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INNOVATIONS

Saving Water, Saves Energy, and Our Climate: A How-To on Estimating Greenhouse Gas Emissions Reductions from Water Conservation

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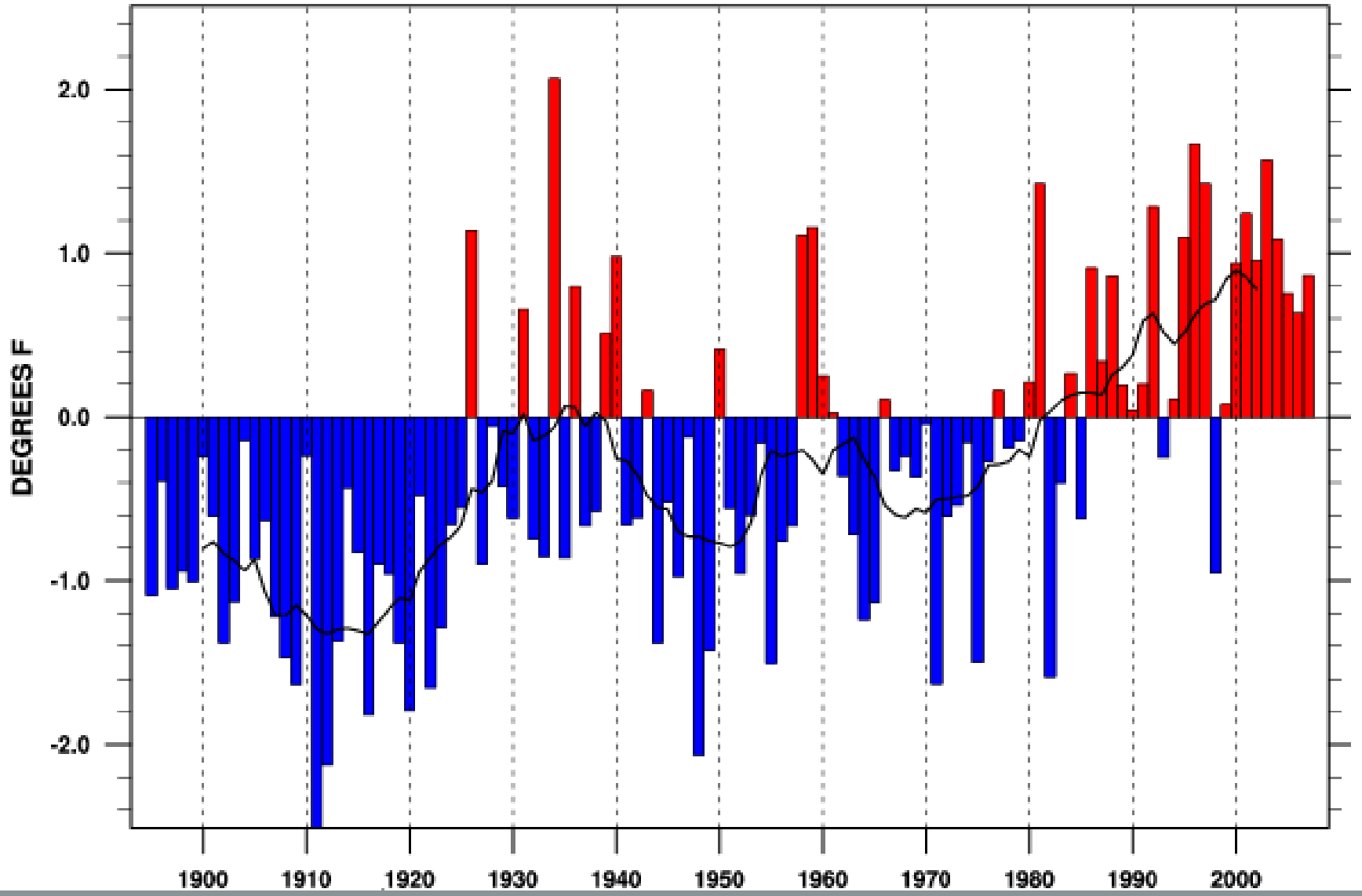
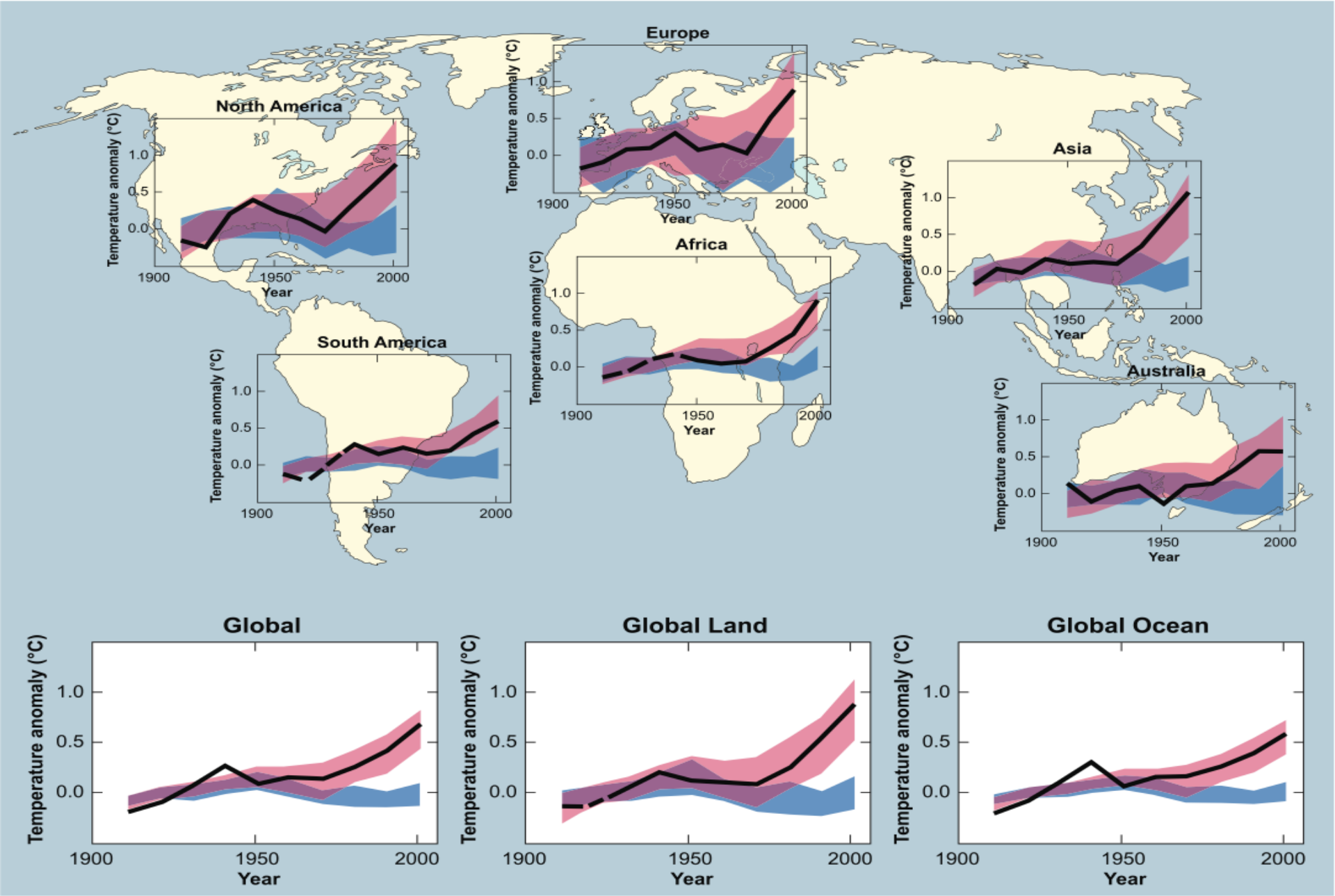
Overview

