Energy Division Staff Proposal for a Water/Energy Cost-Effectiveness Framework

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Purpose of Workshop

- Commission Guidance Decision (May 2012)
  - directed staff to develop a method for analyzing cost effectiveness of programs/measures that save energy by saving water
  - directed energy utilities to implement water/energy efficiency programs
    - These programs cannot be fully evaluated using adopted Standard Practice Manual (SPM) analysis
- Stakeholders have asked for a method to evaluate potential partnership opportunities between energy utilities and water agencies

The *Standard Practice Manual* (SPM)

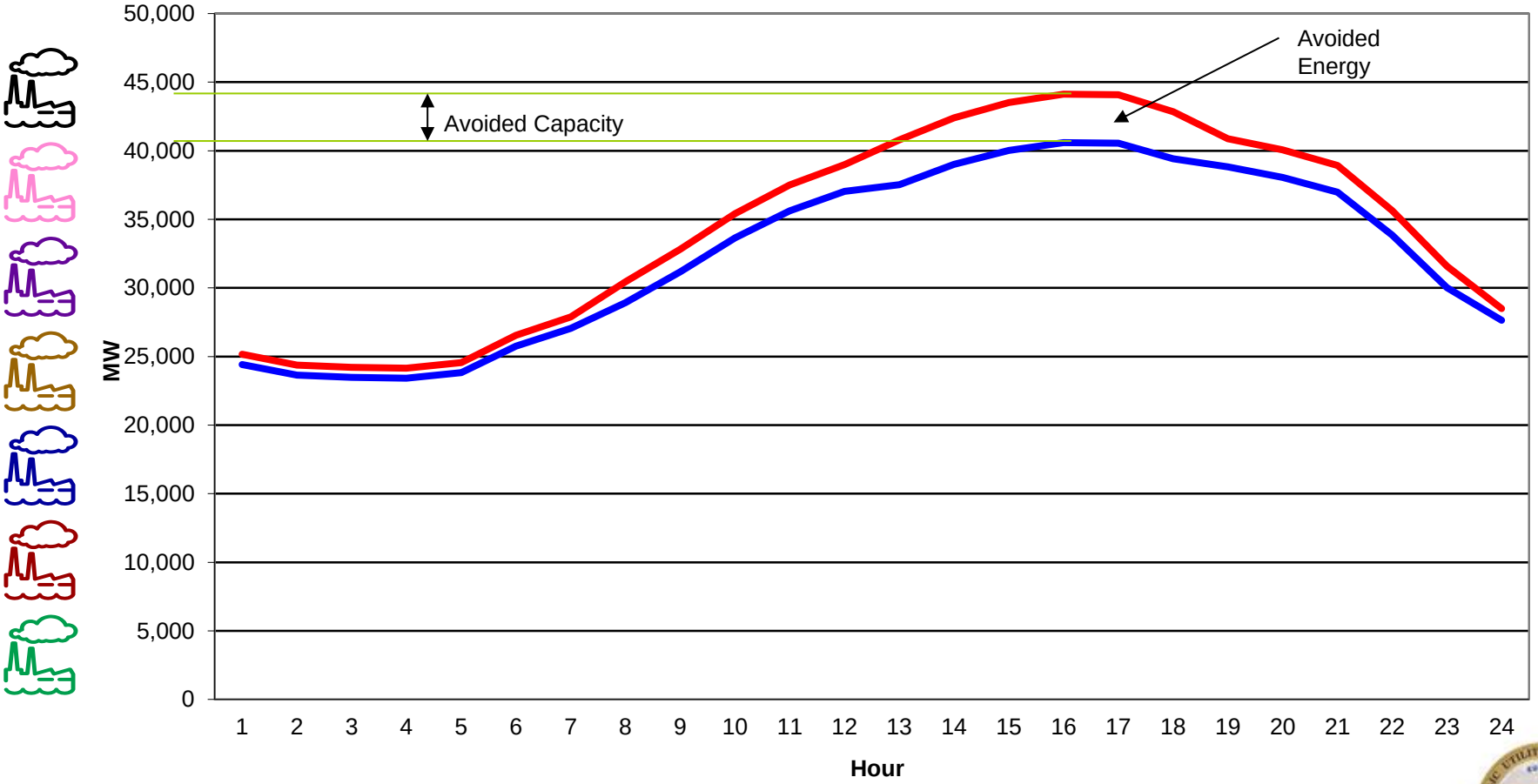
- Developed to measure the cost-effectiveness of Energy Efficiency programs
- Four tests to measure cost-effectiveness from four different perspectives:
  - *Society*: The Total Resource Cost (TRC) test

    "Society" defined as Utility + Participant
  - *Administrator*: The Program Administrator (PAC) test
  - *Ratepayers*: The Ratepayer Impact Measure (RIM) test
  - *Participant*: The Participant Test

The SPM also describes the "Societal Cost Test," a variant of the TRC that includes externalities and uses a social discount rate.

What is an Avoided Cost?

