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A River of Energy Solutions

The Energy-Water Nexus and its Impact on Meeting E.O. 13514 Goals

Diana Pape, ICF International

August 9, 2011

Agenda

Linkage Between Water and Energy

Energy Intensity of Water Supply and Wastewater Treatment

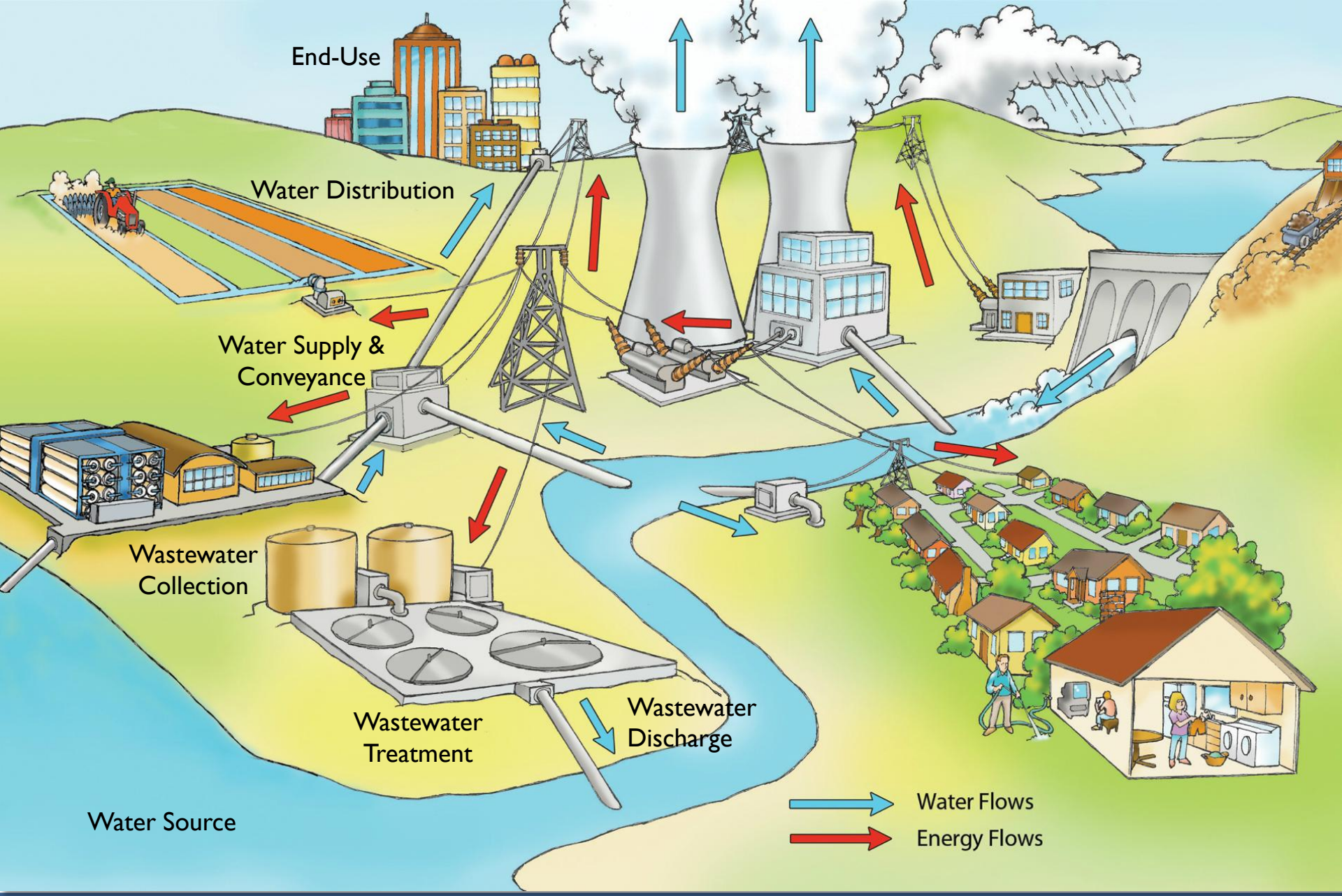
Potential Energy Savings Associated with Water Efficiency Initiatives

Current Executive Agency Water Efficiency Initiatives

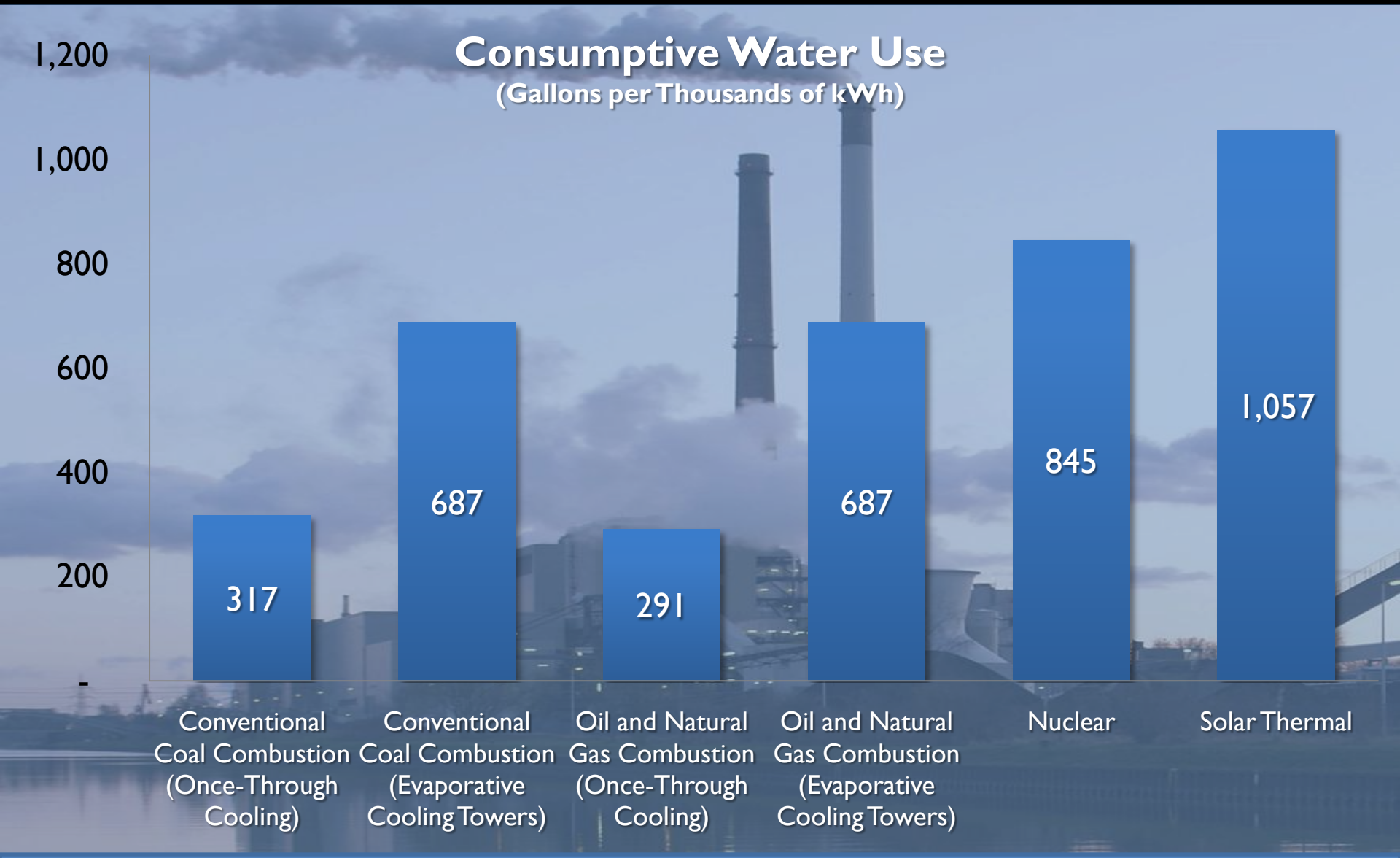
Illustrative Example of Water, Energy, and GHG Savings by Replacing Appliances

Conclusion

Linkage Between Water and Energy


End-Use
Water Distribution
Water Supply &
Conveyance
Wastewater
Collection
Wastewater
Treatment
Wastewater
Discharge
Water Source
Water Flows
Energy Flows