- Big Picture
- Water-Energy-GHG connection
  - Water/Wastewater systems energy usage, O&M and capital facilities
  - End-use energy savings through water conservation
  - GHG savings from water savings
- Case Studies
  - Placer County Water Agency – Energy and GHG Benchmarking Study
  - Sacramento Municipal Utility District partnering with Regional Water Authority

Rising Mean Temperatures
Location: California

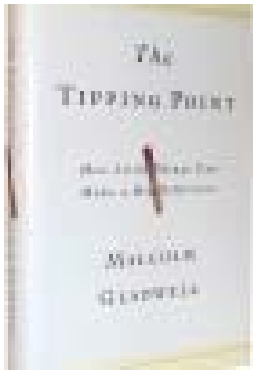


Source: Western Region Climate Center



Reaching Critical Mass and Starting a Word of Mouth Epidemic

- **Tipping points** are "the levels at which the momentum for change becomes unstoppable."
  - Malcom Galdwell

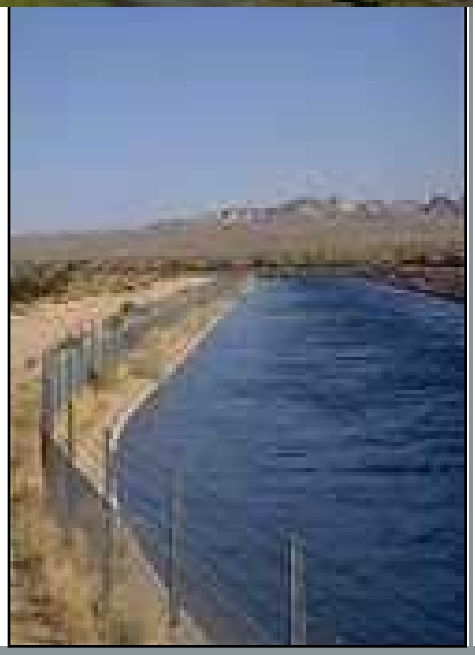


Keys to Action – “Tipping Point”

CLIMATE ACTION RESERVE

- Grass roots level:
  - customers, media, publications
  - GreenPlumbersUSA
  - US Green Building Council, LEED stds
- Utility action: electric, natural gas, wastewater and water
- State action: California Climate Action Registry (voluntary)
- Mandatory legislation (California AB32)
- Federal action: USEPA WaterSense Program, ARRA funding for efficiency

Three Fundamental Questions

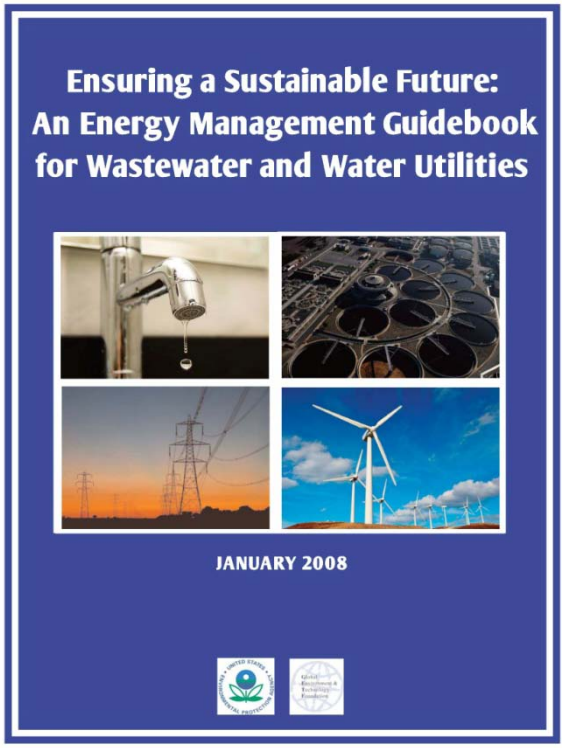


- Emissions are global
  - Does not matter where in location
  - Does not matter when in time
  - It's a "how much" question
- Conserve Water = Conserve Energy?
- How much energy can we save through water conservation? (short term energy crisis response versus long term trend)
- How many millions of tons of Green House Gas Emissions will be avoided?

Why is Water Efficiency a Solution?

- All GHG gases are emitted from consumption
- Easiest way to reduce emissions is to use less fuel
- Lowering water demand reduces total and peak energy demands and total CO_2e
- Scale – load shifting helps but the key is total emissions (CO_2)
- Only other means to lower emissions is to find “clean” sources (e.g., produce own energy, wind/solar, hydropower)

National Summary: Energy Use of Water/Wastewater Operations



- Water is 3rd largest use in residential homes behind AC and refrigeration
- 60,000 water systems and 15,000 wastewater systems in United States (>10,000 connections)
- 75 billion kWh nationally
- 3% of United States electricity use

  Electric Power Research Institute, EPRI's Municipal Water and Wastewater Program, Energy Audit Manual for Water/Wastewater Facilities

