Policies and Programs to Deliver Cost Effective Water and Energy Use Efficiency

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Gary Klein

Gary Klein and Associates
Tel: 916-549-7080
Email: Gary@GaryKleinAssociates.com

The Water-Energy Nexus

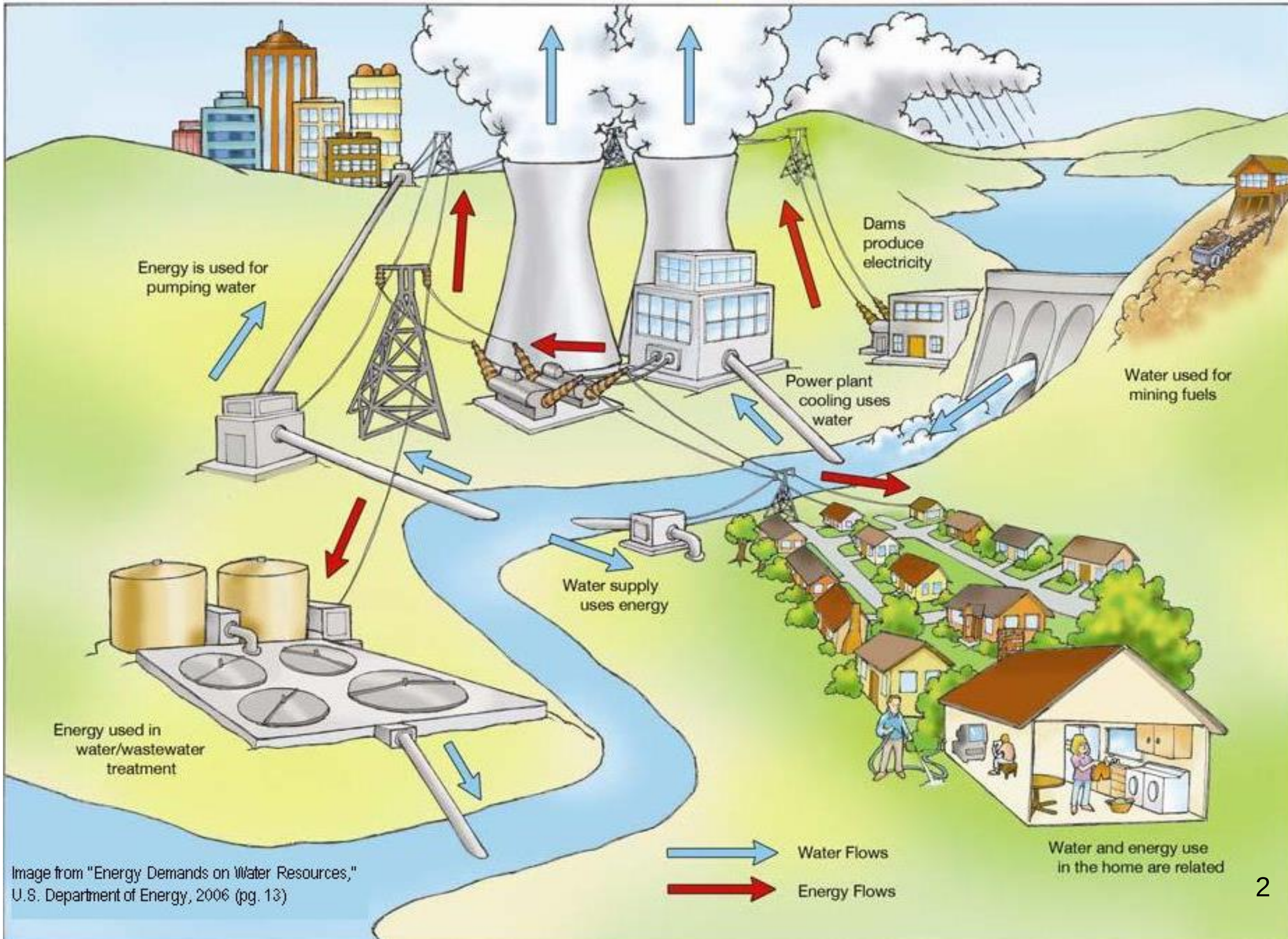


Image from "Energy Demands on Water Resources," U.S. Department of Energy, 2006 (pg. 13)