Energy Supply Requires Water



Gleick 1993

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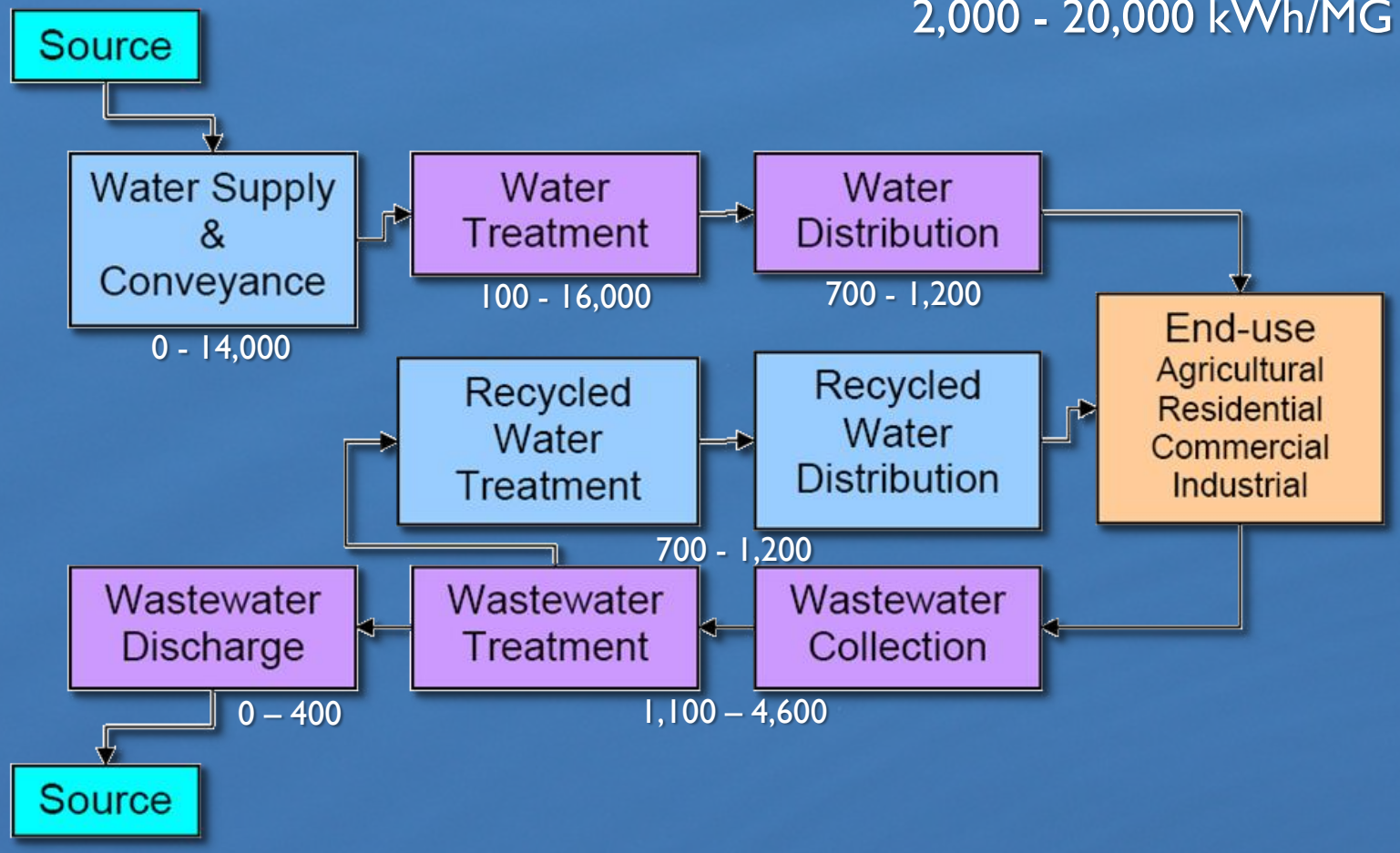
Water Supply and Treatment Requires Energy

California's Total Range
2,000 - 20,000 kWh/MG



All Values in kWh/MG

California Energy Commission 2005

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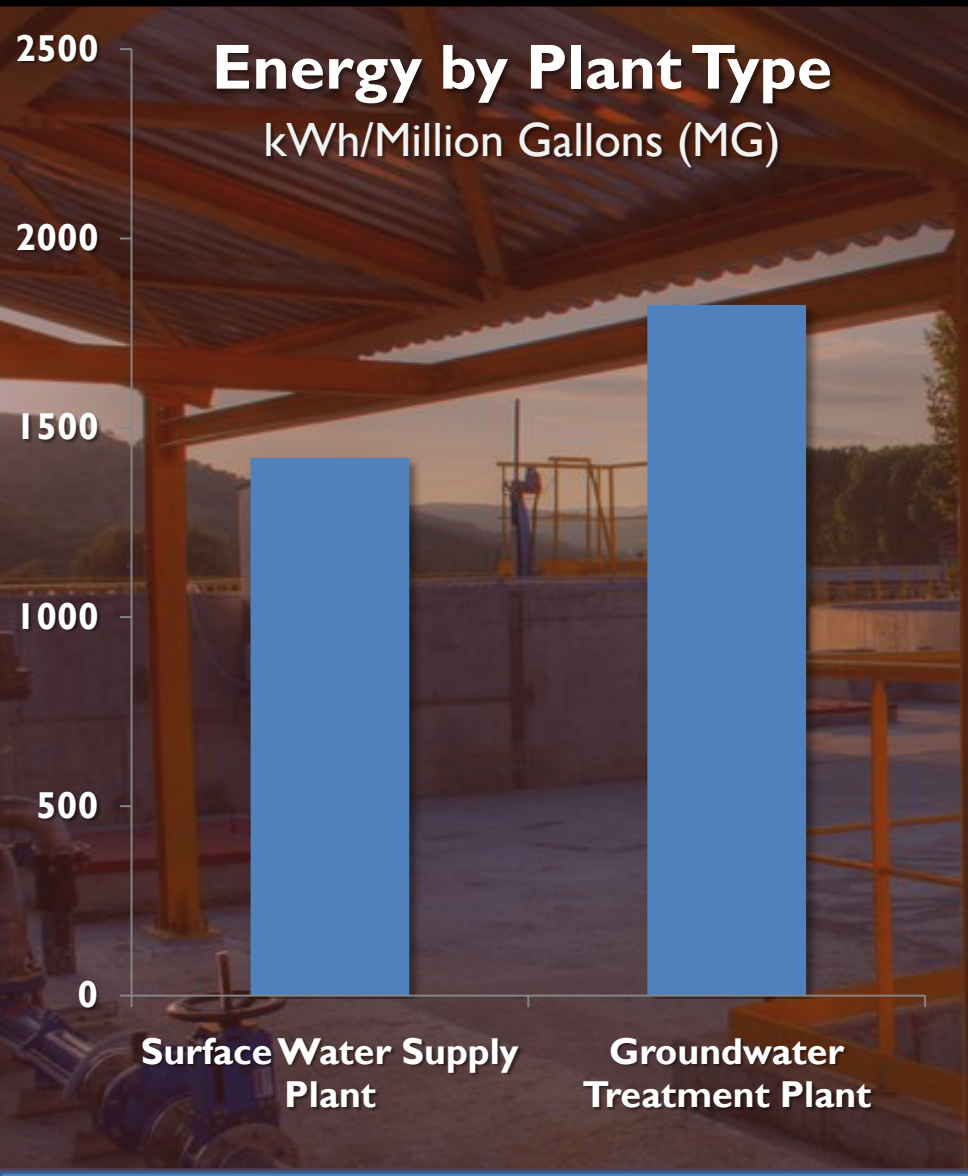
13%

