Energy+Environmental Economics

Water-Energy Avoided Cost Framework

CPUC Energy-Water Workshop
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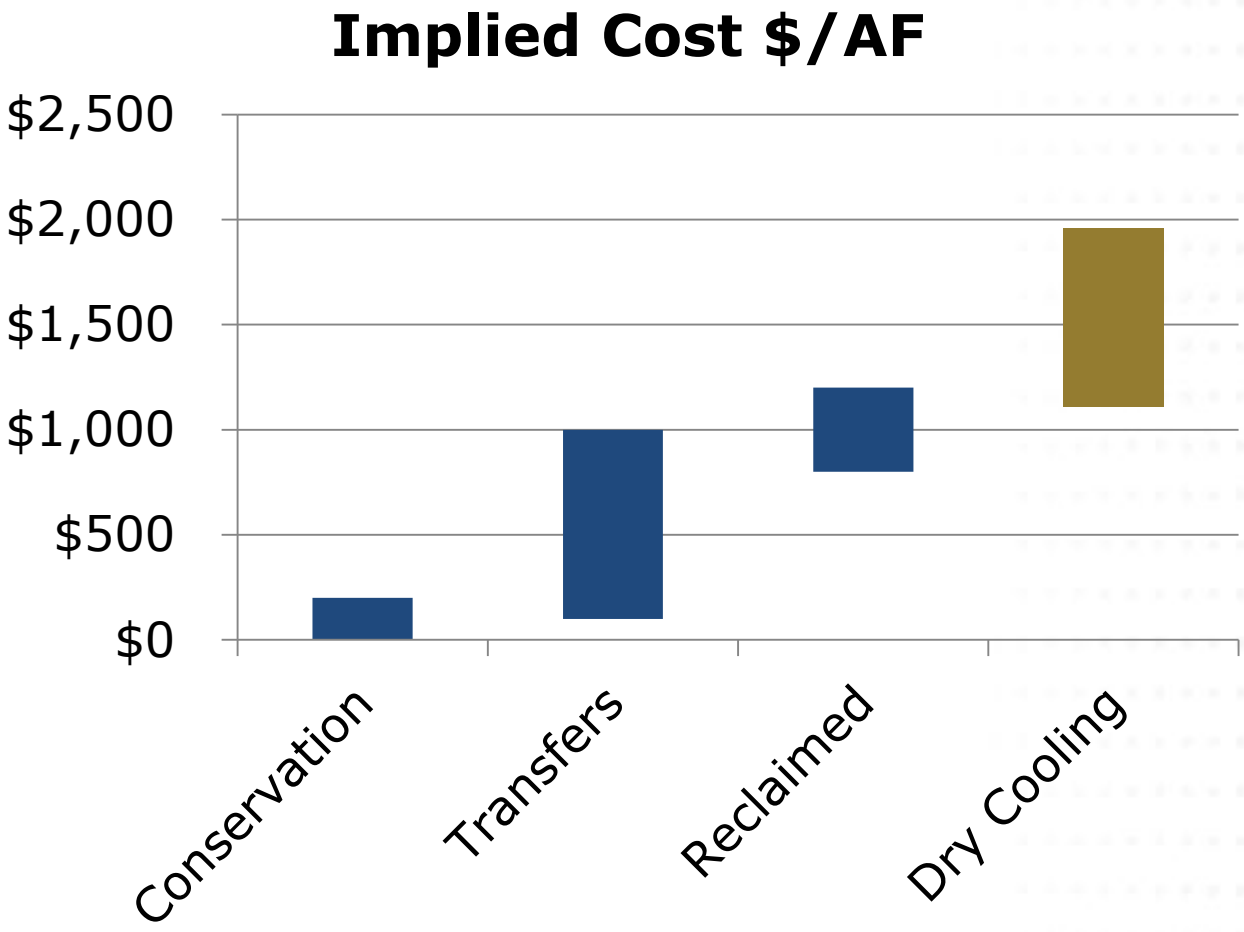
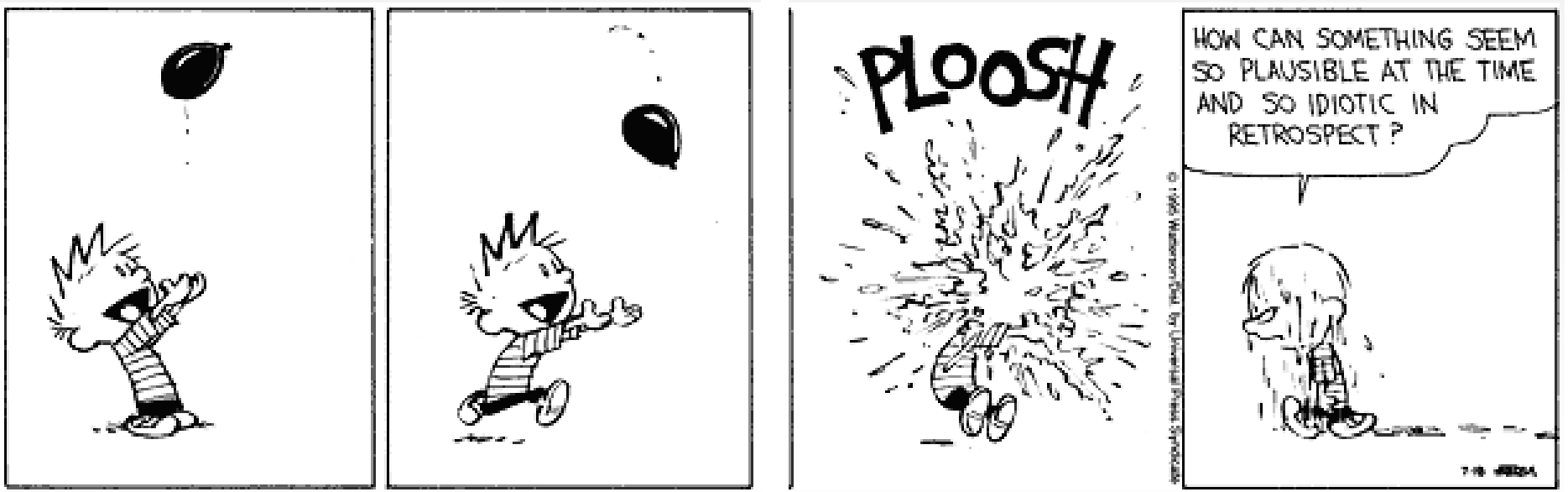
http://urli.st/aPr

Decisions can be improved…



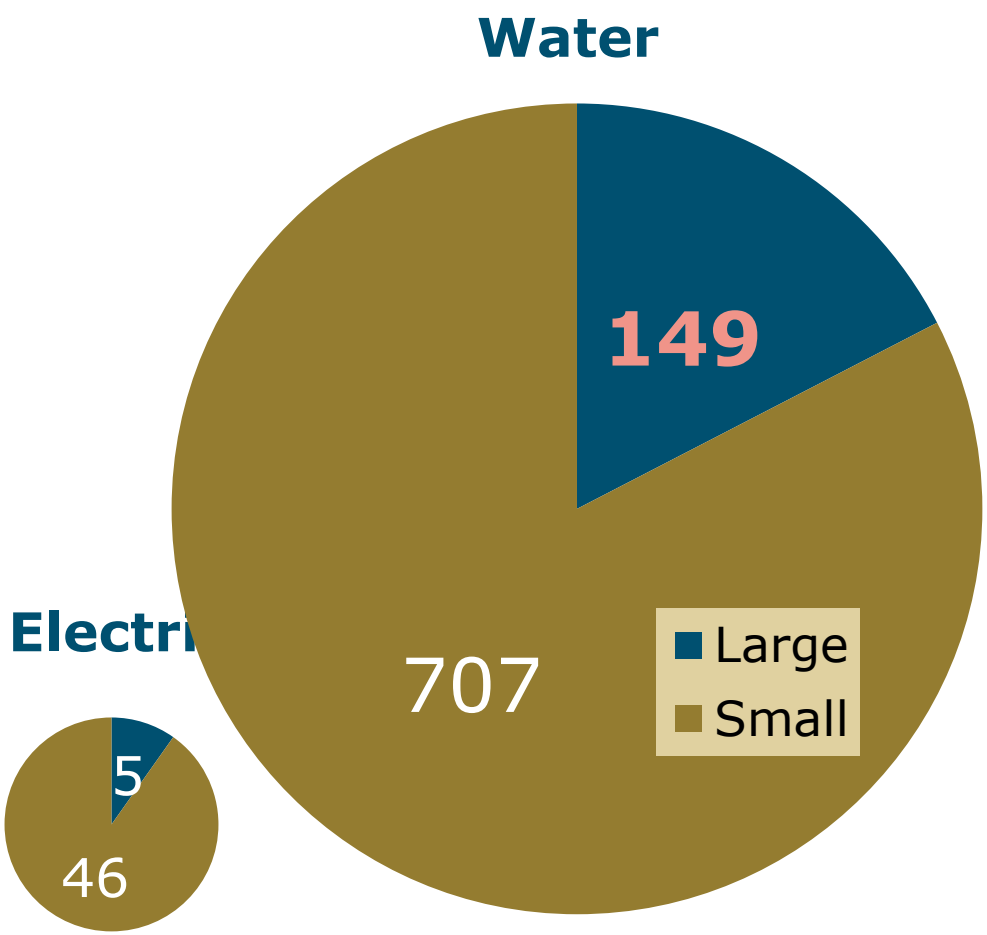
+20,000
Tons GHG


PLOOSH
HOW CAN SOMETHING SEEM SO PLAUSIBLE AT THE TIME AND SO IDIOTIC IN RETROSPECT?

