

A Look at the Bottom Line

Advances in Commercial and Institutional Water Efficiency

Presented by
H.W.(Bill) Hoffman, P.E.
H.W. (Bill) Hoffman and Associates, LLC
512-294-7193



Presented at the 2015 ICI Technical Workshop for Austin Water.

What Will Be Covered

- **A look at the rapid increase in water and sewer costs to business nationally**
- **Examination of what this could mean to your bottom line in the future**
- **Examination of dollar savings by using the new technologies available**
- **How to tell how my facility compares to others in the same business**

Circle of Blue April, 2015

<http://www.circleofblue.org/waternews/2015/world/price-of-water-2015-up-6-percent-in-30-major-u-s-cities-41-percent-rise-since-2010/>

*Price of Water 2015: Up
6 % in 30 Major U.S. Cities;
41 % Since 2010!*

Long-term trends in consumer prices (CPI) for utilities

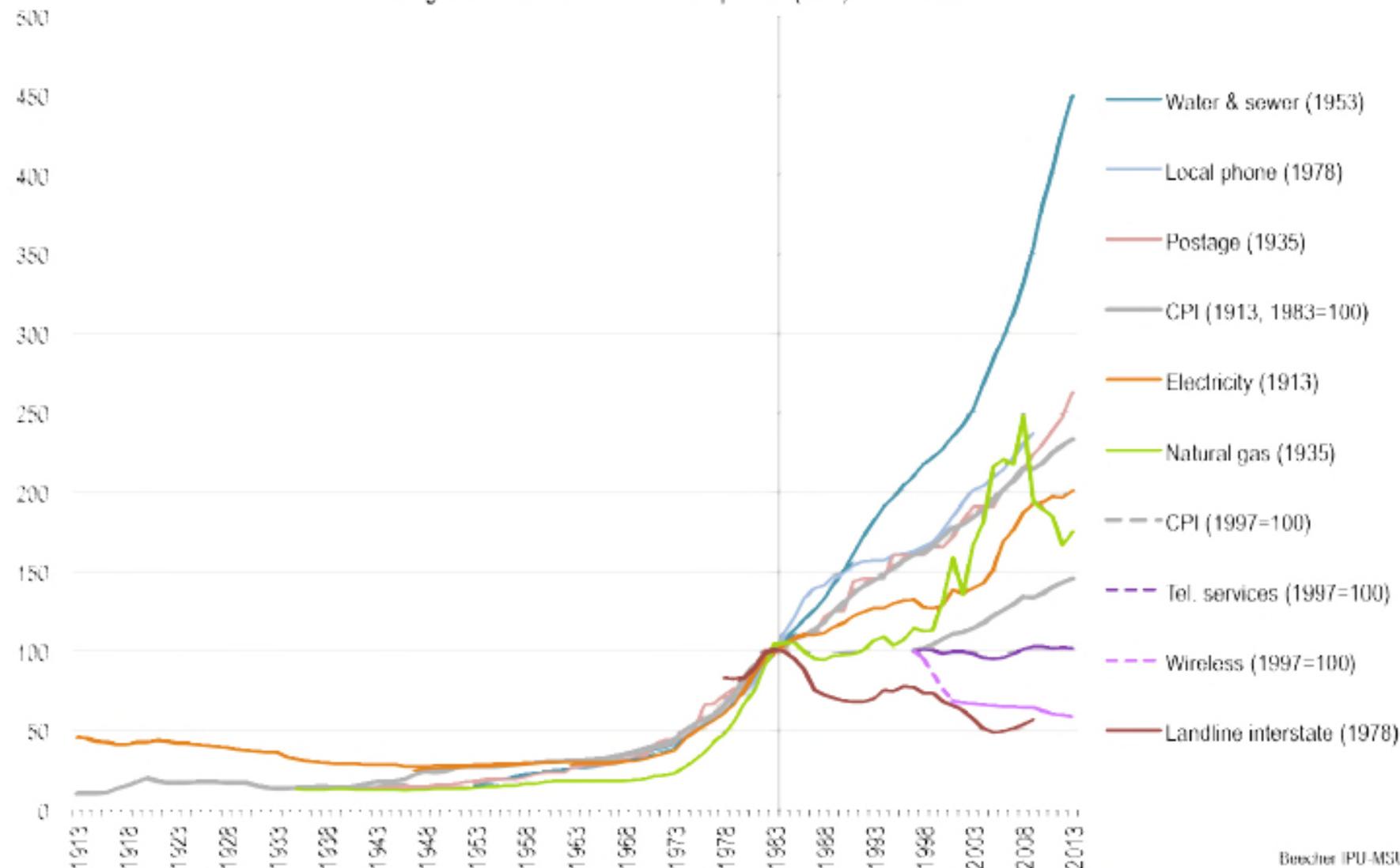


Exhibit 1. Long-term trends in the Consumer Price Index (CPI) for utilities (1913-2013). The index is set to 100 for 1982-1984 except for telephone and wireless services, where the index is set to 100 for 1997. Year (*) indicates start of series.

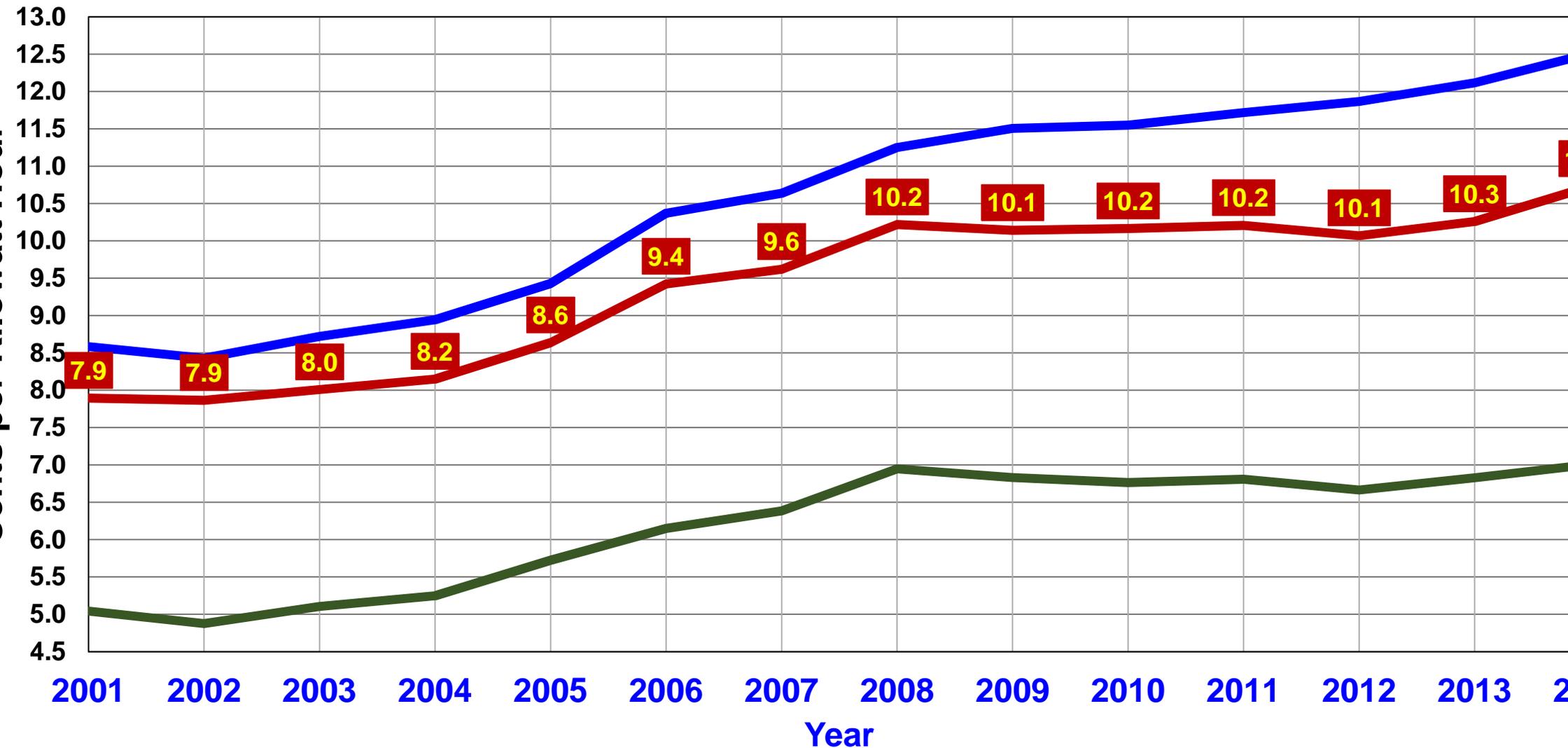
**“Water is the
oil of the 21st
century.”**