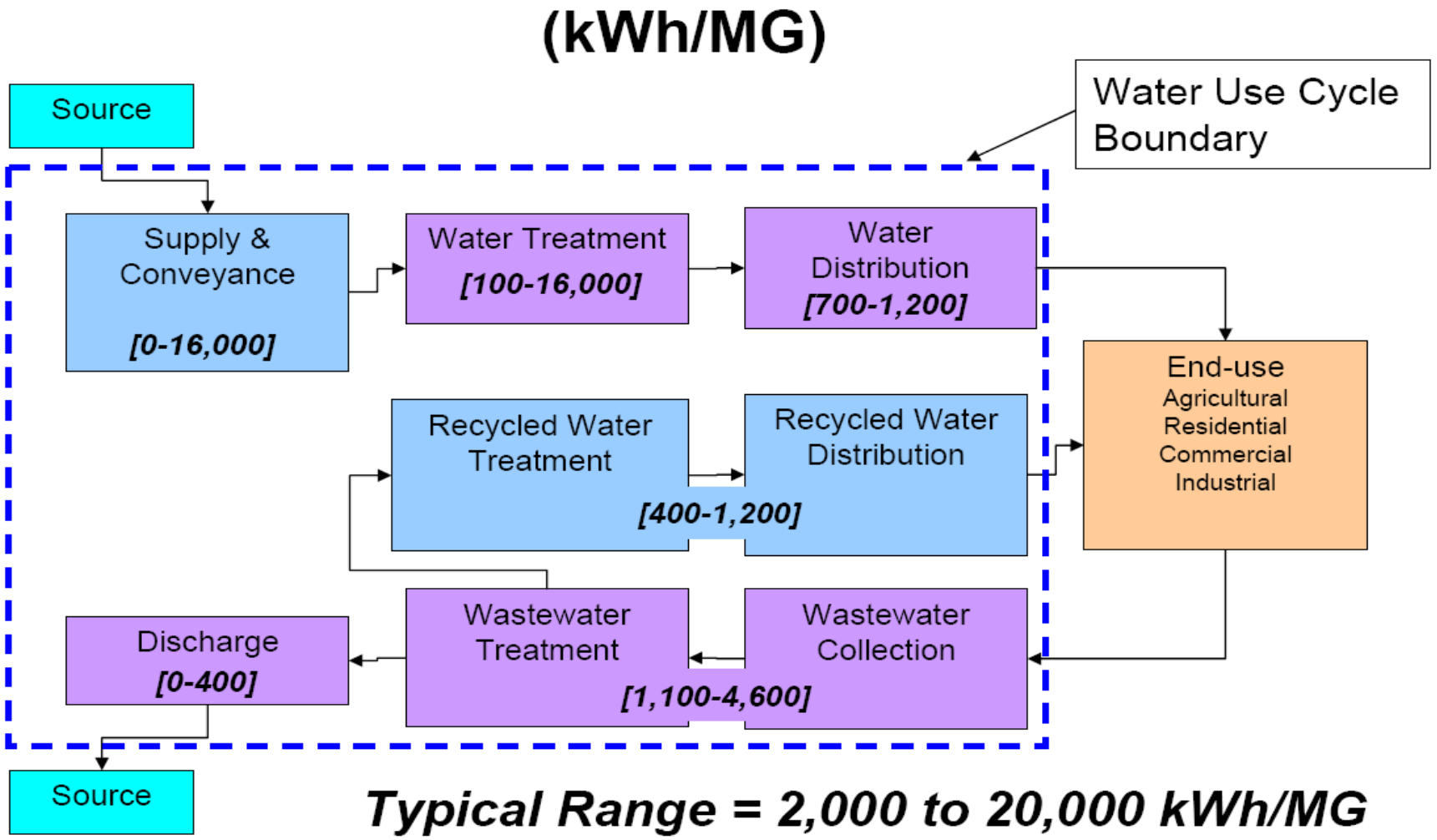
  California Energy Commission Report (104-300)

- Does not include end uses (e.g., natural gas for water heating)