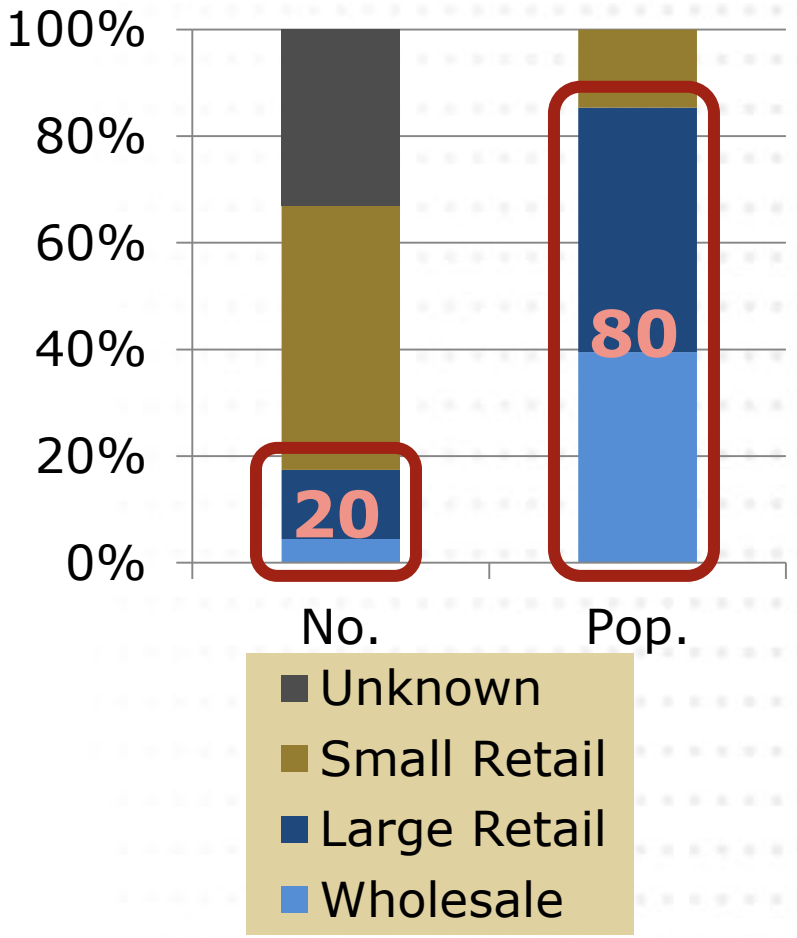

The perfect is the enemy of the good.
Voltaire

Lots of little fish

Utilities



Urban Water Utilities



"These are not the data you are looking for"


Top Down
Bottom Up

Engage all stakeholders

Electric Utility

- **Shareholder earnings**
- **Reliability**

Water Utility

- **Compliance**
- **Reduce costs**
- **Supply reliability**

Regulators

- **Cost-effectiveness**
- **Efficiency & GHG**

Which is why we need an avoided cost of water

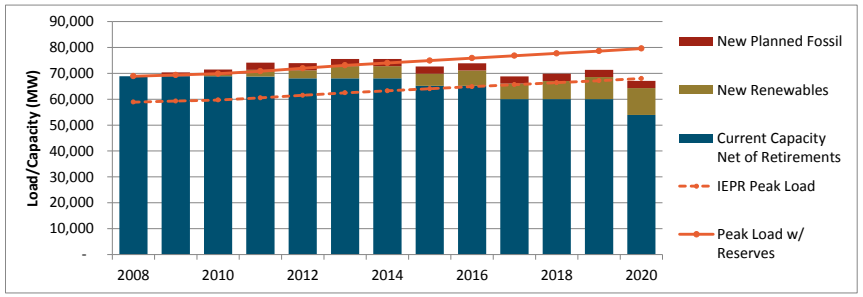
ENERGY AVOIDED COSTS

Energy avoided costs

- Used to justify investment, set incentives, and inform policy goals
- Transparent, credible but not overly complicated
- Broad agreement and stakeholder buy-in on general framework
- Widely applicable to EE, DR, DG, RPS
- Doesn't try to do everything

Energy avoided costs

Forecast Load

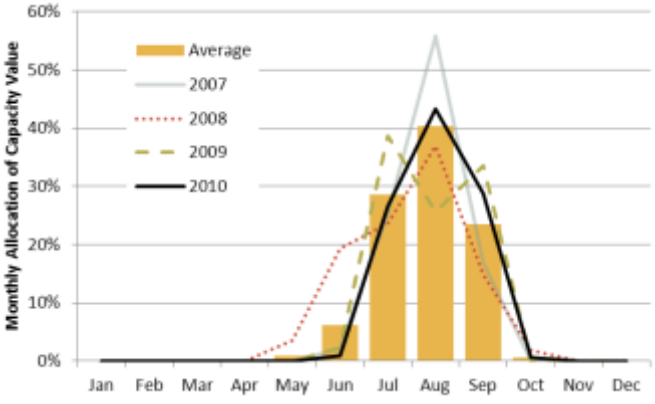


Define Proxy Resource

Calculate Costs

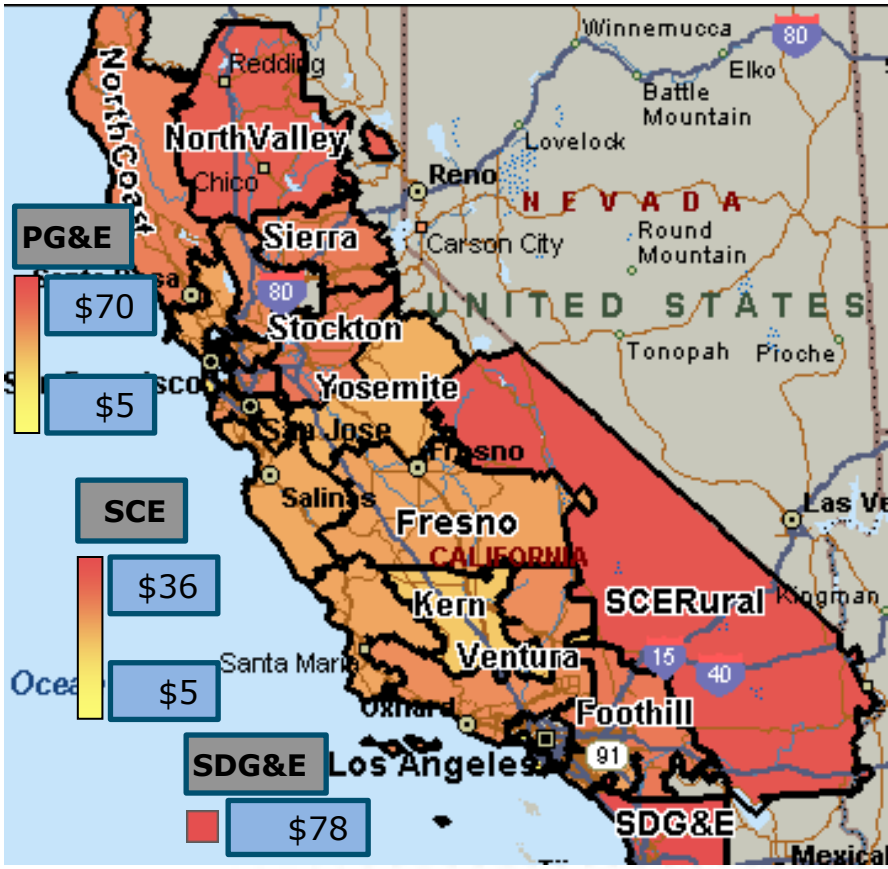
CT Market Operations Summary ($/kW-Yr.)	1	2	3
CT Annualized Fixed Cost	184.63	188.32	192.09
Operating Cost	21.70	22.96	27.74
Real-Time Dispatch Revenue	(66.00)	(71.26)	(85.71)
Ancillary Services Revenue	(5.02)	(5.42)	(6.51)
Capacity Residual	135.32	134.61	127.60
Temperature Adjusted	148.32	147.55	139.84
Capacity Factor	4.9%	5.2%	5.6%

Allocate Costs



Regional aggregation

PG&E Solar PV Program and Renewable Auction Mechanism Map



WATER AVOIDED COSTS

Water avoided costs: potential uses

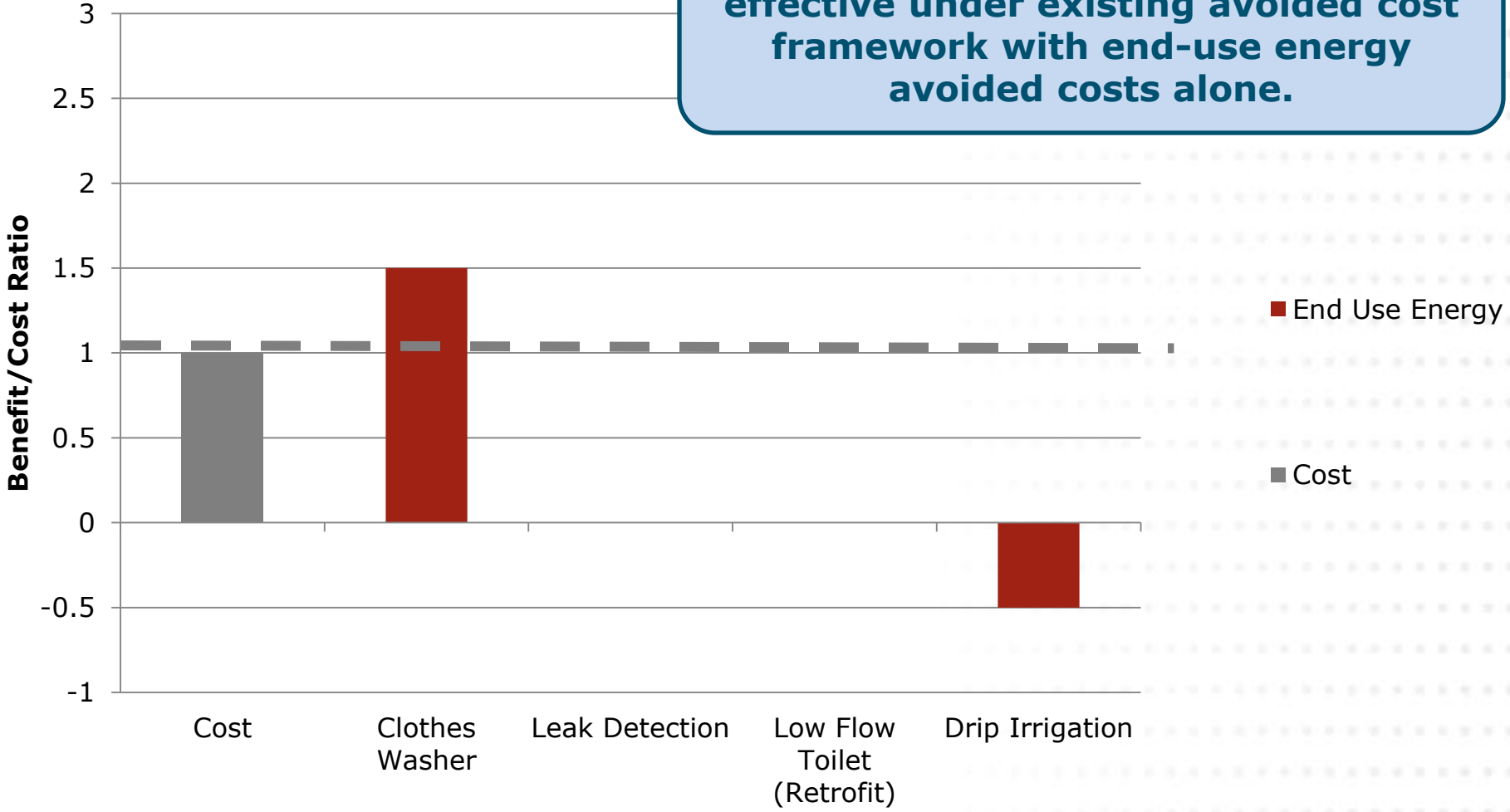
- Identify efficiency and GHG reduction opportunities that "slip through the cracks"
- Evaluate efficiency investments and establish program incentive levels
- Facilitate rational cost-sharing between water and energy utilities
- Improve investment and public policy decisions