Energy Efficiency Impact on Electricity Demand



Original Load (hottest day of the year) — Reduced Load due to Energy Efficiency

Example of previous SPM test modifications

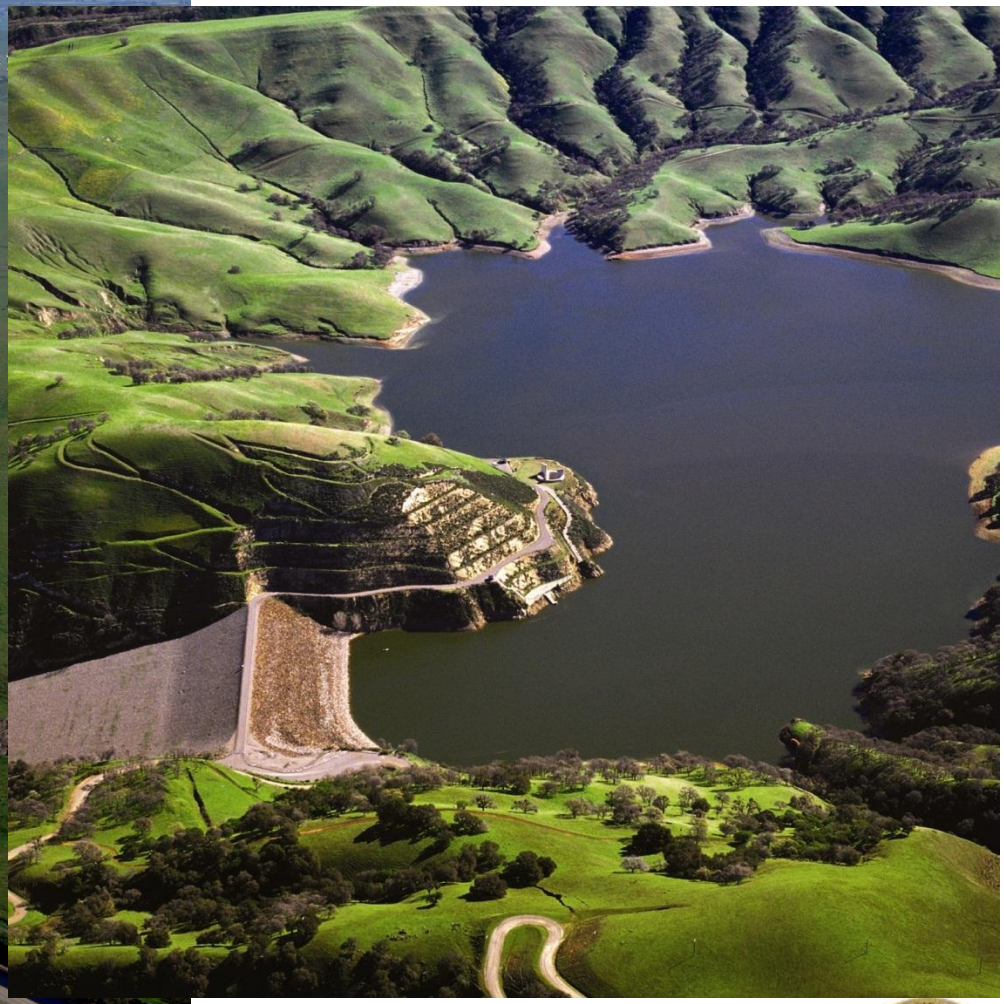
	EE/DG TRC	EE/DG PAC	DR TRC	DR PAC	RIM	DR Participant	ESAP TRC	ESAP MPT (participant)	ESAP UCT
Administrative costs	COST	COST	COST	COST	COST		COST	COST	COST
Avoided costs of supplying electricity	BENEFIT	BENEFIT	BENEFIT	BENEFIT	BENEFIT		BENEFIT		BENEFIT
Bill Increases						COST			
Bill Reductions						BENEFIT		BENEFIT	
CAISO Market Revenue			BENEFIT	BENEFIT	BENEFIT				
Capital costs to participant	COST		COST			COST			
Capital costs to utility	COST	COST	COST	COST	COST		COST	COST	COST
Environmental benefits (GHG only)	BENEFIT	BENEFIT	BENEFIT	BENEFIT	BENEFIT		BENEFIT		BENEFIT
Incentives paid		COST		COST	COST	BENEFIT			
Increased supply costs	COST	COST	COST	COST	COST				
Market benefits			BENEFIT	BENEFIT	BENEFIT				
Non-monetary/Non-energy benefits			*BENEFIT*			*BENEFIT*		*BENEFIT*	*BENEFIT*
Revenue gain from increased sales					BENEFIT				
Revenue loss from reduced sales					COST				
Tax Credits	BENEFIT		BENEFIT			BENEFIT			
Value of service lost and transaction costs to participant			COST			COST			

