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Potential Impacts of Climate Change on California's Water-Energy Relationship

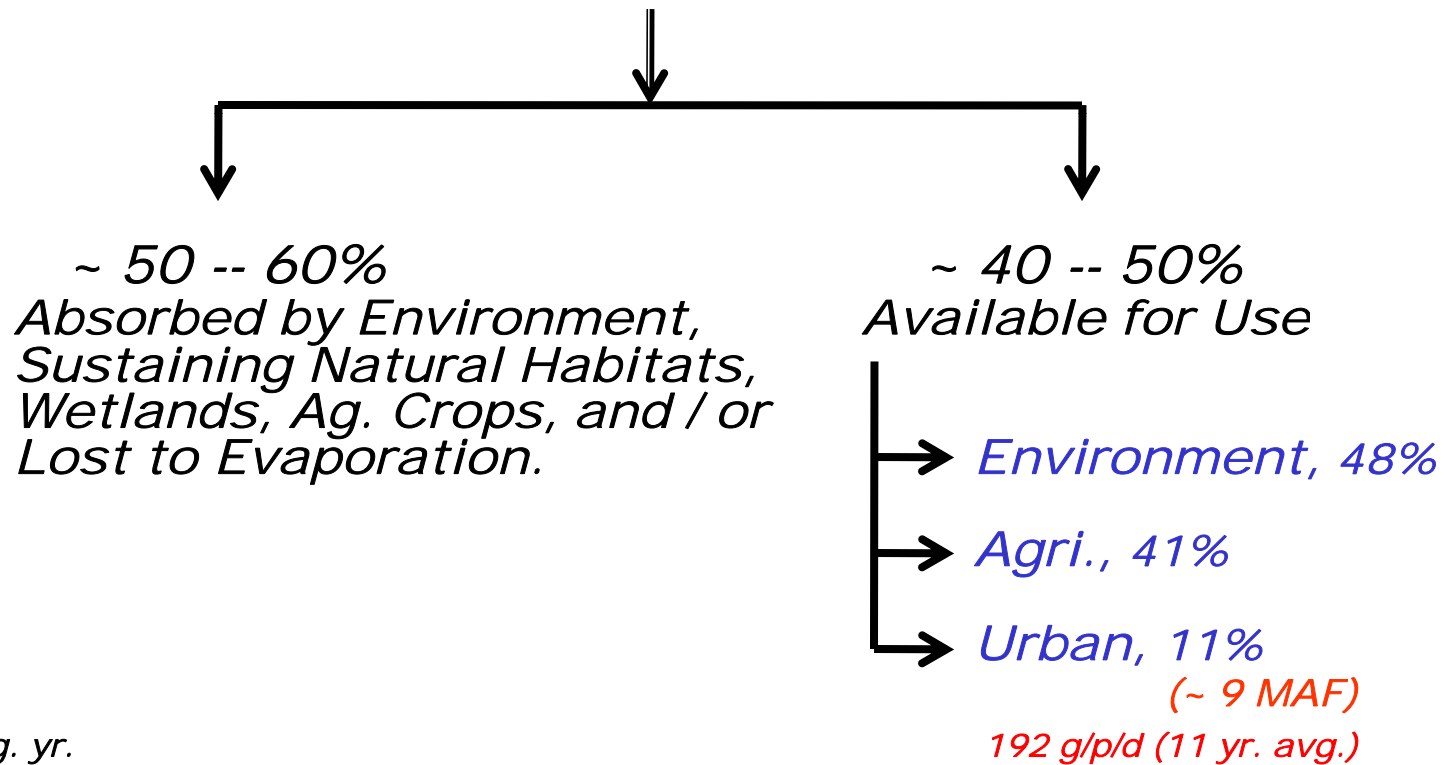
Water/Energy Sustainability Symposium
GWPC Annual Forum 2009
Salt Lake City, UT

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- California's Water Supply - Bigger Picture

