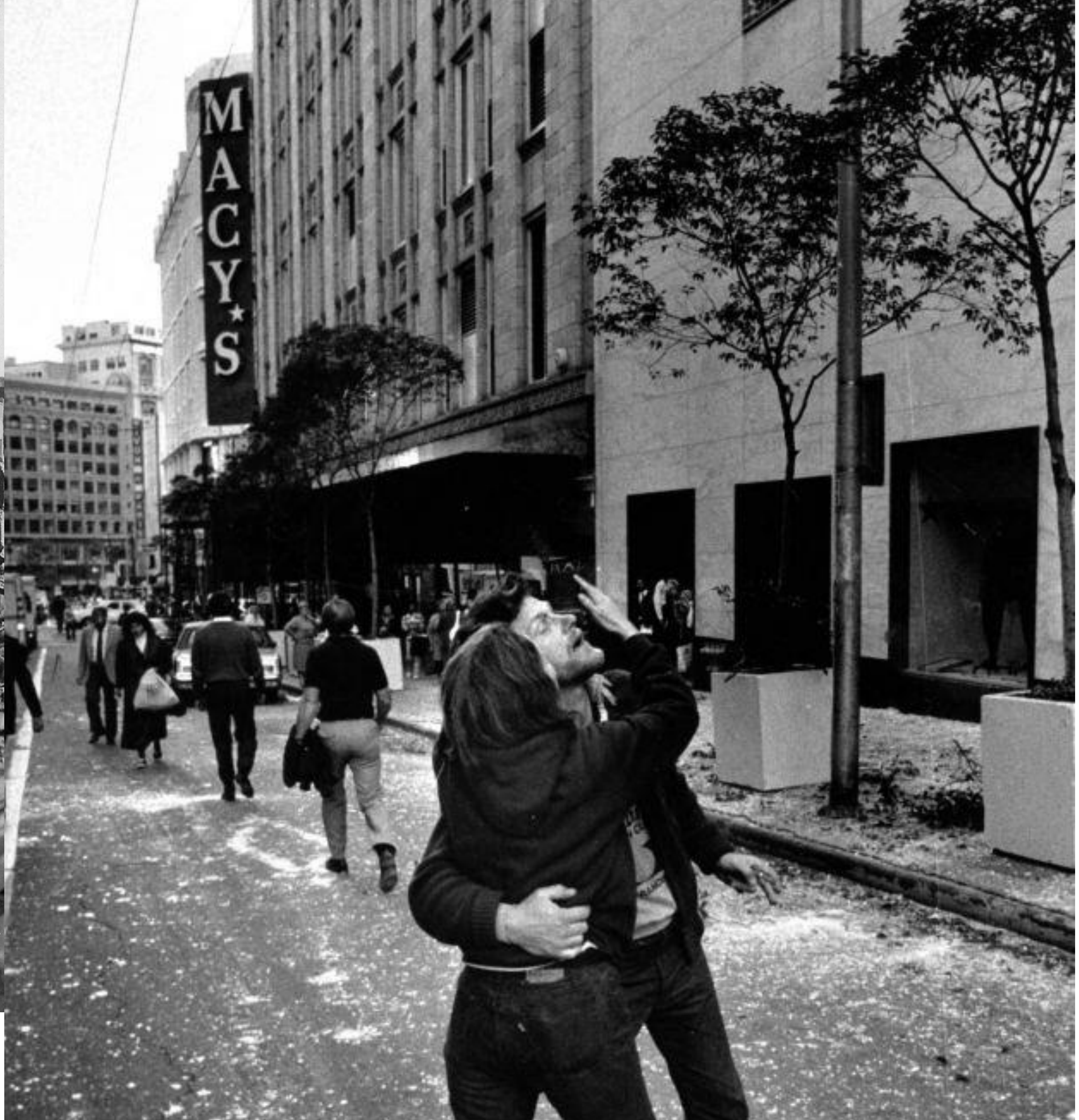
15% of utility personnel report “climate risk and resiliency” as a critical concern while 50% rank “long-term supply availability” as a critical concern.

SPOILER ALERT: WE NEED TO ADAPT

#1 – If you are concerned about long-term supply availability you should be incorporating climate change into your planning

#2 – Using climate information is **not** rocket science

#3 – Climate-informed scenario planning allows your utility to identify how to be more adaptable in the future and pursue **no-regret projects**


MACY*S

STRESS-TESTING OR SCENARIO PLANNING

DWR's Climate Change Technical Advisory Group recommends stress testing, defined as: "Methods to characterize the range of extremes, such as drought or flood; assess vulnerability to these extremes; develop scenario-based analyses that assess system response; and determine ways to increase resilience to these events."