MEASURE

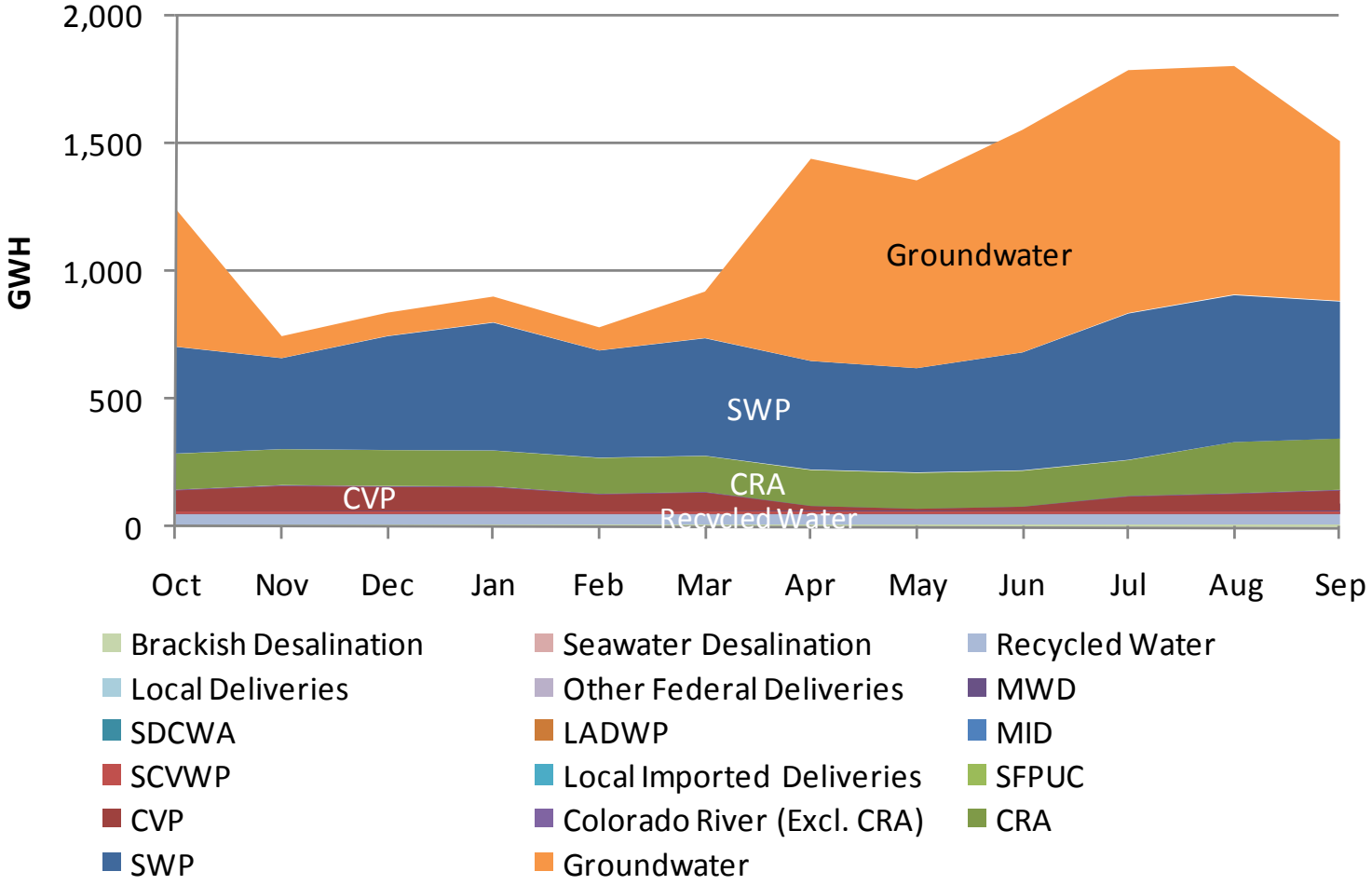
Blue text indicates optional, hard-to-quantify benefits. (DR only)

Italic text indicates that value may be different for different tests.

Green text indicates values that are often considered to be externalities.