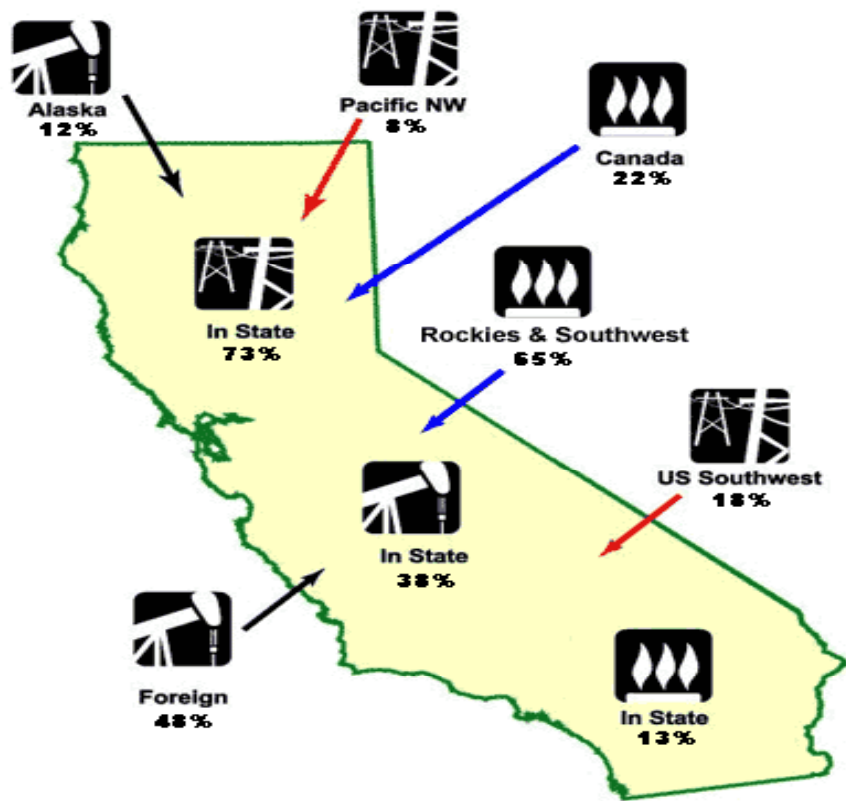
Total Water Supply
200 MAF*





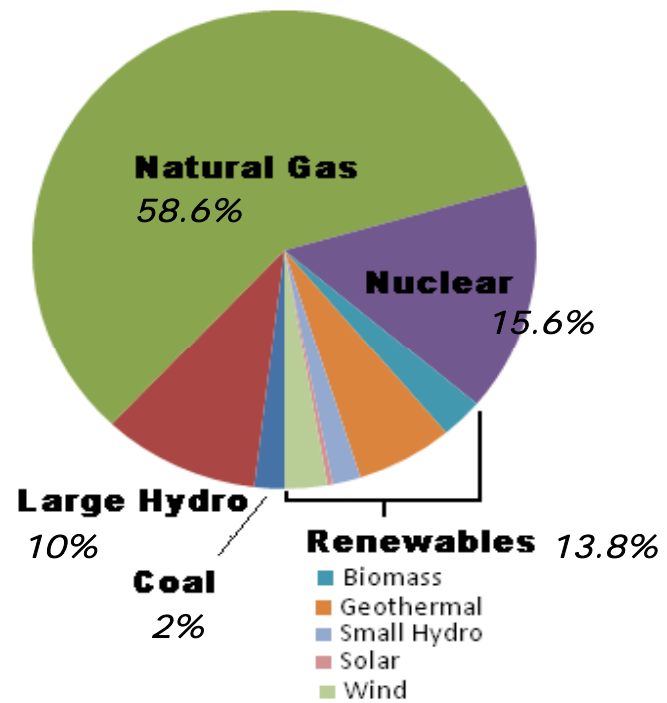
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California's Energy Sources