Scenario planning allows you to assess which management actions perform well over a wide-range of plausible futures but may perform less well under an assumption that one future may be most likely to occur.

CASE STUDY: DENVER WATER

- Traditional Future: The future is extrapolated from past trends, with limited unanticipated major changes. Population is the biggest driver of change, and environmental and social factors remain stationary.
- Water Quality Rules: The public demands the highest practical quality of drinking water.
- Hot Water: A warmer climate is accompanied by more frequent and more severe droughts. Average temperatures increase by 5°F. System yield decreases by 20% and demand increases by 7%.
- Economic Woes: We experience a long period of economic downturns and slow recovery. Demand does not grow as quickly due to reduced growth.
- Green Revolution: Environmental values and sustainable living become dominant social norms. Conservation and urban infill increase within the City and County of Denver.

BENEFITS OF SCENARIO PLANNING

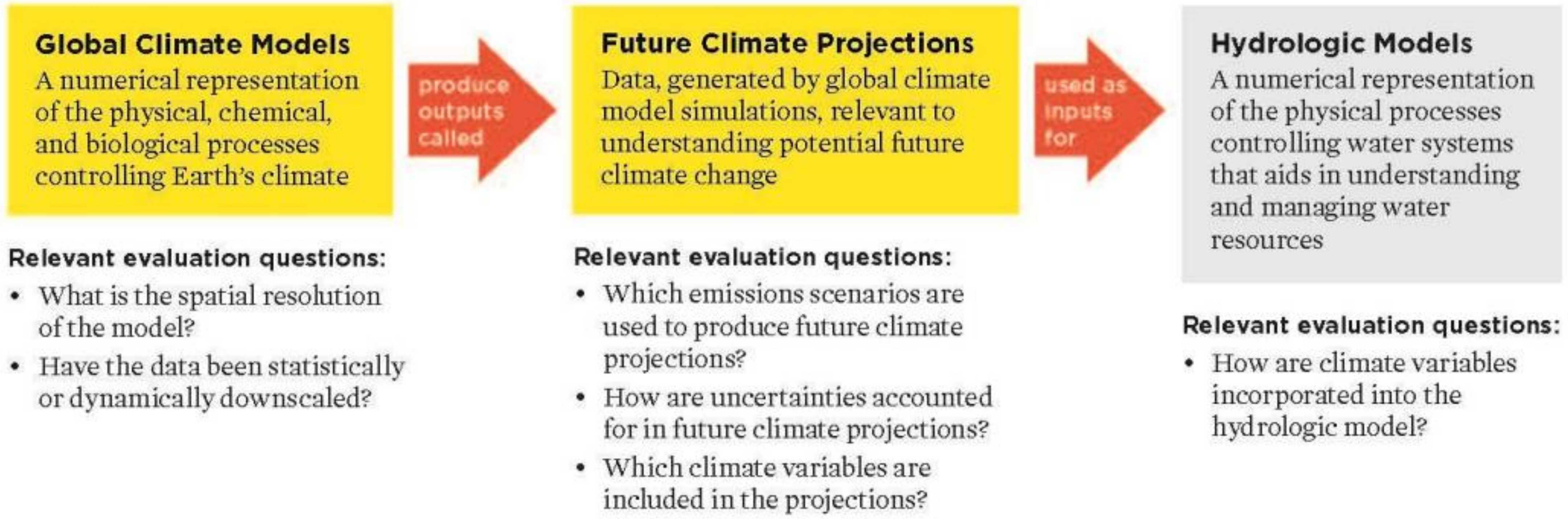
- Scenario planning is a relatively simple way to consider a wide range of uncertainties (demographic, social, economic, etc.) along with climate change, which allows an organization to focus on planning rather than debating a single vision for the future.

- Scenario development calls out assumptions that had become so ingrained in staff members' thinking that they were no longer being recognized. Denver Water shifted away absolutes such as "firm" yield and "build-out" demand.

- Scenario analysis allows you to "preserve options" and avoids path dependency: invest in flexibility/adaptability to allow them to react appropriately in the future rather than fully invest right away.