Water avoided costs: requirements

- Transparent, credible framework
- Directionally correct on the critical issues
- Participation from energy and water utilities, policy makers and stakeholders
- Metrics that inform decisions across energy, water, and GHGs

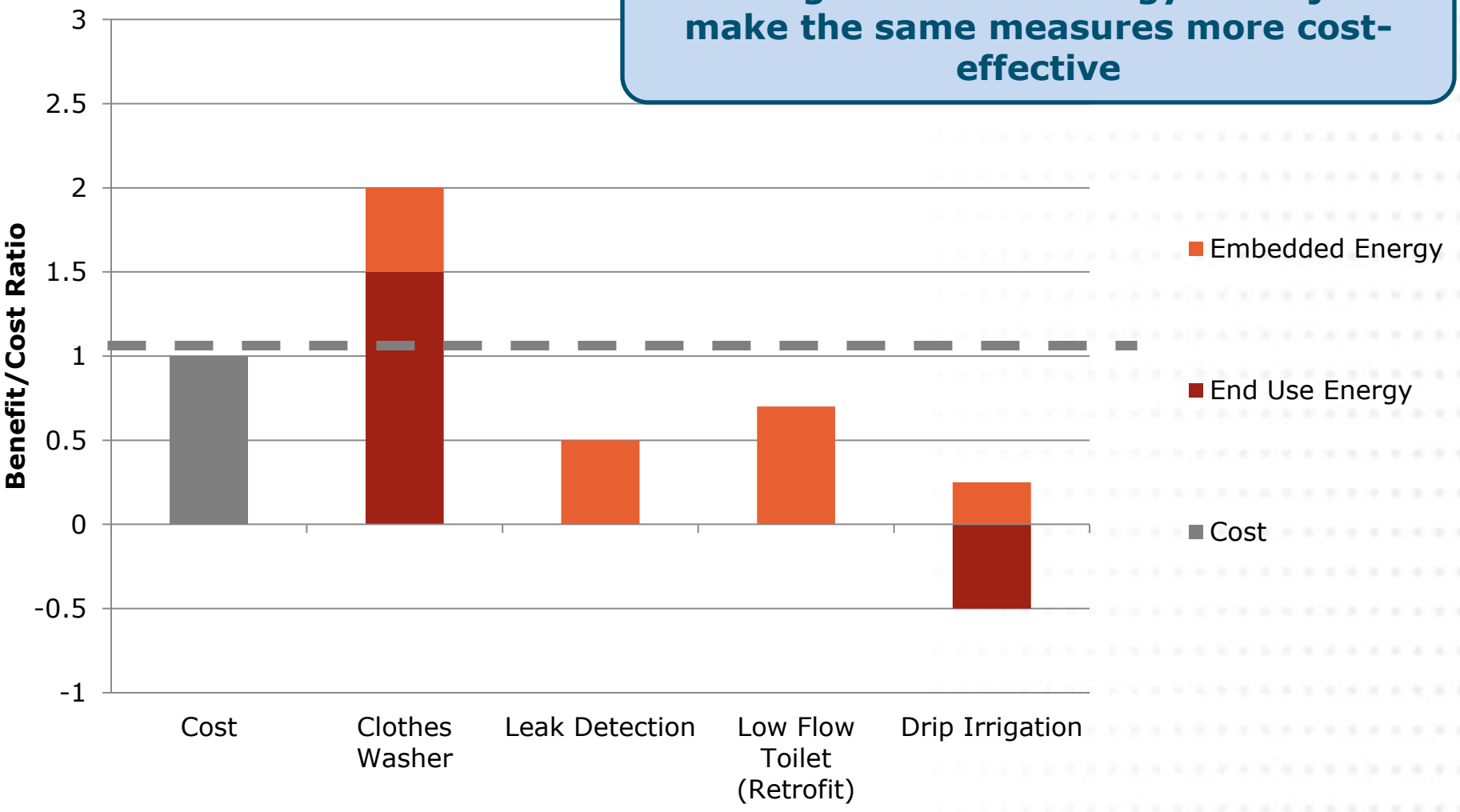
Example: end-use energy only

Some water measures are cost-effective under existing avoided cost framework with end-use energy avoided costs alone.



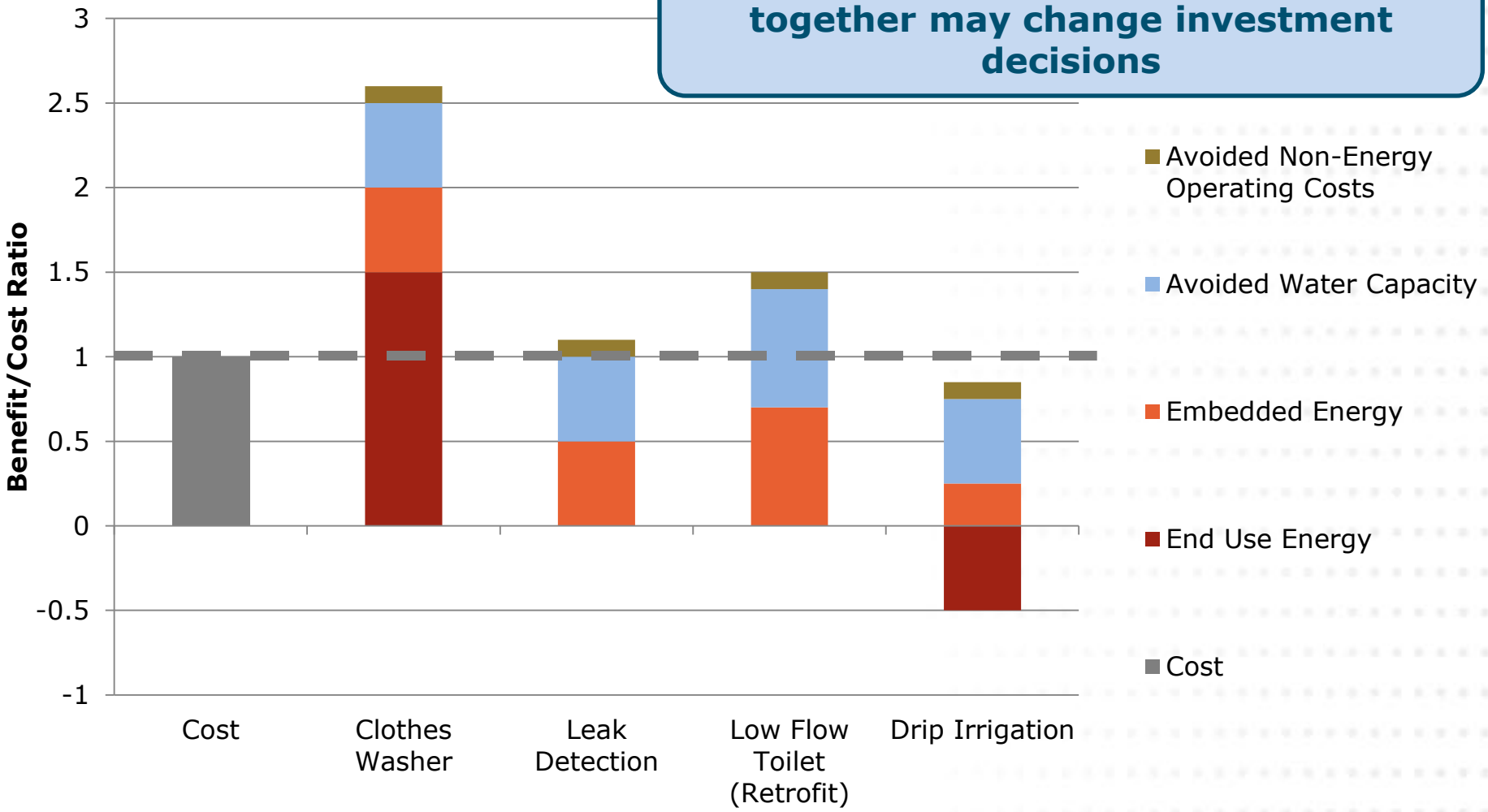
Example: End-use energy & Embedded Energy