Drought in North Carolina
A Birdseye View…
December 13, 2007, 1 PM

Courtesy of:

- Lana Armstrong
- Waterfront Sportsman
- Dale Swiggett
- Bob Epting

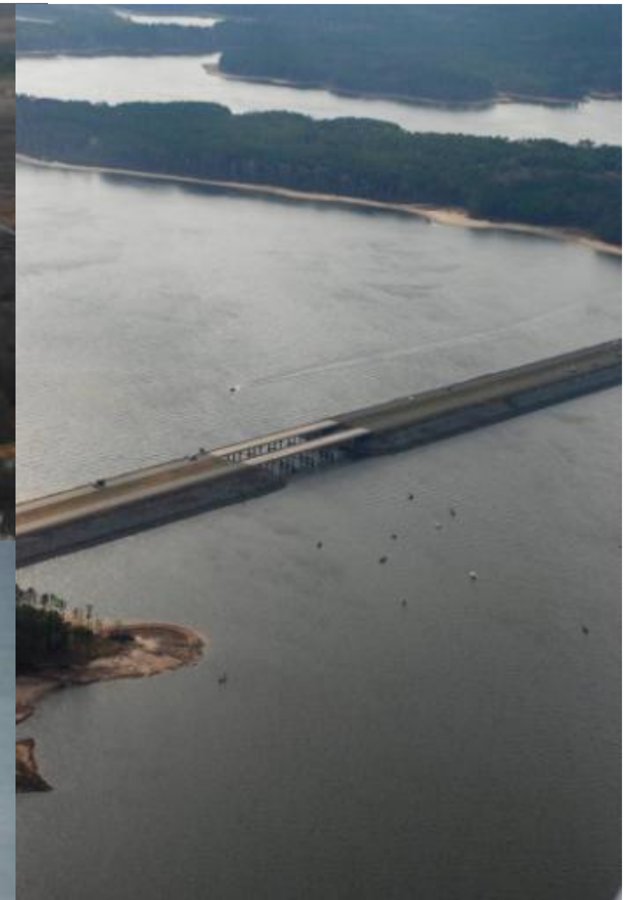
Photographs by:

- Eric Schneider

Falls Lake, North Carolina

Water level down approximately 20 feet; 2 miles of missing reservoir

Jordan Lake, North Carolina



Water level down approximately 10 feet; 1 mile of missing reservoir

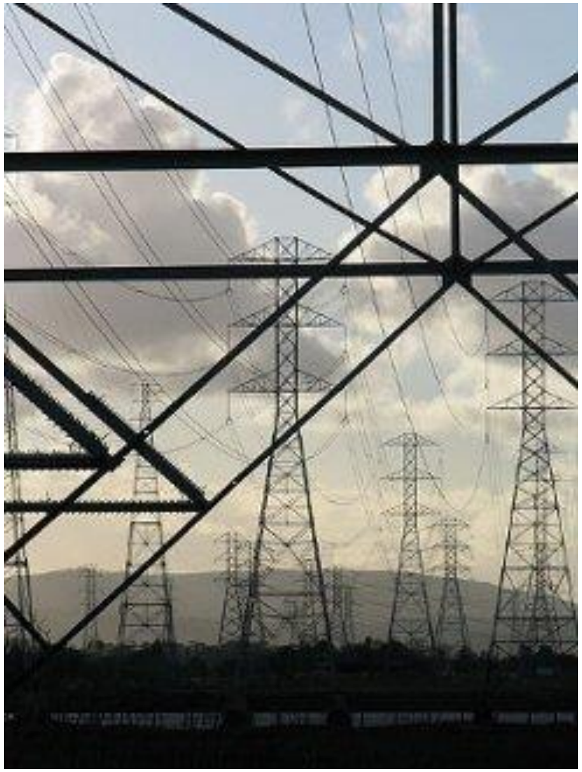
Wastewater Treatment

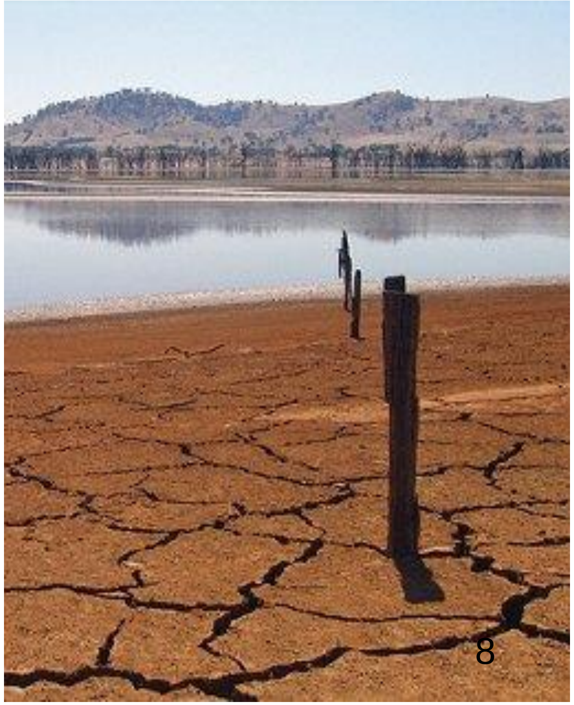
These are source of water running in the “rivers” shown entering Falls Lake and Jordan Lake

Sharon Harris Nuclear Power Plant

Evaporates approximately ½ gallon of potentially potable water per kWh to produce electricity

Water Embedded in Energy





Water *Consumption* per kWh

Power Provider	Gallons Evaporated per kWh at Thermoelectric Plants	Gallons Evaporated per kWh at Hydroelectric Plants	Weighted Gallons Evaporated per kWh of Site Energy
Western Interconnect	0.38 (1.4 L)	12.4 (47.0 L)	4.42 (16.7 L)
Eastern Interconnect	0.49 (1.9 L)	55.1 (208.5 L)	2.33 (8.8 L)
Texas Interconnect	0.44 (1.7 L)	0.0 (0 L)	0.43 (1.6 L)
U.S. Aggregate	0.47 (1.8 L)	18.0 (68 L)	2.00 (7.6 L)

"Consumptive Water Use for U.S. Power Production." National Renewable Energy Laboratory, 2003 http://www.nrel.gov/docs/fy04osti/33905.pdf

