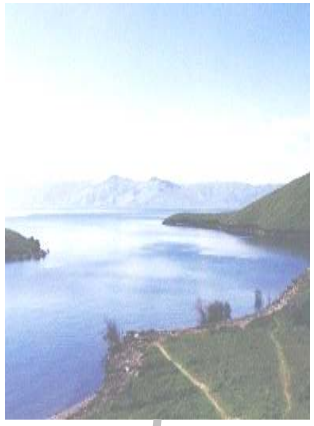

Water & Energy Efficiency: California Style

International Conference on Conservation, Energy Efficiency & Solar

Islamabad, Pakistan

October 2010

Shahid Chaudhry
Winrock International, Pakistan
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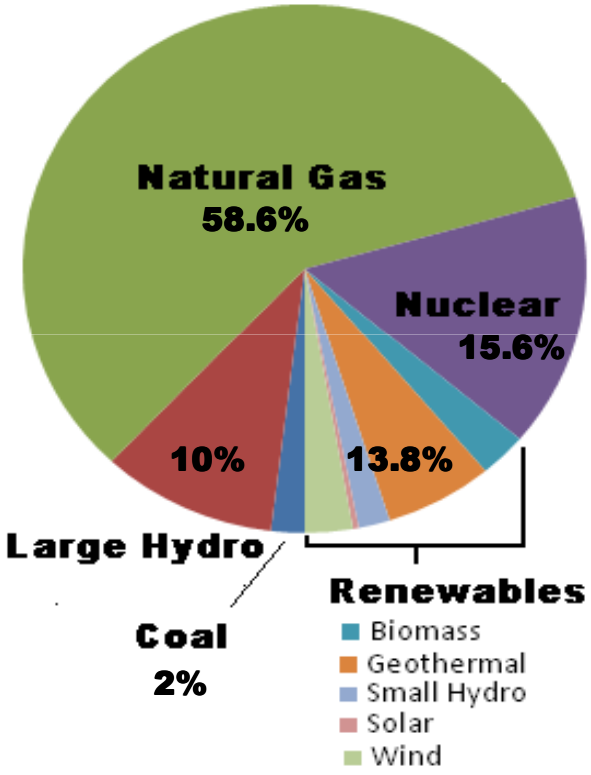
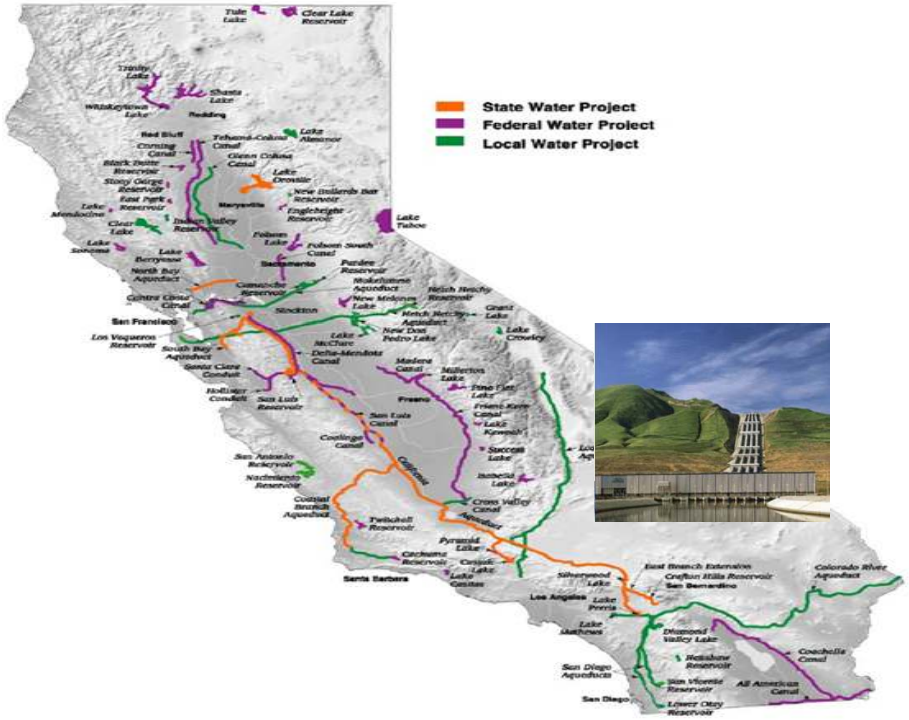
	Pakistan	California	
Area (km^2)	803,940	423,970 (1,240 km x 400 km)	~ 2 : 1
Population (2010)	~ 170 million	36.7 million (Most Populous U.S. State)	~ 5 : 1
Population Density	214 / km^2	87 / km^2	~ 2.5 : 1
Installed Elec. Gen. Capacity	0.11	1.47 kW / person	~ 1 : 13
Water Resources	751 gal/p/day	2,550 gal/p/day	~ 1 : 3.4