CLIMATE INFORMATION 101

FIGURE 1. **DIFFERENT MODEL TYPES AND HOW TO USE THEM**



This flow chart illustrates different types of information used to incorporate climate change into water planning and how they interrelate. This whitepaper focuses on the two yellow boxes, as this information is tends to be the least understood by water managers.

SOURCE: UNION OF CONCERNED SCIENTISTS AND STANFORD UNIVERSITY

GOOD NEWS!
CAL-ADAPT ALREADY DID IT

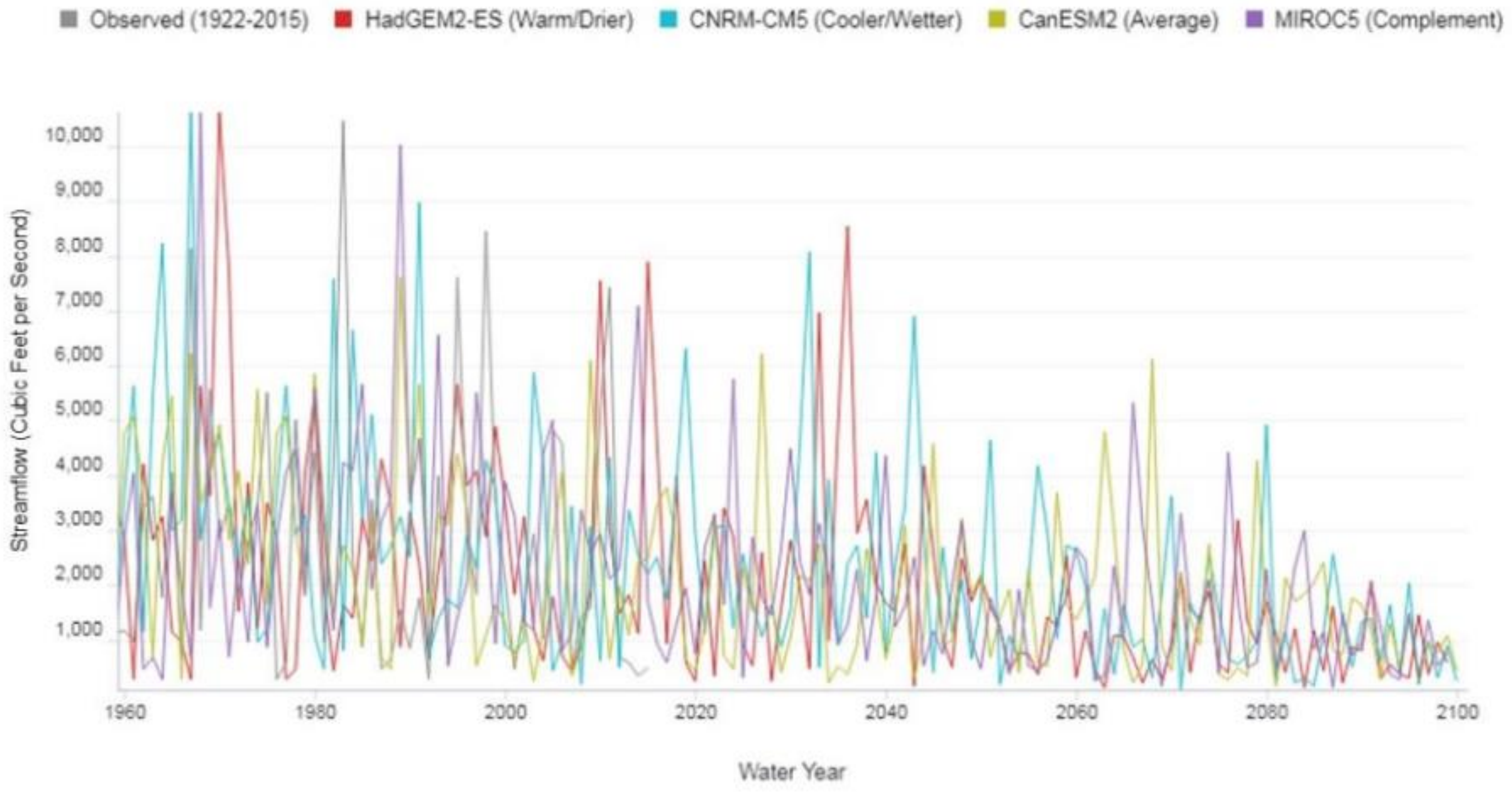


Figure 1| Data from Cal-Adapt shows reductions in June streamflow in the Stanislaus River projected through the 21st century by climate models. Based on data from Cal-Adapt.org.