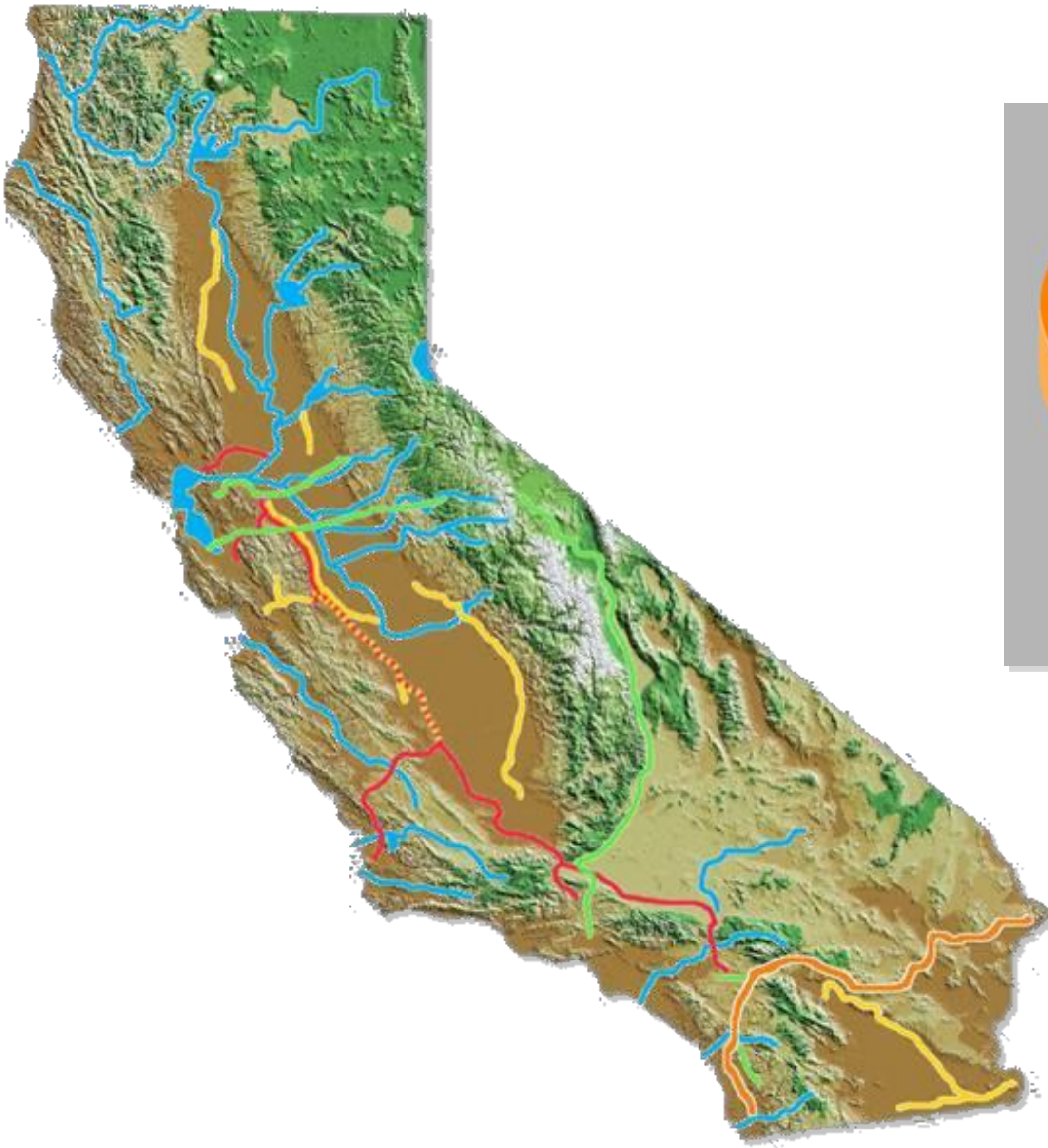
Water: Yet Another Reason to Push for Wind and Solar

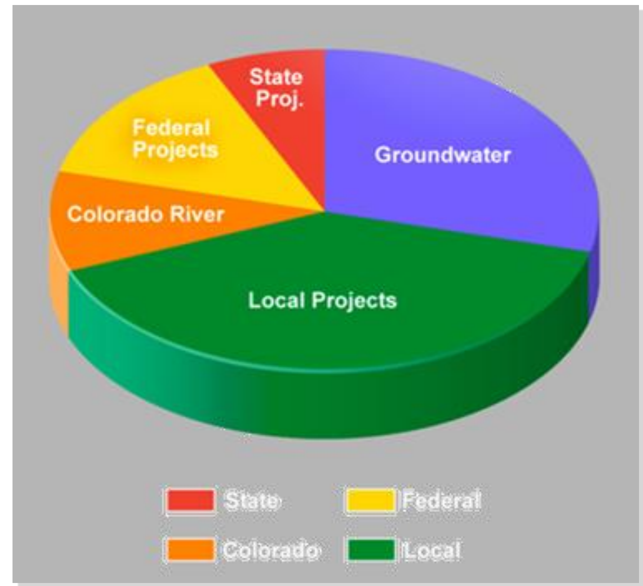
Source	Gallons Per kWh
Wind	**0.001**
PV Solar	**0.030**
Nuclear	0.62
Coal	0.49
Oil	0.43
Hydro	18.27