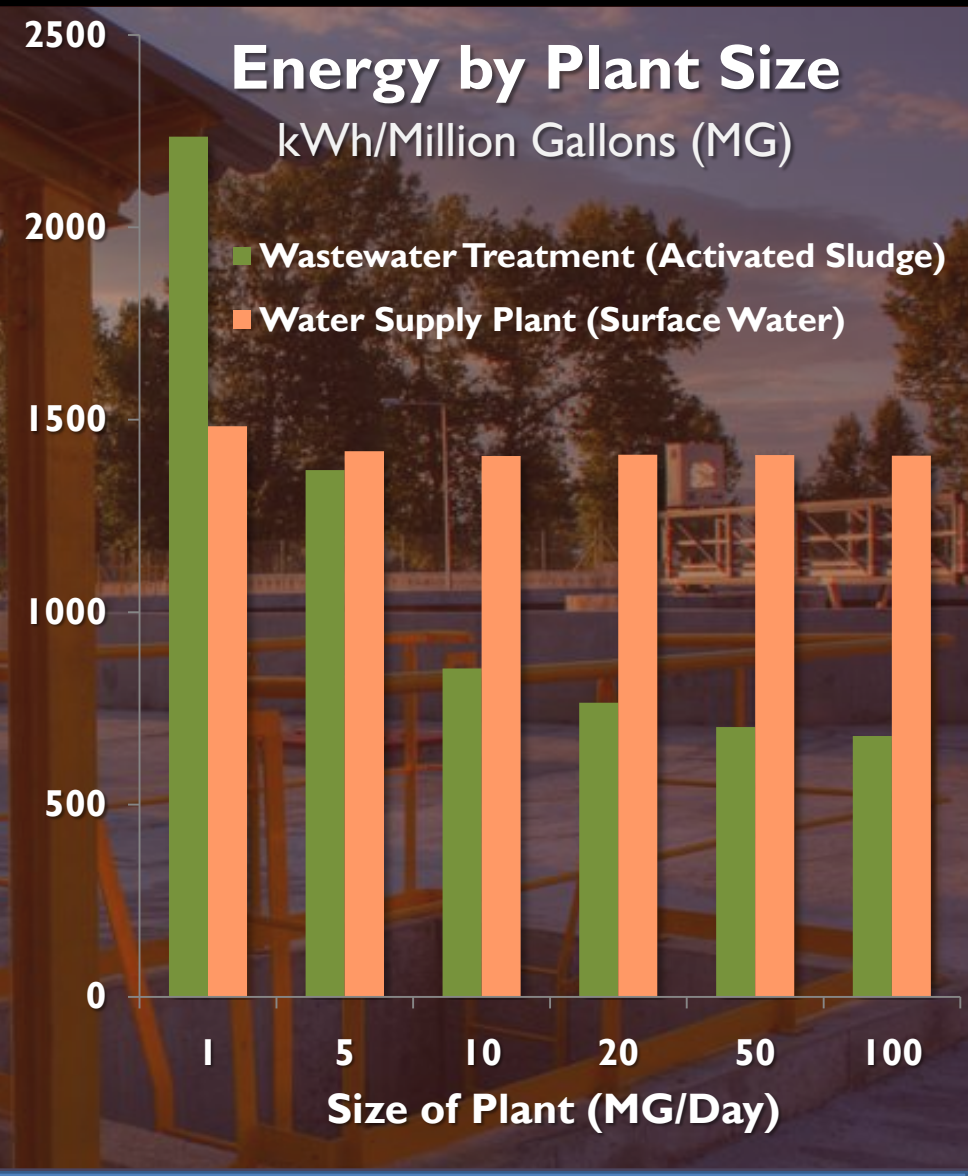
of Nation's electricity consumption is used for

Treatment
Distribution
Heating
Collection
Wastewater Treatment
Discharge

Energy Intensity of Water Supply and Wastewater Treatment

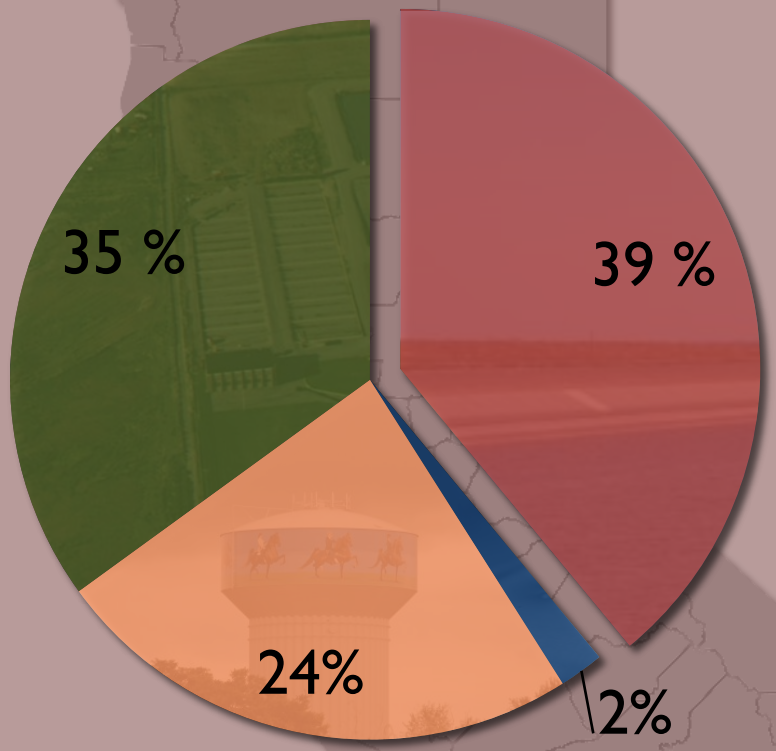
Energy Intensity Varies by System Type and Size

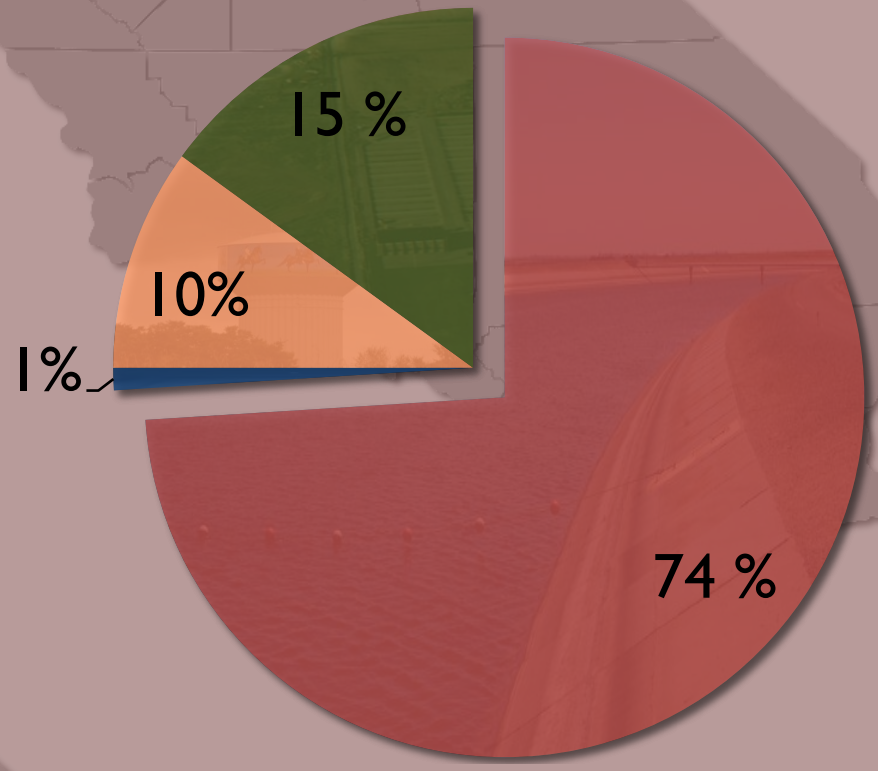




Burton 1996

Energy Intensity Varies by Region





Water Supply and Conveyance | Water Treatment | Water Distribution | Wastewater Treatment

California Energy Commission 2006

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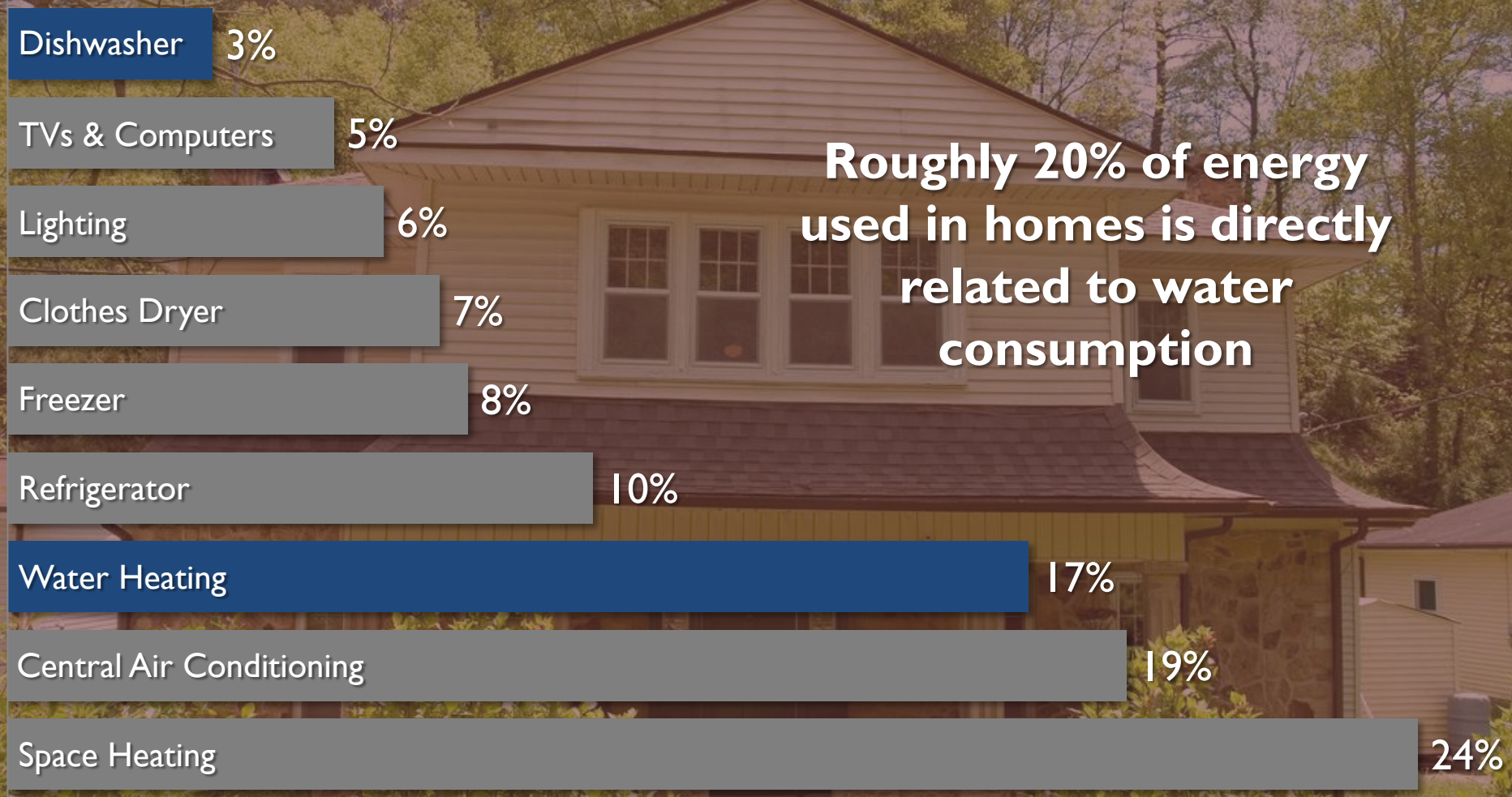
Potential Energy Savings Associated with Water Efficiency Initiatives