2010 Baseline Monthly Energy Profiles of Statewide Water Delivery Operations



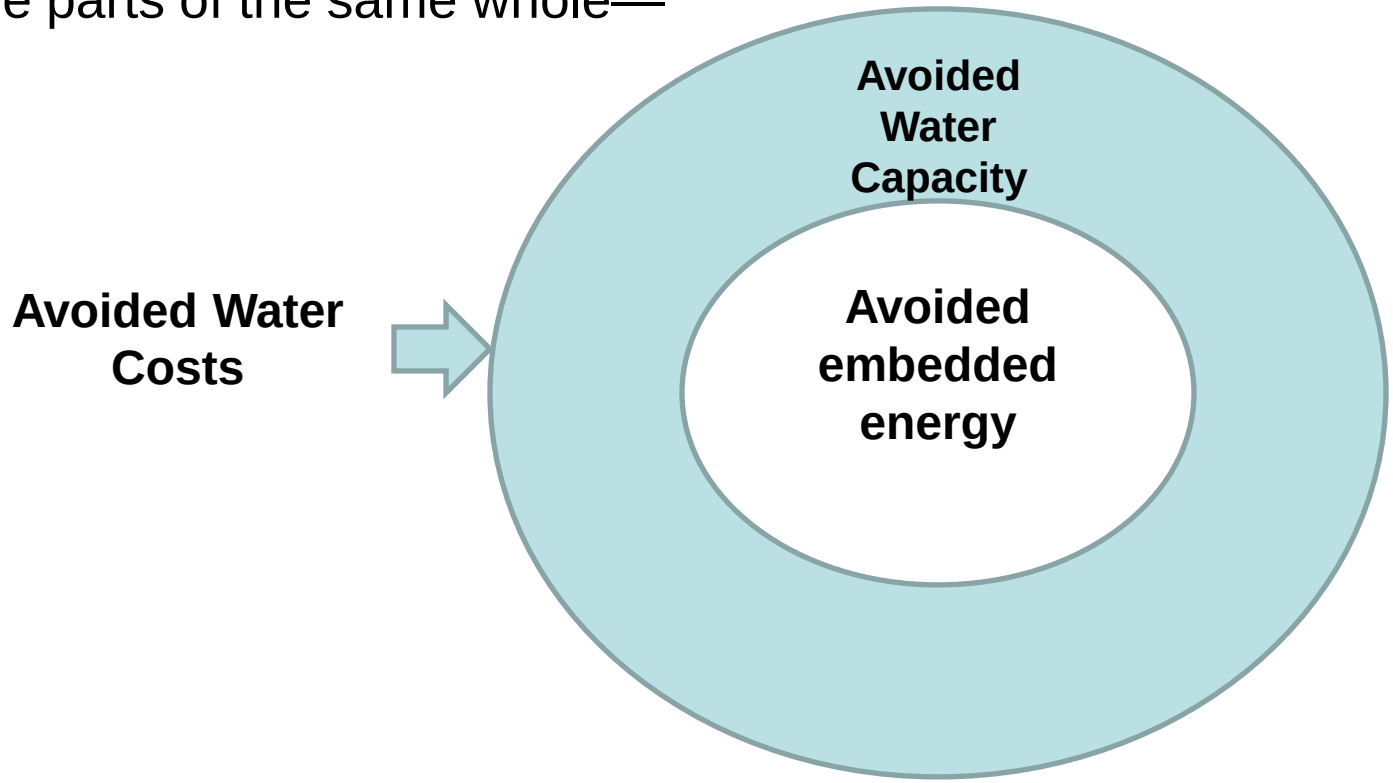
Source: Embedded Energy in Water Studies: Study 1: Statewide and Regional Water-Energy

Main challenge: Identify “missing” benefits and determine method for valuation

Benefits from projects that save water and energy but are not captured in current tests: the overall avoided cost of the water that would otherwise be supplied, delivered, treated, etc., *but for the project’s savings.*

Avoided water cost/ Avoided embedded energy

They are parts of the same whole—

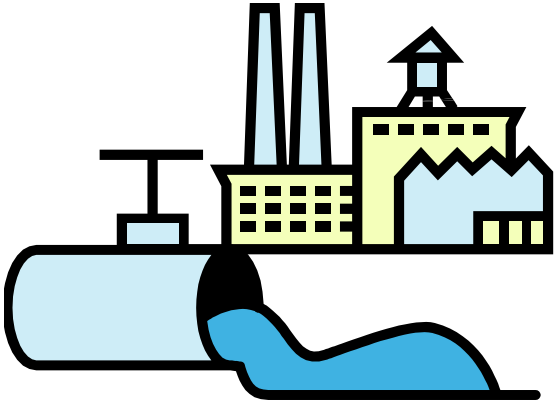


….But we may need to separate them to evaluate them

Task: Define Avoided Costs

Avoided Water Costs =
Avoided water capacity costs + Avoided embedded energy costs

Avoided water capacity costs are analogous to avoided energy capacity costs (generation, transmission, distribution)



Avoided water capacity costs are capital expenditures which include:

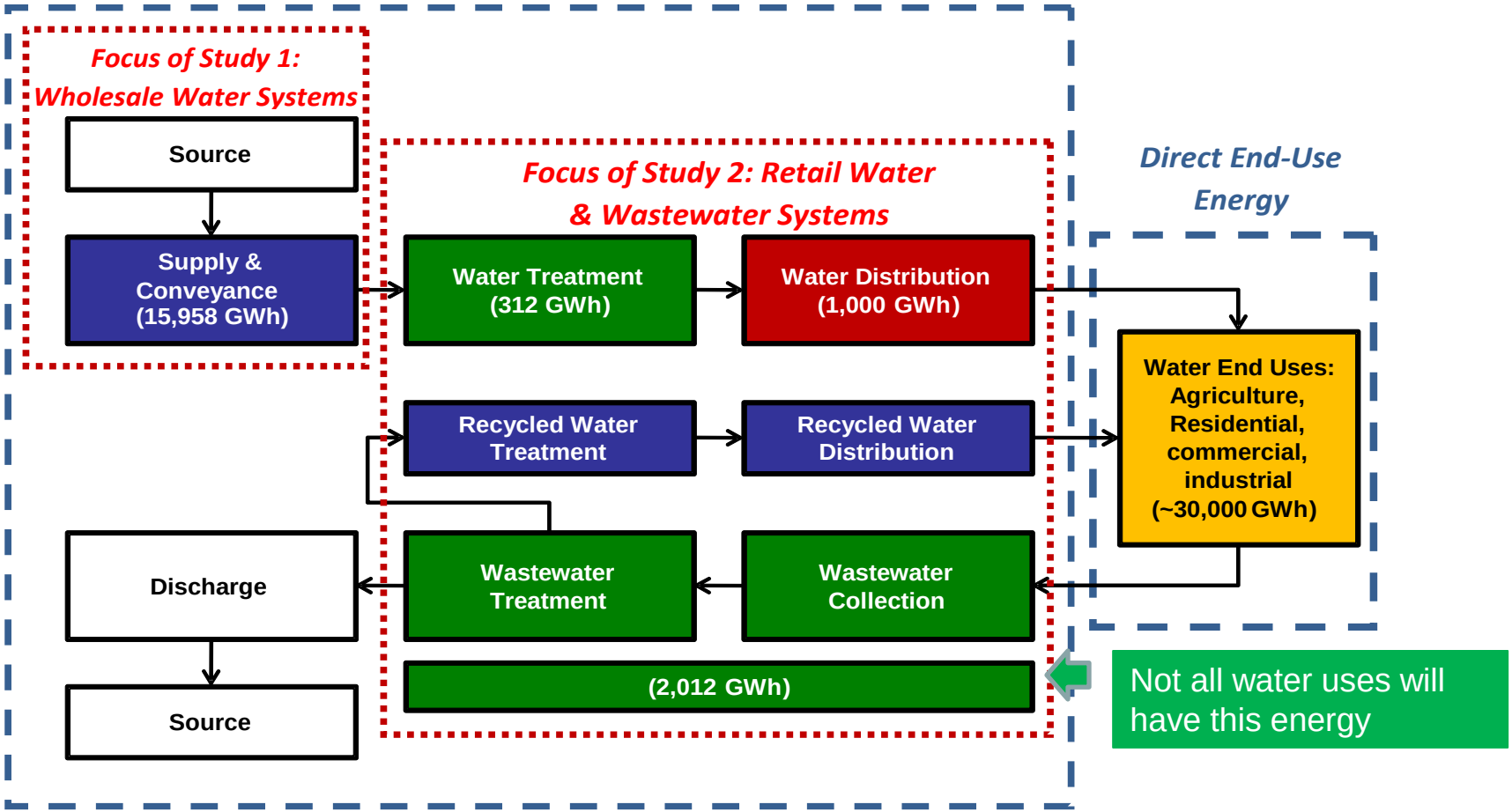
- Avoided purchase of next (marginal) water supply (based on regions)
- Avoided costs of water conveyance, treatment and distribution (building new plants, etc.)
- May be regional values, some are uniform throughout the state

What is Embedded Energy in Water?

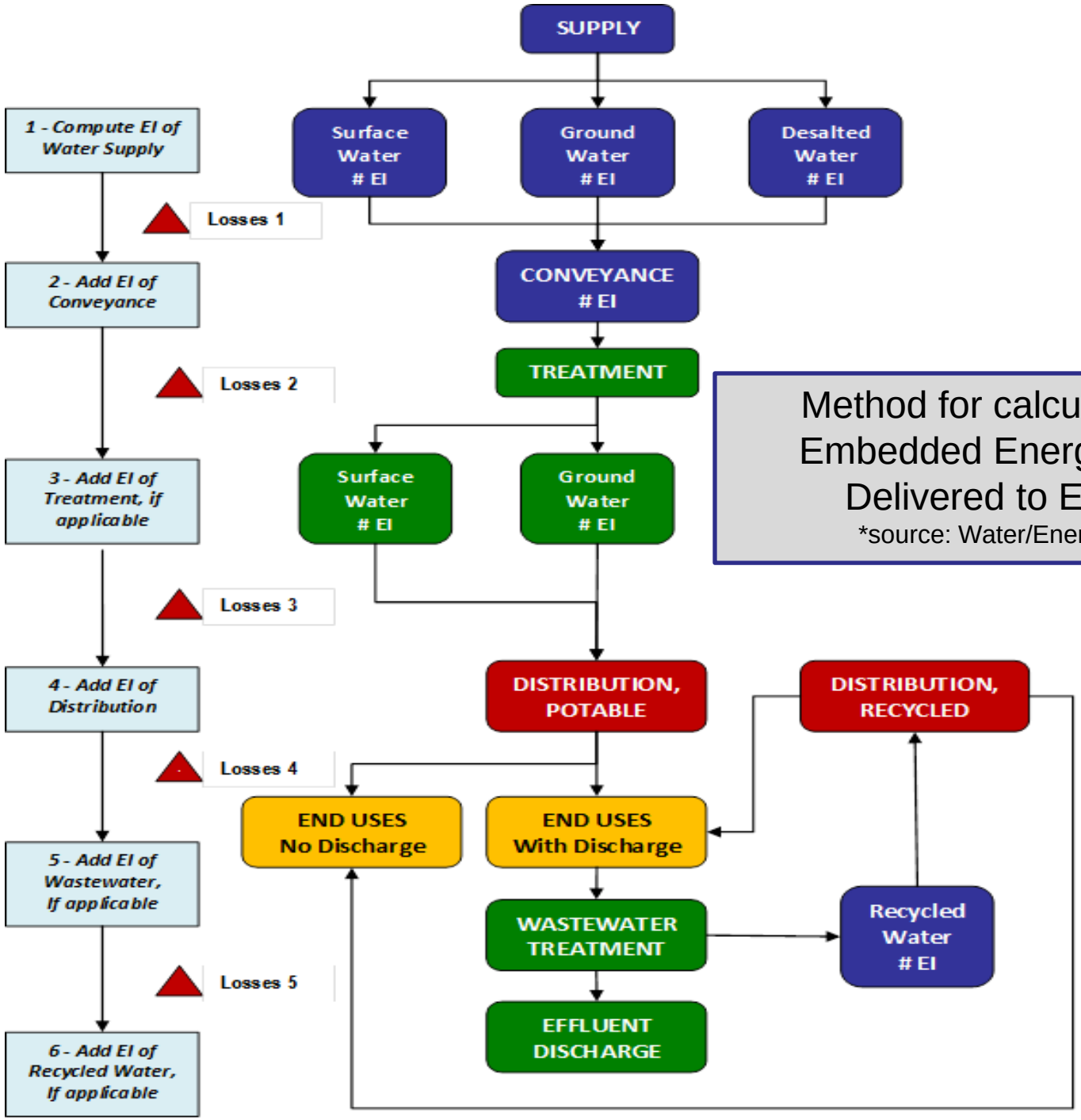
The amount of energy (in kWh) needed to supply, move, and treat water (in million gallons (MG) or acre/ft.) delivered to a user,
and to treat the water post-use (if necessary)