- **California's Electricity & Water Resources**

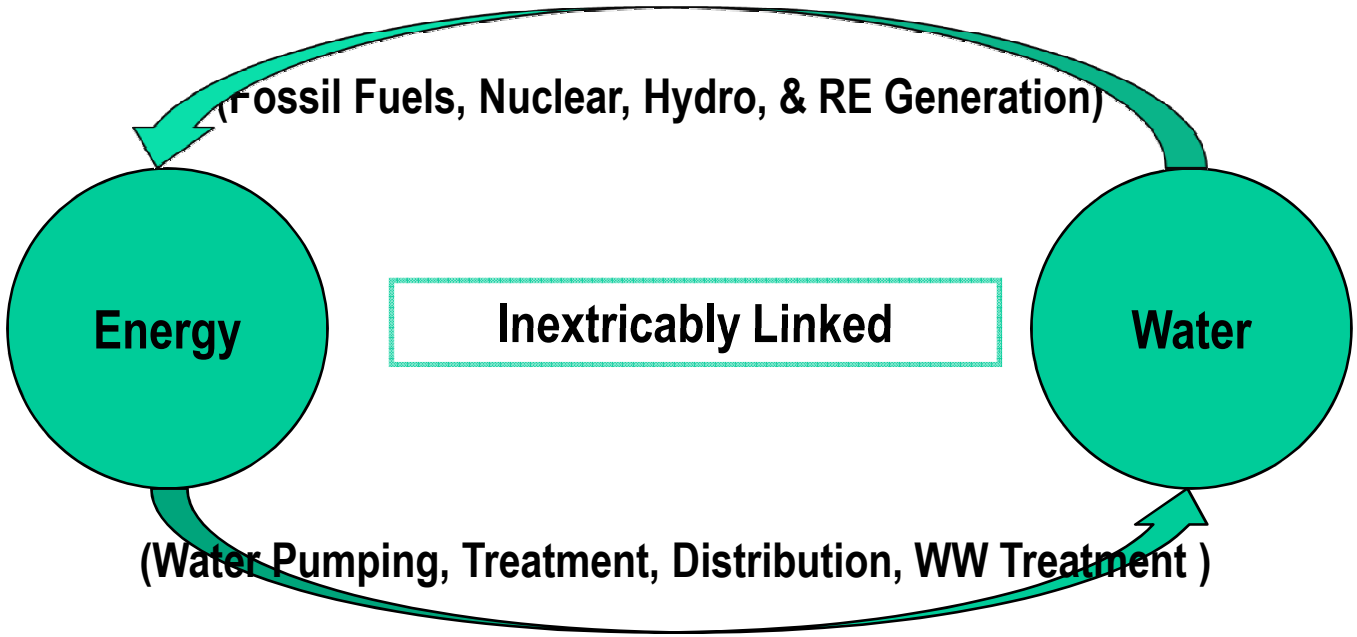


CA's Elec. Generation: 208,600 GWh (2008)