Adding embedded energy could just make the same measures more cost-effective

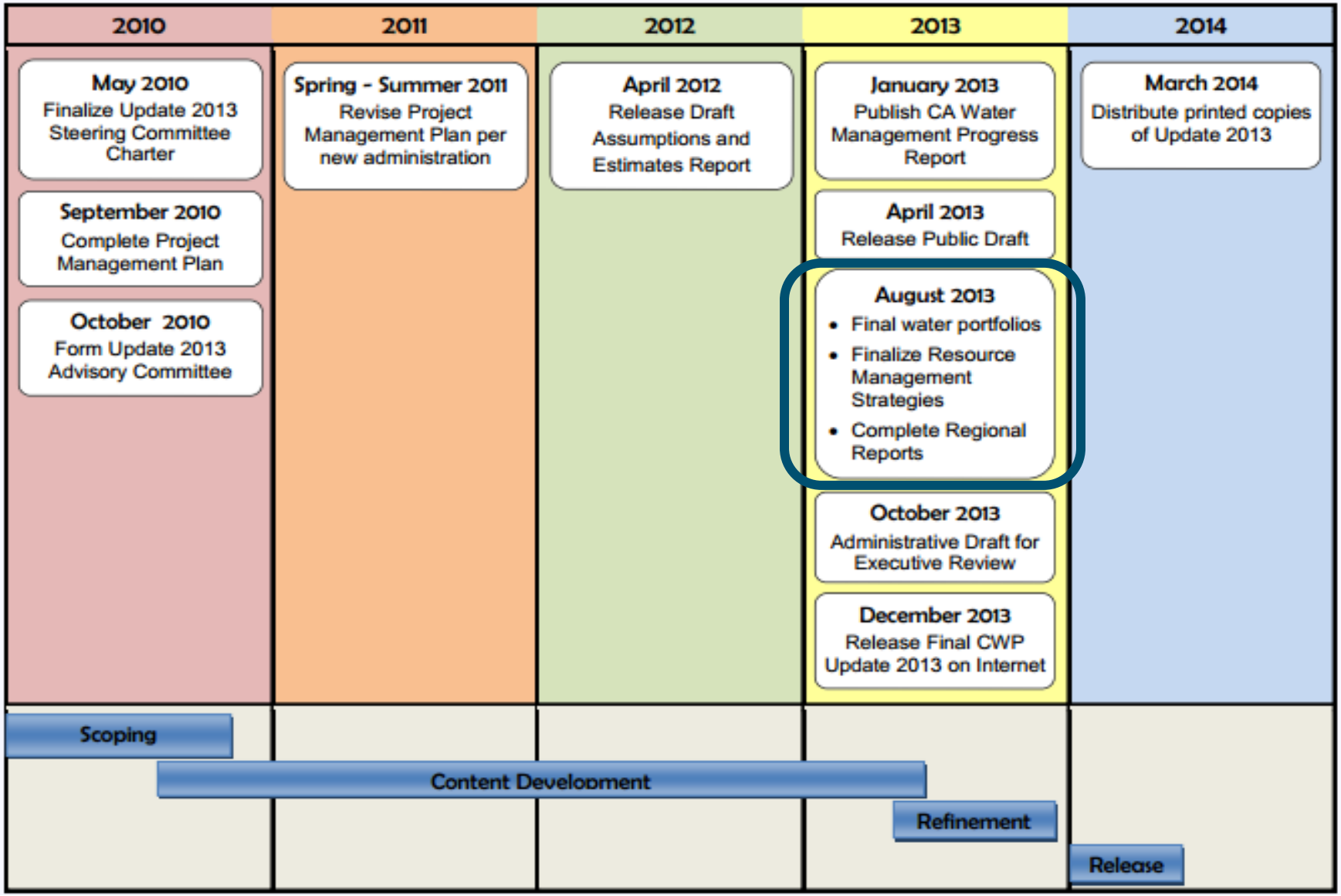


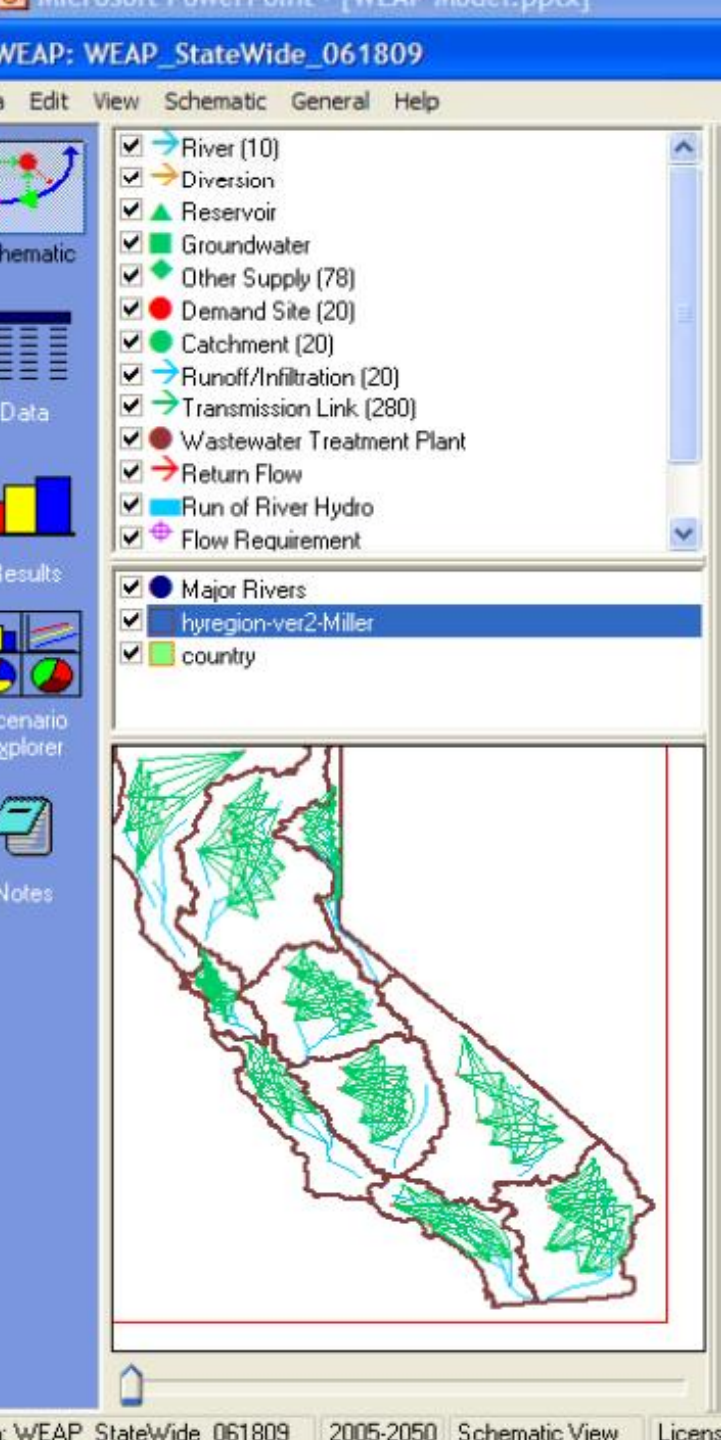
Example: End-uses, Energy and Water Avoided Costs

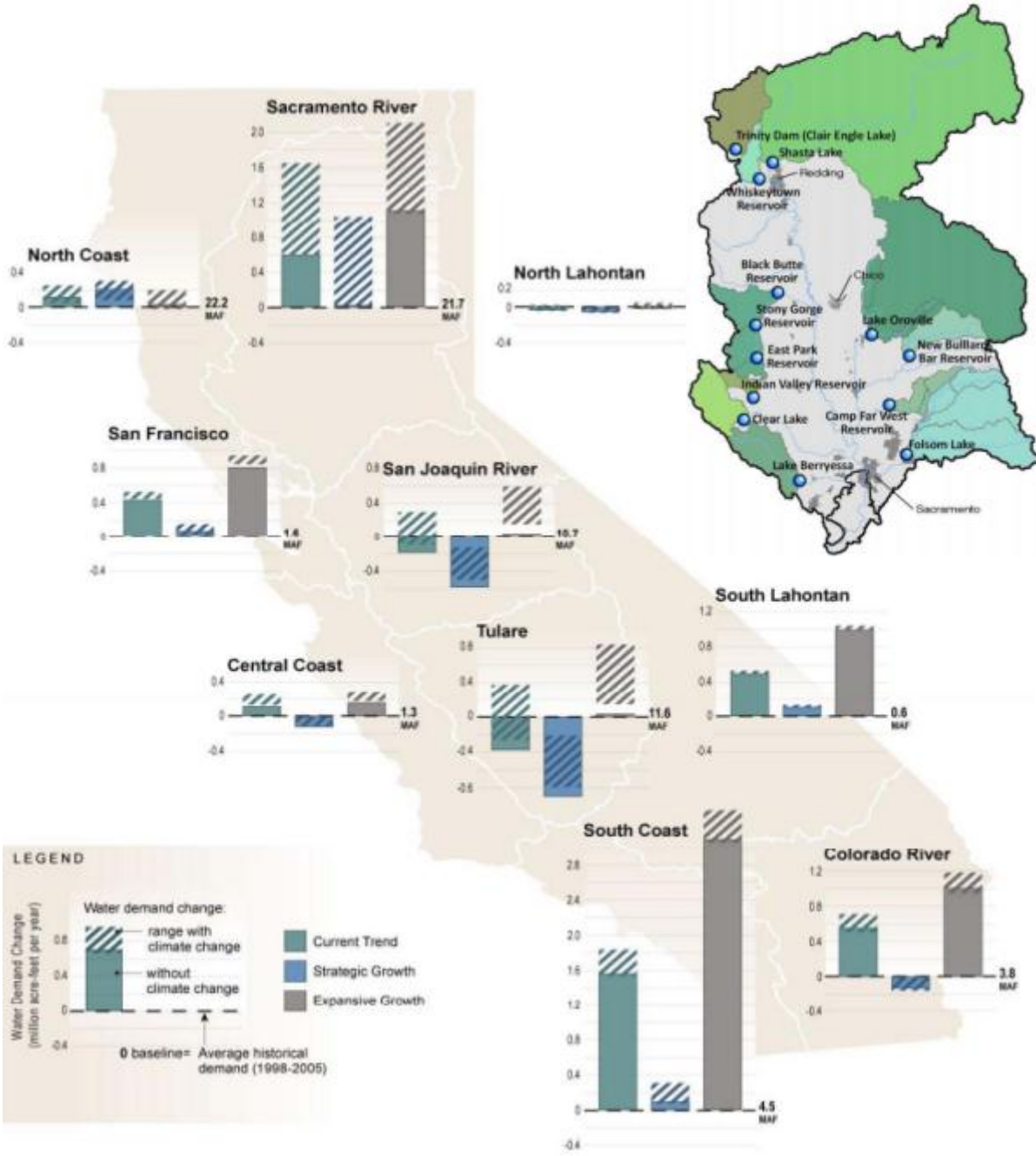
Energy and water avoided costs together may change investment decisions



Water Plan Update 2013
Content Schedule and Major Milestones




WEAP: WEAP_StateWide_061809
Edit View Schematic General Help
River (10)
Diversion
Reservoir
Groundwater
Other Supply (78)
Demand Site (20)
Catchment (20)
Runoff/Infiltration (20)
Transmission Link (280)
Wastewater Treatment Plant
Return Flow
Run of River Hydro
Flow Requirement
Major Rivers
hyregion-ver2-Miller
country
Schematic
Data
Results
Scenario Explorer
Notes
WEAP_StateWide_061809
2005-2050
Schematic View


Sacramento River
North Coast
North Lahontan
San Francisco
San Joaquin River
Central Coast
Tulare
South Lahontan
South Coast
Colorado River
Trinity Dam (Clair Engle Lake)
Shasta Lake
Redding
Whiskeytown Reservoir
Black Butte Reservoir
Chico
Stony Gorge Reservoir
Lake Oroville
East Park Reservoir
New Bullards Bar Reservoir
Indian Valley Reservoir
Clear Lake
Camp Far West Reservoir
Folsom Lake
Lake Berryessa
Sacramento
LEGEND
Water demand change:
range with climate change
without climate change
0 baseline= Average historical demand (1998-2005)
Water Demand Change (million acre-feet per year)
Current Trend
Strategic Growth
Expansive Growth

Rebuttable presumptions

- **Even simple approach could drastically improve decision making**
- **Must prioritize areas for analysis and for simplification**
- **Must include avoided water costs**
  - To fully reflect true regional benefits
  - To address compliance and revenue for water utilities

PROPOSED METHODOLOGY

Water Avoided Costs: Basic Approach

+ Follow the lead of electricity avoided costs:

- Use costs representative of alternative, base-case investments
- Changes the paradigm from EM&V, backwards-looking accounting paradigm to forward-looking planning paradigm
- Establish accepted methodologies first and then allow for continuous improvement as public data becomes available and is refined
- Spatial and temporal resolution/granularity involves compromise: simplify when necessary in order to make the analysis tractable

+ Leverages existing studies!