Gipe, Paul. “Wind Energy Comes of Age,” 1995 http://www.awea.org/faq/water.html

Energy Embedded in Water

California's Water Supply Systems

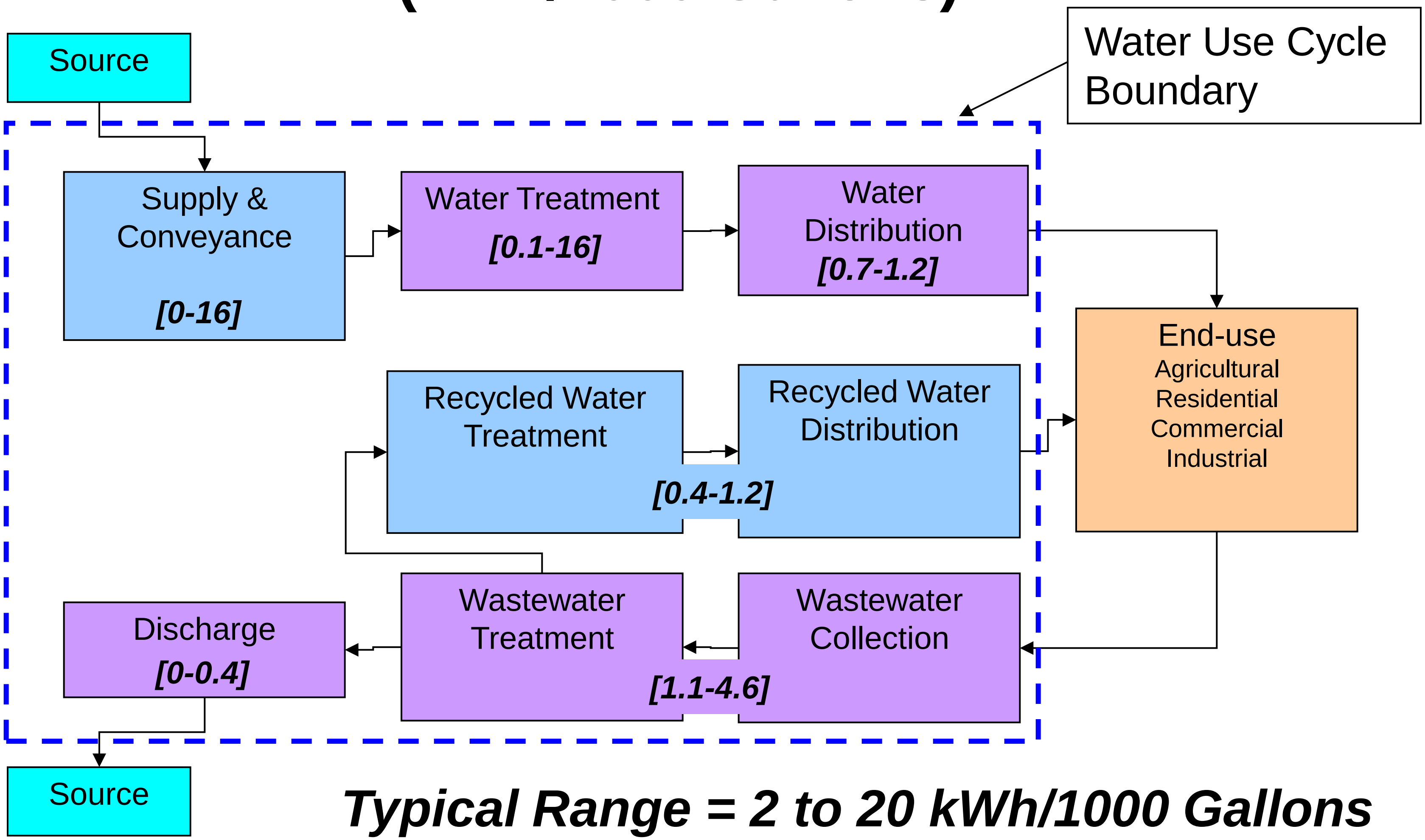




Lester Snow, California Department of Water Resources

Water Use Cycle Energy Intensities

(kWh/1000 Gallons)



Typical Range = 2 to 20 kWh/1000 Gallons

Source: California Energy Commission, 2005 Integrated Energy Policy Report

Water-Related Energy Use-CA 2001

	Electricity (GWh)	Natural Gas (Million Therms)	Diesel (Million Gallons)
Urban Water Use Cycle			
Water Supply	7,554	19	?
Including Conveyance, Treatment and Distribution			
Wastewater	2,012	27	?
Including Collection, Treatment, Discharge and Recycled Water			
End Uses of Water			
Agriculture			
Supply to the Farm	3,188		
On-Farm Pumping	7,372	18	88
Residential	13,528	2,055	?
Commercial	8,341	250	?
Industrial	6,017	1,914	?
Totals	**48,012**	**4,283**	**88**
2001 Consumption	**250,494**	**13,571**	?
Percent of Energy Use	**19%**	**32%**	Small
CO_2 e (Million Metric Tons)	**56**	**50**	Small

Approximately 20-25 % of the nation's stationary energy use goes to water in some form.