*Andrew Liveris,
Chief Executive,
Dow Chemical Co.,
August 2008.*

United States Annual Average Electric Power Rates

Cents per Kilowatt Hour

<http://www.eia.gov/electricity/data/browser/#/topic/7?agg=2,0,1&geo=g&freq=M>

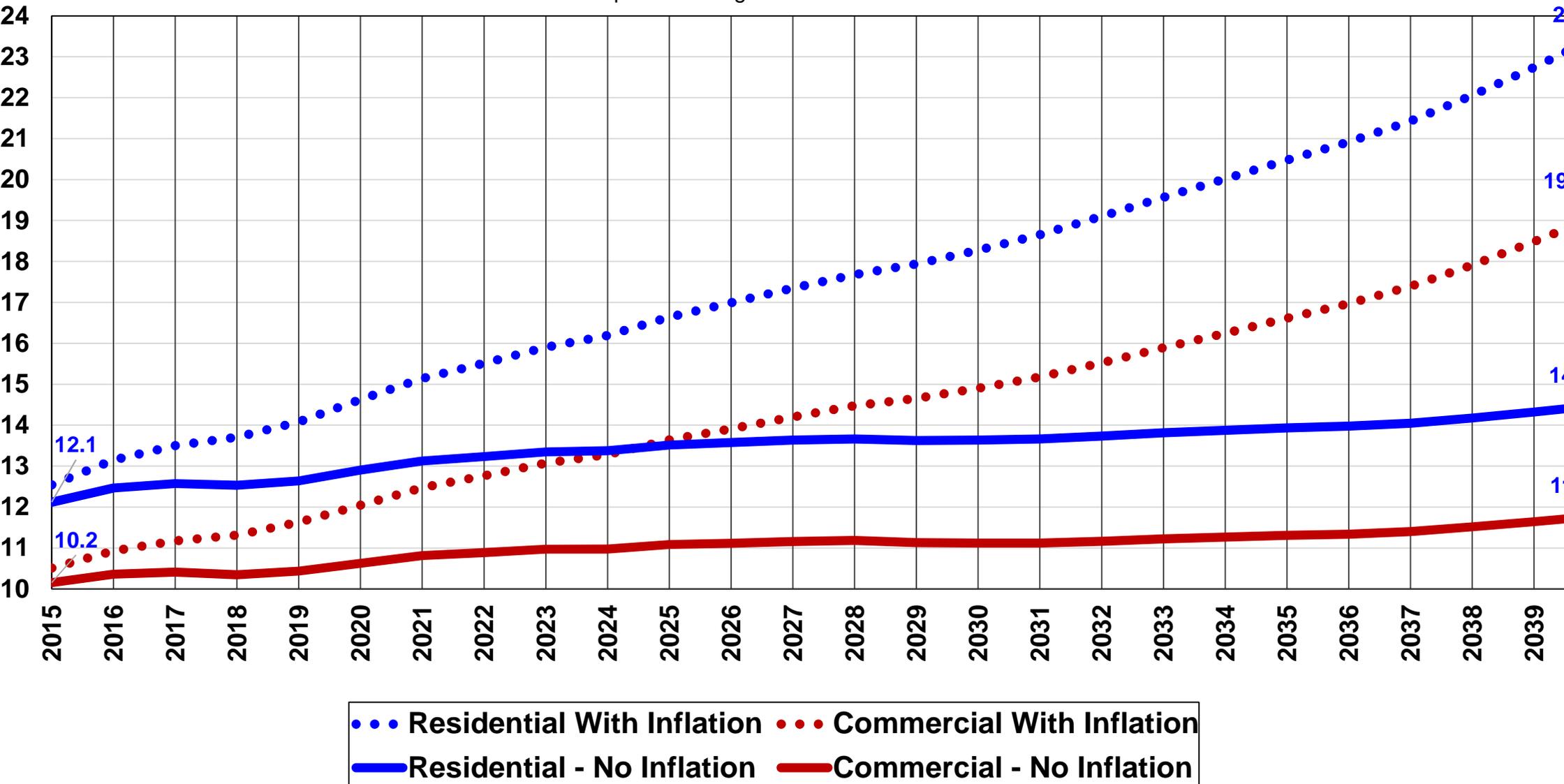


— Residential — Commercial — Industrial

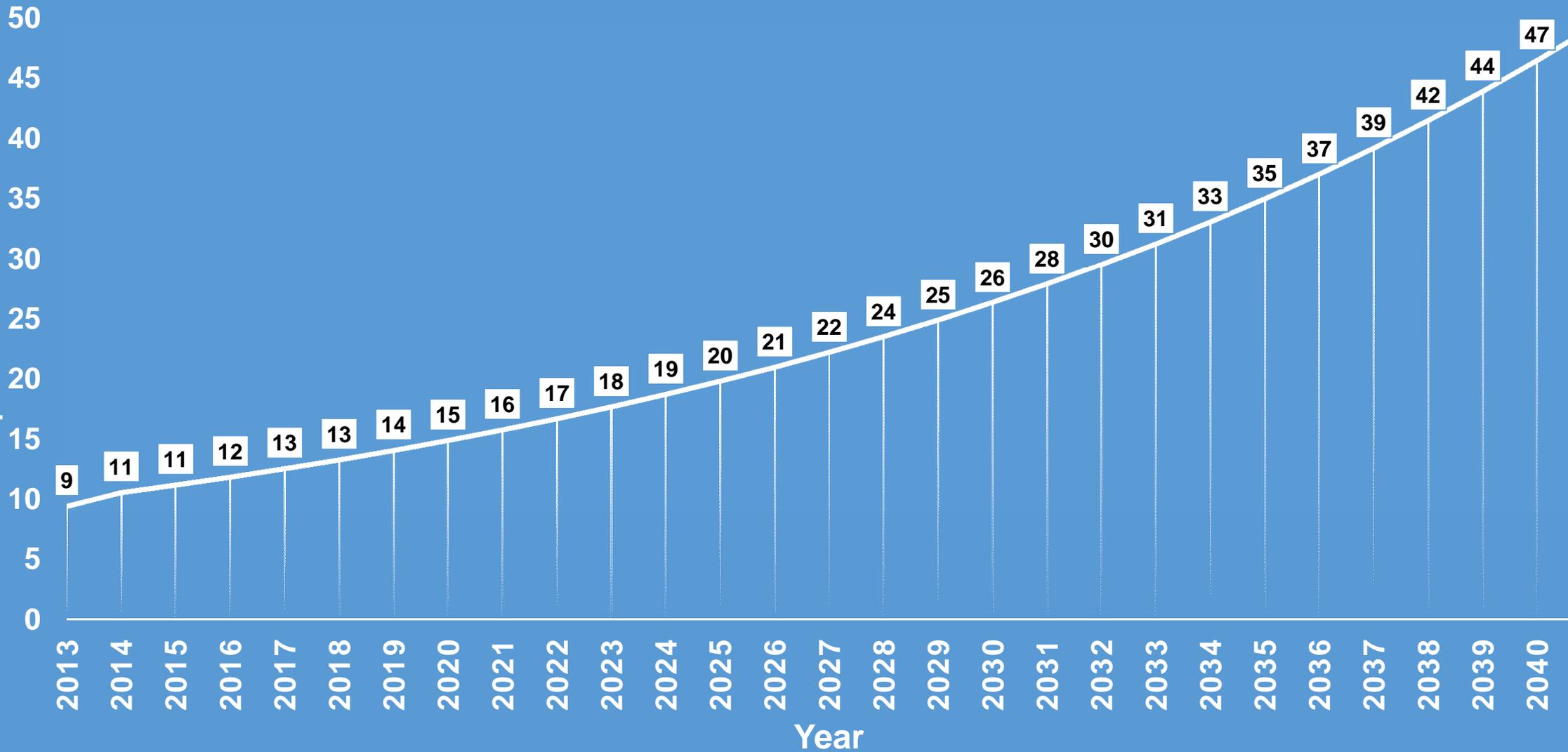
Projected Price of Electricity for the Residential and Commercial Sectors in the USA 2015-2040