Annual Water Available in California
→ 82.5 MAF

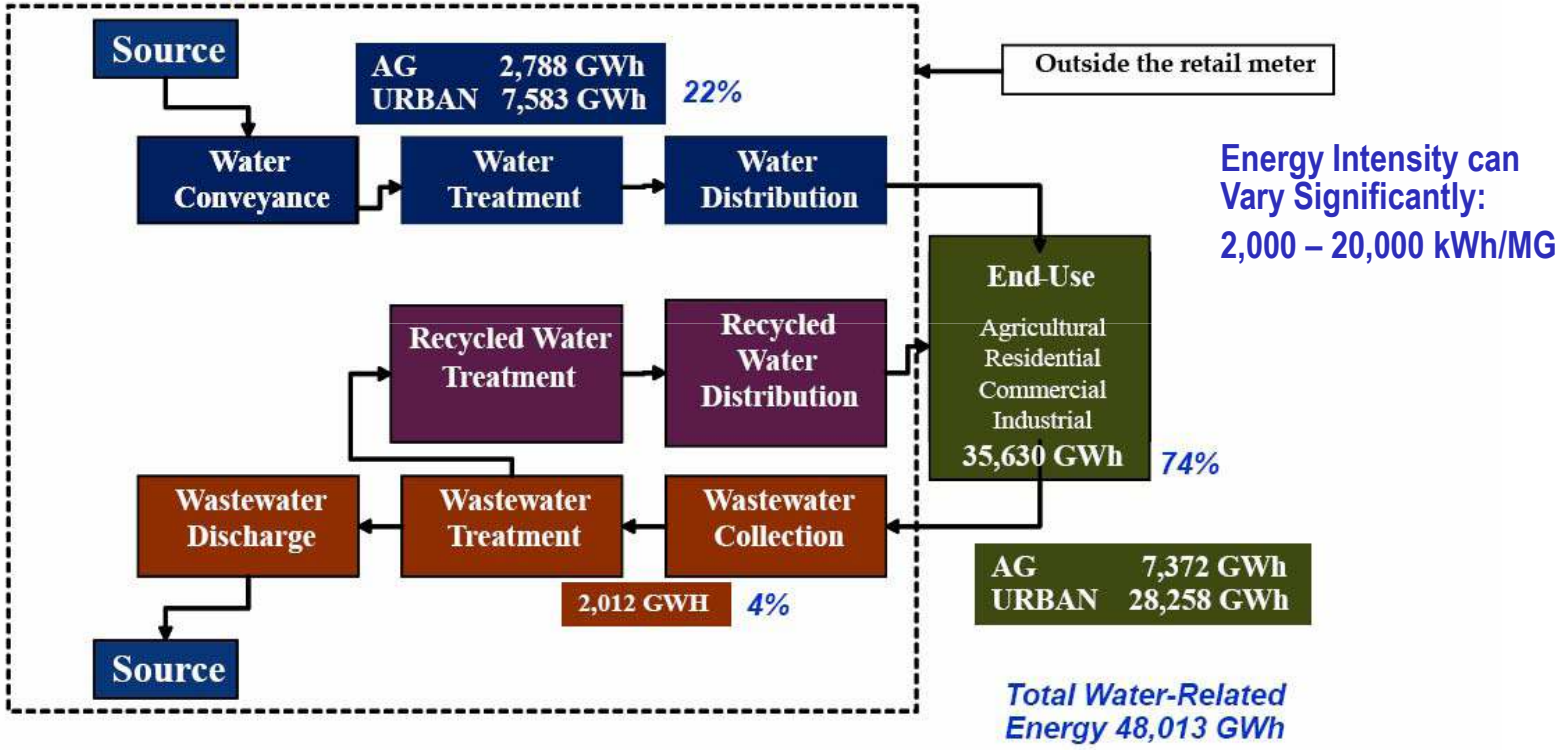
- **Water-Energy Nexus**



Reliability & Sustainability of Both Entities Depends on Each Other

Framework The Water Use Cycle

Estimates adjusted Oct 2006



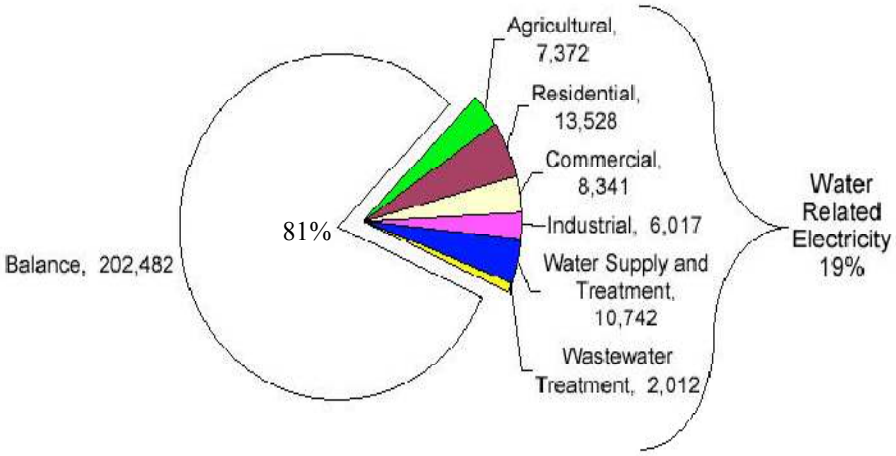
Energy Intensity can Vary Significantly:
2,000 – 20,000 kWh/MG

Total Water-Related Energy 48,013 GWh

Where are the greatest near-term opportunities for significant energy benefits?

- **Energy Use by Water Sector –**

California Case Study



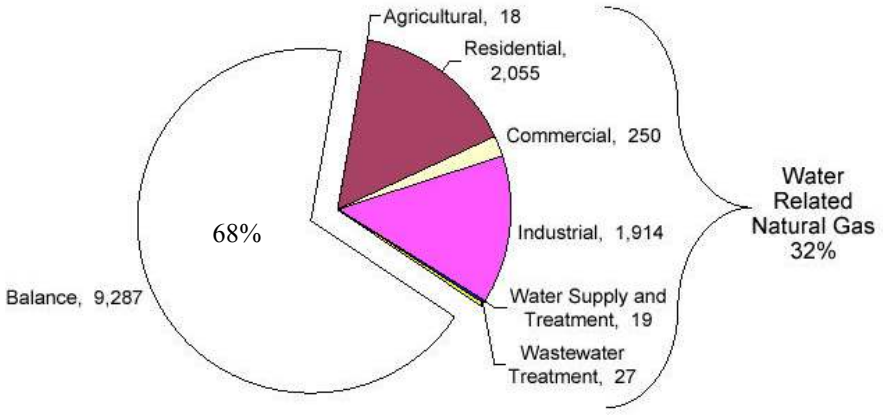
Total Electricity Demand in 2001 = 250,454 GWh

Electricity Use:

Water Supply & Treatment:	4.3%
Industrial:	2.4%
Commercial:	3.3%
Residential:	5.4%
Agricultural:	2.9%
WW Treatment:	0.8%

Nat. Gas Use:

Ag., W & WWT:	0.5%
Residential:	15.1%
Commercial:	1.8%
Industrial:	14.1%



Total Natural Gas Demand in 2001 = 13,571 therms

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

- **California's Loading Order on Resource Conservation vs. Developing New Water & Energy Resources**

Resource Conservation
Water Use Efficiency / Energy Efficiency } **Top Priority**
Water Recycling / Electrical Load Management
Developing New Resources
(e.g. Water Recycling & Water Desalination / Renewable Energy)

"[The] goal is for California's energy to be adequate, affordable, technologically advanced, and environmentally-sound…[C]ost effective energy efficiency is the resource of first choice for meeting California's energy needs. Energy efficiency is the least cost, most reliable, and most environmentally sensitive resource, and minimizes our contribution to climate change." (Energy Action Plan II, 2005)