Proposed Methodology: Fundamental Choices

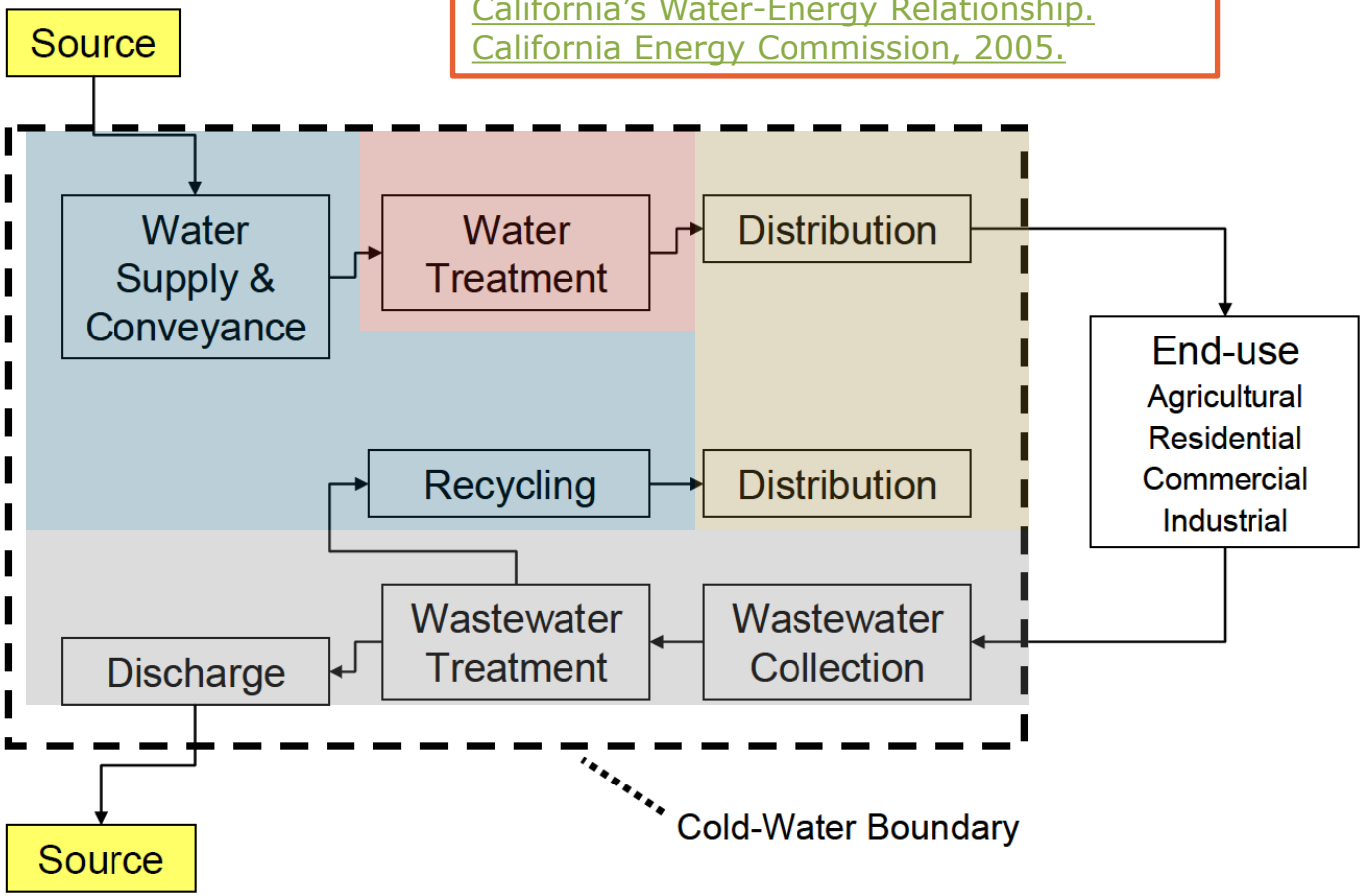
- **Initial tasks in developing methodology are similar to those for energy avoided costs:**
  - Determine appropriate financial convention to represent avoided costs of each stage of water supply cycle
  - Determine geographic granularity needed to provide reasonable representation for each stage
  - Determine the needed temporal resolution
  - Seek available public sources of data and support for analytical decisions

What Are Potential Avoided Costs for Water?

- **Avoided costs for water would incorporate avoided costs found in the following water supply stages, not incorporated into current planning frameworks:**
  - Water Supply
  - Water Treatment
  - Water Distribution
  - Wastewater Treatment
- **Avoided capacity costs**
  - Avoided capital investments required to meet supply needs
- **Avoided embedded energy costs**
- **Avoided non-energy operating costs**
  - Variable non-energy operating costs (i.e. pump maintenance, treatment chemicals, etc.)

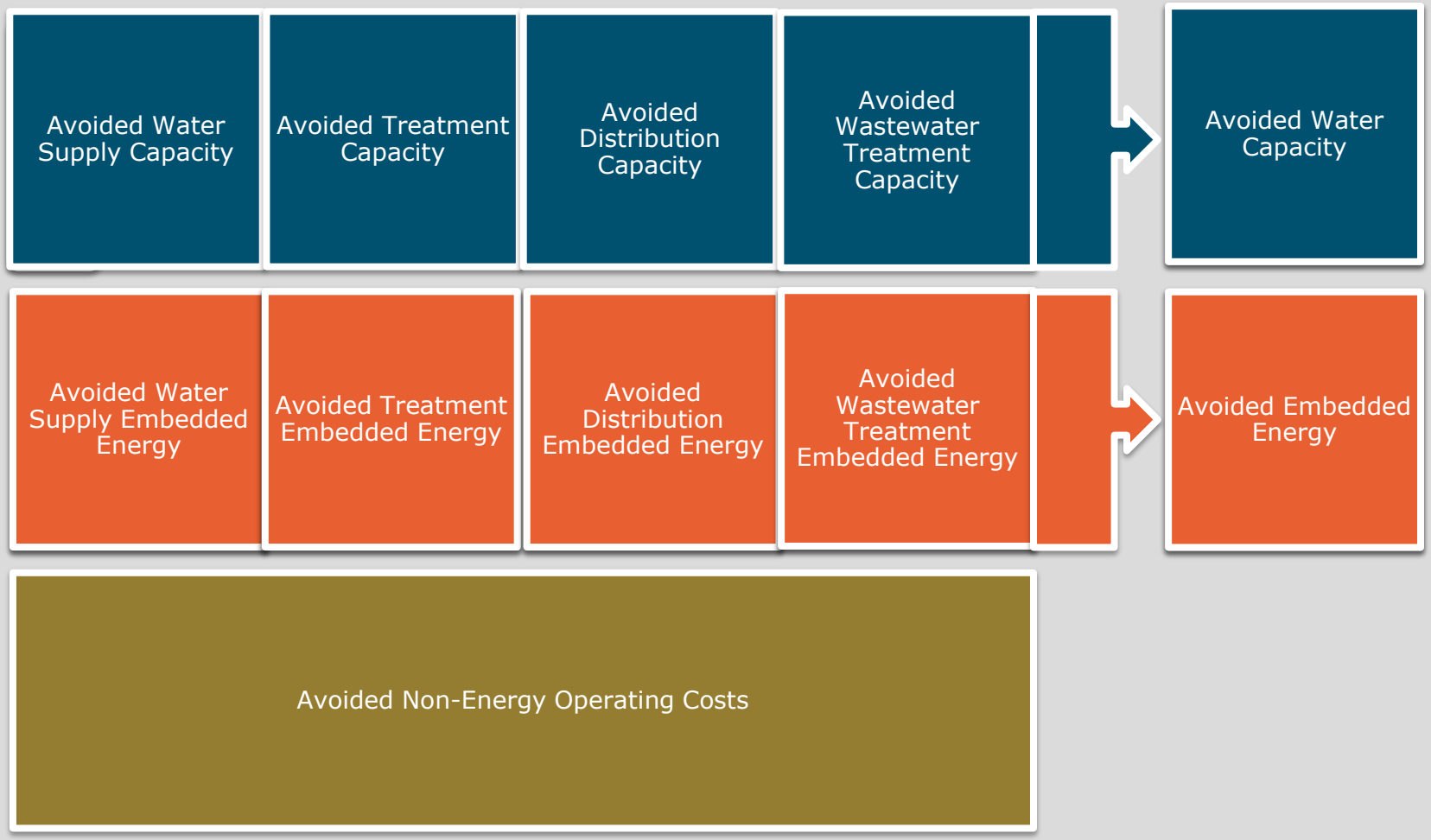
Water Supply Stages Definition

California's Water-Energy Relationship.
California Energy Commission, 2005.