Energy Inputs

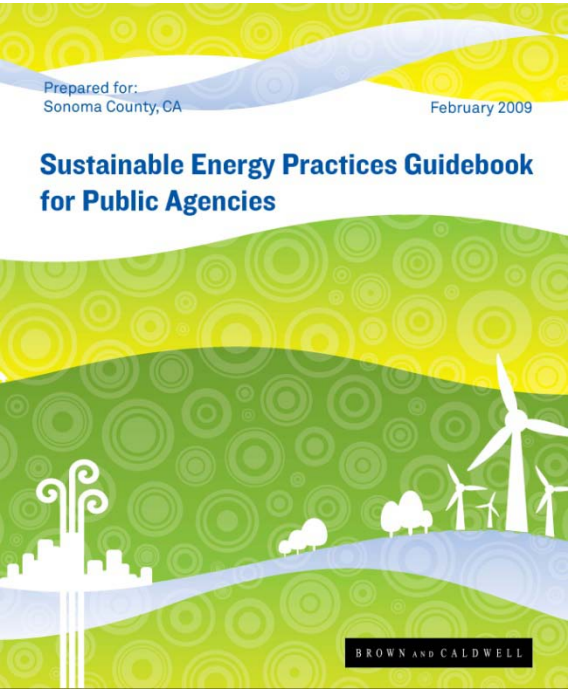
- Water systems use for pumping and processes
- Supply side higher due to pressurized flow
- Wastewater systems use gravity but treatment processes more energy intensive
  - Ultraviolet (UV)
  - Ozone generators
- Treatment systems electrical use projected to increase 20% over years (1996 EPRI Report CR-106941)

Water Use Cycle Energy Intensities = Embedded Energy



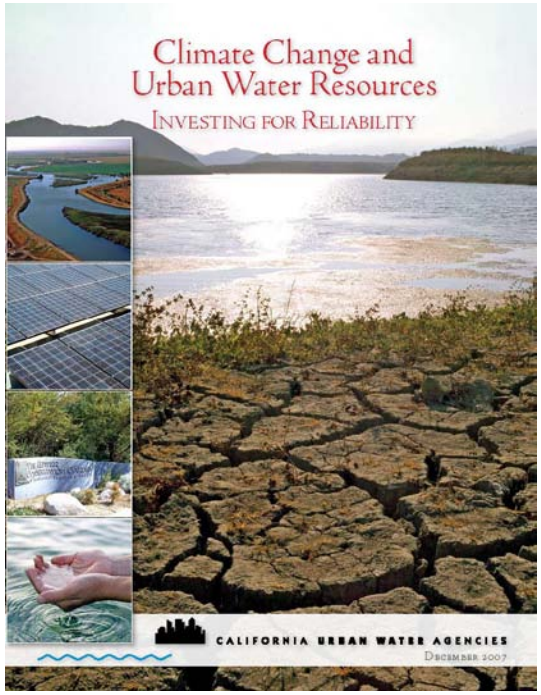
Source: California Energy Commission, 2005 Integrated Energy Policy Report

California's Water-Energy Connection



- Critical elements of California's surface water infrastructure are highly energy intensive
  - Long distances
  - Significant Elevations
- Geographical variation in water sources
- 60% population in southern California
- Different treatment requirements due to variance in water quality

California Assembly Bill 32
GHG Inventories and Reduction Measures



- Assembly Bill 32, 2006
  - Text of the law that empowered the Air Resources Board to regulate greenhouse gas (GHG) emissions.
- New protocol for water/wastewater utilities emission inventories protocols
- Early action measures to be implementation 2010
- Expanded reduction measures list to be 2011 target energy conservation
- GHG Cap and Trade system

Water-Related Energy Use – CA 2001

	Electricity (GWh)	Natural Gas (Million Therms)	Diesel (Million Gallons)
Water Supply and Treatment			
Urban	7,554	19	?
Agricultural	3,188		
End Uses			
Agricultural	7,372	18	88
Residential	27,887	4,220	?
Commercial			
Industrial			
Wastewater Treatment	2,012	27	?
Totals	**48,012**	**4,284**	**88**
2001 Consumption	**250,494**	**13,571**	?
Percent of Energy Use	**19%**	**32%**	?
CO_2 e (Million Metric Tons)	**56**	**50**	

Approximately 25% of the nation's stationary energy use goes to water in some form.