Source: CPUC Water/Energy Studies 1&2

"Embedded" Energy (Upstream & Downstream of End Use) = Direct Energy Use by Water & Wastewater Agencies



So, embedded energy depends on the point of use and the type of use



Method for calculating Total Embedded Energy in Water Delivered to End-User

*source: Water/Energy Study 2

Summer and Winter Ranges of Energy Intensity for water agencies, by IOU (kWh/MG)

	PG&E		SCE		SDG&E	
	Range of Summer Averages	Range of Winter Averages	Range of Summer Averages	Range of Winter Averages	Range of Summer Averages	Range of Winter Averages
Raw Water Pumps	5 - 1104	1 - 1213	28	40	-	-
Groundwater Pumps	906 - 2437	1019 - 2924	1574 - 2542	1416 - 2652	1824	1415
Filter Plants	134 - 272	168 - 718	-	-	46	66
Booster Pumps	379 - 1116	518 - 1000	82 - 1262	45 - 1321	168 - 1357	196 - 1574
Pressure Regulators	1780	2569	-	-	360	374
Waste Water Pumps	256 - 256	275 - 275	3 - 231	4 - 259	455	430
Wastewater Treatment Plant	1072 - 1452	1622 - 2165	1146 - 3410	488 - 3398	1087	1086
Recycled Water Pumps	1050	1505	1024	796	-	-

Avoided Costs of Embedded Energy

- *Calculated* embedded energy = actual energy used to supply, move and treat water delivered from its source to a customer

- *Estimated* avoided cost of embedded energy: value of energy savings that result from conserving water

For Cost-Effectiveness analysis, you must first know the *total* avoided embedded energy

- To calculate embedded energy from an IOU ratepayer perspective we must ask: who provided the embedded energy that was saved?

How to Calculate Embedded Energy Avoided Costs?

Options:

- based on actual energy use in water deliveries from all upstream water deliveries to customer and all downstream energy uses

OR

- use proxy values based on assumptions of energy intensity of next available water source, and delivery of this source to customer

OR

- Localize avoided energy costs to only include distribution, treatment, and groundwater pumping

OR

???

Proposal: 4-Part Total Resource Cost Test

A: “Energy” TRC Test (electric utility perspective)

B: “Water” TRC Test (water agency perspective)

C: “Combined” Water/ Energy TRC Test

(perspective of both agencies together)

D: “Societal” TRC Test for Water/Energy

(perspective of society as a whole)

	TRC\				PAC			RIM		Participant	
	Energy	**Water**	**Both**	**Societal**	**Energy**	**Water**	**Both**	**Energy**	**Water**	**End-User**	**Water Agency**
Administrative costs to energy utility	COST		COST	COST	COST		COST	COST			
Administrative costs to water agency		COST	COST	COST		COST	COST		COST		COST
Avoided costs of supplying electricity	BENEFIT		BENEFIT	BENEFIT	BENEFIT		BENEFIT	BENEFIT			
Avoided costs of water capacity		BENEFIT	BENEFIT	BENEFIT		BENEFIT	BENEFIT		BENEFIT		BENEFIT
Avoided embedded utility energy in water	BENEFIT	BENEFIT	BENEFIT	BENEFIT	BENEFIT	BENEFIT	BENEFIT	BENEFIT	BENEFIT		BENEFIT
Avoided embedded additional energy in water		BENEFIT	BENEFIT	BENEFIT		BENEFIT	BENEFIT		BENEFIT		BENEFIT
Avoided embedded water in energy*		BENEFIT	BENEFIT	BENEFIT		BENEFIT	BENEFIT		BENEFIT		
Energy and Water Bill Reductions										BENEFIT	BENEFIT
Capital (measure) costs to participant	COST	COST	COST	COST						COST	COST
Capital (measure) costs to energy utility	COST		COST	COST	COST		COST	COST			
Capital (measure) costs to water utility		COST	COST	COST	COST		COST		COST		
Incentives paid by energy utility					COST		COST	COST		BENEFIT	BENEFIT
Incentives paid by water utility						COST	COST		COST	BENEFIT	
Increased supply costs	COST	COST	COST	COST	COST	COST	COST	COST	COST		
Revenue loss from reduced energy sales								COST			
Revenue loss from reduced water sales									COST		
Tax Credits	BENEFIT	BENEFIT	BENEFIT	?						BENEFIT	BENEFIT

*This benefit would only be included in the unlikely event that the water agency was supplying water to the electric utility.