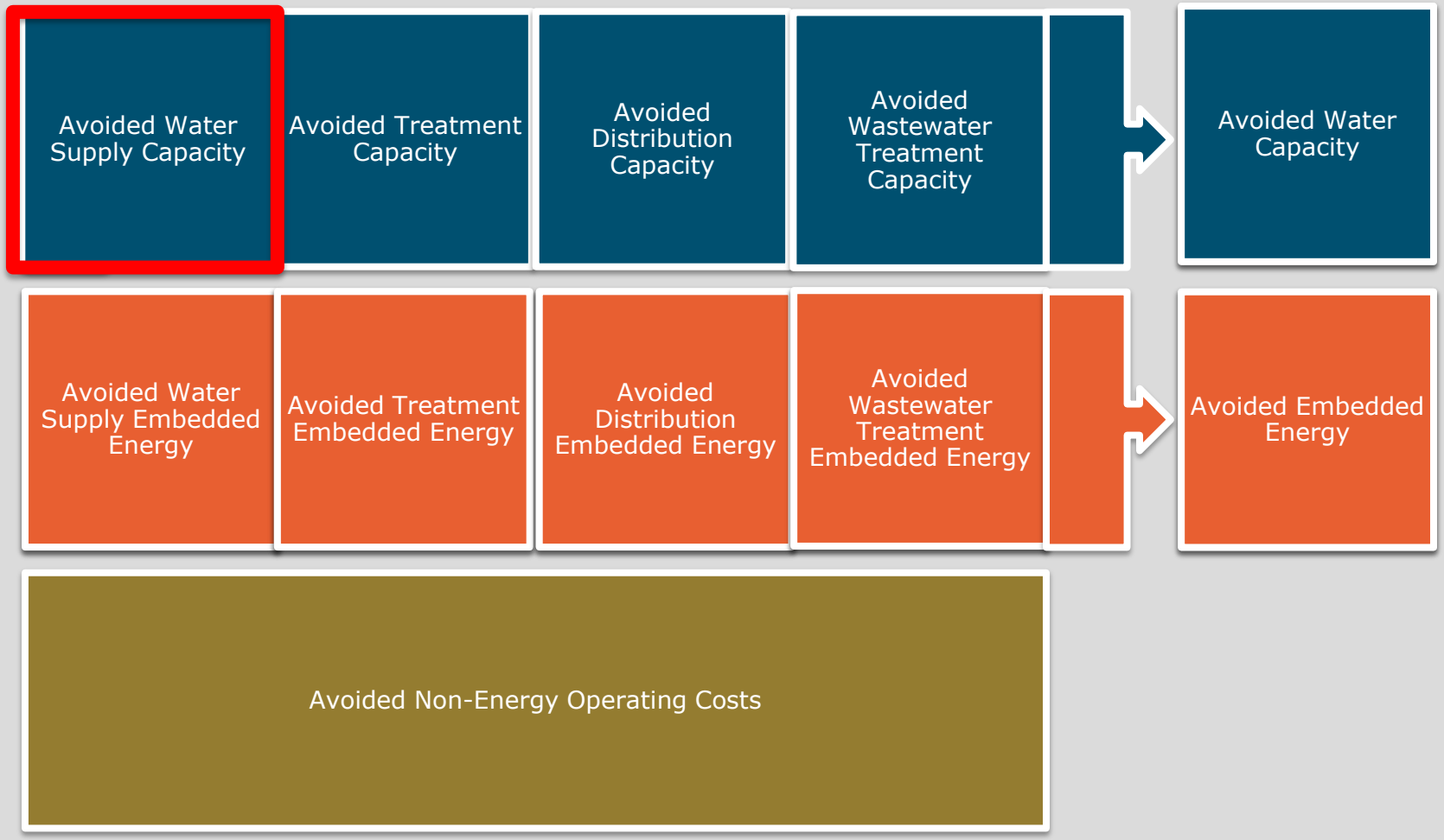


Water Supply	Water Treatment	Water Distribution	Wastewater Treatment

Avoided Water Cost Framework

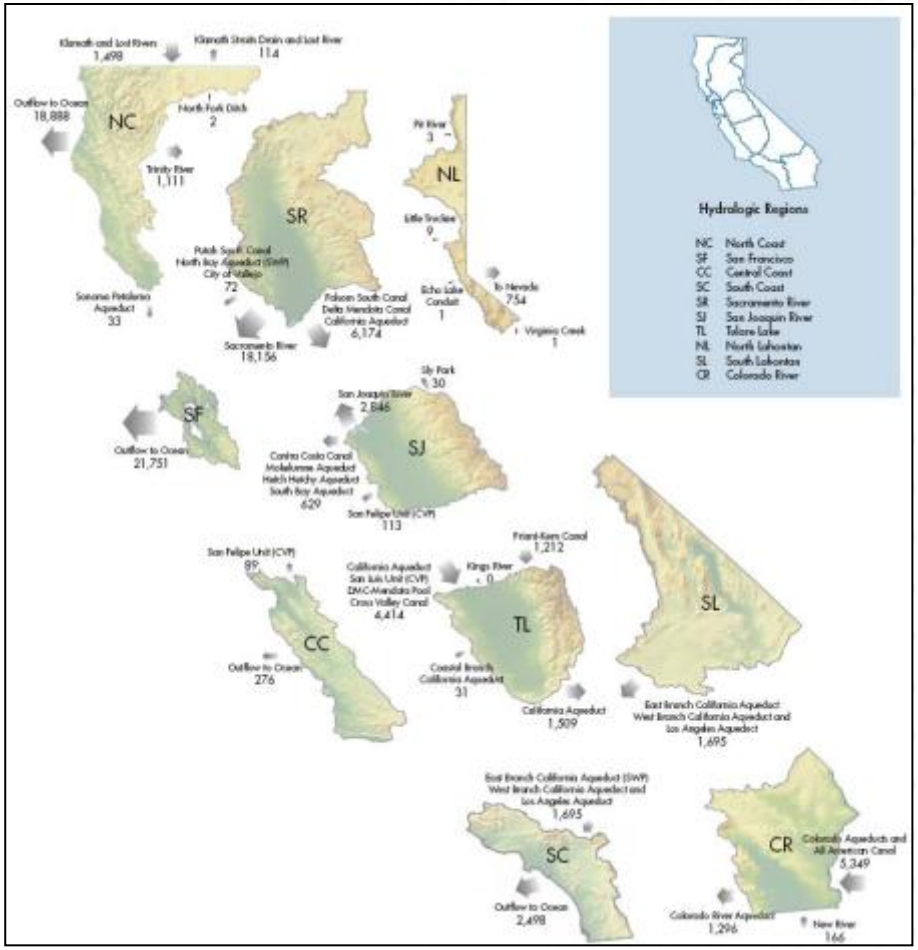


Avoided Water Cost Framework



Avoided Water Supply Capacity

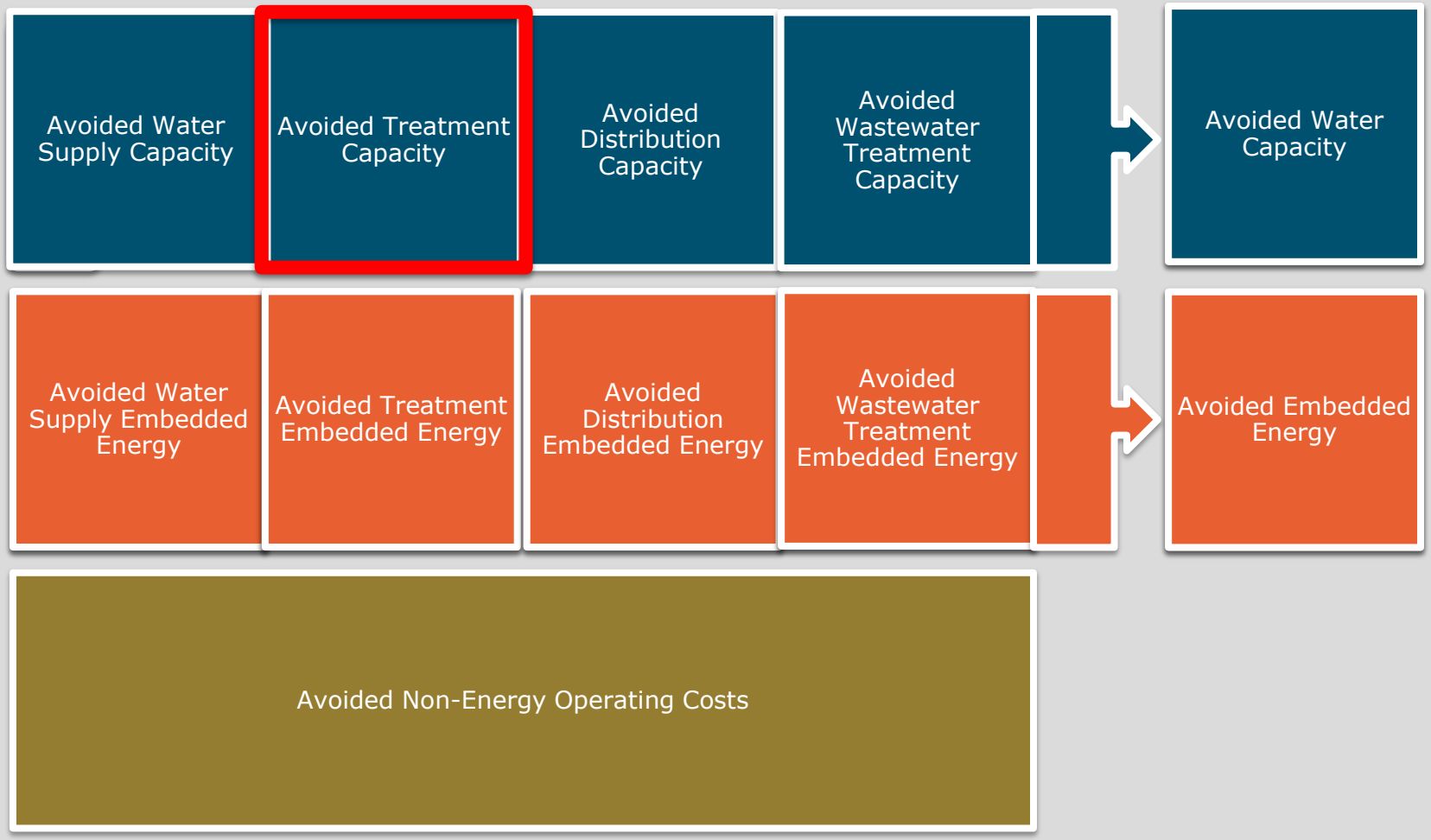
- **Previous water/energy studies have focused primarily on average water/energy supply issues**
- **Significant differences on a sub-regional scale in terms of average water supply due to:**
  - Historical water rights
  - Development history
  - Local geography/water resources
- **Avoided water costs require marginal analysis similar to electricity avoided costs**
- **Marginal avoided water supplies have reasonable uniformity on a regional basis**
  - Simplifies analytical challenge
  - Initial recommendation: hydrologic regions



Avoided Water Supply Capacity

- **Regional marginal supplies composed primarily of:**
  - Seawater desalination
  - Brackish desalination
  - Reclaimed water (potable or non-potable reuse)
  - New groundwater extraction (regionally limited)
- **Develop capital cost and financing estimates**
- **Determine base case investment based on demand projections**
- **Use either the present worth method or carrying cost method to calculate the value of avoiding investment ($/MGD-year)**
- **Allocate annual avoided cost by month**
- **Analogous to methods used in electric avoided costs for T&D or system capacity**