Source: California Energy Commission, 2005 Integrated Energy Policy Report

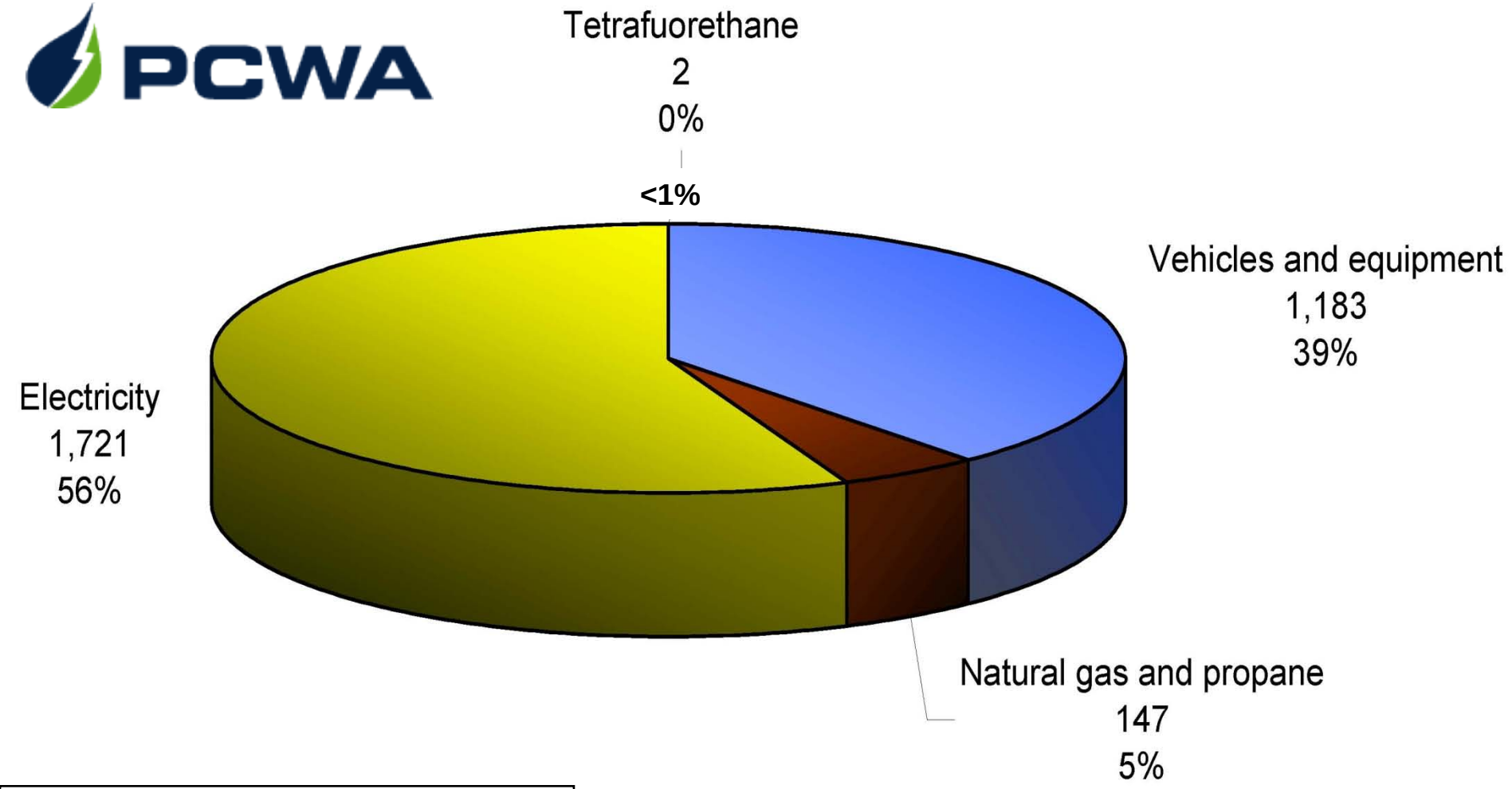
5 Step Approach to Estimating GHG Reductions Related to Water Efficiency