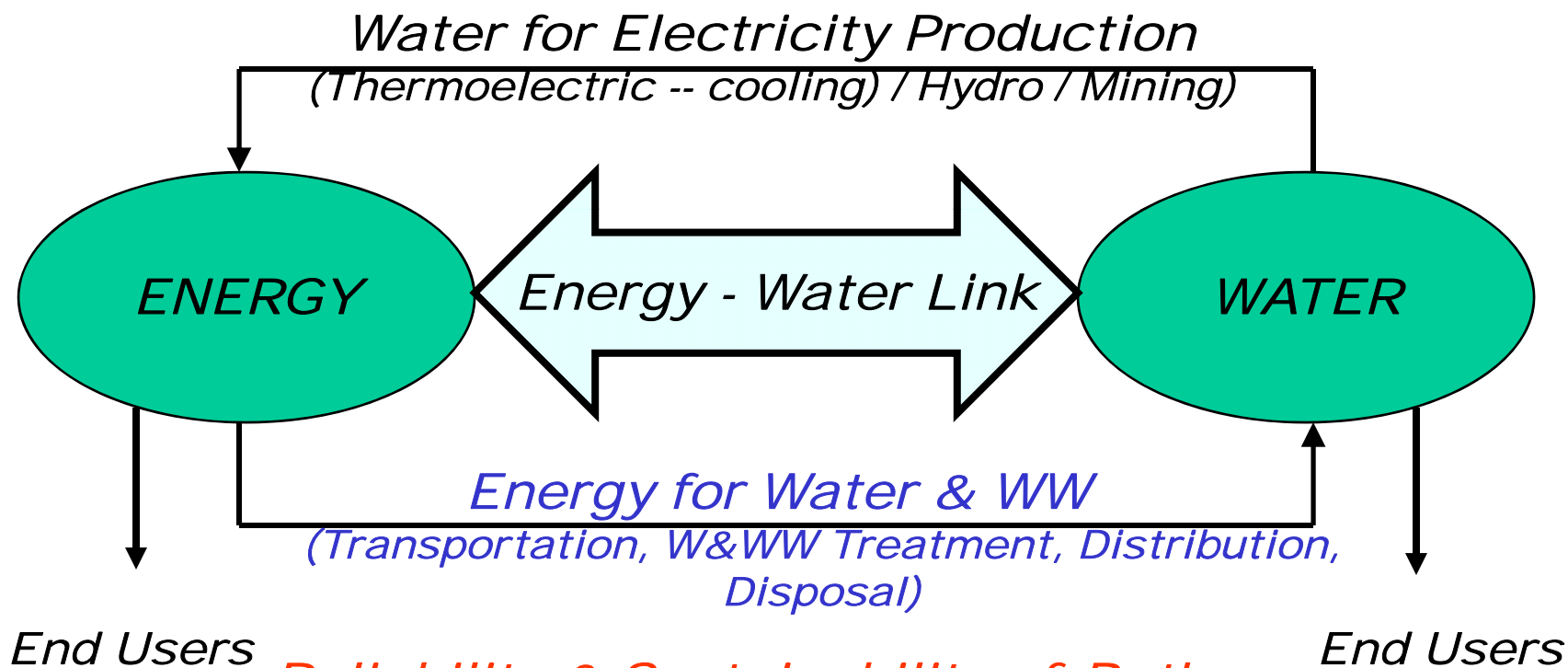
CALIFORNIA'S ENERGY SOURCES

California's Electricity Generation: 208,600 GWh (2008)





- Water-Energy-GHG Link**

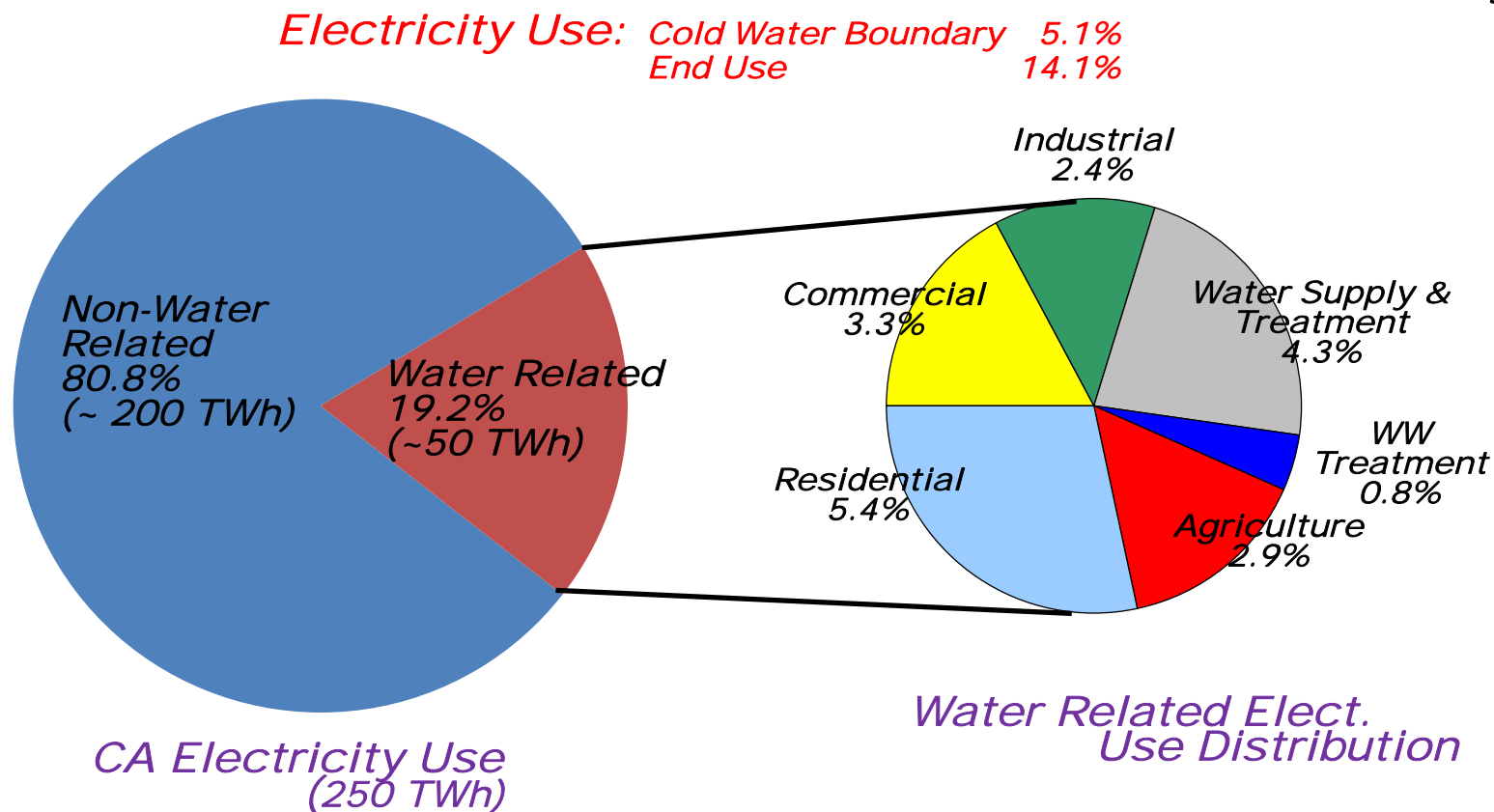


Reliability & Sustainability of Both Link with Each Other Strongly



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• *Electricity Use by Water Sector: California Case Study*