Utilities are required to first meet their "unmet resource needs through all available energy efficiency and demand reduction resources that are cost effective, reliable, and feasible." (Public Utilities Code Section 454.5(b)(9)(C))

- **Strategies to Reduce Energy Consumption**

  On Water Side

  Water Loss / Unaccounted Water Reduction

  Water Conservation / Water Use Efficiency

  Adding More Storage for System Flexibility

  Resource Water (Wastewater) Recycling

  Developing New Local Resources – *e.g. Desalination*

  Rain Water

- **Water Conservation Makes Best Economic Sense**

Ag. Water Conservation	$100 / AF
Water Sales by Farmers	$150 / AF
Urban Water Conservation	$300 / AF
Water Reclamation	$500 / AF
Seawater Desalination	$850 / AF

- **California's Leadership in Developing New Water Sources –**
  Few Examples

Best Management Practices:

Water Use in the City of Los Angeles is Same as it was 25 years ago, despite Adding Almost ONE million New Residents,

Water Conservation & Efficiency can Meet 25% Annual Energy Demand for the City of San Diego (~ 3 million people).

Water Recycling

Orange County: 72,000 AF Treated WW is Injected into Ground Water Aquifer Since Oct. 1976,

West Basin MWD: FIVE Different Grades of Recycled Water for Different Applications.

Desalination

Brackish & Seawater with Thermal & Membrane Technologies
(on the horizon)

CPUC's Pilot Program

Quantifying Energy Savings from Water Use Efficiency

- **Strategies to Reduce Energy Consumption**

  On Energy Side

  Energy Conservation / Energy Efficiency

  Water Transfer Operations; Treatment Processes; Efficient Lighting & Equipment
  ***(e.g.* pumps and motor systems, aeration etc.)**

  Load Management

  Distributed / Decentralized Generation

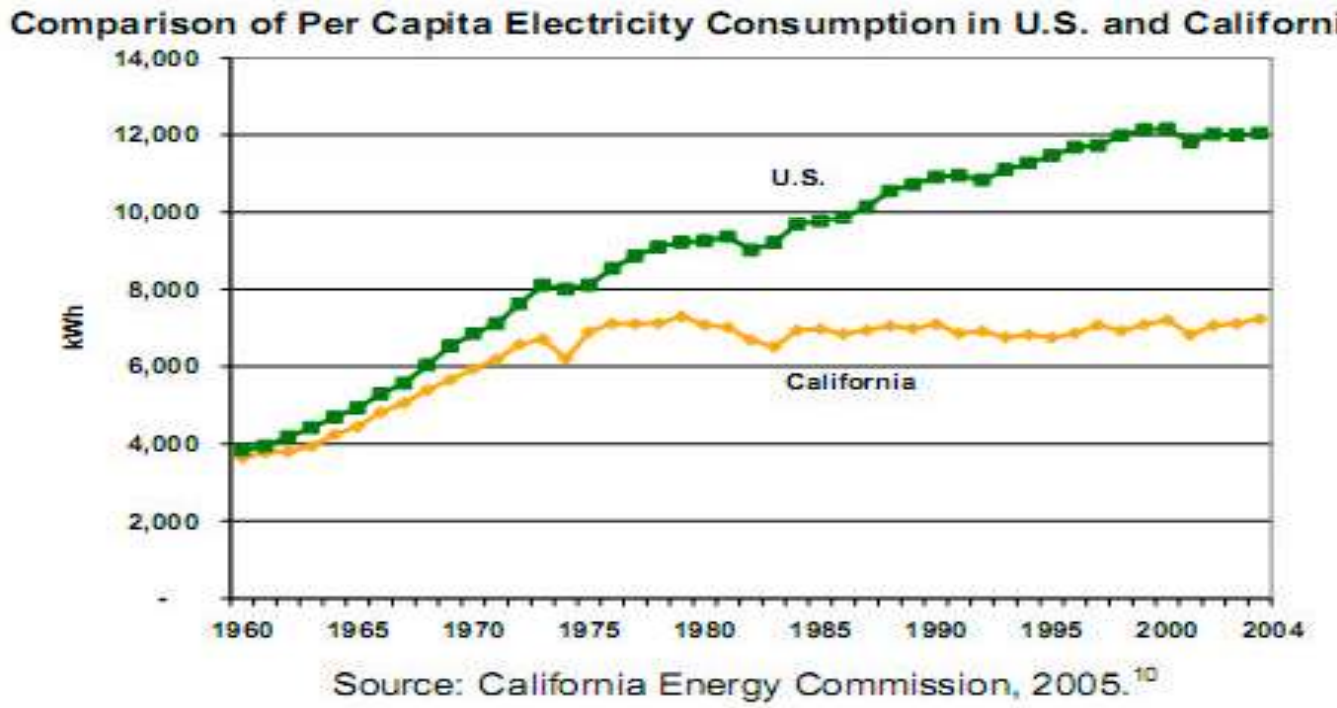
  Cogeneration / Combined Heating & Power