1. Calculate embedded energy (kWh/AF)
   - Divide annual energy demand by annual water production
     - Source: Water utility energy analysis
   - May be multiple energy providers
     - Source: Energy or water provider GHG inventory
2. Research GHG emissions (lbs CO_2e per MWh)
3. Calculate water savings estimates (AF/year)
   - Use quantifiable water (and wastewater) savings potential (AF/year or MG/year)
     - Source: Conservation plans (i.e., GPCD targets, business case benefit cost analyses)
4. Multiply results to get GHG reductions from water conservation (metric tons CO_2e per yr)
   - Results may be by type of water conservation measure or overall program savings and across years (using appropriate useful life per measure)
5. Speak to and publish estimates
   - Merge information into Climate Action Plan or other planning documents, public and school outreach campaigns, websites, media interviews, etc

Case Study: Placer County Water Agency Energy Analysis

- Board Strategy
- Partnership Discussions and Opportunities
- Quantify Total Energy Use: Current use, future use
- Optimize PG&E Energy Costs: Rate structures and rebates
- Evaluate Alternative Energy Sources
- Electric Power Reliability
  - Outage frequency
  - Exiting backup power
  - Energy reliability improvement
  - Water supply during a blackout
- Estimate GHG Footprint
- California Climate Action Registry Support Evaluate Energy Conservation and Optimization
  - Existing conservation efforts
  - Linkage between water conservation and energy conservation
  - Future energy conservation and optimization options
  - Identify water treatment and distribution system optimization

2007 Greenhouse Gas Inventory (Metric Tons of CO_2 Equivalent)



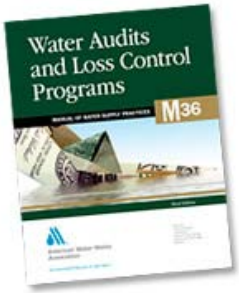
Total PCWA Greenhouse Gas Emissions: 3,053 Metric Tons

GHG per Acre-Foot of Water Supply

- 2007 treated water raw water pumping by source:
- PG&E supply (Bear/Yuba Rivers) = 29,500 AF
  - Total electrical demand = 1.5 million kWh
  - Emissions factor for PGE power = 0.45581 lbs CO_2e per kWh
  - GHG for PGE supply = 712,659 lbs CO_2e
- Middle Fork Project (American River) = 2,400 AF
  - Total electrical demand = 1.03 million kWh
  - Emissions factor = 0.45581 lbs CO2e per kWh
  - GHG emissions = 472,584 lbs CO_2e
- Future Growth =

  double in water demand but have 7 times more energy demand

Opportunity
Reduce Water Losses = GHG Reduction



- 2007 Total losses = 2,429 AF
  - Average 78 kwh/AF
  - Emission factor = 0.45581 lbs
  - 86,000 lbs CO_2e
- Loss Reduction from 2006 to 2007 = 585 AF
  - Reduced 20,790 lbs CO_2e
  - Saving 39 metric tons CO_2e compares to removing all 31 metric tons CO_2e generated from off-road vehicles
- Shifting Focus to Zone 1 – most western and warmest (lowest elevation) has the highest energy demand and the newer pipes and homes

Energy

Green house Gas

Solar

Hydropower

Conservation

Fossel Fuel Efficiency

Sacramento Water-Energy Partnership

- Regional Water Authority and Sacramento Municipal Utility District
- Goals:
  - water savings (RWA members)
  - end-use energy savings
  - GHG savings (SMUD)
- Memorandum of Understanding 2006
  - Historical coordination and in-kind support
  - Clothes Washer Support for combined rebate (participating water districts adding $50 to SMUD $125) for CEE Tier 3
  - More outreach and partnering planned in 2010

Sacramento Municipal Utility District Partnership

- 14 of the Top 40 SMUD customers are water districts in 2005
- Total estimated over 100 GWh for 19 water utilities for total energy cost of $20 million in 2005
- SMUD analyzed average embedded energy savings from water and wastewater
  - Average 700 gals water saved = 1 kWh
  - Same for wastewater (700 gals = 1 kWh saved)

2006 GHG Inventory Report for SMUD

- Owns 1,733 MW of electricity generation capacity and imports from New Mexico
  - 993 MW natural gas fired plants
  - 690 MW hydroelectric power
  - 38 MW wind power
  - 10.2 MW solar power
- Delivered over 10,000 GWh of electricity
- Generated about 2 million metric tons CO_2
- Generated 555 lbs CO_2 per MWh delivered to customers

SMUD Technical Analysis Summary Results

		Water Efficient Toilets	Water Efficient Clothes Washers	Pre-Rinse Spray Valves	Conductivity Controllers
Useful Life (yrs)		25	15	5	5
Assumed Total Number of Units Replaced		Multi-family: 2,300 CII Toilets: 2,500 CII Urinals: 1,000	Residential: 7,500	CII: 7,000	CII: 45
SMUD Incentive		$25	$125	$75	$200
Benefit-Cost Ratio	**Water, Wastewater, and Electric**	1.3[a]	1.7	2.0	3.7
	Water Only	1.2[a]	3.3	1.4	2.8
	Electric Only	1.0[a]	0.6	0.5	0.8

[a]Assumes no useful life decay.