Household Energy Consumption



Roughly 20% of energy used in homes is directly related to water consumption

California Energy Commission 2006

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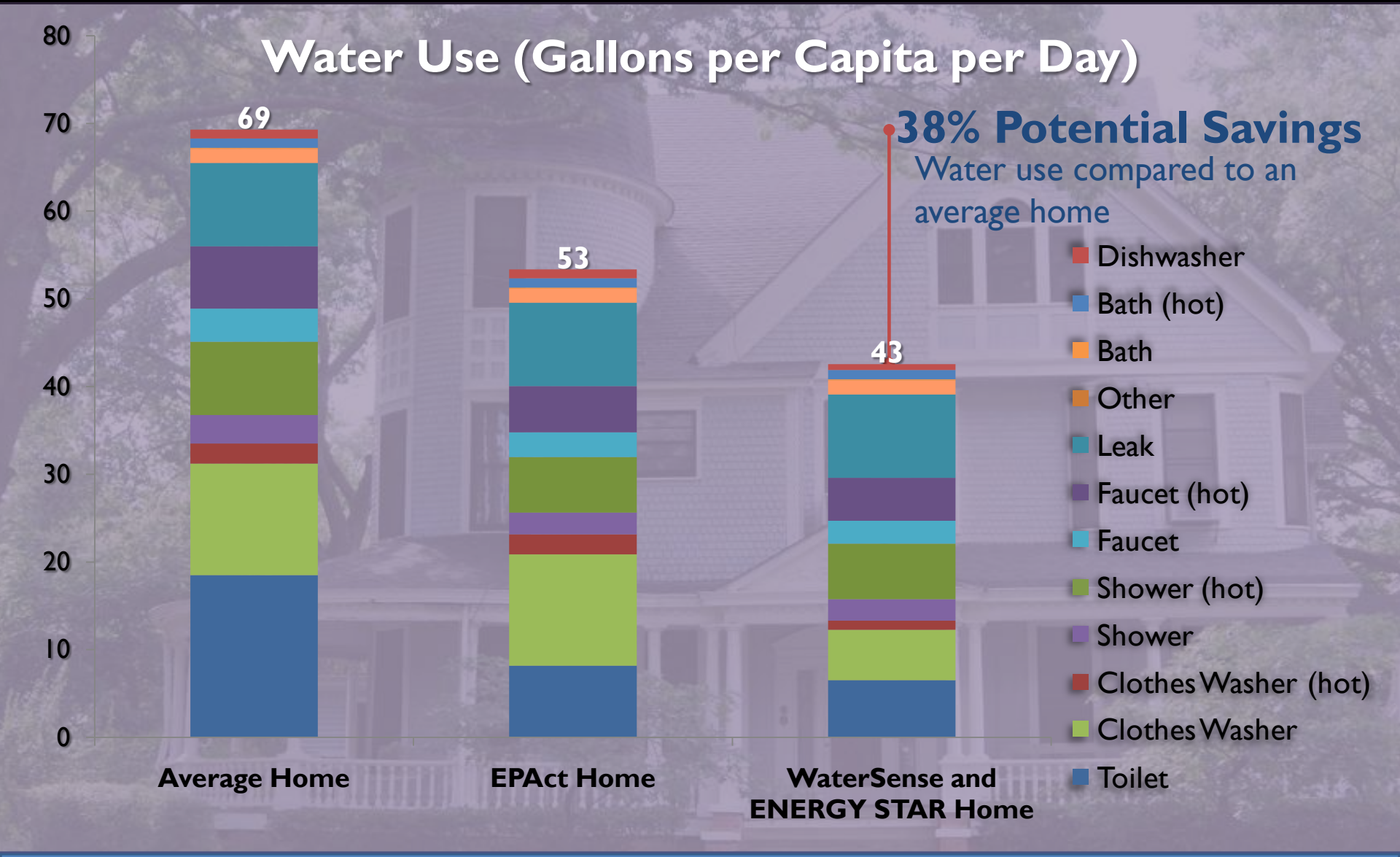
Residential Water Saving Strategies



Meyer et al. 1999, Aquacraft 2003, ENERGY STAR calculators, WaterSense specifications, and EPAct Standards