  (Using Waste Heat from Electricity Generation for other Useful Purposes)

  Renewable (PV, Wind, Fuel Cells etc.)

- **Energy Efficiency – A Tradition in California**

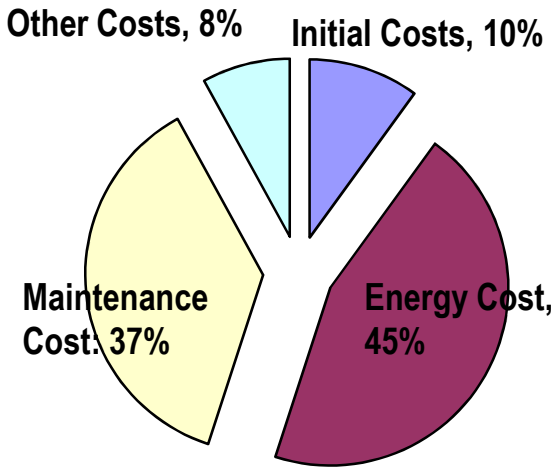
  National Leader in Energy Efficiency Strategies using Regulatory and Market-Based Approaches.



Source: California Energy Commission, 2005.[10]

- **Electric Motor/Pump Systems**

Single Largest Category of Electric End-Use,
Consumes 23% of all Electricity Sold in the U.S.,
Most Pump-sets Inefficient (Survey: Eff. Range 25 – 50%).



Life Cycle Cost of Pump
(Source: World Pumps – Jan 2008)