CEC: W-E Report 2005 (using data for 2001)



• *California's Existing Water Supply Challenges*

Back-to-Back Dry Years

→ *Low Reservoir Storage*

Significant Restrictions on Pumping / Delta Operations – Court Decisions & Pending Actions on Species

→ *at least 40 to 50% Less Water*

Reduced Colorado River Supplies

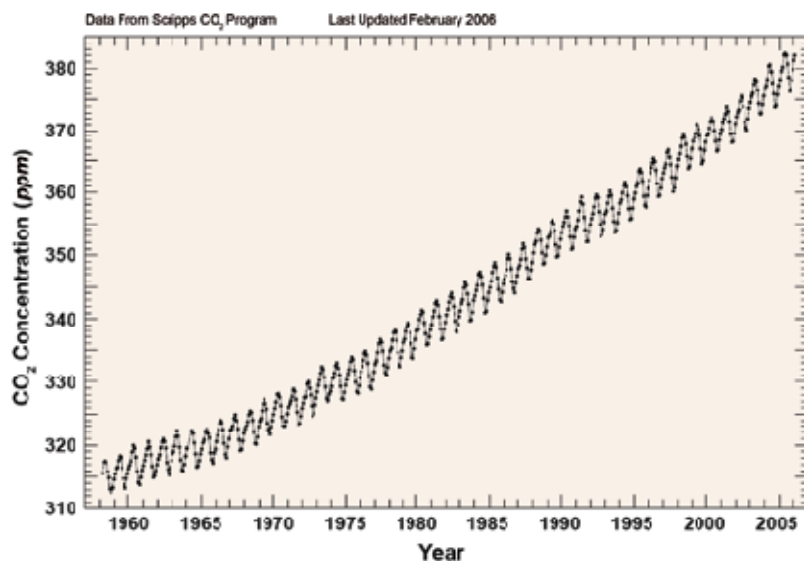
→ *from 5.2 MAF to California's Legal Entitlement of 4.4 MAF*

Impacting Water Supplies to Southern California



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- *Emerging Issue --*
Increasing GHG Emission →
Rising Temperature →
Global Warming



Source: AWWA Opflow - Feb 2008

Future CO₂ Levels:
500 - 1,000 ppm (by 2100)

Faster Temperature
Rise in 21st Century
than the 20th Century:
2°F - 11°F (by 2100)

(IPCC)

Impacts on Energy & Water Demands?



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- *Global Warming is Exerting Uneven Impacts*

*In Isolated
Cases, Glaciers
Still may Grow*

--



*Argentina: Perito Moreno Glacier in
Los Glaciares National Park*

http://news.yahoo.com/s/ap/20090614/ap_on_re_la_am_ca/lt_argentina_glacier (June 14, 2009)



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-- *But, Otherwise in All Cases*



Courtesy: Matt Starman, Yreka Western Railroad

*Lake Shasta (CA) 155 feet from the Crest
29% Full (Nov 7, 2008)*



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- *Impacts of Climate Change on California's Water Resources - Observations*

- Increased Average Temperatures*

- More Extreme Hot Days, & Fewer Cold Nights*

- Increased Water Demand;*

- Shifts in Water Cycle -*

- Overall 12 - 35% Precipitation Decrease than Historical Annual Averages*

- More Winter Precipitation as Rain than Snow -*

- Reduced Water Supply from Sierra Snowpack*

- Sooner Snowmelt & Rainwater Running*

- Intense Rainfall Events*

- Longer Growing Season --*

- Increased Irrigation & Agricultural Water Demands*

- Increased Evapotranspiration Rates from Plants, Soils and Open Water Surfaces*

- Moisture Deficits in Non-irrigated Agriculture, Landscaped Areas and Natural Systems*

- Increased Urban Water Use*

- @ Possible Expense of Agriculture Water*



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- *Impacts of Climate Change on California's Water Resources - Observations contd.*

Over the Last Century, *Sea Levels in California have Gone-up by as much as 7 inches along the Coast:*

Increasing Erosion and Pressure on the State's Infrastructure, Water Supplies, and Natural Resources in Terms of:

Increased Stress on Sacramento - San Joaquin Delta Levees

Saltwater Intrusion into Estuaries, Bays, and Coastal Groundwater

*→ Changed Water Quality
Transformed Ecosystems
Reduced Freshwater Supplies
Higher Contaminant Concentrations*

→ Increased Energy Demand



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• Impacts of Climate Change on California's Electricity Resources

Early Snowmelt & Intense Rains

- *Storage Capacity*
- *Inability to Support Controlled Releases of Water*
- *Impacts on Hydropower Generation*