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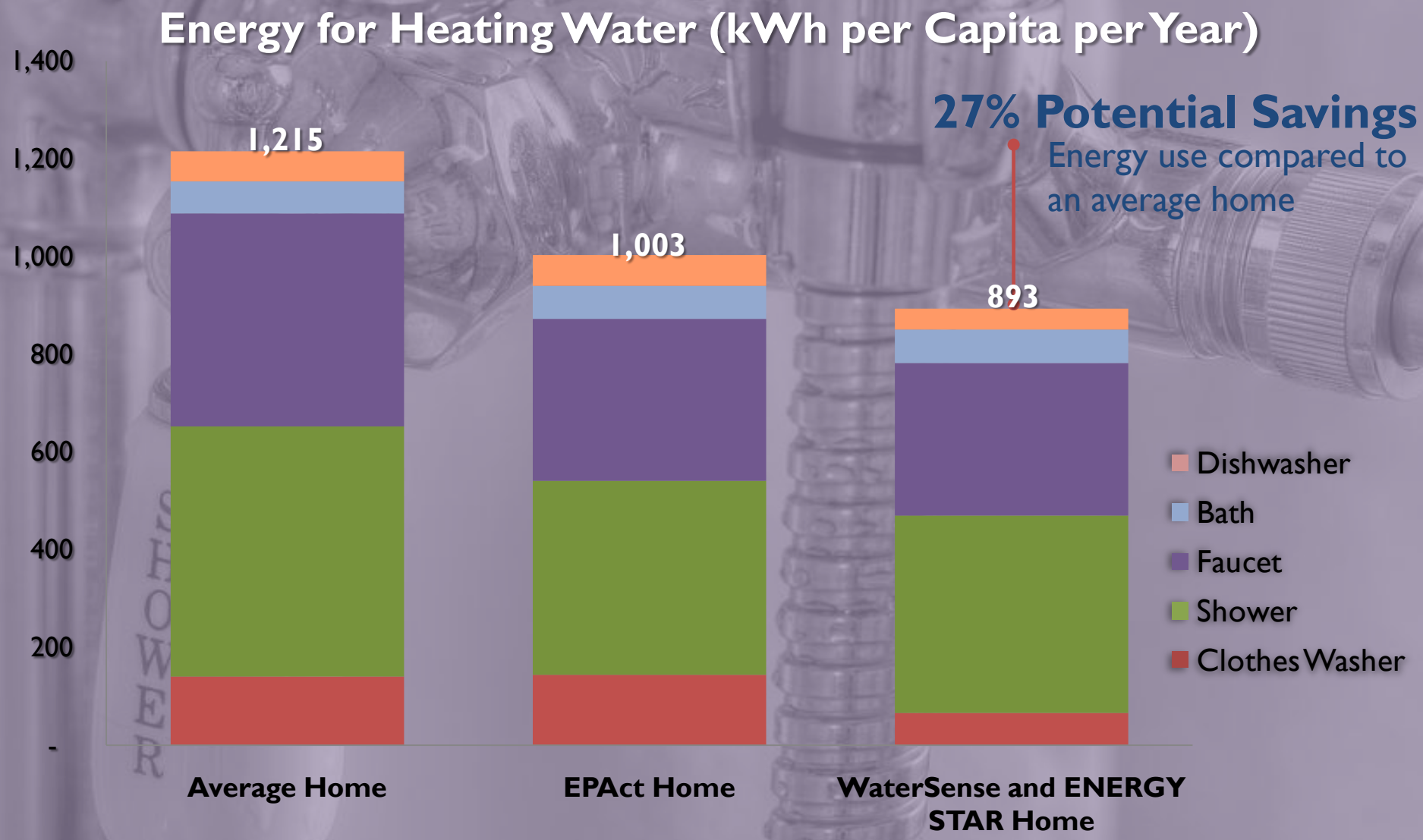
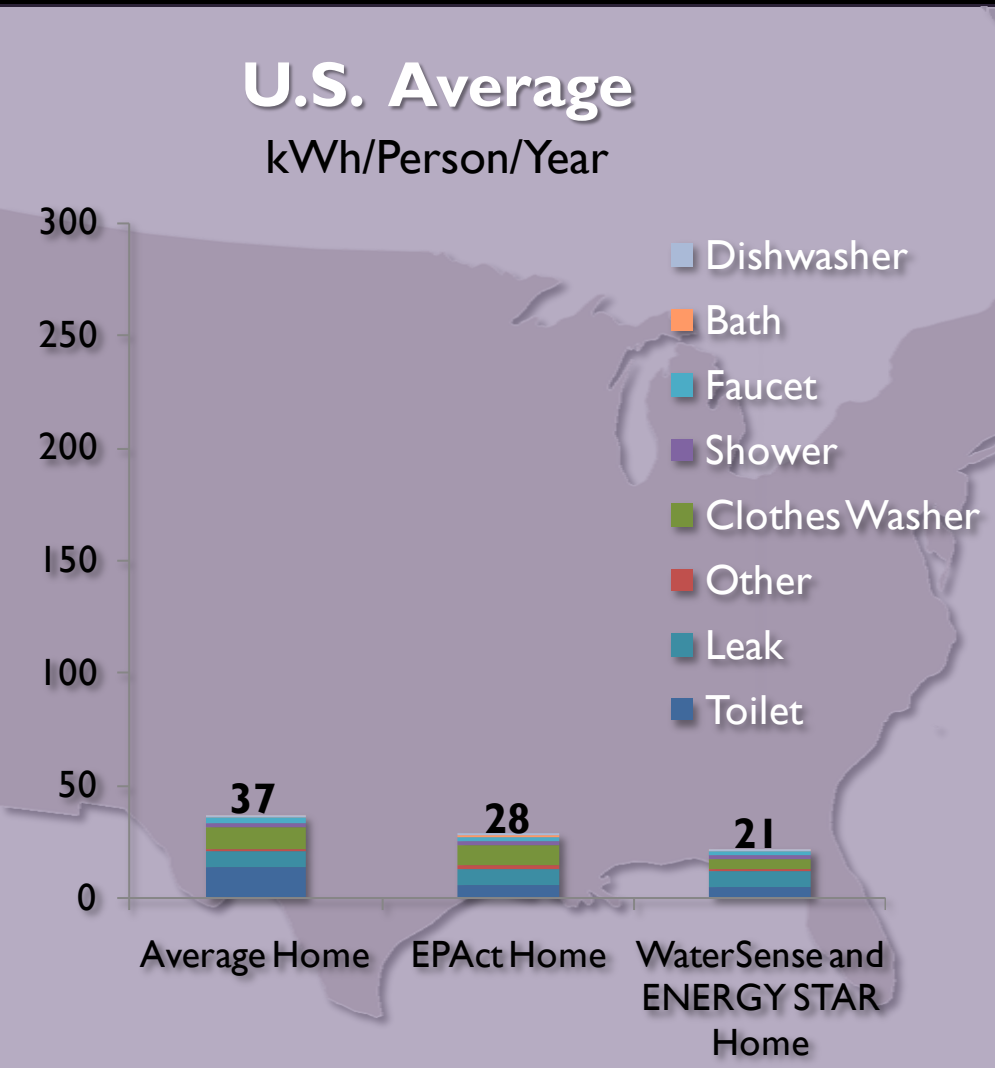
Residential Hot Water Energy Consumption