Pumping Energy Needs

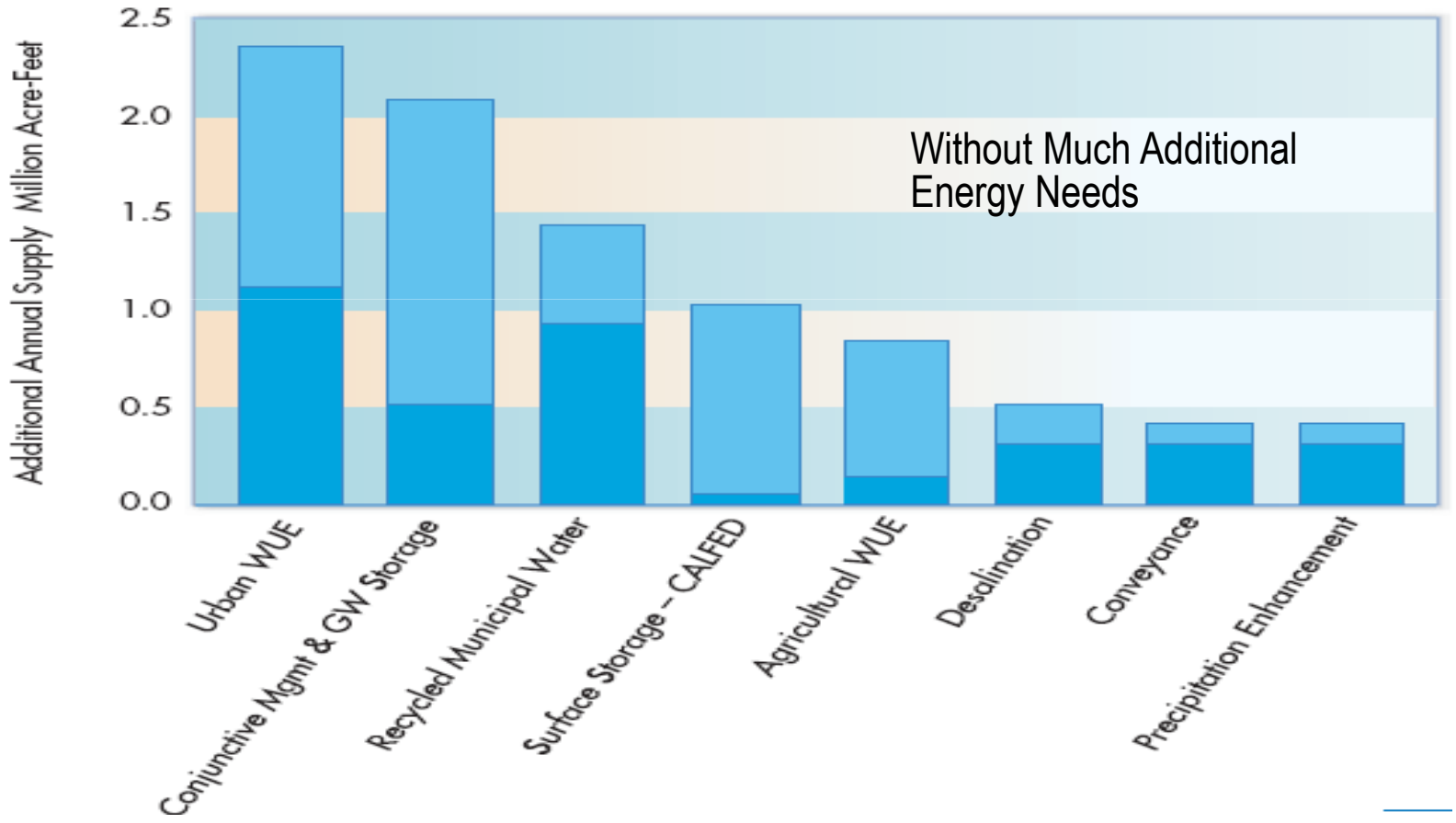
Raising 1 AF of Water by 100 ft Needs:

Theoretically: 102 kWh

@ 25% → ~400 kWh
@ 50% → ~200 kWh

Replacement of Inefficient Electric Motor/Pump Sets with Efficient Systems Provides "the Most Bang for the Buck".

- **Estimated New Water Supply by 2030** (4 – 9 MAF)