Severe / More Wildfires

- *High Voltage Transmission Capabilities*
- *Potential Disruption in Electric Service*
- *Possible Blackout / Brownouts*
- *Impacts on Water Supply & WWT Systems*

Increased Energy Demand for Water Transfers

- *Energy Sector's Ability to Meet Peak Electrical Demand*

Water Chemistry

- *Algal & Microbial Growth*
- *Water Quality* → *More Energy Needs*

Lack of Freshwater Supplies → *More Energy Needs*

Demand for Water & Electricity is Growing, but Water Related Electricity Use is Growing Faster



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- *Resulting Challenges for California's Water Sector*

Maintaining Water Supply & Protecting Water Quality → Associated Energy Needs → GHG Emissions

Climate Change Considerations can't be a Basis for Lowering Water Quality Standards.

Integrated Use of Water within the Broader Context of a Watershed that is NOT Defined by Artificial Boundaries

Need to Use Available Water More Efficiently.

Impacts on Traditional Water Rights in California –

Not Business as Usual under Shifting Paradigm as CC is Expected to Alter the Seasonal Water Availability,

Future Water may not be Available for Particular Users Under the Terms of Their Water Rights.



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- *California's Response to Changing Climate:*
Adaption & Mitigation

Short-Term Actions

Expanding Water Storage *(Both Surface and Groundwater)*
improved Coordination *between Stored and Other*
Water Supplies;

(e.g. Recycled Municipal Water, Surface Runoff, Flood Flows, Urban Runoff, Imported Water, Water Transfers, and Desalted Brackish & Seawater);

Developing *Conjunctive Use* *Management Plans*
Integrating Floodplain Management, Groundwater Banking and
Surface Storage;

Aggressively Increasing *Water Use Efficiency*

20% Reduction in Statewide Urban Water Use by 2020;

Introducing Incentive to Promote Aggressive Conservation
Programs; Imposing Water Conservation Measures in the
Permitting Process.

Water Efficiency in Ag. Sector *by Applying All Feasible*
Efficient Water Management Practices

Increasing Use of *Recycled Water*

Drought-Proof & Energy Efficient Option (in many cases)



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- *California's Response to Changing Climate:*

- Long Term Strategies include*

- R&D and Monitoring & Evaluation Activities*

- Identifying Research Needs to Help Reducing California's Vulnerability to Climate Change;*

- (In Partnership with Research Entities and Federal & State Agencies)*

- Evaluating Long Terms Impacts of Climate Change on Future Water Supply;*

- Expanded Monitoring and Atmospheric Observations to Detect Climate Change and Tracking Changes in Rain and Snow Pattern;*

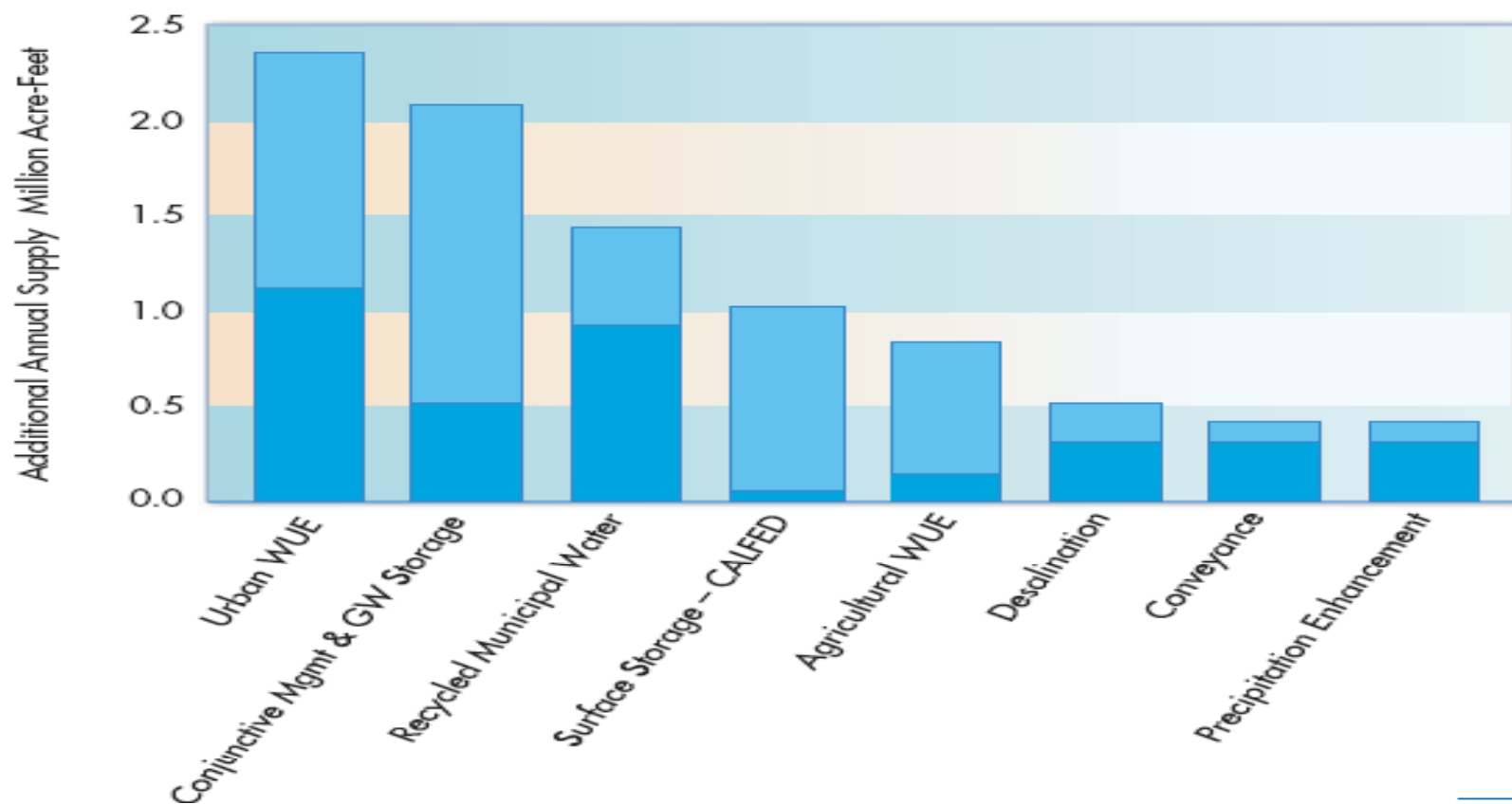
- Conducting a Feasibility Study for a Water Use Measurement Database and Reporting System; &*