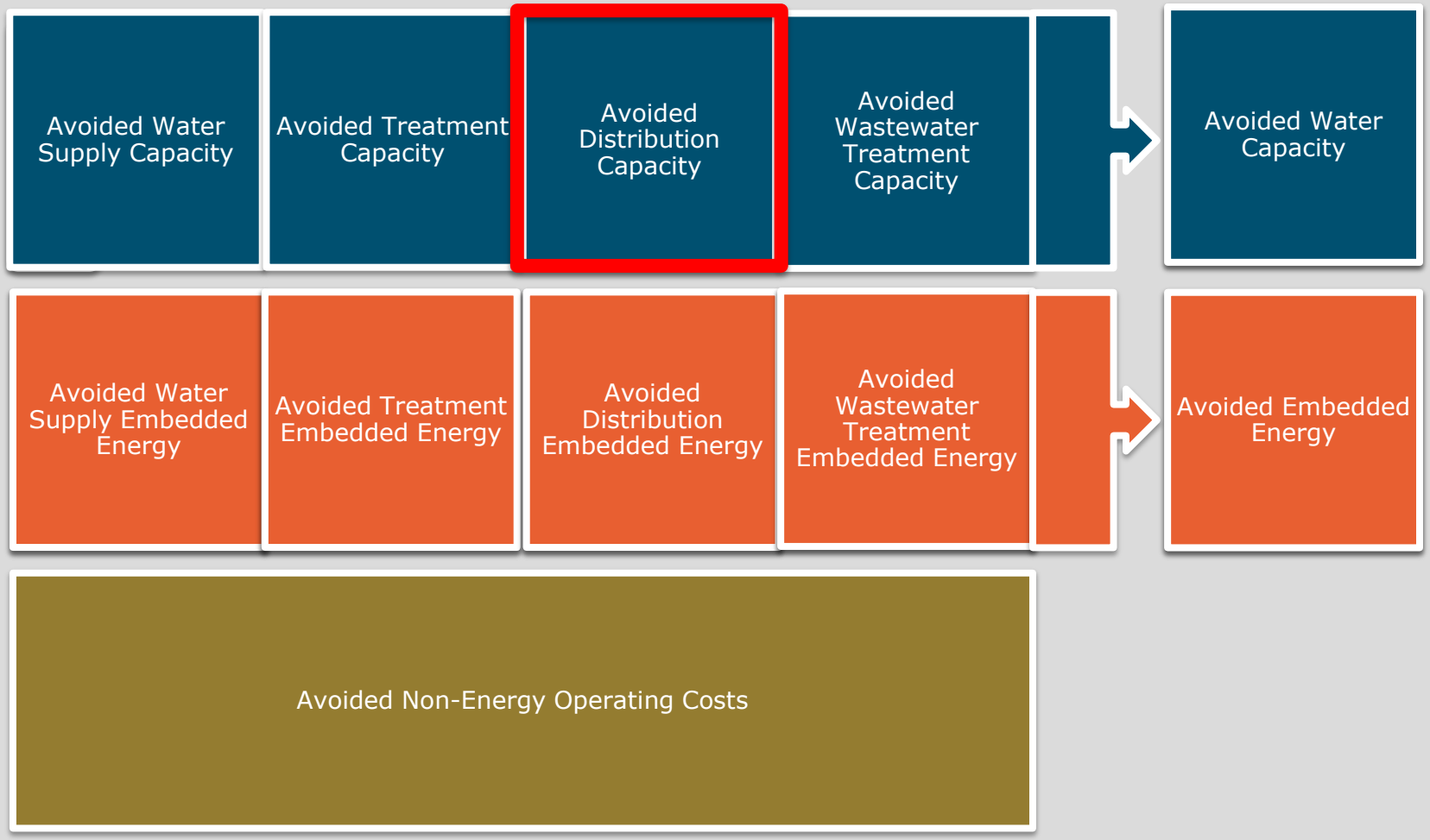
Avoided Water Cost Framework



Avoided Treatment Capacity

- **Treatment needs are based on marginal supply projections**
- **Estimate capital costs of water treatment capacity investments**
  - E.g EPA Drinking Water Investment Needs Survey and Assessment
- **Develop $/MGD-year fixed cost estimates for treatment technologies**
- **Allocate annual avoided cost by month**
- **Analogous to system capacity convention in electricity avoided costs ($/kW-year)**

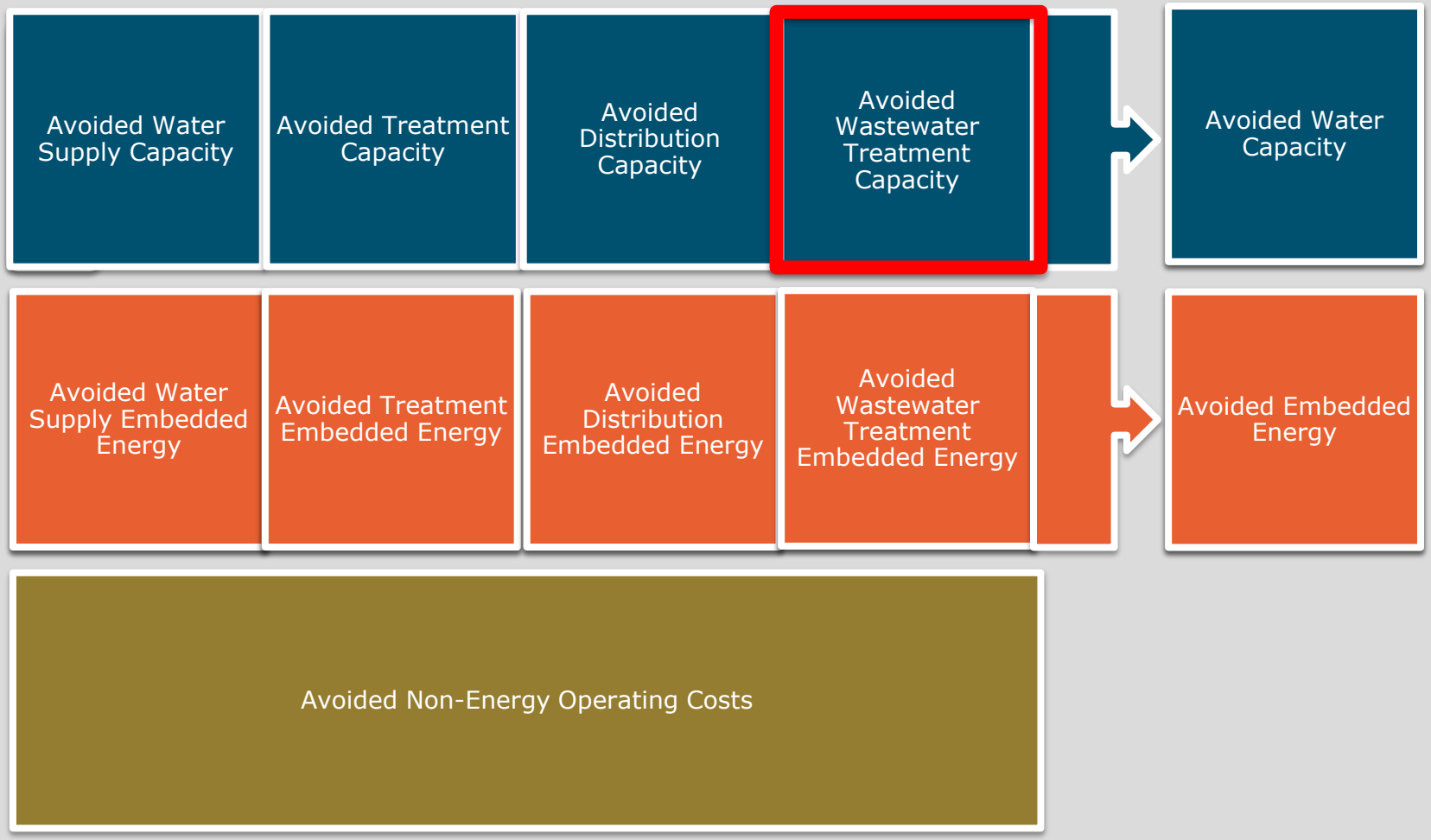
Avoided Water Cost Framework



Avoided Distribution Capacity

- **Use investment plans of water utilities to identify growth-driven distribution investments**
  - Water main upgrades
  - Local storage projects
  - Local pumping stations (booster pumps, etc.)
- **Deferral values a function of peak demand projections**
  - Costs are utility-specific but higher level of aggregation needed
- **Allocate annual deferral value by month**
- **Analogous to electric T&D avoided costs**

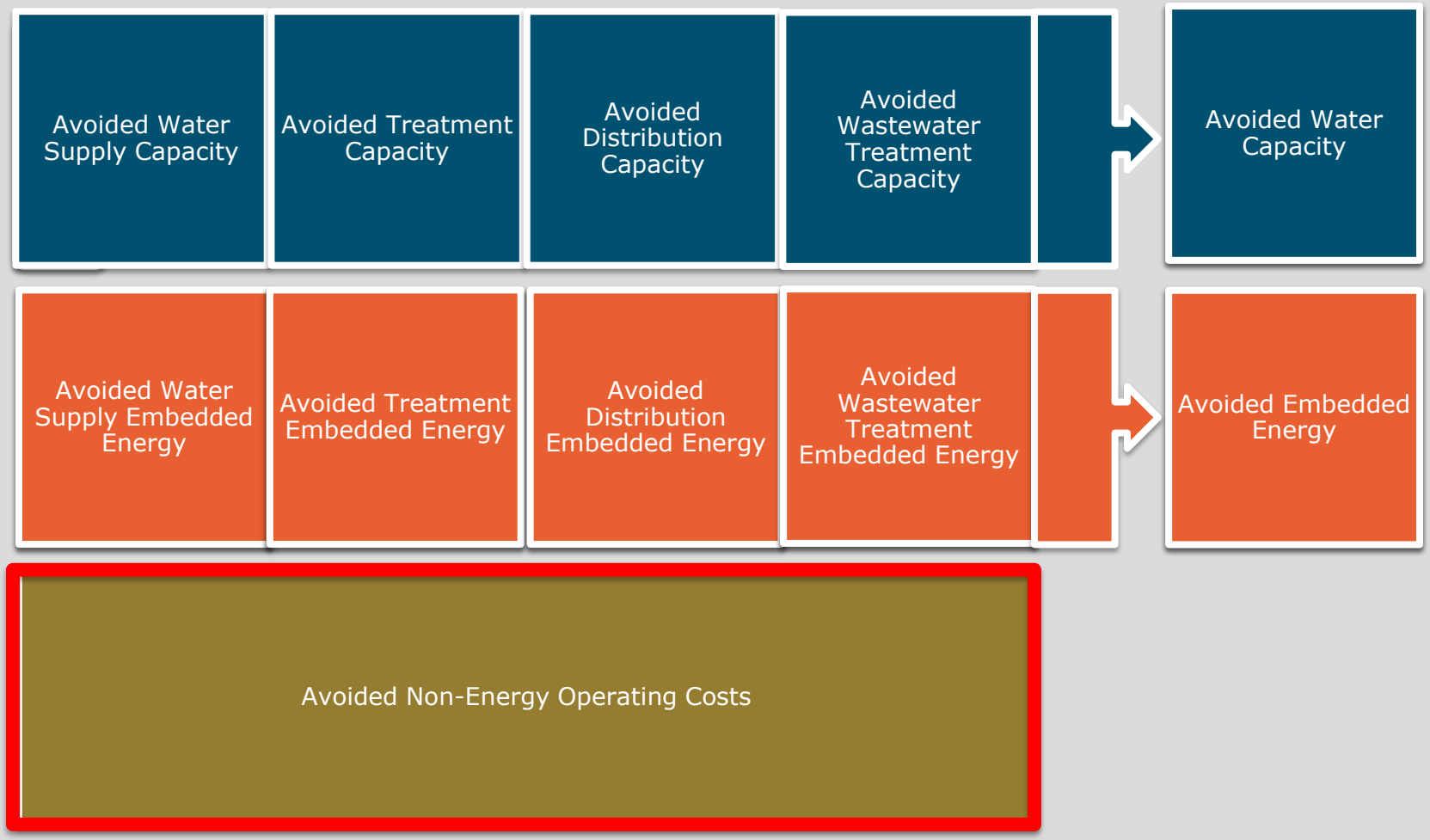
Avoided Water Cost Framework



Avoided Wastewater Treatment Capacity

- **Similar methodology to avoided treatment capacity**
- **Key differences:**
  - Most wastewater capacity needs are driven by storm water
  - Need to determine water use that affects wastewater capacity needs
- **Determine marginal wastewater treatment technologies by region**
  - Might need to use representative "industry standard"
- **Develop $/MGD-year fixed cost estimates for treatment technologies**
- **Allocate annual avoided cost by month**
- **Analogous to system capacity convention in electricity avoided costs ($/kW-year)**