Source: California Energy Commission, 2005 Integrated Energy Policy Report

Water-Related Energy Use-CA 2001 Another Perspective

	Electricity (GWh)	Natural Gas (Million Therms)	Diesel (Million Gallons)
Urban Water Use Cycle	9,566	46	
End Uses of Water			
Agriculture	10,560	18	88
Residential, Commercial, Industrial	27,886	4,219	
Totals	**48,012**	**4,283**	**88**
2001 Consumption	**250,494**	**13,571**	?
Percent of Energy Use			
All Water-Related Energy	19%	32%	Small
Urban Water Use Cycle	4%	0.3%	
Agriculture	4%	0.1%	Small
Residential, Commercial, Industrial	11%	31%	

Source: California Energy Commission, 2005 Integrated Energy Policy Report

Water Use Efficiency Strategies

- **Outdoor**
  - Landscape
  - Hardscape
- **Advanced Systems**
  - Graywater collection
  - Reclaimed water reuse
  - Rainwater collection and use
  - Mechanical Systems
- **Indoor**
  - Cold
  - Hot

Water Use Efficiency

- **Outdoor**
  - Landscape
    - Climate appropriate plant selection
    - Watering methods
    - ‘Need-based” controls
  - Hardscape
    - Solid
    - Porous

Water Use Efficiency

- **Advanced Systems**
  - Graywater
    - On-site collection and reuse
      - Separate drain lines
      - Separate delivery piping
  - Reclaimed water reuse
    - Outdoor or indoor use?
  - Rainwater collection and use
    - Outdoor or indoor use?
  - Mechanical Systems
    - Cooling towers
    - Condensate recovery

Water Use Efficiency

- **Indoor**
  - Cold
    - Toilets, Faucets, Aerators, Showerheads, Dish machines, Clothes washers, Ice machines
  - Hot
    - Wring out the Wastes
      - Improve hot water delivery
      - Capture waste heat running down the drain
      - Insulate hot water piping
    - Install water use efficient hot water devices
    - Select Water Heaters Compatible with WUE

Why Do I Work on Hot Water?

- Energy Intensity of Indoor Cold Water
  - Range from 3 to 32 kWh per 1000 gallons
- Energy Intensity of Hot Water

	Electric		Natural Gas	
	Resistance (85% Efficient)	Heat Pump (COP = 2)	(50% Efficient)	(95% Efficient)
kWh/1,000 Gallons	201	85	342	180
Relative Energy Intensity compared to 5 kWh/1,000 gallons	40	17	68	36

- Typically 40-68 times more energy intensive than indoor cold water.

The most valuable water to conserve is hot water
at the top of the tallest building,
with the highest elevation,
in the area with the greatest pressure drop.