A 1.87 fold increase

Source: <http://www.eia.gov/beta/aeo/#/?id=8-AEO2015>



PROJECTED FUTURE COST OF WATER AT CURRENT INFLATION RATE OF 5.85%



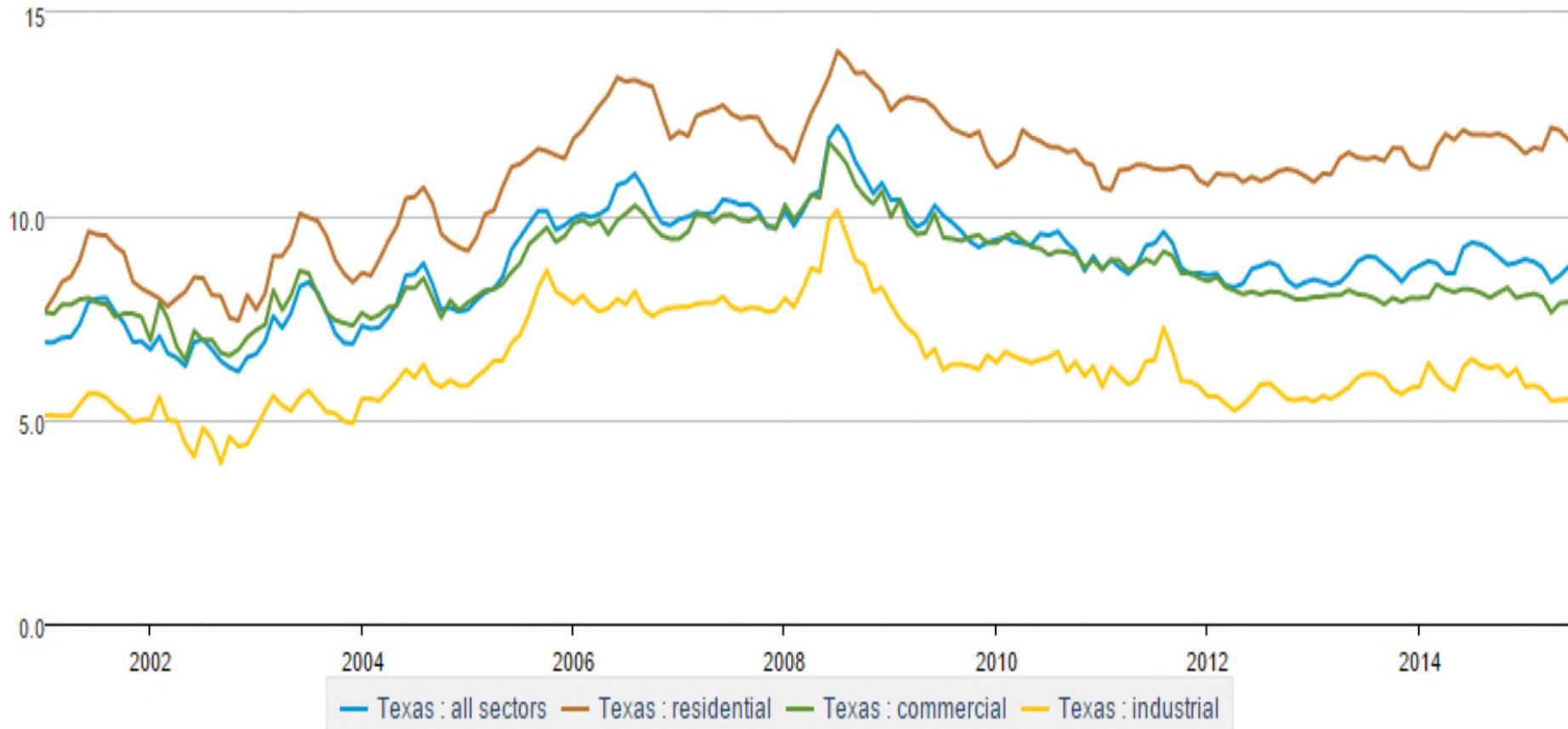
Average Electricity Prices in Texas

Average 2015 price 8.9 Cents/kWh

Average retail price of electricity, monthly

 DOWNLOAD

cents per kilowatthour

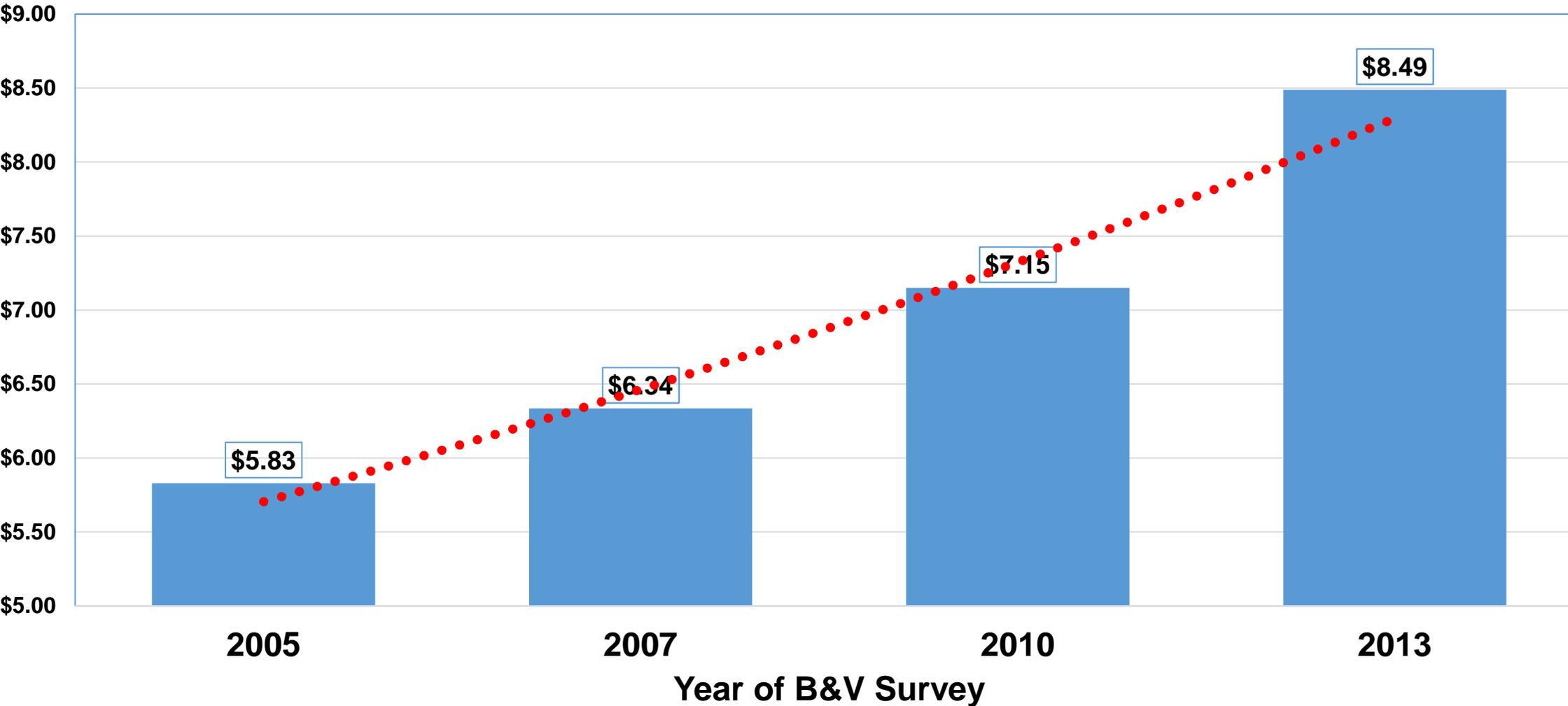


Data source: U.S. Energy Information Administration

Average Water & Wastewater Rates for Six Largest Cities in Texas

Austin, Dallas, El Paso, Fort Worth, Houston, & San Antonio

Source: Black & Veatch Reports for Top 50 Cities in USA

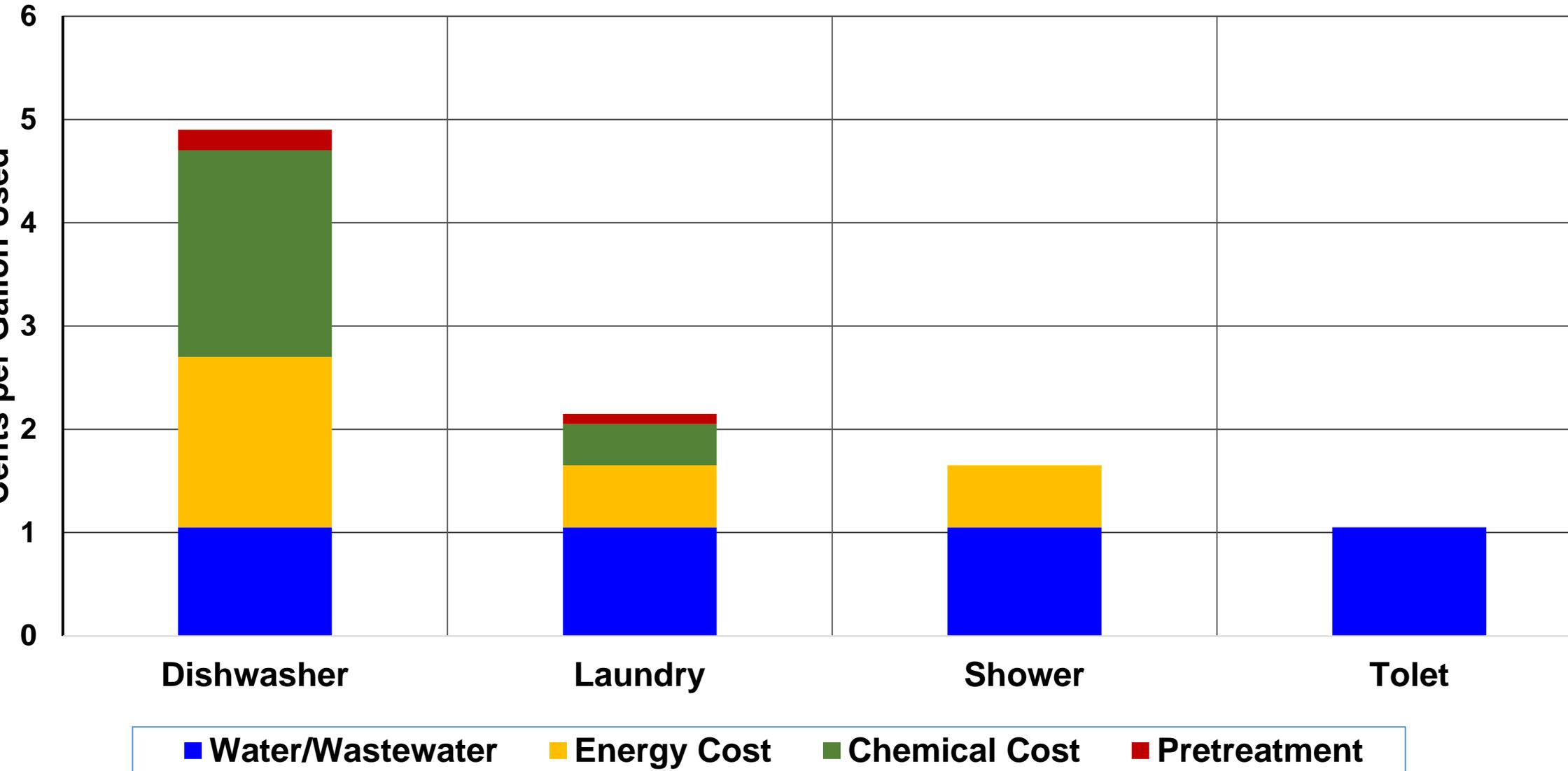


And again -

The True Cost of Water

- **Water Cost**
- **Sewer/Pre-treatment**
 - **Energy**
 - **Chemicals**
- **Solid Waste Disposal**
 - **Capital Equipment**
 - **Labor**
 - **Liability**

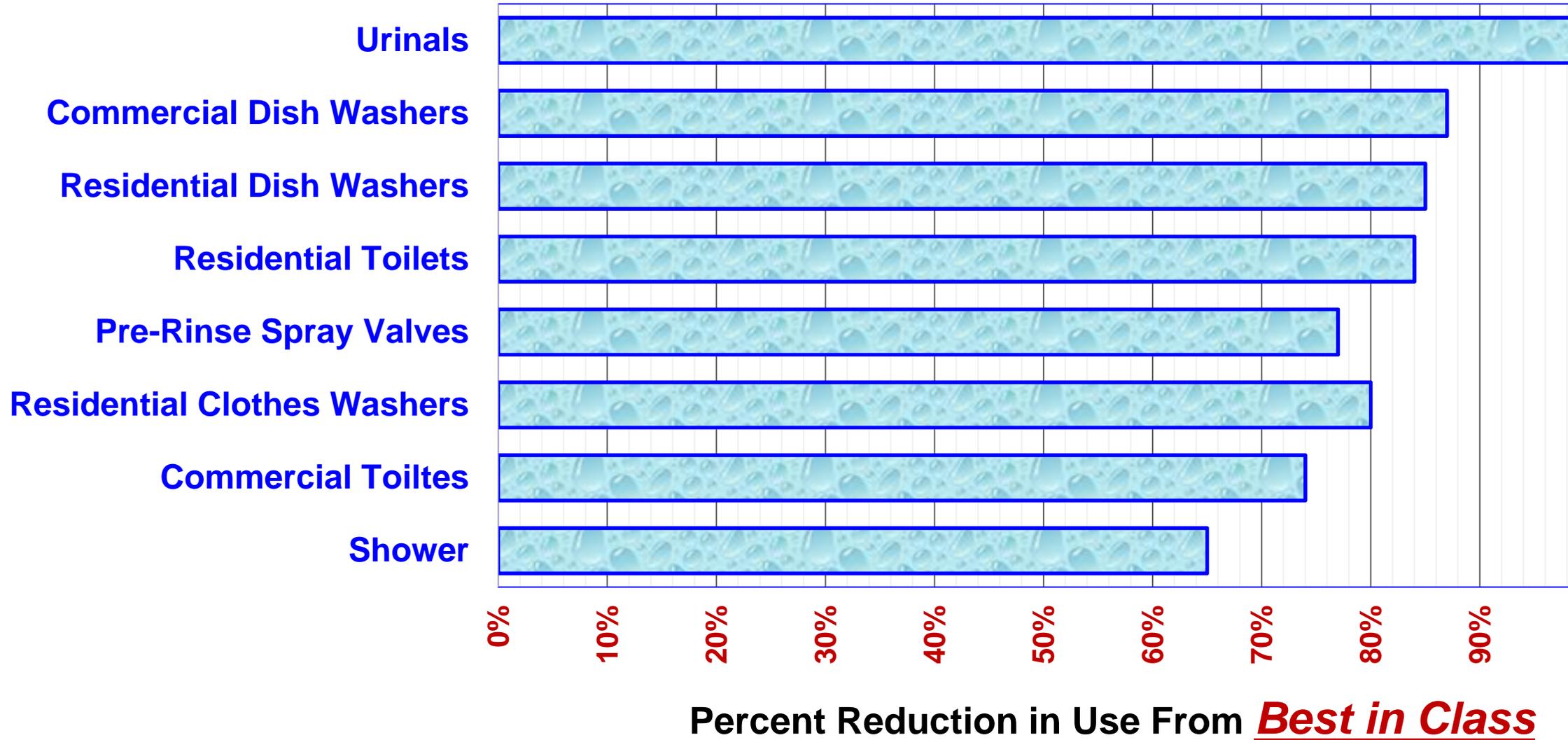
Cents per Gallon of Water Used By Type of Use 2015