A:“Energy Only” TRC for Water/Energy

- **Costs=** admin cost to electric/gas IOU + equipment (measure) cost
- **Benefits=** avoided cost of energy (from direct energy savings, to the IOU) + avoided cost of embedded IOU energy

Example: SunnyCA rebate program for new high efficiency commercial washing machines

Incentive is offered by an electric IOU, SunnyCA to end user, Beverly Hilzton, to install a new type of washing machine that reduces energy consumption AND uses less water than the average model.

- Assume: SunnyCA electricity used to distribute/treat water that WaterCA delivered to the Beverly Hilzton

- Costs: admin cost to SunnyCA + measure cost (equipment cost)
- Benefits: avoided cost from direct energy savings (SunnyCA and Hilzton) + avoided cost from embedded energy savings (attributable to water savings)

B: Water Only TRC for Water/Energy

- Costs = admin cost to water agency + equipment cost (for H2O saving measure-paid by water agency and water end user)
- Benefits = avoided cost of water supply + avoided energy costs (from reduction in distribution, treatment, etc)

C: Combined Water/Energy TRC

- Costs = [admin costs to electric + gas+ water utilities] + equipment (measure) costs
- Benefits = avoided costs of water capacity, avoided cost of IOU embedded energy in water (direct energy savings to water agency), avoided cost of non-IOU embedded energy in water*

*only if not fully captured in avoided water capacity costs

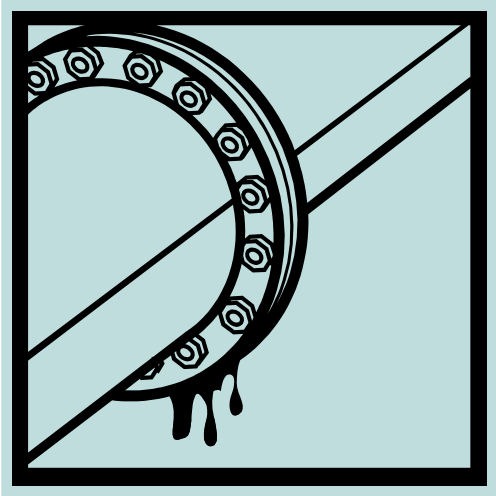
Water/Energy Combined Example

Example: NorCal Gas&Electric (NCG&E/ Bay Area Municipal Utility District (BAMUD) partnership

- Jointly implement a leak/loss detection and repair program
- How to determine cost sharing between ratepayers?
- Costs= admin cost to NCG&E + admin cost to BAMUD + equipment costs (for detection, repair, replacement)
- Benefits= avoided costs of NCG&E energy embedded in water + avoided cost of additional energy + avoided cost of water capacity over the expected lifetime

Benefit to both NCG&E and BAMUD ratepayers

Benefit to BAMUD ratepayers



NorCal Gas&Electric (NCG&E/ Bay Area Municipal Utility District (BAMUD) partnership program cont….

Avoided embedded energy costs:

- Benefit to NCG&E ratepayers = avoided cost of electricity otherwise provided by NCG&E to treat and pump lost water through BAMUD's system
- Benefit to BAMUD ratepayers: cost savings from avoided energy purchases

Potential Calculation:

expected water savings (MG) **x** avg. kWh/MG for H_2O delivery*

* this will not include wastewater treatment values, as lost water does not need post-treatment