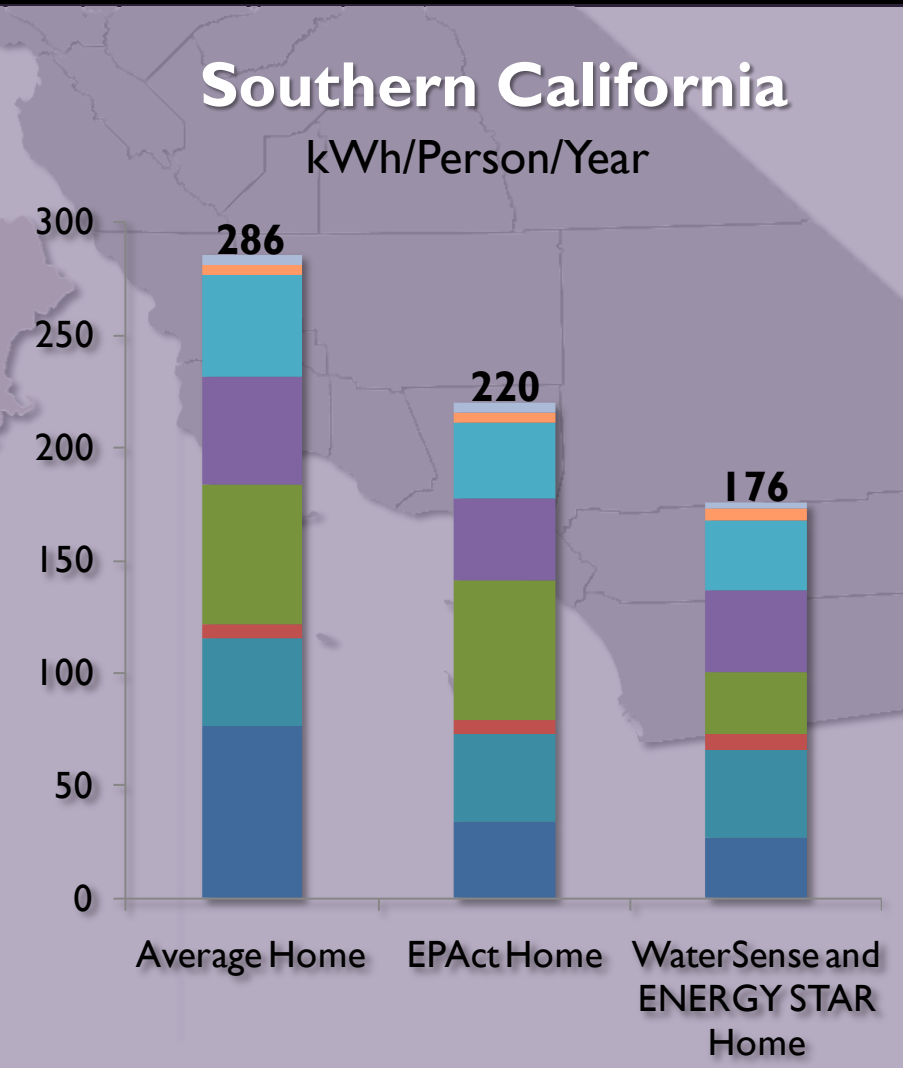


Aquacraft 2003

Residential Embedded Energy for Water Supply



Water Supply: 1,785 kWh/MG



Water Supply: 11,110 kWh/MG

California Energy Commission 2006

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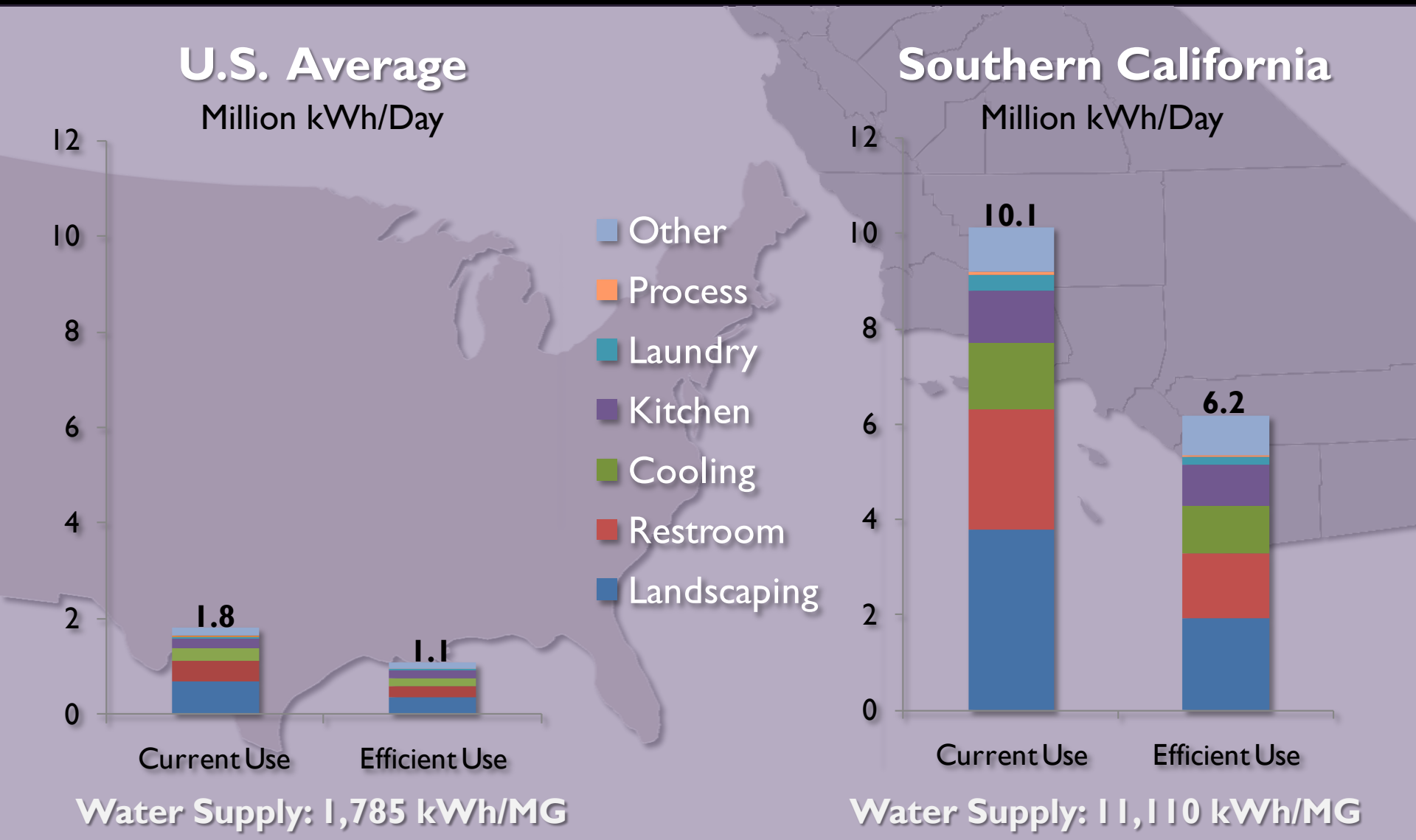
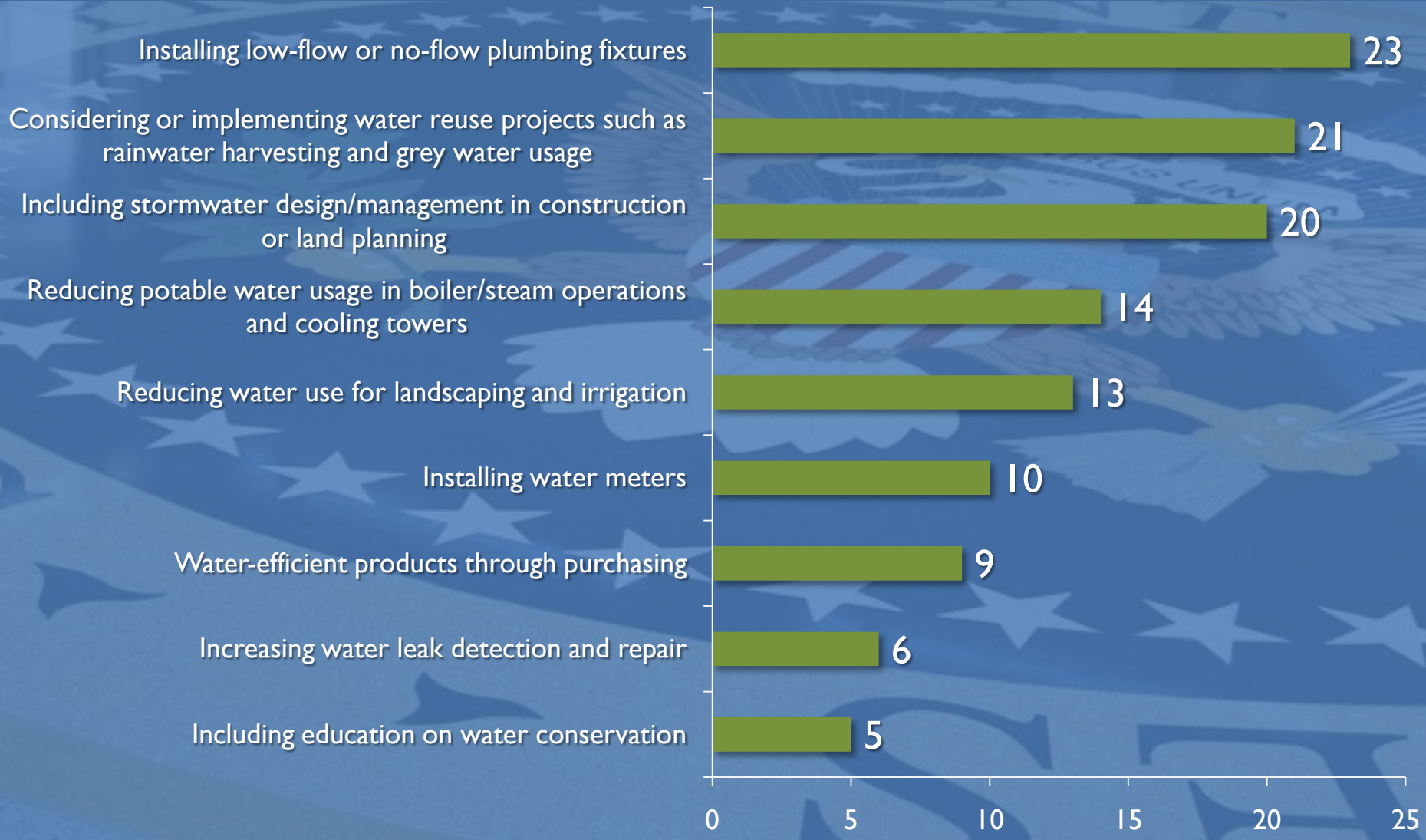
Potential Embedded Energy Savings in Nine C&I Sectors in California



California Energy Commission 2006

Current Executive Agency Water Efficiency Initiatives

Current Executive Agency Water Efficiency Initiatives



Number of Agencies that included this strategy as a way to reduce potable water intensity

Office of Management and Budget 2011

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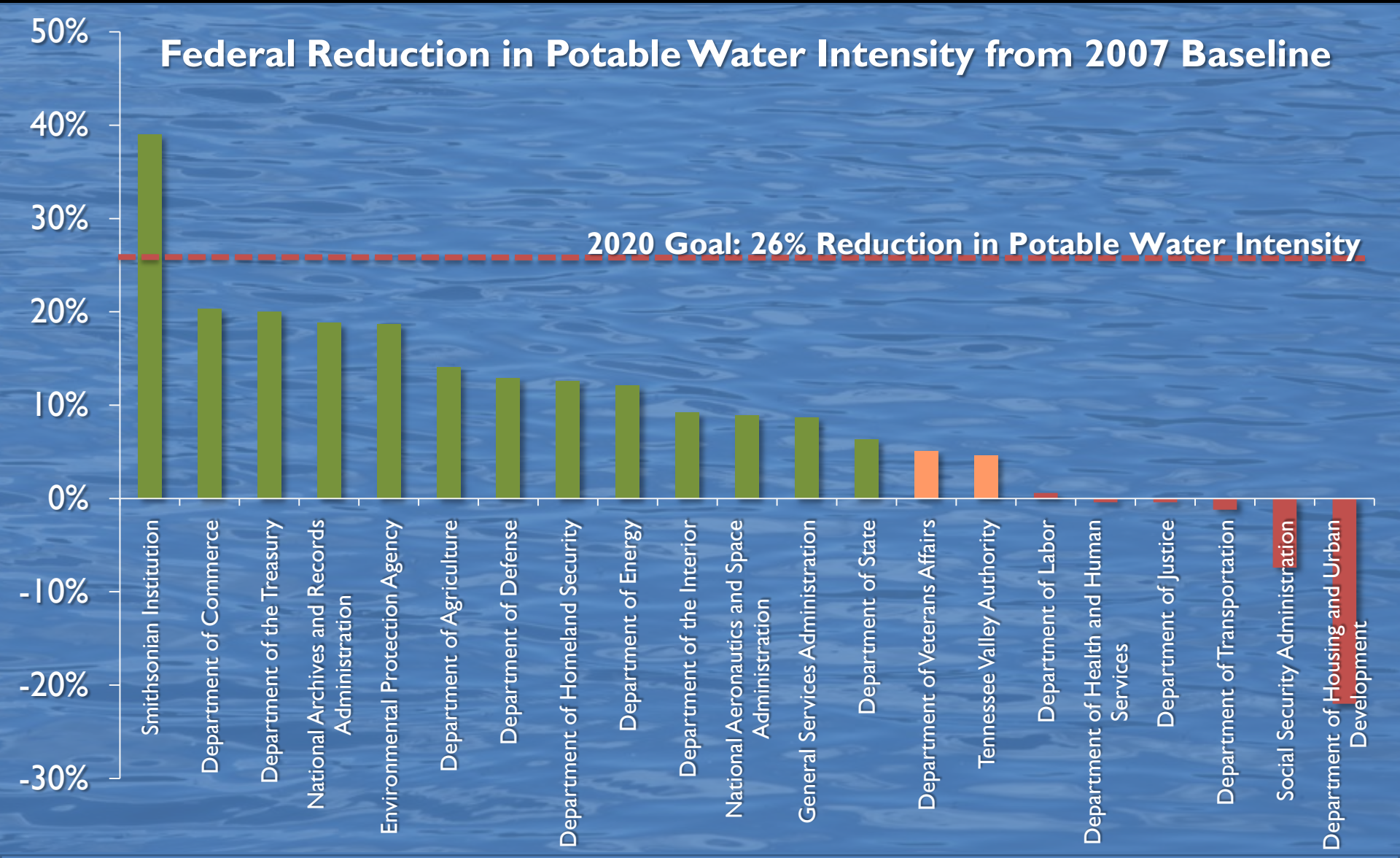
Agency Water Reduction Accomplishments FY2010