- Providing Sustainable Funding for Statewide Integrated & Regional Water Management Plans.*



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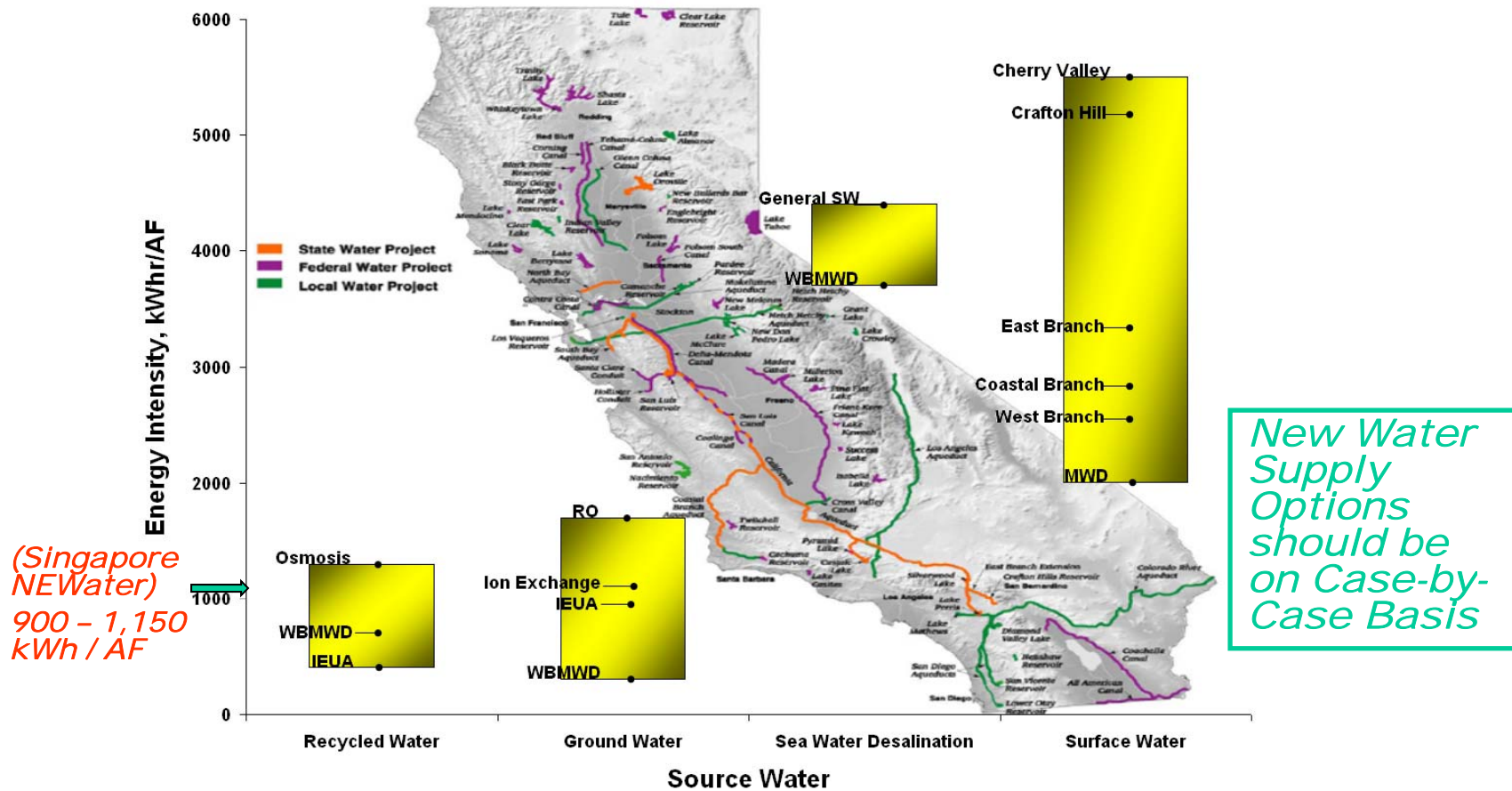
- New Water Sources by 2030 (4 - 9 MAF)*