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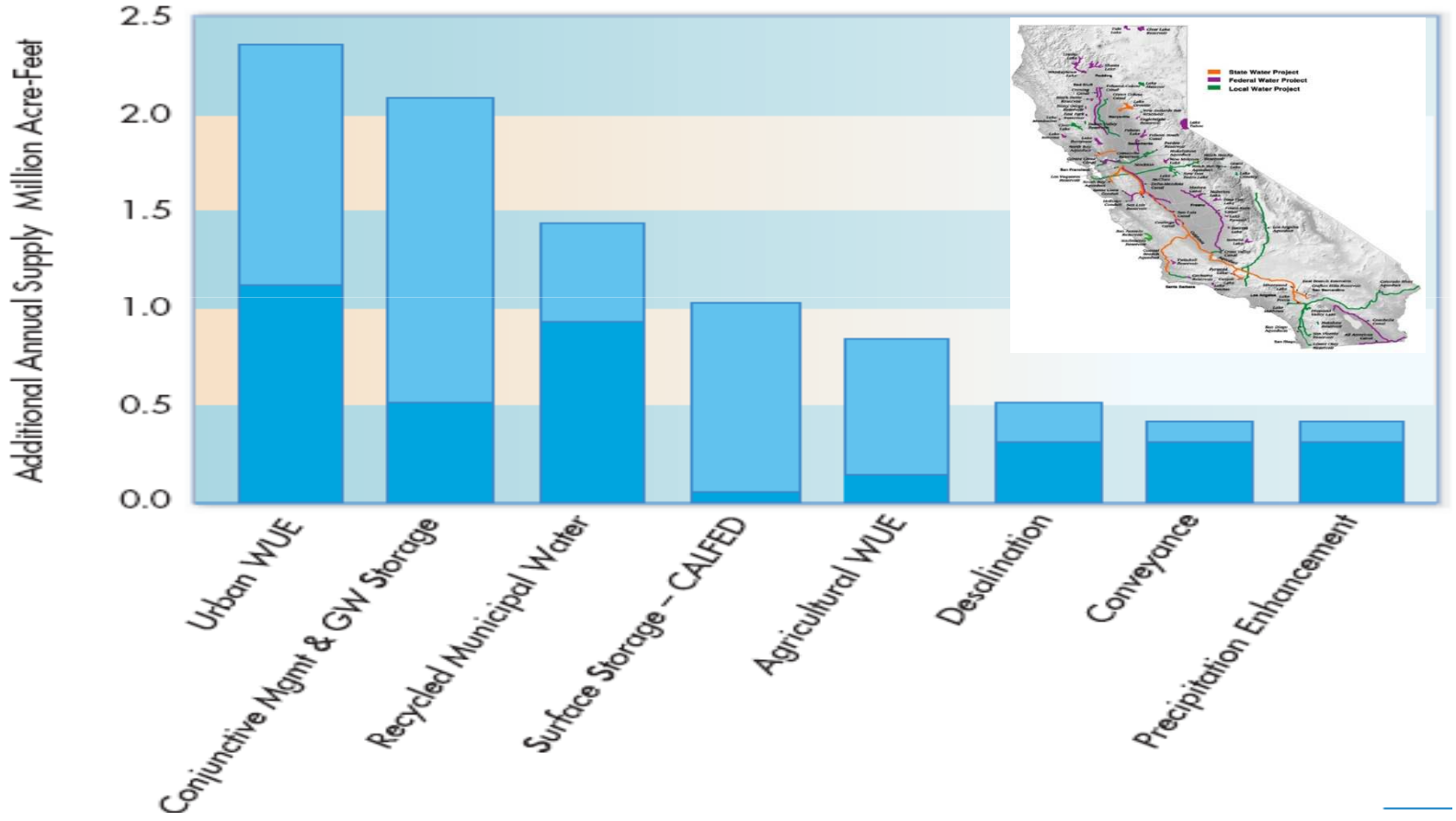

- **How Pakistan can Benefit from California Experience?**

  Developing a Benchmark for Water Sector Energy Use;

  Establishing a Loading Order for Investment in Water & Energy Sectors;

  Developing Short-Term & Long-Range Integrated Plans for Water & Energy Resource Management;

  Developing Regulatory & Market Based Approaches to Encourage Conservation and Efficient Use of Both Entities;

  Modifying Educational Curriculum, especially at Schools Level, to Incorporate the Significance of Water & Energy;

  Promoting Outreaching & Dissemination Activities on the Subject, especially to Women; &

  Establishing a Close Coordination / Collaboration among Stake Holders.

- **IN SUMMARY**
  - **Water-Energy Nexus is Much Stronger, but Mostly Ignored;**
  - **Upgrading Inefficient Equipment & Aged Water use Practices Provide Ample Opportunities to Extend the Use of Existing Water Resources without Additional Energy Needs;**
  - **"Top-Down, Bottom-Up, & Across" - Parallel Approaches Needed;**
  - **Technology Alone is Not Enough – A Change in Mind-Set is More Important than Any Technology;**
  - **Price Signals Alone are NOT Always the Most Effective Way;**
  - **A Combination of Regulatory & Market Based Measures, in Addition to Customer Education, are More Effective.**