USING CLIMATE INFORMATION TO PLAN

1. **Determine** your management objective
2. **Evaluate** existing climate change information
3. **Select** appropriate climate change information
4. **Stress-test** potential management actions

ADAPTATION: KEY TAKE-AWAYS

#1 – If you are concerned about long-term supply availability you should be incorporating climate change into your planning

#2 – Using climate information is **not** rocket science

#3 – Climate-informed scenario planning allows your utility to identify how to be more adaptable in the future and pursue **no-regret projects**

ADAPTATION ALONE IS NOT ENOUGH

In California, about 20% of the state's electricity consumption is for heating, pumping, treating, collecting, and discharging water and wastewater.

Energy consumption by public drinking water and wastewater utilities, which are primarily owned and operated by local governments, can represent 30%-40% of a municipality's energy bill.

Energy is the second-highest budget item for these utilities, after labor costs, so energy conservation and efficiency are issues of increasing importance to many of them.

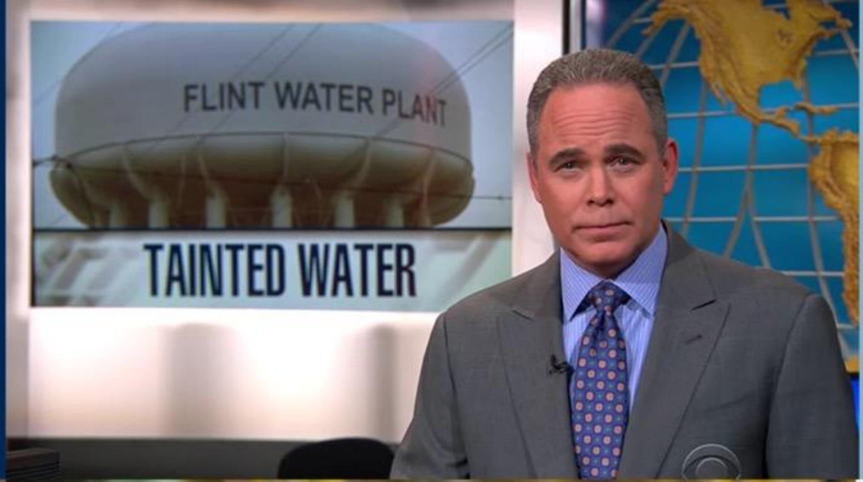
MITIGATION IS ADAPTATION

Many opportunities for mitigation exist, such as:

- upgrading to more efficient equipment,
- improving energy management,
- purchasing clean energy, and
- generating energy on-site to offset purchased electricity.

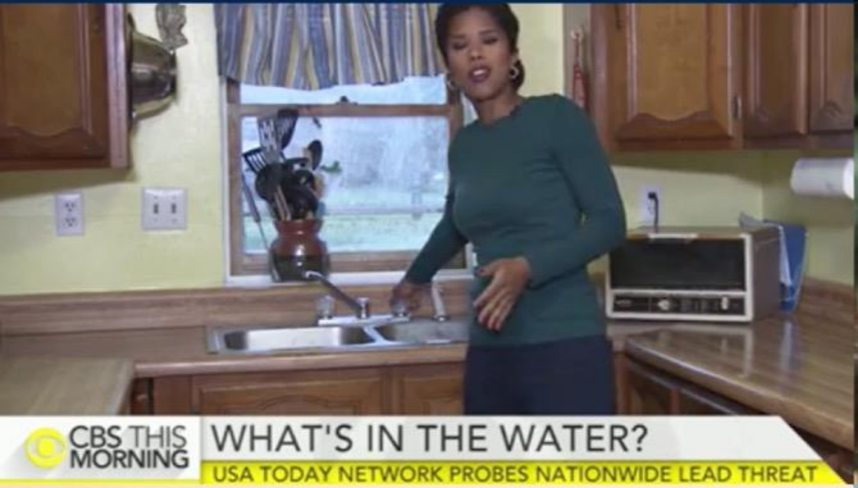
BUT WILL WE LEARN BEFORE IT'S TOO LATE?

OPPORTUNITY



Water Pollution Tops Americans' Environmental Concerns

GALLUP



66% Believe Water Supplies in the West Are Becoming More Unpredictable.

WaterPolls.org