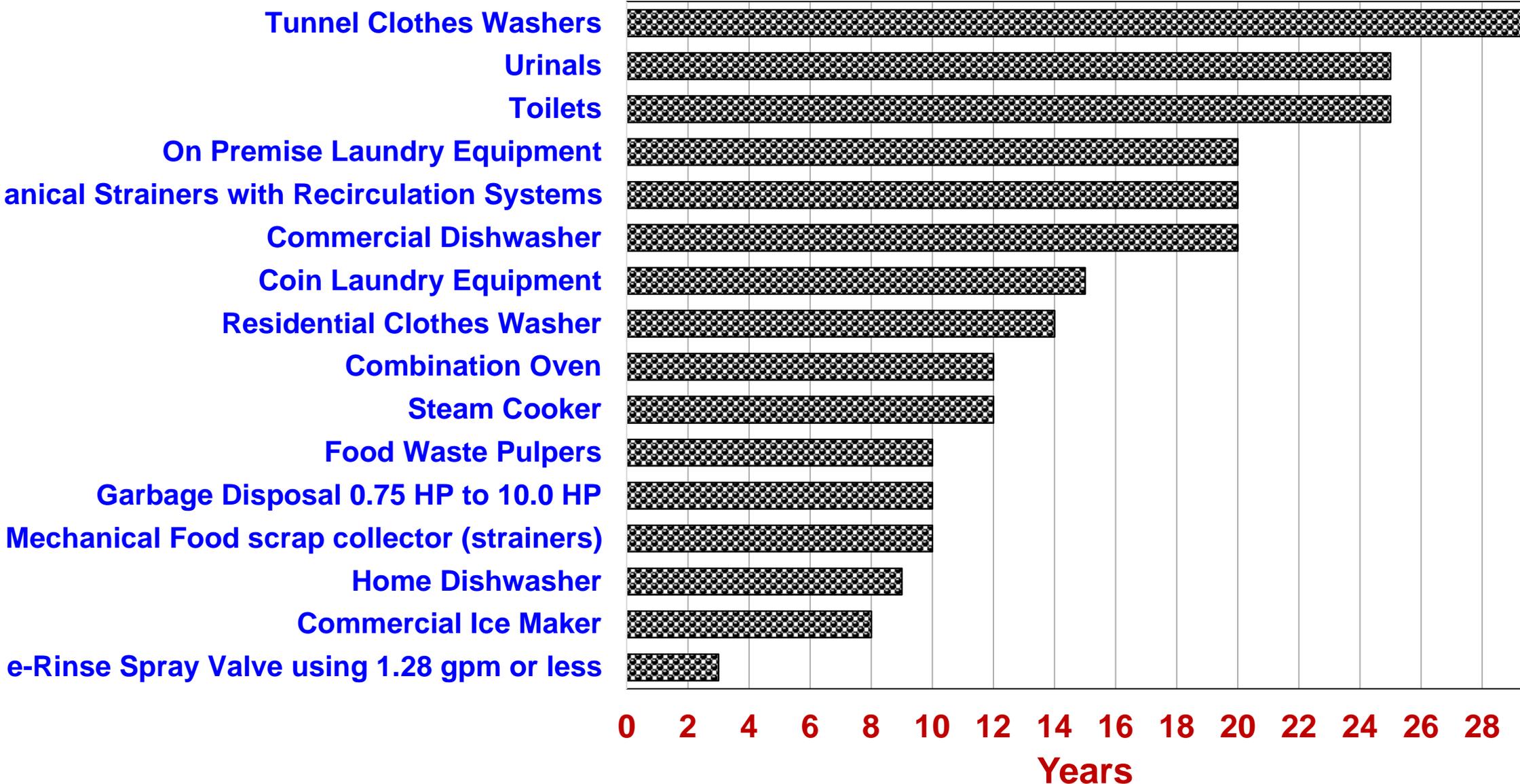
So How Does this Apply to

My Business!

Reduction in Water Use Since 1980 for Appliances and Plumbing Fixtures



Average Life of Appliances



Diaphragm Flush Valves Have Interchangeable Parts!



Cost to Flush a Toilet at Current Inflation Rate of 5.85%

Gallons per Flush	Cents per Flush in 2015	Cents per Flus in 2035
5	4.9	15.4
3.5	3.4	10.8
1.6	1.6	4.9
1.28	1.2	4.0

Dollars per Year for Flushing One Toilet in 2035

Gallons per Flush	Cents per Flush	Type of Facility		
		Home	Office	Restaurant
		6 flushes per day (365 days)	35 flushes per day (260 days)	75 flushes per day (365 days)
5	15.4	\$337	\$1,401	\$4,216
3.5	10.8	\$237	\$983	\$2,957
1.6	4.9	\$107	\$446	\$1,341
1.28	4	\$88	\$364	\$1,095

Water Use by Fixture Type

Fixture Type	Current Lowest <i>(commercial)</i>	Energy Policy Act	1980's	Before 1980's
Toilet (Gal./Flush)	1.28	1.6	3.5	5
Urinal (Gal./Flush)	0	1.0	1.5	3.5
Faucets (Gal./Min.)	0.5	2.2	3.5	3.5

Typical Plumbing Fixture Uses Per Person Per Day

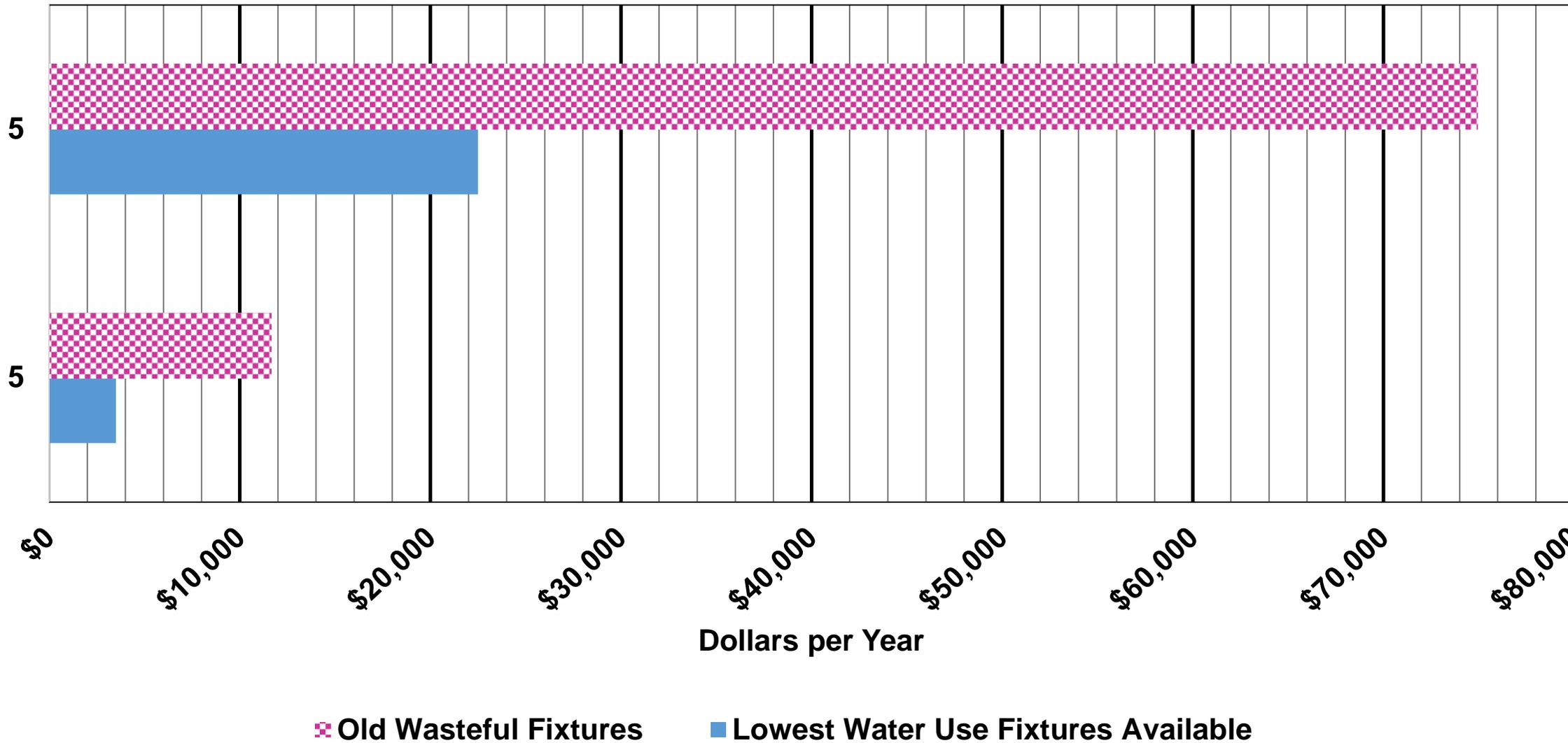
	Toilet	Urinal	Faucet
Males	1.2	2.5	4
Females	3.5	0	4
50%/50%	2.35	1.25	4

Total Water Daily Use per Person

Assumes 50%/50% male/female

Fixture Type	Lowest	Energy Code	1980's	Before 1980's
Toilet	3.0	3.8	8.2	11.8
Urinal	0	1.3	1.9	4.5
Faucet	0.2	0.9	1.4	1.4
TOTAL	3.2	5.9	11.5	17.5

Plumbing Cost For Example Building Now and In 2035



Pop up Sprinkler Heads Have Flow Rates of 1.5 gpm to 5.5 gpm



What does it cost to water?

The old standard pop up uses 4 gpm.

That is 4¢ per head per minute

If there are 15 heads and you operate it for 20 minutes, it costs \$12.

That is equal to paying an employee \$36 per hour.