SoCalGas Hot Water Demonstration Lab

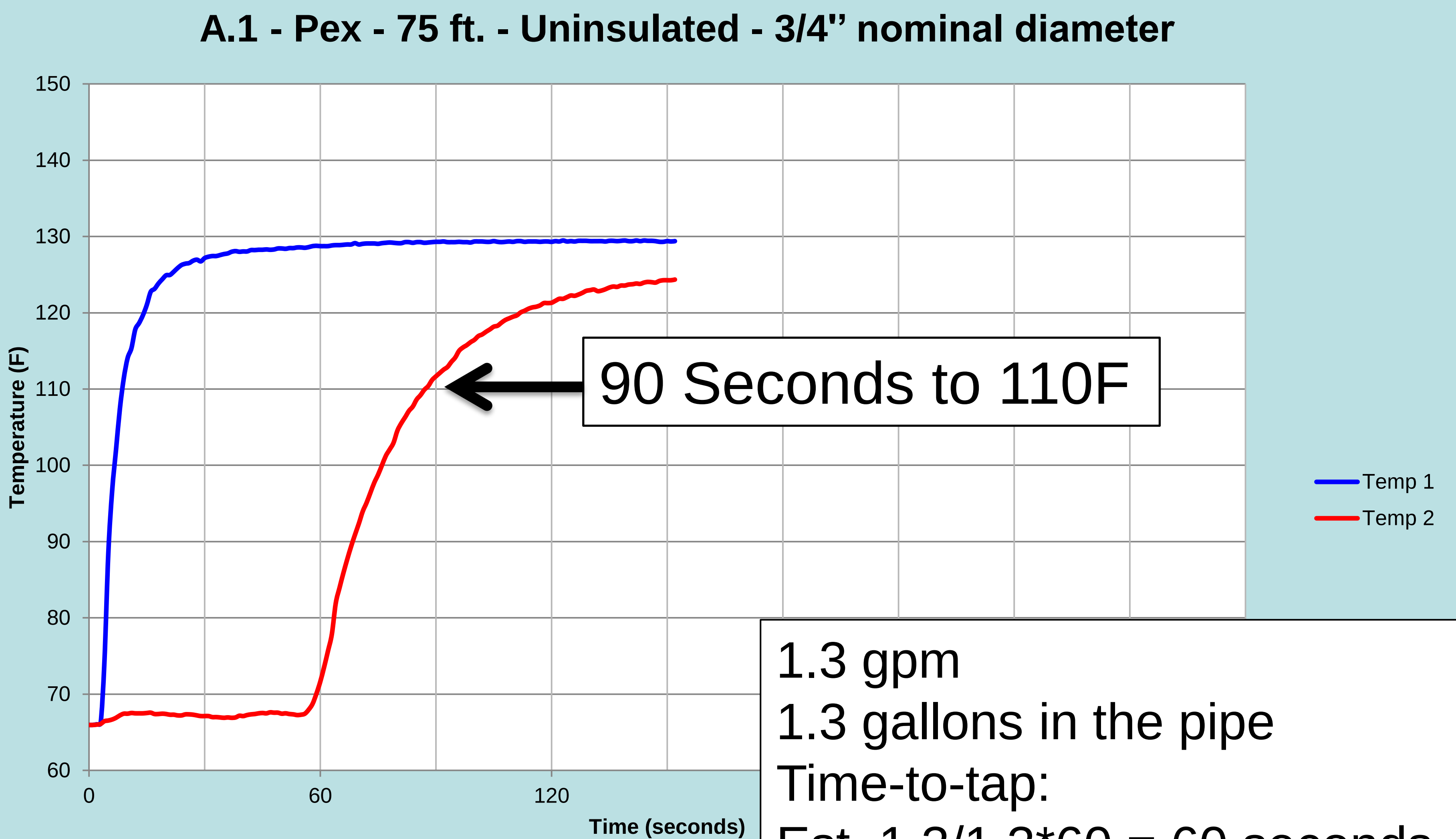
Entering Section of Experiment:

1. Flushing and Priming
2. Flow Rate
3. Pressure 1
4. Temperature 1

Exiting Section of Experiment:

1. Pressure 2
2. Temperature 2
3. Discharge through Plumbing Fixture

Demonstrating Performance



1.3 gpm

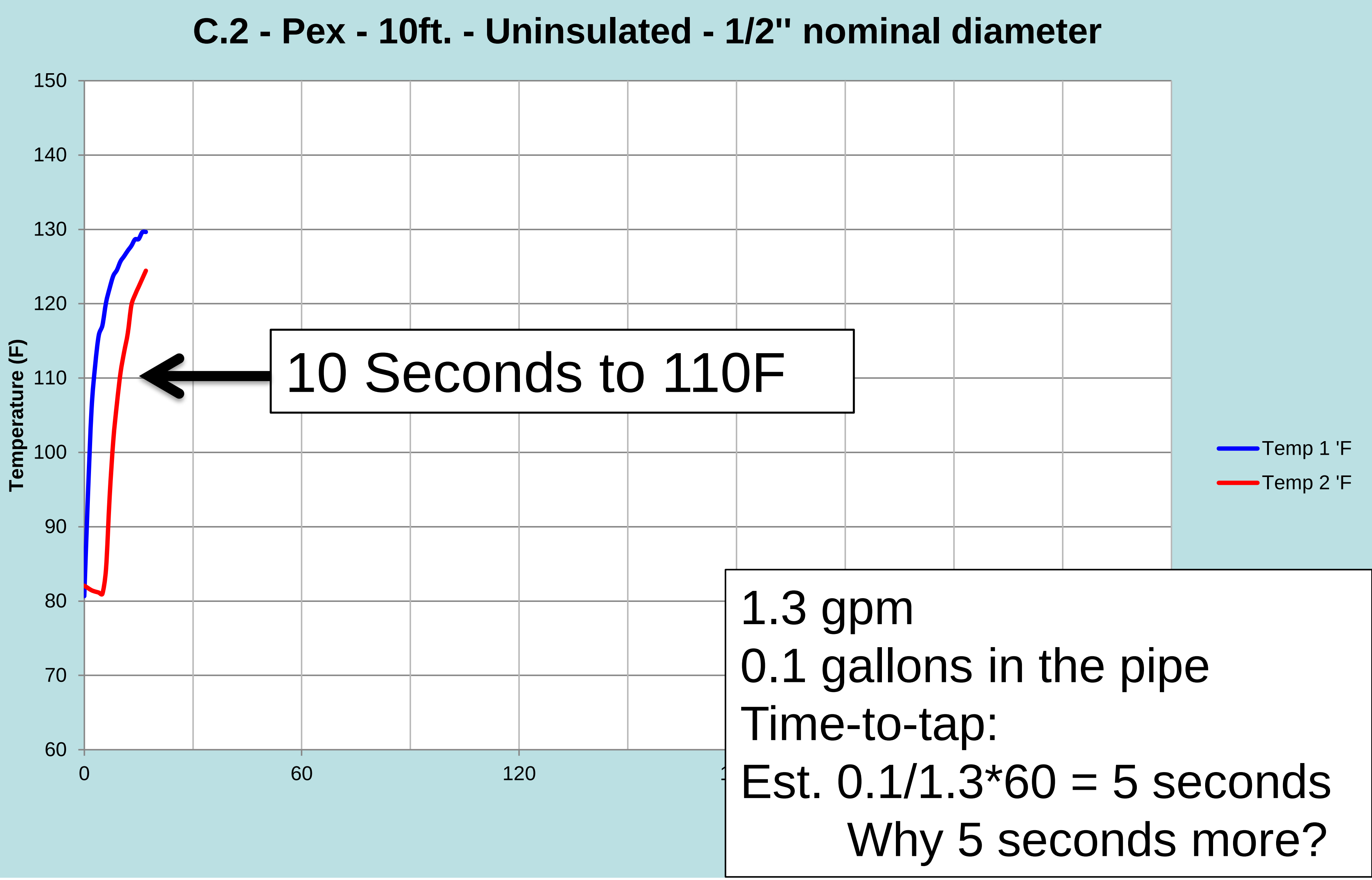
1.3 gallons in the pipe

Time-to-tap:

Est. 1.3/1.3*60 = 60 seconds

Why 30 seconds more?

Demonstrating Performance



Water-Energy Relationship: Synergies

- ✓End-User Water and Energy Conservation
  - ✓ Saving water can save energy
  - ✓ Saving energy can save water
- ✓Water and Wastewater Utility Operational Efficiency
  - ✓ Increasing water and wastewater system efficiency reduces energy in the water use cycle
- ✓Water Storage
  - ✓ Increased water storage and more flexible water storage shifts peak energy requirements
  - ✓ Pumped storage increases peak electric generation and improves electric system efficiency
- ✓Improve Price Signals
  - ✓ Time of use water rates and meters
  - ✓ Time of use electric rates and meters
- ✓Renewable Generation by Water and Wastewater Utilities
  - ✓ Increase generation from in-conduit hydro and biogas. Add generation from solar and wind.
  - ✓ Assist in meeting California's renewable generation goals

If we did all this,

what would be the combined impact on GHG emissions?

The Unintended Consequences of Increasing Water Use Efficiency

Given human nature,
it is our job
to provide the infrastructure
that supports efficient behaviors.

Thank You!

Gary Klein

Gary Klein and Associates
Tel: 916-549-7080
Email: Gary@GaryKleinAssociates.com