Office of Management and Budget 2011

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Illustrative Example of Water, Energy, and GHG Savings by Replacing Appliances

Example Building Assumptions

Building	10 Stories, 1,000 Employees, 1 Cafeteria
Toilets/Urinals	8 toilets and urinals per floor
Faucets / Aerators	8 faucets per floor
Spray Valves	2 spray valves per cafeteria
Commercial Dishwashers	1 commercial dishwasher in the cafeteria
Residential Dishwashers	1 residential dishwasher per floor
Showers	4 showers per building

ENERGY STAR Products

Annual Savings per ENERGY STAR Appliance in an Office Environment

ENERGY STAR	*Potential ENERGY STAR Savings*	Water Savings (Gallons)	Energy Savings (kWh)	Greenhouse Gas Savings (lbs. CO_2)
Commercial Dishwasher	*0.5 Gallons/Cycle*	255	2,845	3,801
Residential Dishwasher	*2 Gallons/Cycle*	520	91	122

Assumes one cycle per day for residential dishwashers. Assumes commercial dishwashers clean two racks per day. A Federal office is open for 260 days a year. Energy and GHG savings come from water pumping, treatment, heating, and wastewater management.

WaterSense℠ Products

Annual Savings per WaterSense℠ Appliance in an Office Environment

EPA WaterSense	*Potential WaterSense Savings*	Water Savings (Gallons)	Energy Savings (kWh)	Greenhouse Gas Savings (lbs. CO_2)
Toilets	*2.2 GPF*	25,530	77	102
Urinals	*0.5 GPF*	5,750	17	23
Faucets	*0.6 GPM*	1,725	227	304
Showers	*0.5 GPM*	1,150	152	203
Spray Valves*	*1.1 GPM*	5,482	723	967

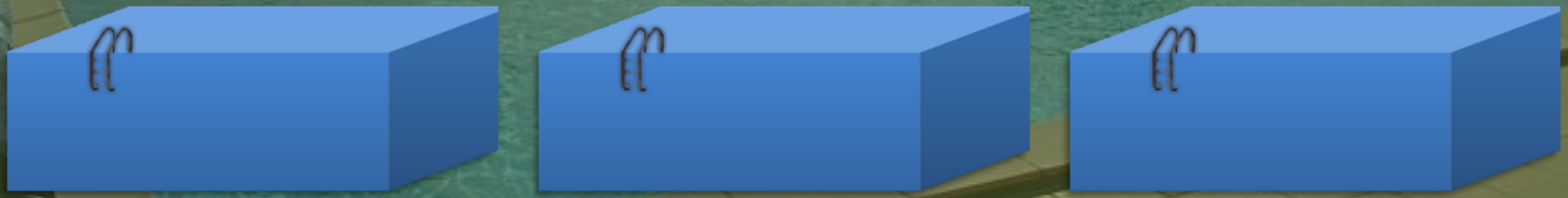
Assumes 50 flushes per day, per toilet and urinal in an office environment. A faucet is used for 12.5 minutes per day. Showers run for 50 minutes per day. *Spray valves values come from assumptions from a Notice of Intent and are based upon 50 dishes a day. Energy and GHG savings come from water pumping, treatment, heating, and wastewater management.

WaterSense℠ Toilets

Replacing a **single** traditional toilet with a WaterSense℠ (1.28 GPF) toilet would save **25,500 gallons** per year

=

Enough water to fill 3 swimming pools



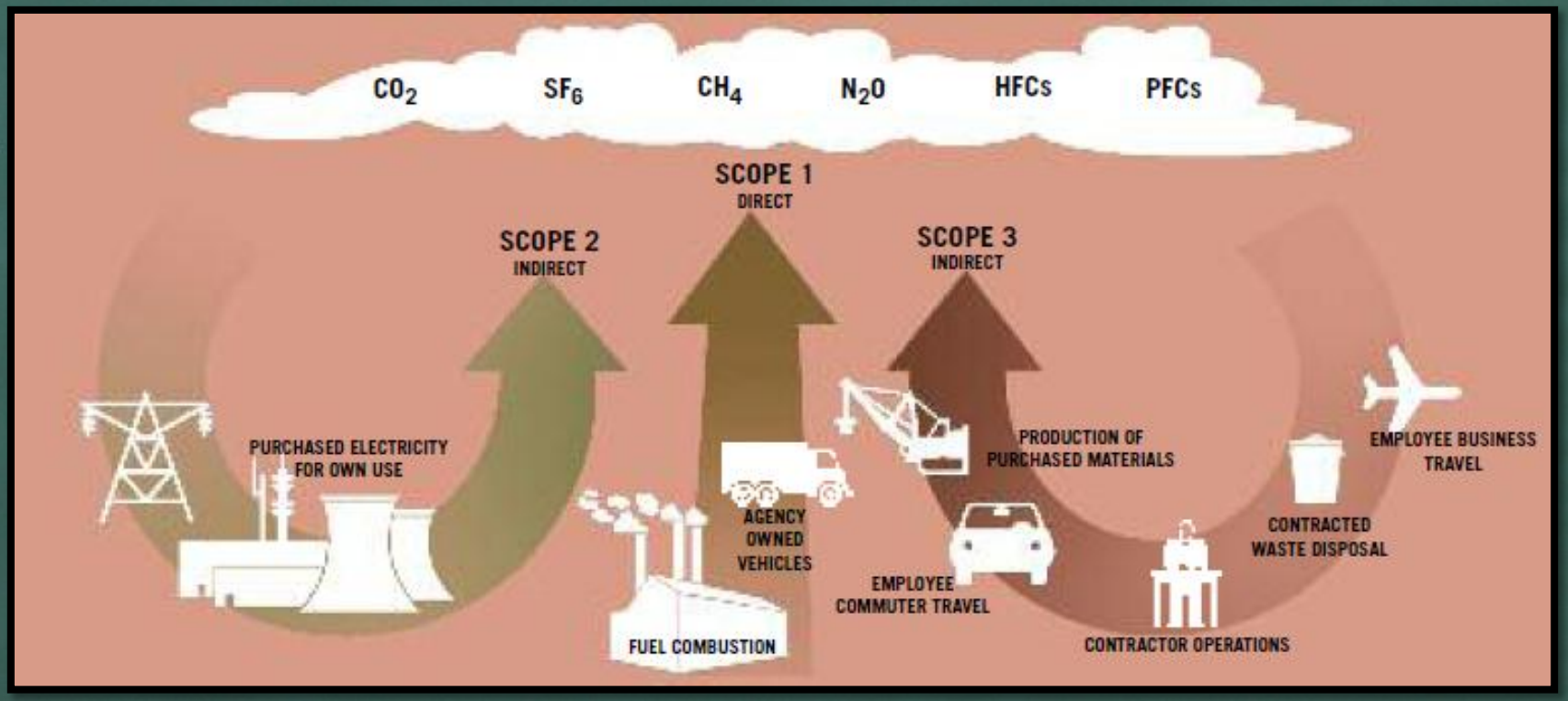
Annual Greenhouse Gas Savings By Scope

Annual GHG Emissions Savings per Appliance

Appliance	Heating & Operational Energy	Water Supply & Distribution
Toilets	-	102 lbs CO_2
Faucets/Aerators	297 lbs CO_2	7 lbs CO_2
Spray Valves	945 lbs CO_2	22 lbs CO_2
Commercial Dishwashers	3,800 lbs CO_2	1 lbs CO_2
Residential Dishwashers	120 lbs CO_2	1 lbs CO_2
Showers	198 lbs CO_2	5 lbs CO_2