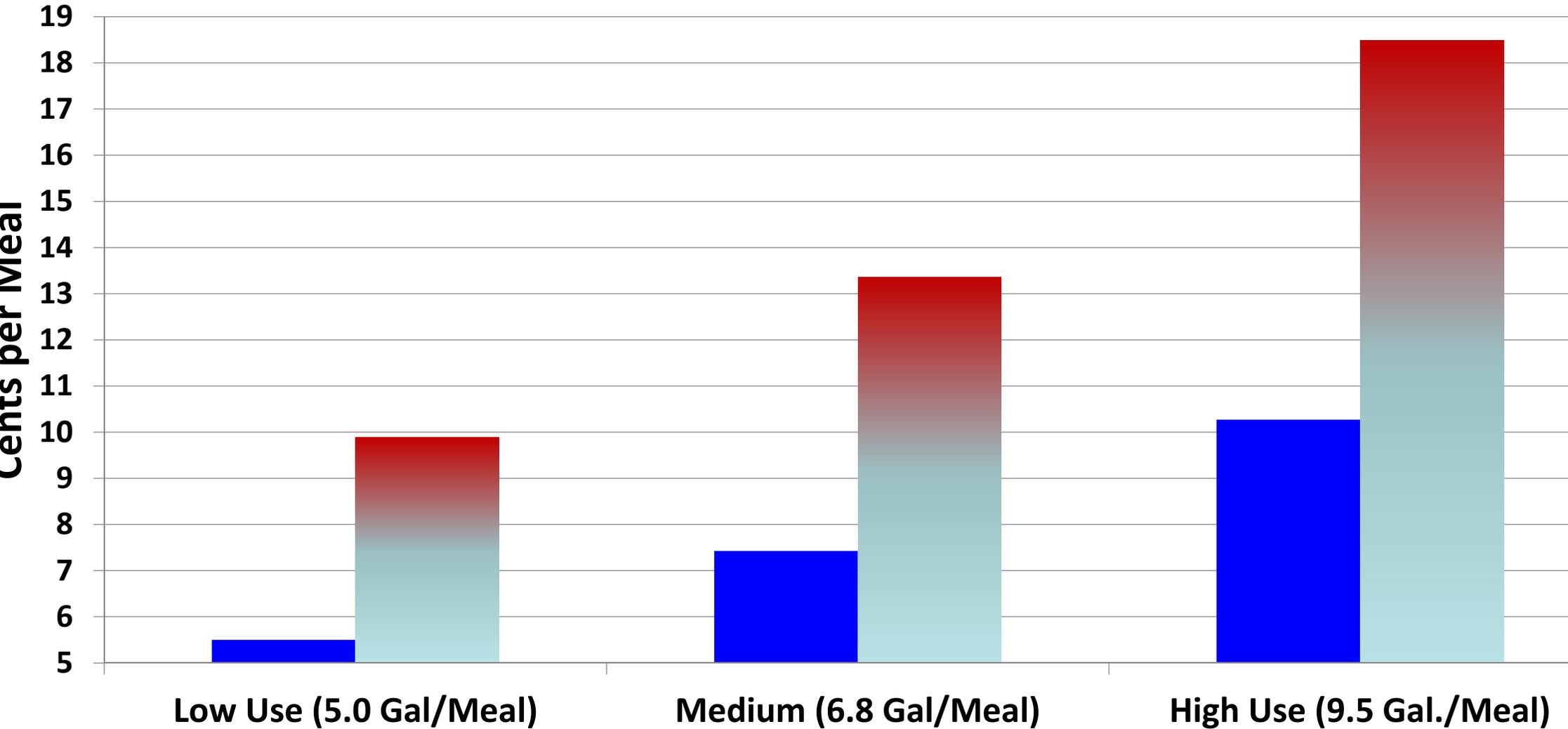
How many zones do you have and how many times do you run them per week?

By the way, at 5.85% inflation, in 20 years (2035) it will cost you \$38 to water 20 minutes which is equal to an employee at \$114 per hour.

Another Example from Restaurants and Food Service

Current and Future Cost per Meal 2014 & 2034

Includes kitchen, restrooms & other indoor uses

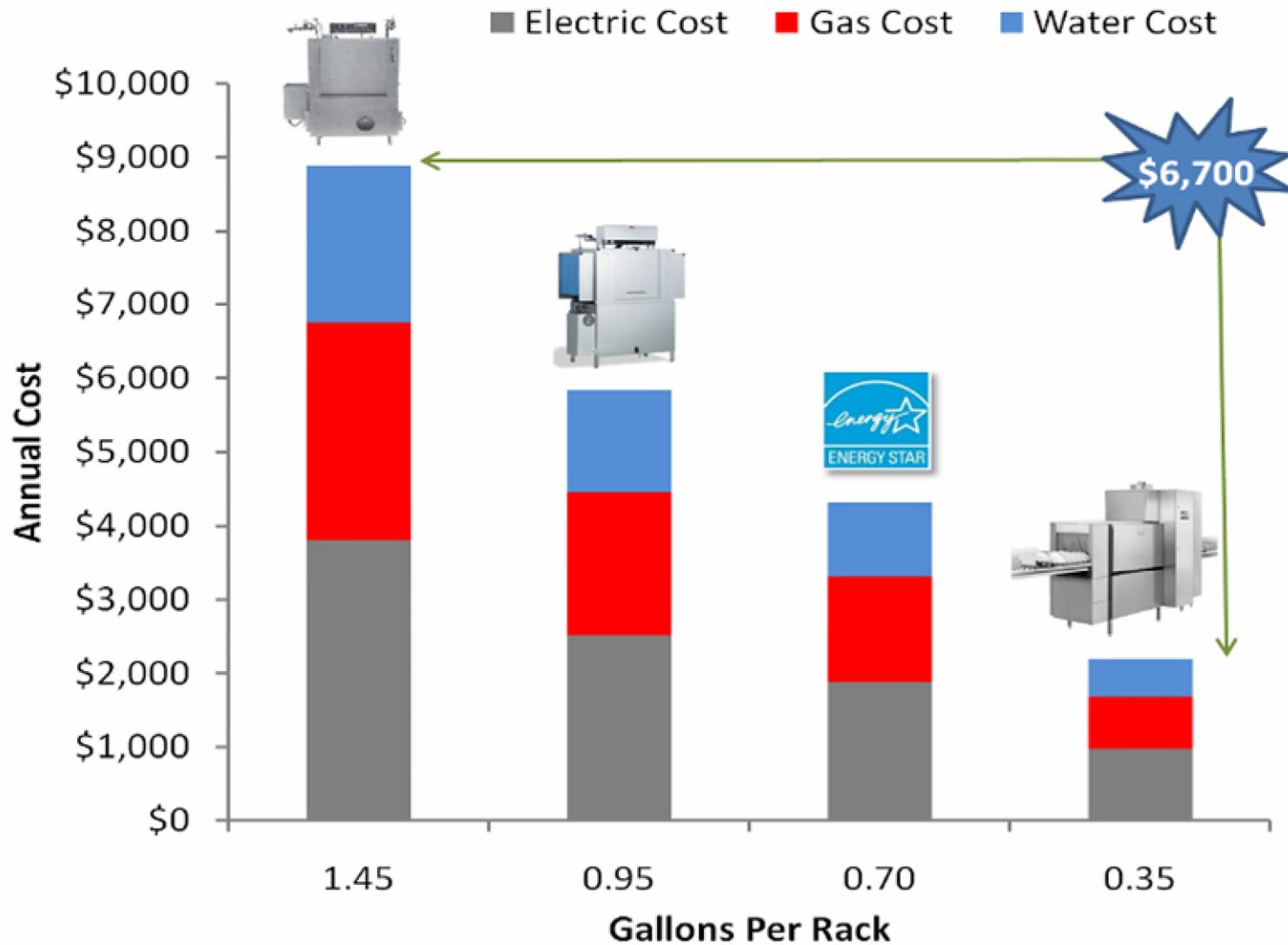


The Evolution of Ware Washing

Based on conveyor type dishwasher

- **1990's - 2.5 Gallons per Rack**
- **2000 - 1.2 Gallons per Rack**
- **2015 most efficient < 0.4 Gal./Rack**

Conveyor Dish machines



***Refrigeration
&
Ice Making***



Air cooled ice machine



Water cooled ice machine
(no louvers)

[Jump to first page](#)



Generalized Energy Recommendations from DOE for Ice Machines Used at Federal Facilities

Machine Capacity in Pounds of Ice Produced per Day	Kilowatt Hours for Air Cooled Machines	Kilowatt Hours for Water Cooled Machines	Difference	Energy Cost Savings (Cents per 100 pounds of ice @ 10)
500 to 750	<5.5	<4.1	1.4	14
750 to 1500	<5.0	<3.5	1.5	15
1500 up	<4.6	<3.4	1.2	12
Average Savings per 100 Pounds of Ice Based on Electricity at 10 Cents per kWh				13.7

Air Cooled Cost Savings Using DOE Latest Recommended Energy Standards for Ice Machines

At a water & sewer cost of only **\$2.50/Kgal!!!!**

Gallons per 100 lb.	Cost of Water and Wastewater Combined \$2.50 per kGal (Cents/100 Pounds)	Energy Savings per 100 Pounds With Water Cooled Equipment (Cents/100 Pounds)	Net Savings per 100 Pounds with Air Cooled Equipment (Cents/100 Pounds)
85	21.25	13.7	7.6
100	25	13.7	11.3
150	37.5	13.7	23.8
200	50.0	13.7	36.3

Air Cooled Cost Savings Using DOE Latest Recommended Energy Standards for Ice Machines

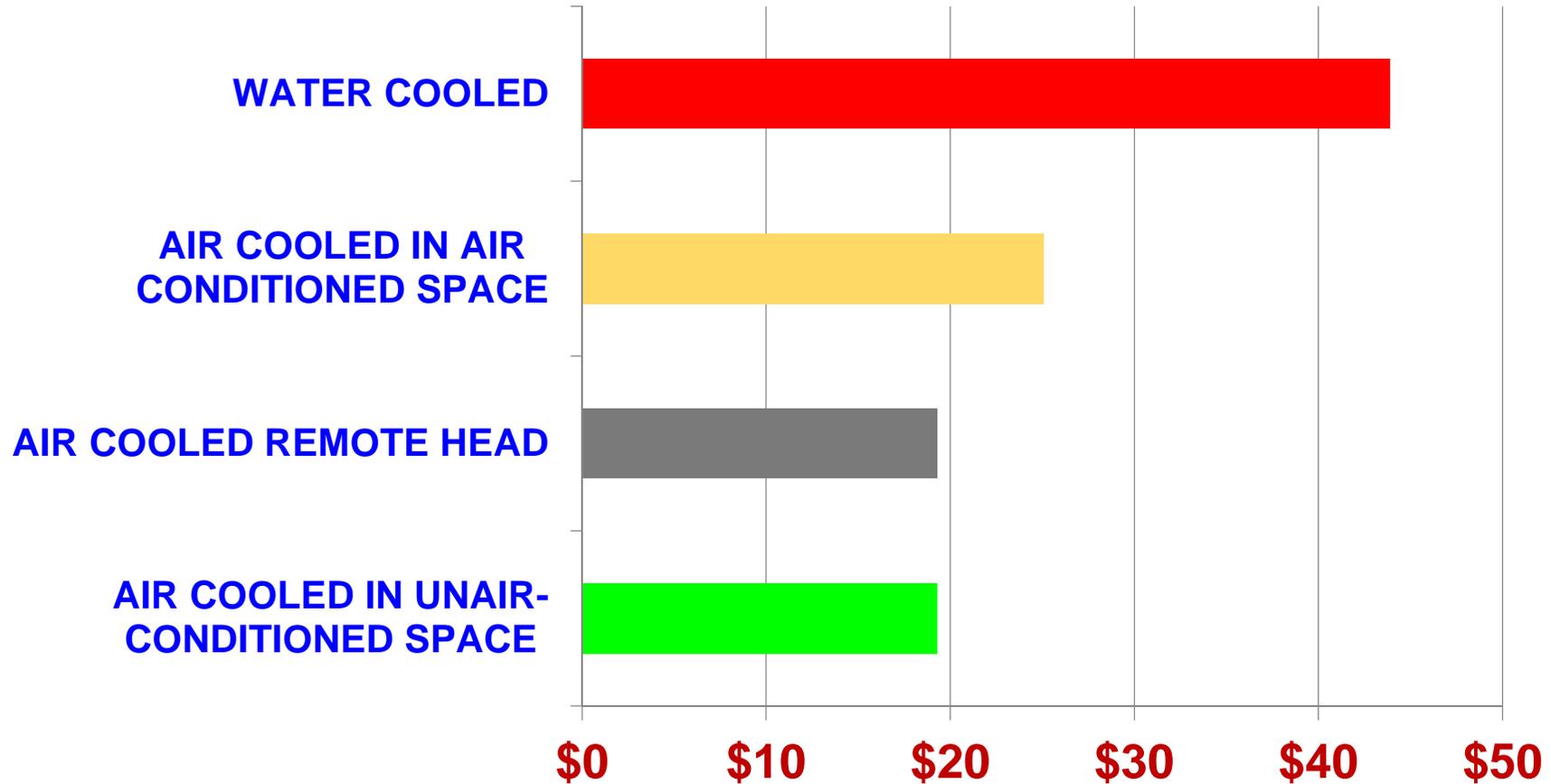
At a water & sewer cost of \$10 per 1,000 gallons