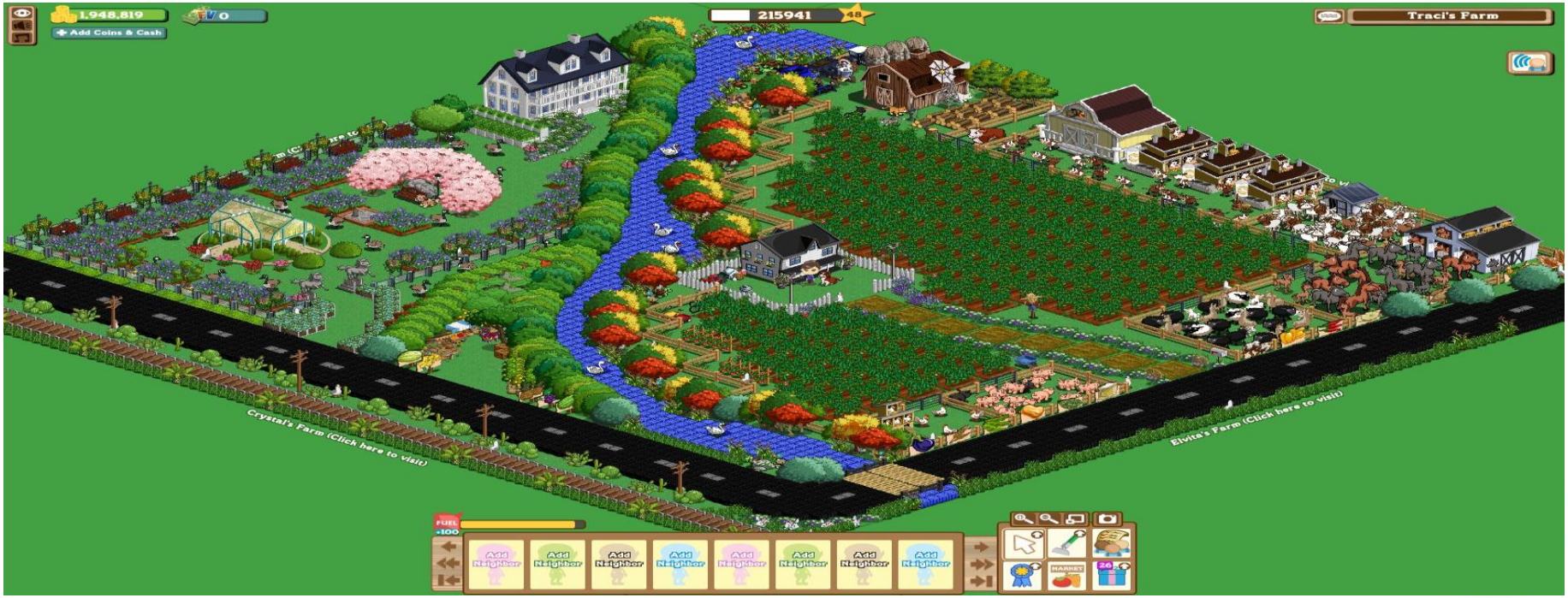
Avoided Cost of Water Capacity: water capacity costs offset by water savings x expected life of repairs (in years)

Example 2: Combined TRC evaluation for "Improved Irrigation Project" Partnership between Farmville Irrigation District and Farmville Electric & Gas Company

- Incentives for growers in Farmville for system wide replacement of outdated irrigation systems, resulting in both water and energy savings
- Utilities share incentive costs
- Assumptions: Farmville Irrigation District (ID) self-generates ¼ of its electric needs and purchases remaining from Farmville Electric & Gas Company.
  - Both Farmville ID and Farmville Electric & Gas Company purchase their water from the State Water Internal Supply House (SWISH).
  - In a below-average water year, Farmville ID supplements their SWISH water supply with groundwater pumping.

Results: Farmville Irrigation Project

- **Results**: Project evaluation determined that in 2012 participants(growers) in Farmville saved ***2100*** kWh of energy, including ***70*** kW of peak demand, and ***100 MG*** of water.
- Farmville Irrigation District saved ***3000*** kWh in avoided energy including **100** kW of peak demand.



Avoided Costs—Farmville Irrigation Project

- <u>Avoided costs of water capacity</u>

  Costs Farmville ID would have incurred providing water to participants (growers) without savings

- <u>Avoided embedded IOU energy costs</u>

  Avoided costs of energy supplied by Farmville Gas & Electric embedded in avoided water otherwise delivered to Farmville ID

- <u>Avoided additional embedded energy costs</u>

  Avoided cost of embedded energy from other sources, not accounted for in avoided cost of water, purchased from SWISH

**Because this is an agricultural water user, embedded energy for water treatment would relatively low, and there would be no downstream embedded energy

Perspective D: Societal TRC

- The Societal TRC could capture total benefits to society when an energy saving measure saves water or a water saving measure saves energy. This would include things that the SPM considers external costs & benefits that accrue to society as whole and/or all Californians, (i.e. “non-energy benefits”)

- Design: this would include entire life cycle values:

  embedded energy in water + life cycle values of embedded water in energy

- Potential benefits: Environmental/ecosystem benefits from water conservation, additional GHG benefits
  - What should be considered?
  - How could these benefits be valued?

QUESTIONS?

- Next, presentation from Jeff Hirsch on Water-Energy End Use Calculator

Followed by…….

- E3's presentation on avoided cost valuation methods

…….then

- Roundtable Discussion of Cost-Effectiveness

Discussion Questions

- What are your current needs for evaluating water/energy projects/ partnerships?
- How should we calculate the embedded energy in water savings? Is an avoided cost calculation acceptable/appropriate?
  - Alternative?
  - How can we avoid double counting the embedded energy in water in the new combined TRC test?
- What method should be used to value avoided water capacity?
- What assumptions need to be made regarding future water supplies? Timeframe?
  - Are these avoided cost calculations made on a regional basis? What level of granularity is *necessary*?

Discussion Questions Continued

- For Energy Efficiency: How do we measure the expected useful lifetime of installed equipment or infrastructure?
  - “lifespan” of “measures” may be difficult for infrastructure projects

- “Incremental Measure Cost”: how do you determine the incremental cost for large custom/calculated programs/measures, such as infrastructure replacements or process improvements?