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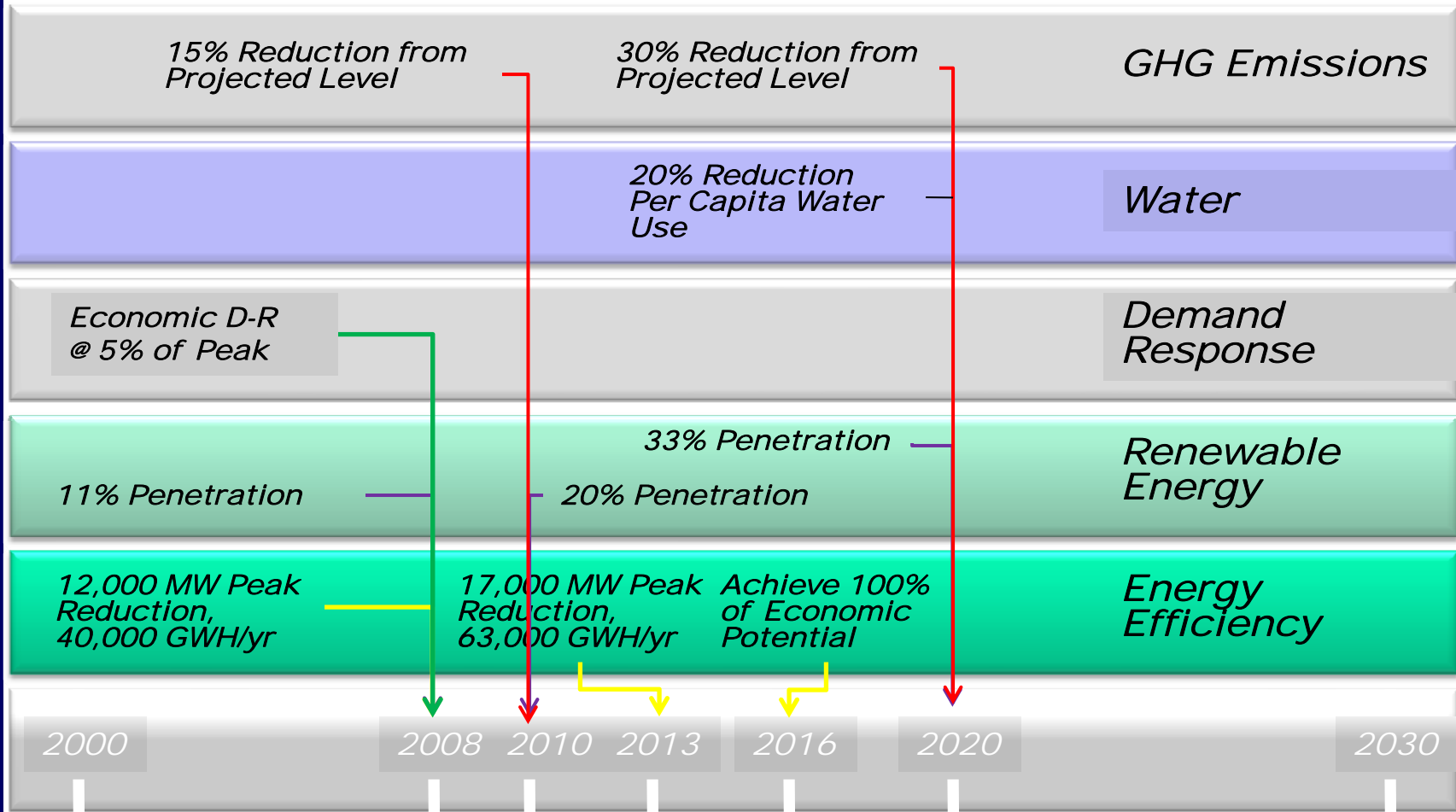
• Energy Consumption Comparison