gallons per 100 lb.	Cost of Water and Wastewater Combined \$10.00 per kGal (Cents/100 Pounds)	Energy Savings per 100 Pounds With Water Cooled Equipment (Cents/100 Pounds)	Net Savings per 100 Pounds with Air Cooled Equipment (Cents/100 Pounds)
85	85	13.7	71.3
100	100	13.7	86.3
150	150	13.7	136.3
200	200	13.7	186.3

At 150 gallons per 100 pounds of ice this means that you pay an extra \$1.36 for the ice with water cooled equipment

Lifetime Utility Cost Analysis

1,000 lb/day machine, Water \$7.60/kGal. Elec. 10 cents/kWh, 120 gallons of cooling water, DOE Recommended Efficiencies



Thousands of Dollars over 8.5 Year Lifetime

Keeping it cool



Cooling towers
come in all
sizes

Energy Savings With Cooling Tower over Air Cooling

Energy savings

0.3 to 0.4 kWh/Ton-Hr

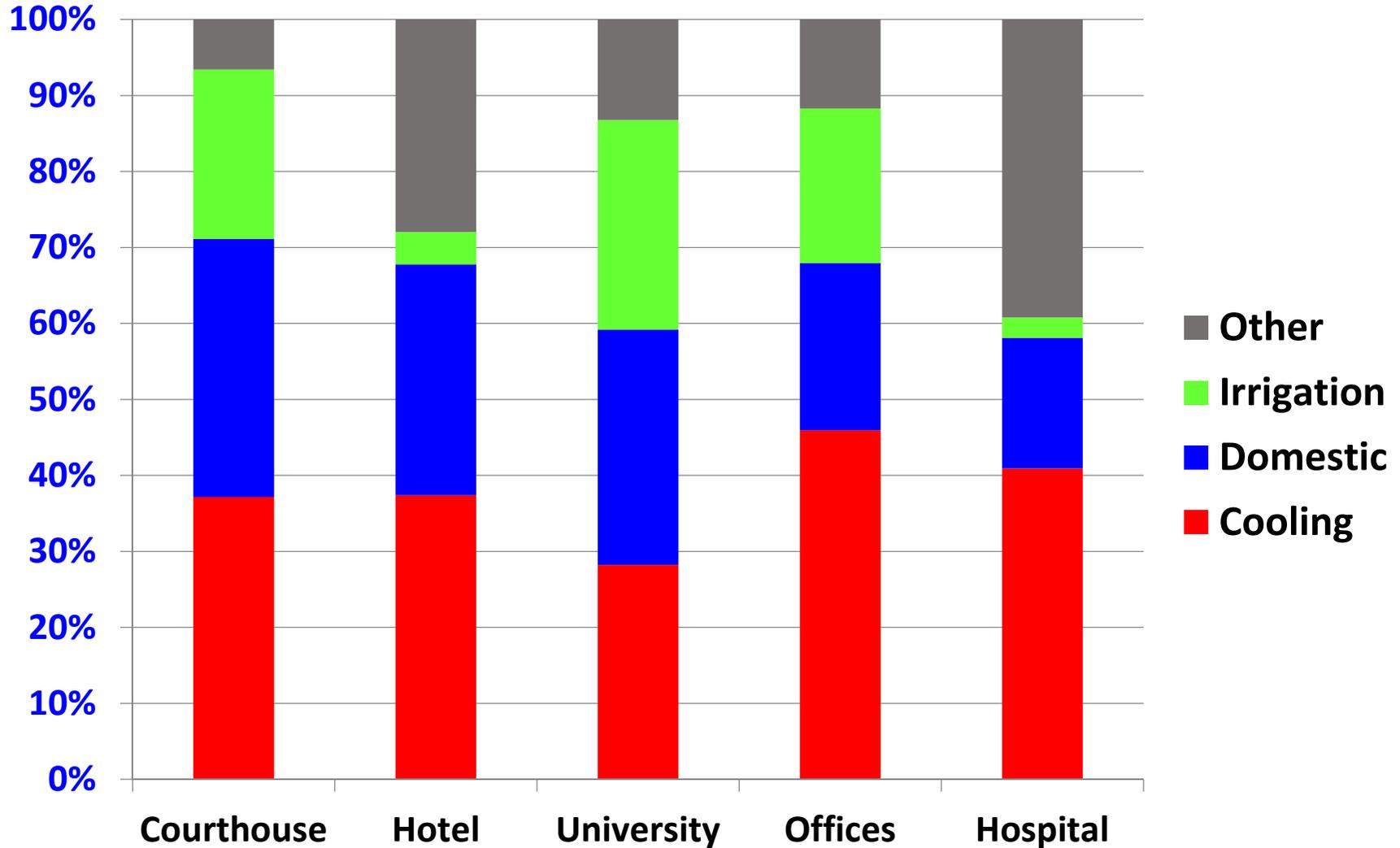
Equal to about

3.0 to 4.0 cents

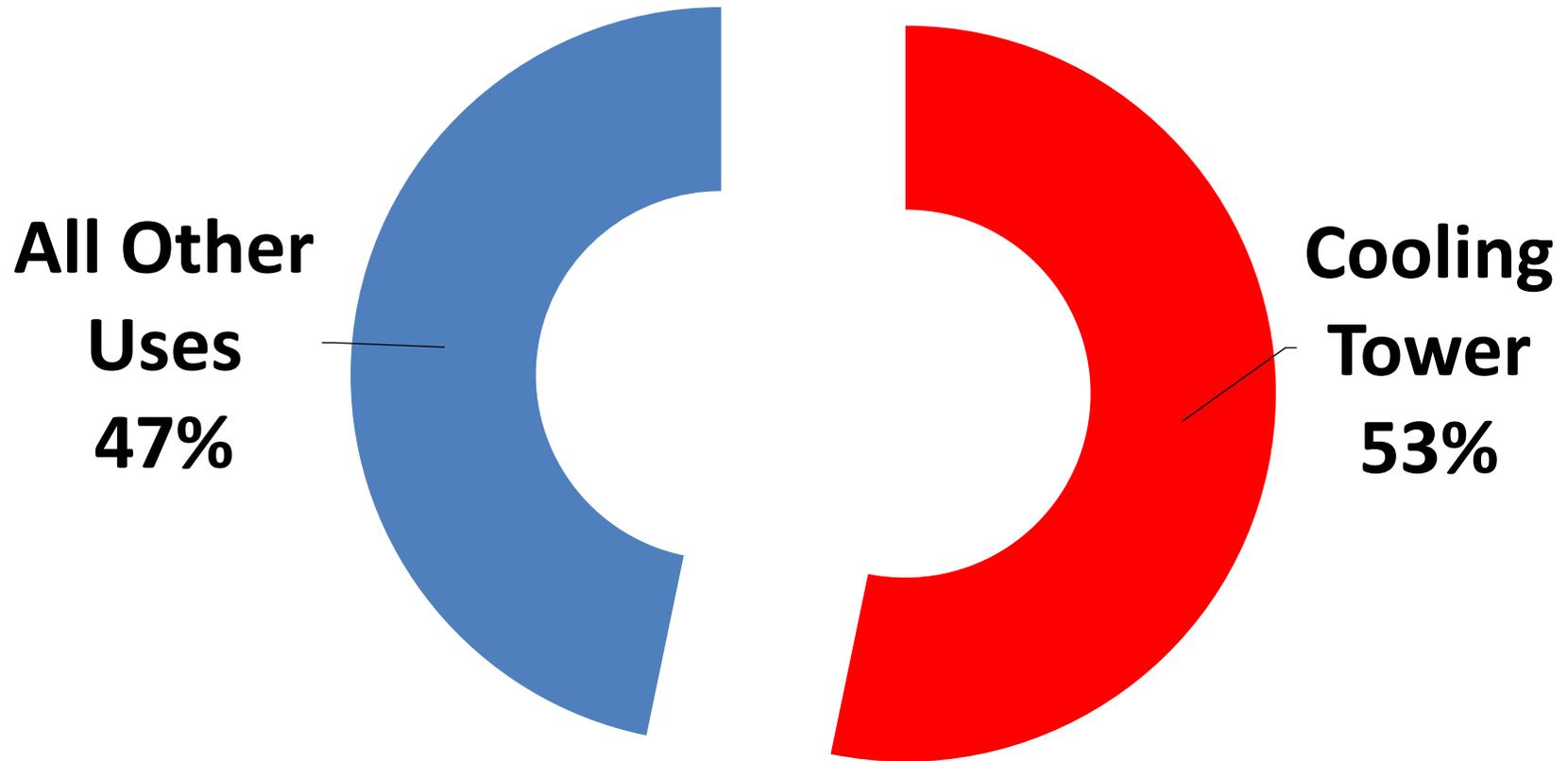
in most markets

Summary of Audits of 30 Large Facilities with Cooling Towers in Downtown Fort Worth Texas