GHG Savings from Water Conservation

	Water Efficient Toilets	Water Efficient Clothes Washers	Pre-Rinse Spray Valves	Conductivity Controllers
Total Estimated Water Savings (kgal/yr)	75,000	93,000	50,000	33,000
Total Estimated Wastewater Savings (kgal/yr)	75,000	93,000	50,000	NA
Total SMUD Annual Energy Savings (kWh/yr)	108,000	133,000	72,000	48,000
Total Annual CO_2 Savings* (tons)	30	40	20	20
Total Estimated CO_2 Savings (tons for useful life of device)	750	1,000	500	500

* Calculated using SMUD GHG Inventory Report (2006) of 555 lb CO_2/MWh generated from electricity delivered to customers

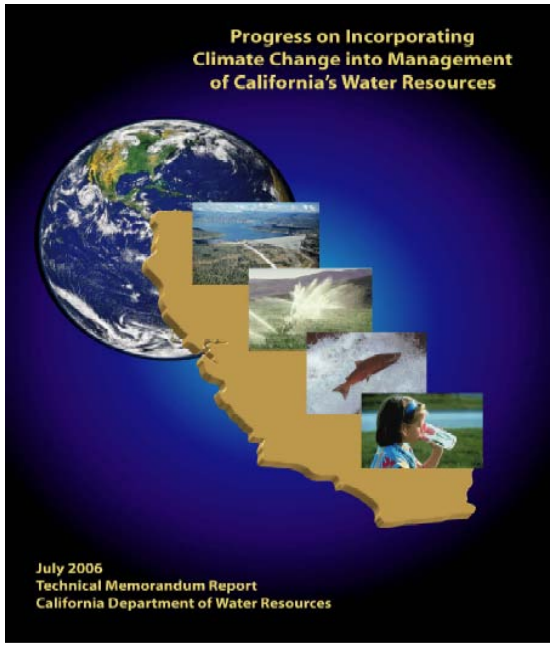
Ranked Outcomes

Measure	No. of measures	CO_2e savings (lbs) per measure	Benefit-cost Ratio
Conductivity Controllers	45	888.9	3.7
Water Efficient Clothes Washers	7,500	10.7	1.7
Water Efficient Toilets (ULFTs)	5,800	10.3	1.3
Pre-rinse Spray Valves	7,000	5.7	2

Final Thoughts

- Going beyond water savings....
- What resources are we really wasting?
- What is the potential added savings of reducing on-peak demand and wastewater flows?
- How much energy demand lowered?
- How much cost savings for energy?
- Bottomline: How much GHG emissions are eliminated when water demand is reduced?

California Water-Energy Key References



- Climate Action Team Report, 2006

  http://www.climatechange.ca.gov
- Progress for Incorporating Climate Change into Management of California's Water Resources, July 2006
- California's Water-Energy Relationship, California Energy Commission, Gary Klein, et. al., 2005
- Methodology for Analysis of the Energy Intensity of California's Water Systems, and an Assessment of Multiple Potential Benefits Through Integrated Water-Energy Efficiency Measures, UCSB, Robert Wilkinson, 2000
- AWWARF Residential End Uses Study, 1999

Useful Web Sites

- Climate Action Reserve
  - http://www.climateactionreserve.org
- US Department of Energy (Energy Star)
  - www.doe.gov
- US EPA WaterSense Program
  - www.epa.gov/watersense
- California Energy Commission
  - www.energy.ca.gov
- California Department of Water Resources
  - www.water.ca.gov
- California Urban Water Conservation Council
  - www.cuwcc.org
- CUWCC's Water Saver Home
  - www.h2ouse.org

EPA WaterSense

Questions?

It’s not about us,
its about our future

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