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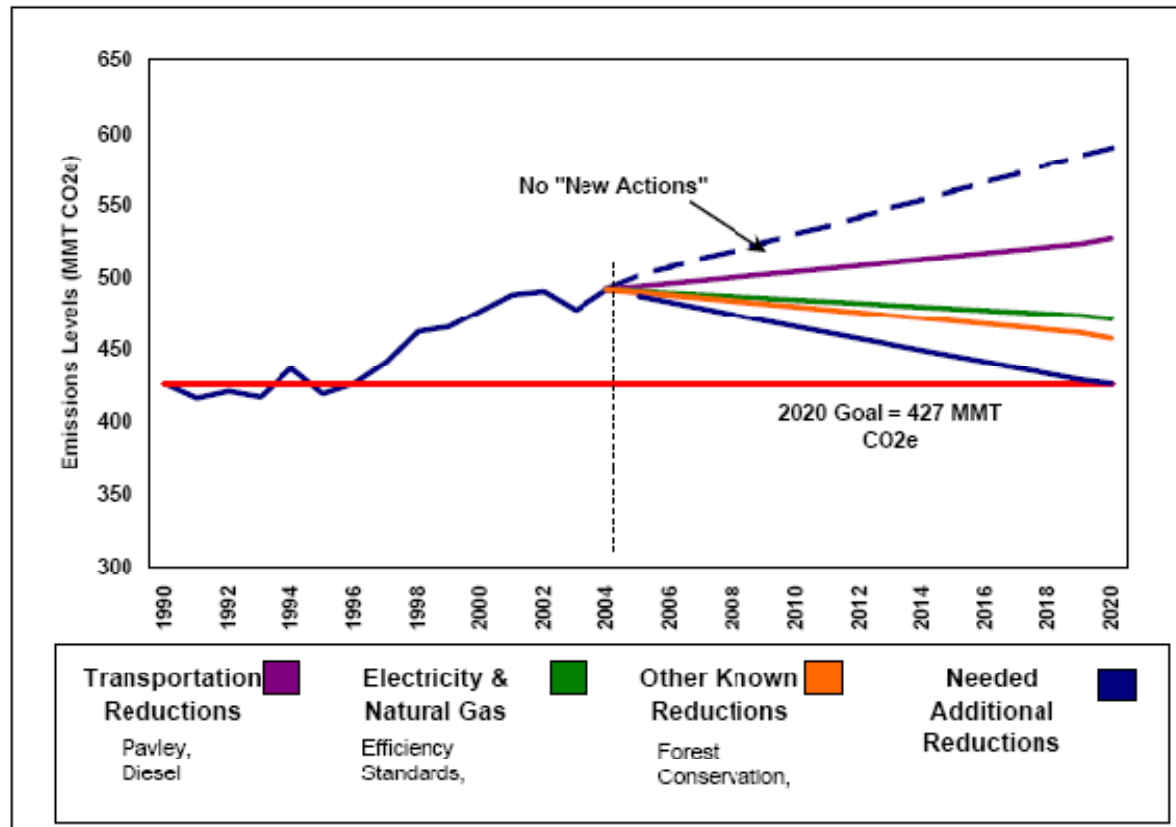
California's Energy & Water Policy Time Lines





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- *CA AB32 – Achieving Targets*





- Estimated GHG Reduction from Water Sector*

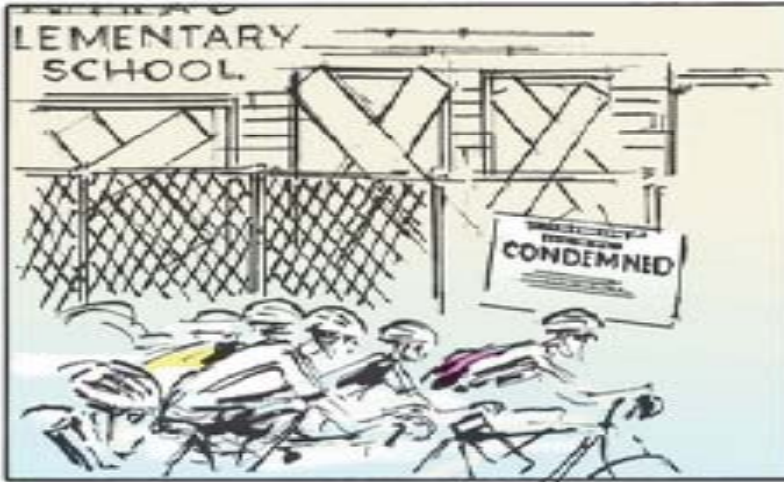
<i>Water Conservation & Efficiency</i>	<i>1.4 MMTCO_{2e}</i>
<i>Urban Water Runoff Reuse</i>	<i>0.2 MMTCO₂</i>
<i>Water Recycling</i>	<i>0.3 MMTCO_{2e}</i>
<i>Water System Energy Efficiency</i>	<i>2.0 MMTCO_{2e}</i>
<i>Increased RE Production</i>	<i>0.9 MMTCO_{2e}</i>
<i>Total Reductions</i>	<i>4.8 MMTCO_{2e}</i>

A Public Goods Charge will Provide Funding for Implementing Above Strategies



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TOUR OF CALIFORNIA





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Questions?