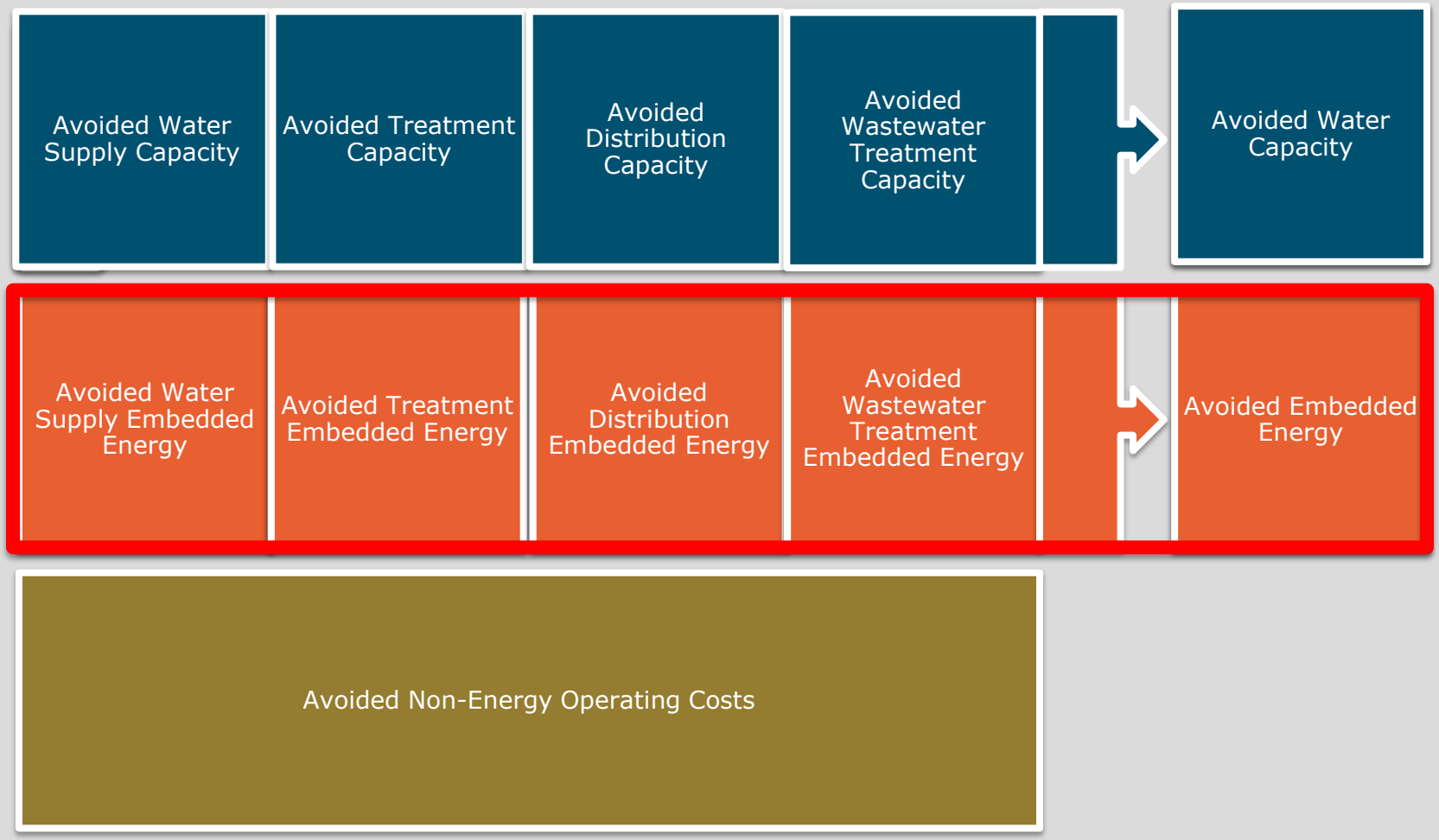
Avoided Water Cost Framework



Avoided Non-Energy Operating Cost

- **Use public sources to determine avoided operations and maintenance costs for each water supply stage**
  - Ex. Non-energy operating costs for seawater desalination can be almost 50% of total operating costs
  - Water and wastewater treatment chemicals

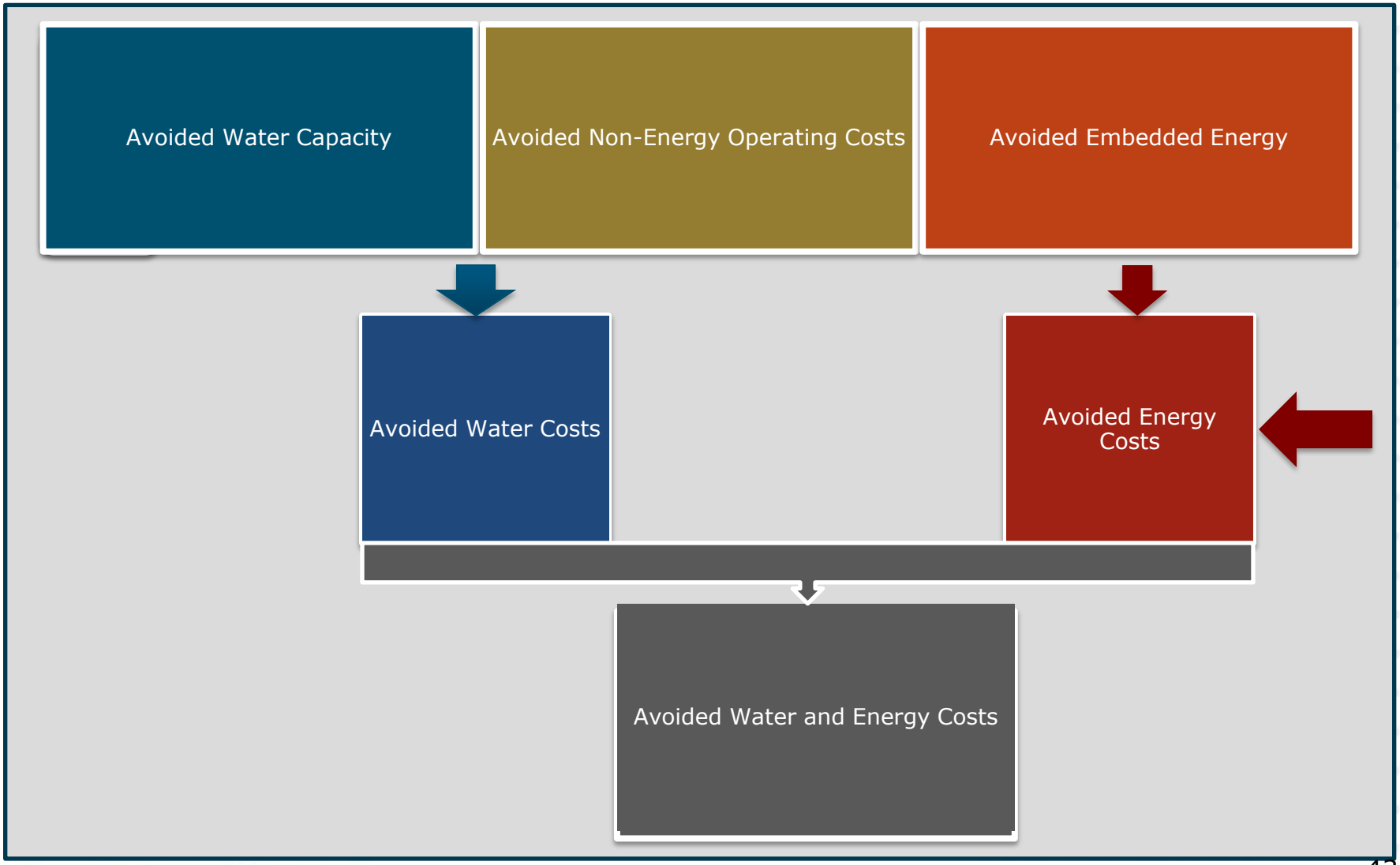
Avoided Water Cost Framework



Long-run marginal approach simplifies embedded energy

- **Previous studies have addressed complications inherent in existing water supply**
  - Complicated surface withdrawals, water rights, conveyance allocations
  - Diversity in water quality requiring different treatment technologies
  - Calculating the energy is complicated with large-scale conveyance
- **Embedded energy becomes a function of discrete marginal supply resources and treatment technologies (MWh or MMBTU/AF)**
  - Marginal energy intensity of avoided marginal supplies
  - Marginal energy intensity of avoided treatment
  - Marginal intensity of distribution
  - Marginal energy intensity of avoided wastewater treatment

Avoided Cost Integration



Conclusion

- **Developing an avoided cost framework in water is possible**
  - Requires stakeholder input on key analytical decisions
- **Will allow for rationalized cross-sector planning and efficiency investment**
- **Marginal approach avoids challenges of previous embedded energy and water studies**
- **Integrated avoided cost framework would allow for the calculation of TRC benefits**
  - Avoided costs of water represent necessary first step

Energy+Environmental Economics

Thank You!

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Public Sources

- 2013 State Water Plan Update
- 2010 Urban Water Management Plans
- Integrated Regional Water Management (IRWM) Reports
- EPA Drinking Water Needs Assessment Survey: Cost Model
- CPUC Embedded Energy in Water Studies
- CPUC General Rate Case Applications

Stakeholder benefits

	Concerns	Benefits
Electric	• Reliability • Siting • Once-through cooling • Achieve EE, GHG goals	• Better risk assessment • Feasible mitigation options • Increased potential savings
Water	• Regulatory compliance • Access to capital • Rate increases • Limited resources • Supply reliability	• Facilitate external funding • Cost savings/revenues • External resources • Investment deferral
Regulator	• Institutional barriers to rational decision making • Achieving GHG goals • Resource management	• GHG reduction potential • Rational, integrated resource planning