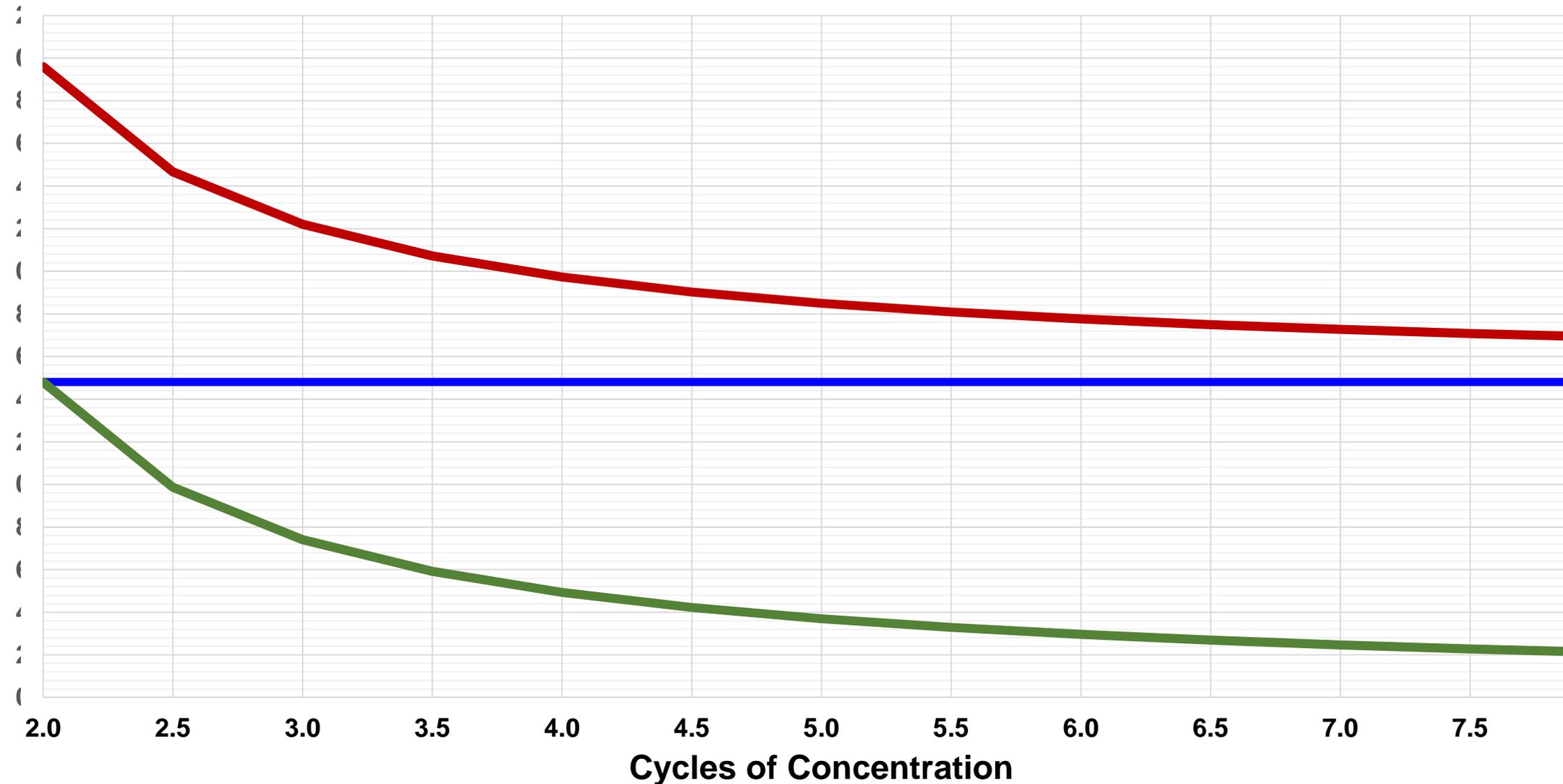
Water Management, Inc.



Eleven Office Buildings in Austin, Texas

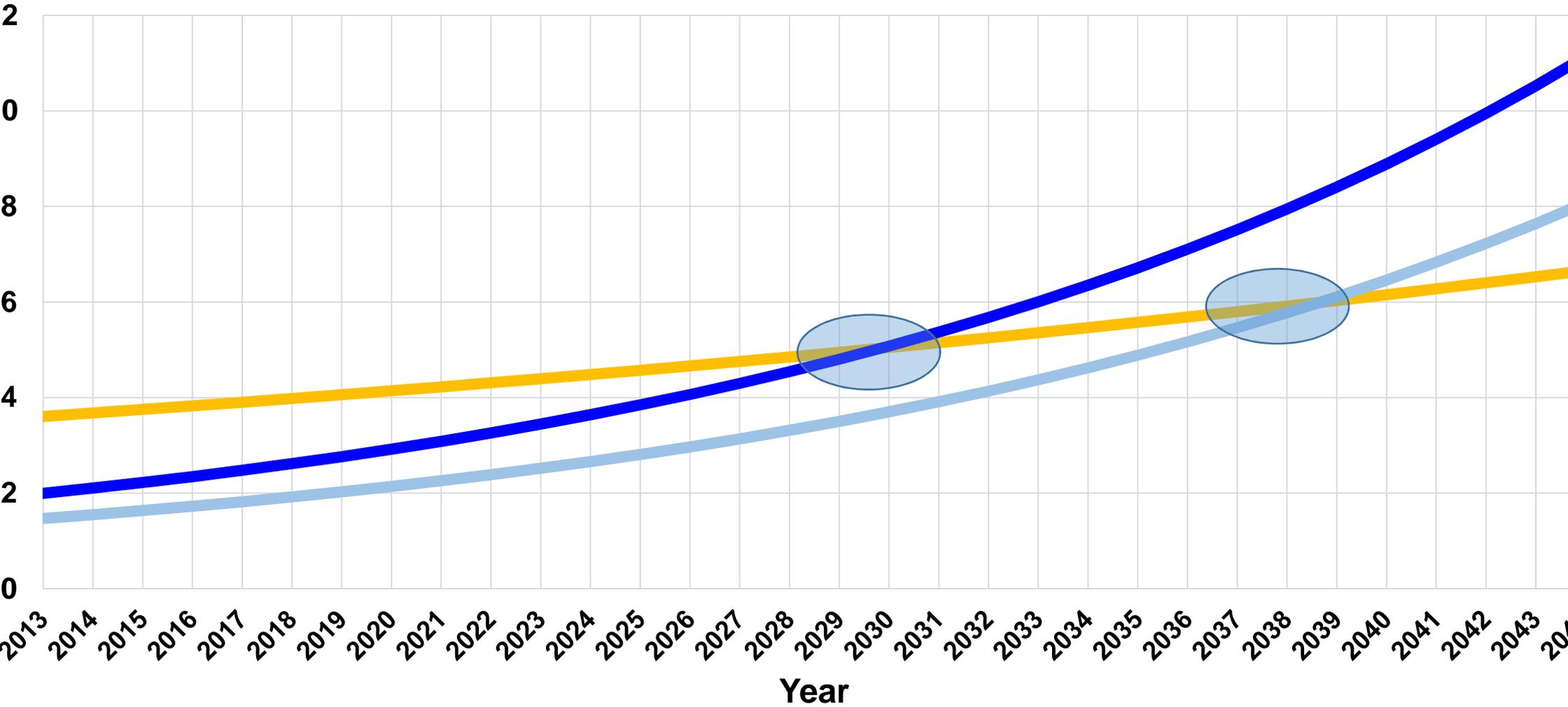


Make Up, Blowdown and Evaporation vs. Cycles of Concentration



Graph of Water, Sewer & Water Treatment Costs Vs. Electric Energy Savings With Chilled Water/Cooling Tower Air Conditioning

Assumes a savings of 0.35 kWh/ton hour with cooling tower and national average water use of 2.0 gallons per ton hour



Energy Costs vs. Water Costs

Where are the

Tipping Points?



If you don't
measure it, you
CAN NOT
manage it!

NATIONAL GREEN BUILDING STANDARDS, GUIDELINES & CODES

Comparison of specific water use efficiency provisions – maximum water use

Metering and Sub-metering	CalGREEN ¹ (provisions effective Jan 1, 2014)	LEED V.4 July 2014	ASHRAE SS189.1 (v.2-2011, updated with addendum v)	ASHRAE S191P (Public review draft v.1)	ICC 700- 2008 (with NAHB)	IAPMO Green Plumbing & Mech Code Supplement (2015 version)	IgCC Green Code (2015 version)
Metering tenant water use (usage in gallons per day)	Where non-residential tenant usage >100g + all bldgs where >1000g		Tenants or buildings where >1,000 g	Tenants or buildings where >1,000 g		Where non-resid. tenant use = >1,000 g/day OR high-use occupancy: all resid tenant space; all common area uses	Where usage >1,000 g/day
Meter reclaimed & potable water needed to supplement onsite water collection systems		Reclaimed				Potable and reclaimed water	
Sub-metering process water use – industrial/commercial (usage in gals per day)		Sub-meter at least 80% of process water, including pools	Where usage >1,000 g	Where usage >1,000 g		All where usage >1,000 g	Industrial usage >1,000 g
Sub-metering ornamental water features, swimming pools, in-ground spas			Make-up water supply to all ornamental water features	Make-up water supply lines		Make-up water supply to ornamental water features w/auto refill; make-up water to pools/spas	Make-up water supply lines
Sub-metering cooling towers			Towers of >500 gpm flow (through-put): make-up & blow-down water supply lines	Towers of >500 gpm flow (through-put)		Make-up water supply	Towers of 100 tons or greater: make-up and blow-down water supply lines
Sub-metering evaporative coolers			Where use in excess of 0.6 gpm: meter make-up water supply	Where use in excess of 0.6 gpm: meter make-up water supply		Make-up water supply where cooler has air flow in excess of 30K cfm	Where use in excess of 0.6 gpm: meter make-up water supply