ENERGY STAR 2011, WaterSense 2011

Overview of Emission Scopes



WRI - Greenhouse Gas Protocol 2010

What Your FEMP Report Will Show

	Water	Energy Purchased for Heating	GHGs	Energy for Water Supply & Treatment	GHGs
Toilets					
Faucets/ Aerators					
Spray Valves					
Dishwashers					
Clothes Washer					
Showers					

Assumes purchased electricity for water heating

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What The Environment Sees

	Water	Energy Purchased for Heating	GHGs	Energy for Water Supply & Treatment	GHGs
Toilets					
Faucets/ Aerators					
Spray Valves					
Dishwashers					
Clothes Washer					
Showers					

Assumes purchased electricity for water heating

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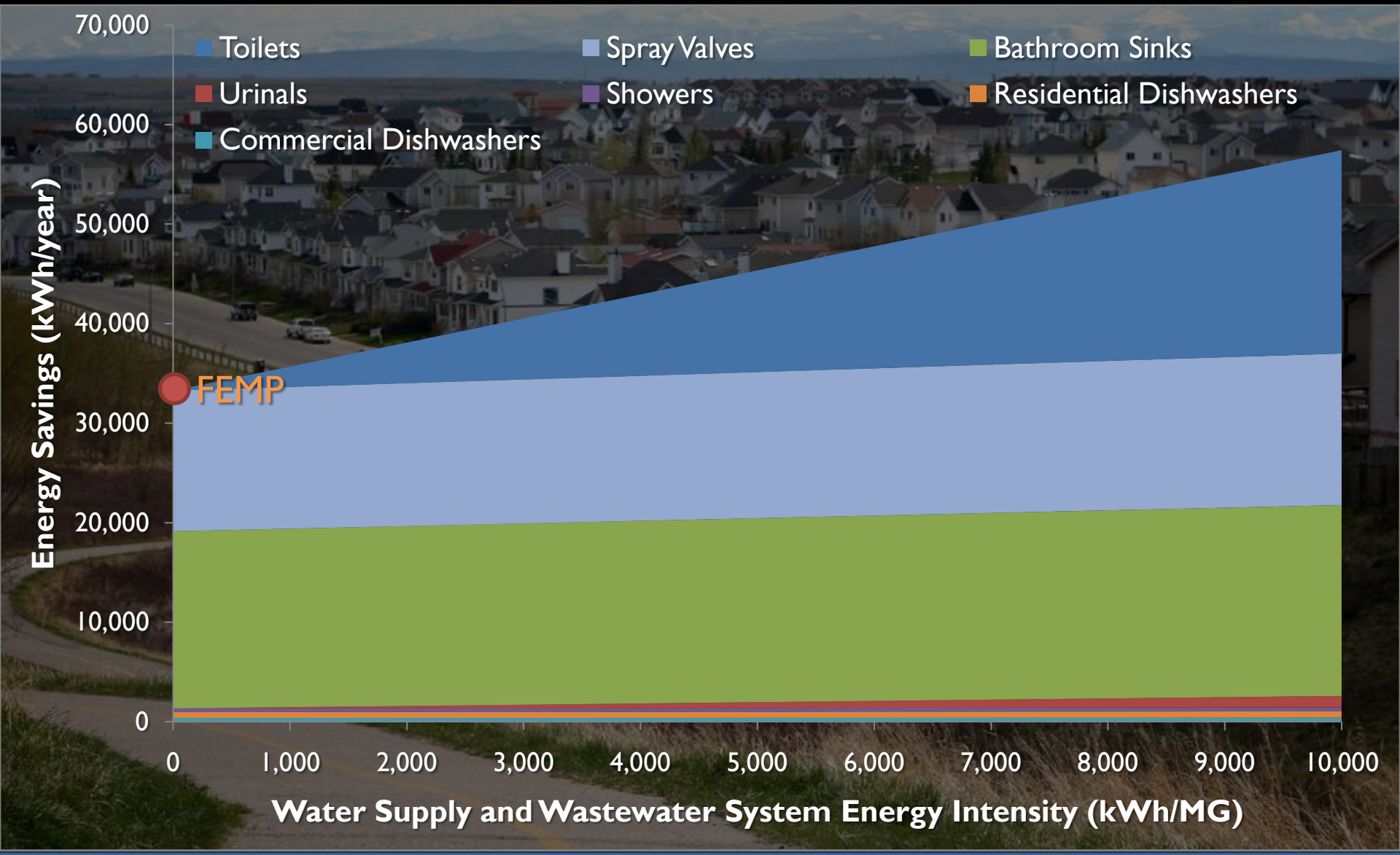
Potential Energy Savings By Replacing Appliances In a 1,000-Person Building



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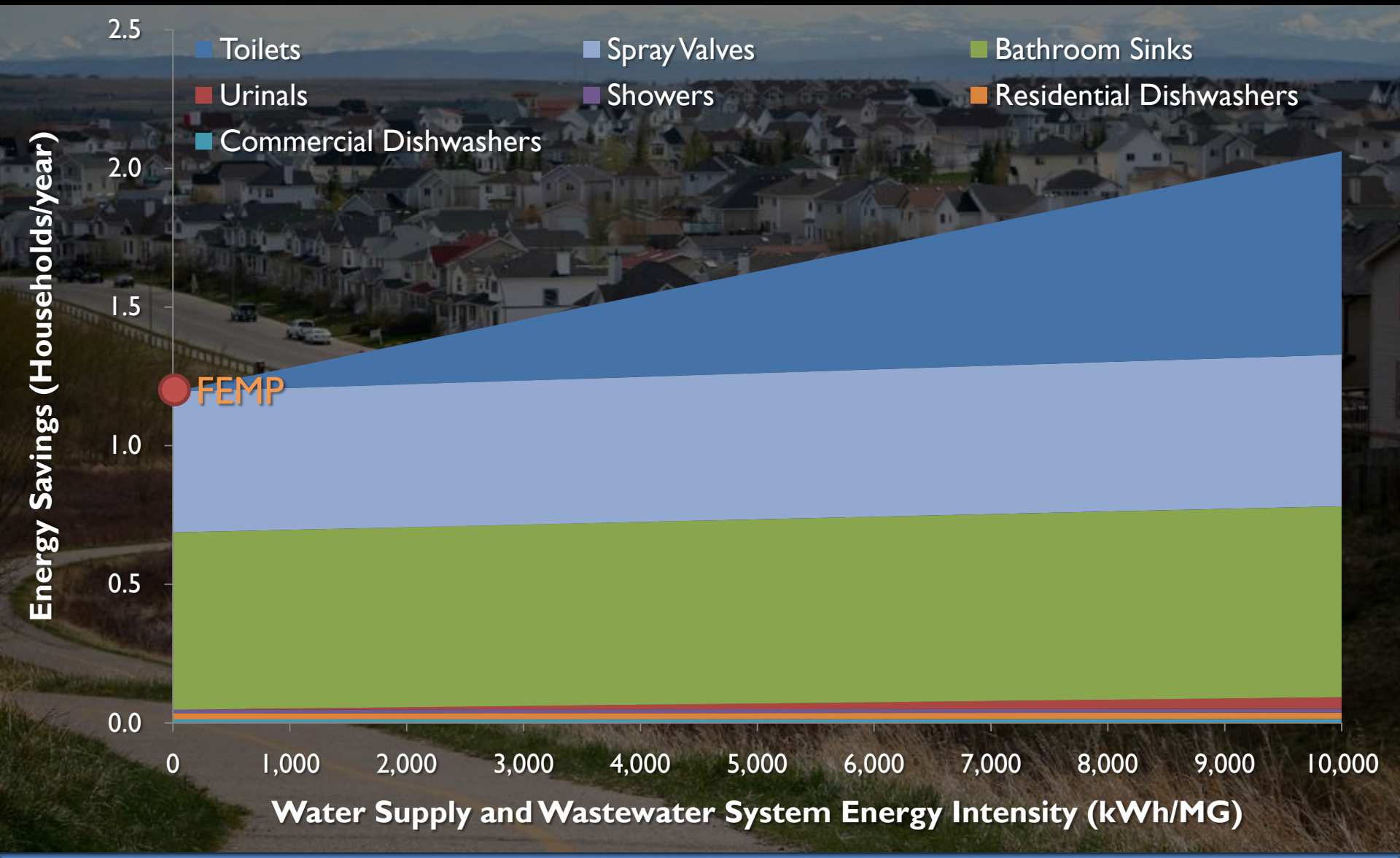
Equivalent Number of Homes Removed from the Grid



U.S. Energy Information Administration 2004

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Conclusions

Energy and Water are Linked

Energy Intensity is Site Specific

Opportunities Exist to Leverage Water and Energy Efficiency Initiatives to Save Both Resources

Energy and GHG Savings are a Significant Co-benefit of Water Efficiency Initiatives

Water Efficiency Initiatives Are Strategy to Contribute to Meeting Scope 1 and 2 GHG Goals

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Thank You!

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