¹ Prescriptive option only

NATIONAL GREEN BUILDING STANDARDS, GUIDELINES & CODES

Comparison of specific water use efficiency provisions – maximum water use

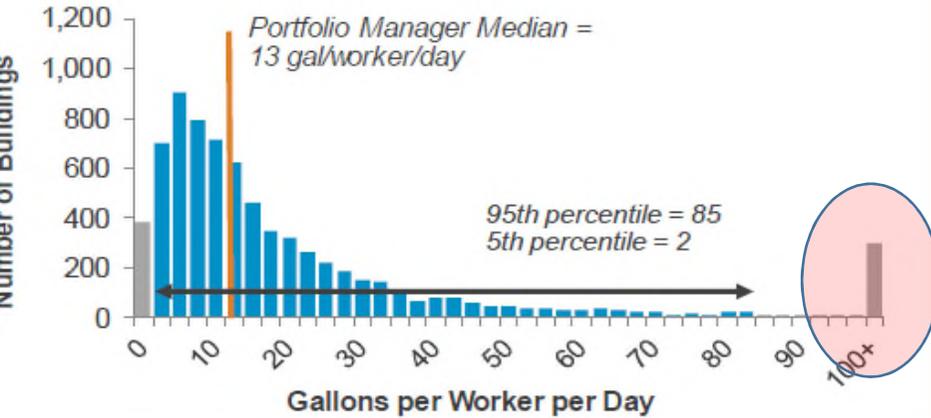
Metering and Sub-metering	CalGREEN (provisions effective Jan 1, 2014)	LEED V.4 July 2014	ASHRAE SS189.1 (v.2-2011, updated with addendum v)	ASHRAE S191P (Public review draft v.1)	ICC 700-2008 (with NAHB)	IAPMO Green Plumbing & Mech Code Supplement (2015 version)	IgCC Green Code (2015 version)	
Sub-metering boilers		Make-up water supply to boilers: drawing more than 100K gallons annually or rated at 500K Btu/hr or more	Steam & hot water boilers rated at 500K Btu/hr or more	Steam & hot water boilers rated at 500K Btu/hr or more		Make-up water supply to boilers collectively exceeding 1 mil Btu/hr	Make-up water supply to boilers: drawing more than 100K gallons annually or rated at 500K Btu/hr or more	
Sub-meter indoor plumbing fixtures & fittings		Required. Alternate path of calculated use is provided.						
Sub-meter domestic hot water		Meter at least 80% of domestic hot water						
Sub-meter health care processes		Meter process water systems, e.g. purified water, dietary dept., laundry, labs, physiotherapy/hydrotherapy, surgical & hydronics						
Sub-metering landscape irrigation	Where non-residential landscape >1,000 sq.ft.**	Meter at least 80% of irrigated landscape, excluding Xeriscaping and native vegetation	Where total irrigated landscape >25,000 sq.ft.	Where total irrigated landscape >5,000 sq.ft.		Where >2,500 sq.ft. irrigated landscape	Yes, all irrig systems that are automatic	
Building Meter Data Management System			Require remote data communication to central system, recording hourly consumption data			Requires remote data collection & transfer capability where more than 10 non-utility-owned meters are installed	Meters must be <u>capable of connecting & communicating</u> water use data; direct connection to central bldg system not req'd	

Benchmarking

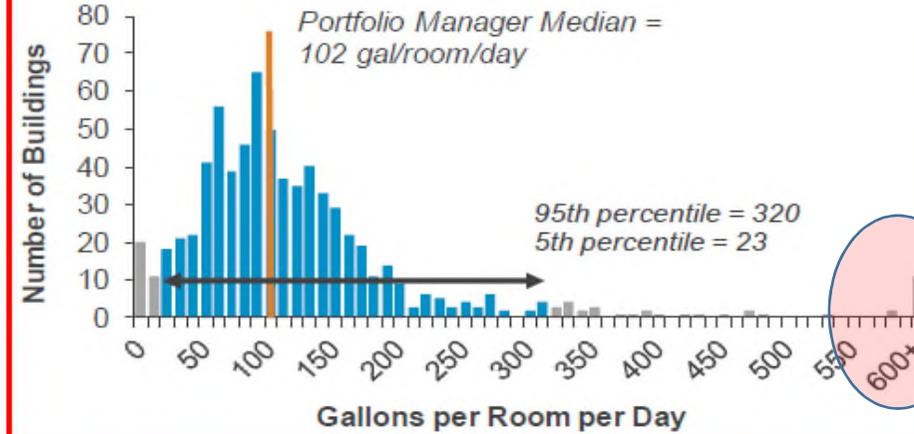
EPA Portfolio Manager Information on Water



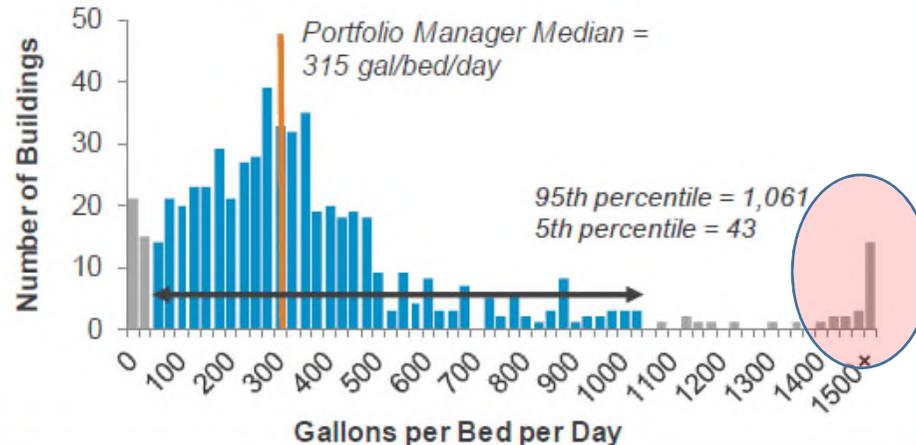
Office Use Per Worker



Hotel Use Per Room



Hospital Use Per Bed



Summary of Six United States Studies Reporting Water Use by Gallons per Square Foot of Heated Space per Year

Type of Facility	EPA Portfolio Manager ¹	University of Florida ²	Santa Fe, New Mexico ³	Colorado Water Wise - Brendle Group. ⁴	AWWA End Use Study 2000 ⁵	Austin 2011
	Gallons per Square Foot of Heated Space per Year					
Manufacturing		221		173 to 211	130 to 330	215
Health Care Facilities	61	106		62 to 101		
Hotels	54	85		79 to 165	60 to 115	72
Universities	52	31				58
Warehouse/ Supermarket	24	95	36		52 to 64	
Governmental Offices	19	34	49			
Offices	13	20	26		9 to 15	
Manufacturing/ Financial	12	89				
Household	11					
Schools	10	20		12 to 19	8 to 16	
Places of Worship	7	15				
Offices/ Shopping Centers	5	32	20			
Refrigerated Warehouses	3	8				

¹ U.S. Environmental Protection Agency, Portfolio Manager, Data Trends, Water Use Tracking <http://www.energystar.gov/buildingtools-and-resources/water-use-tracking>

² A. Morales and J. P. Heaney, Estimating Non-Residential Water Use with Publicly Available Databases, Conserve Florida Water Clearinghouse, Department of Environmental Engineering Sciences, University of Florida, P. 116450, Gainesville, FL 32611

³ A. Morales, J. P. Heaney, K.R. Freidman, J.M. Martin, Estimating Commercial, Industrial, and Commercial Water Use on the Basis of Heated Building Area, AWWA Journal, June 2011

⁴ Planning Division, City of Santa Fe, New Mexico, Water Use in Santa Fe, 2001

⁵ The Brendle Group, Inc. Benchmarking Task Force- Collaboration for Industrial, Commercial & Institutional Water Conservation, 226 S. Remington St. #3 Fort Collins, CO 80524

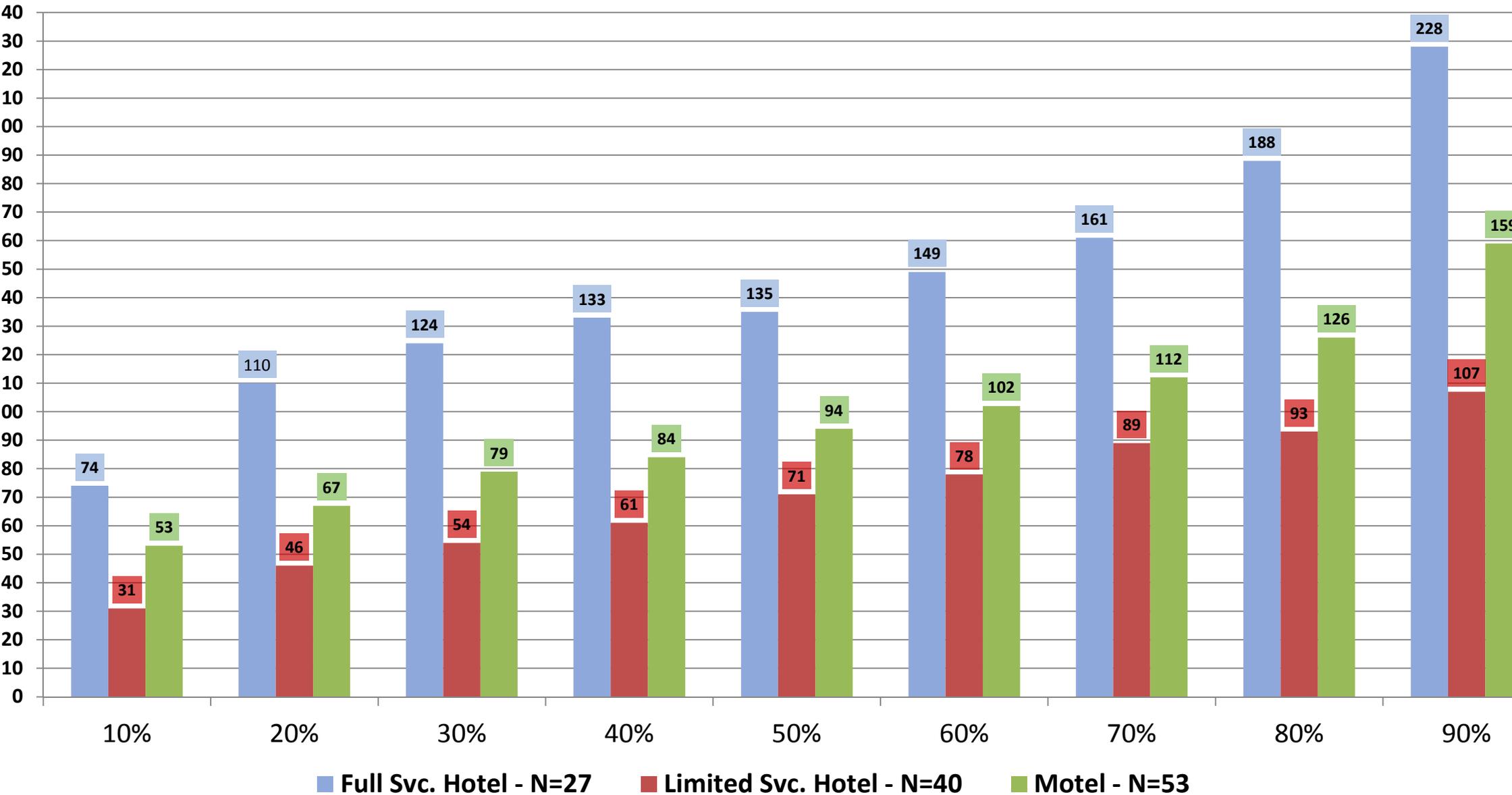
⁶ American Water Works Association Research Foundation, Commercial and Institutional End Uses of Water, 2001, 6666 Quincy Avenue, Denver Colorado, <http://ufdc.ufl.edu/WC13511002/00001/5j>

Summary of Restaurant Water Use Coefficients from Various Studies

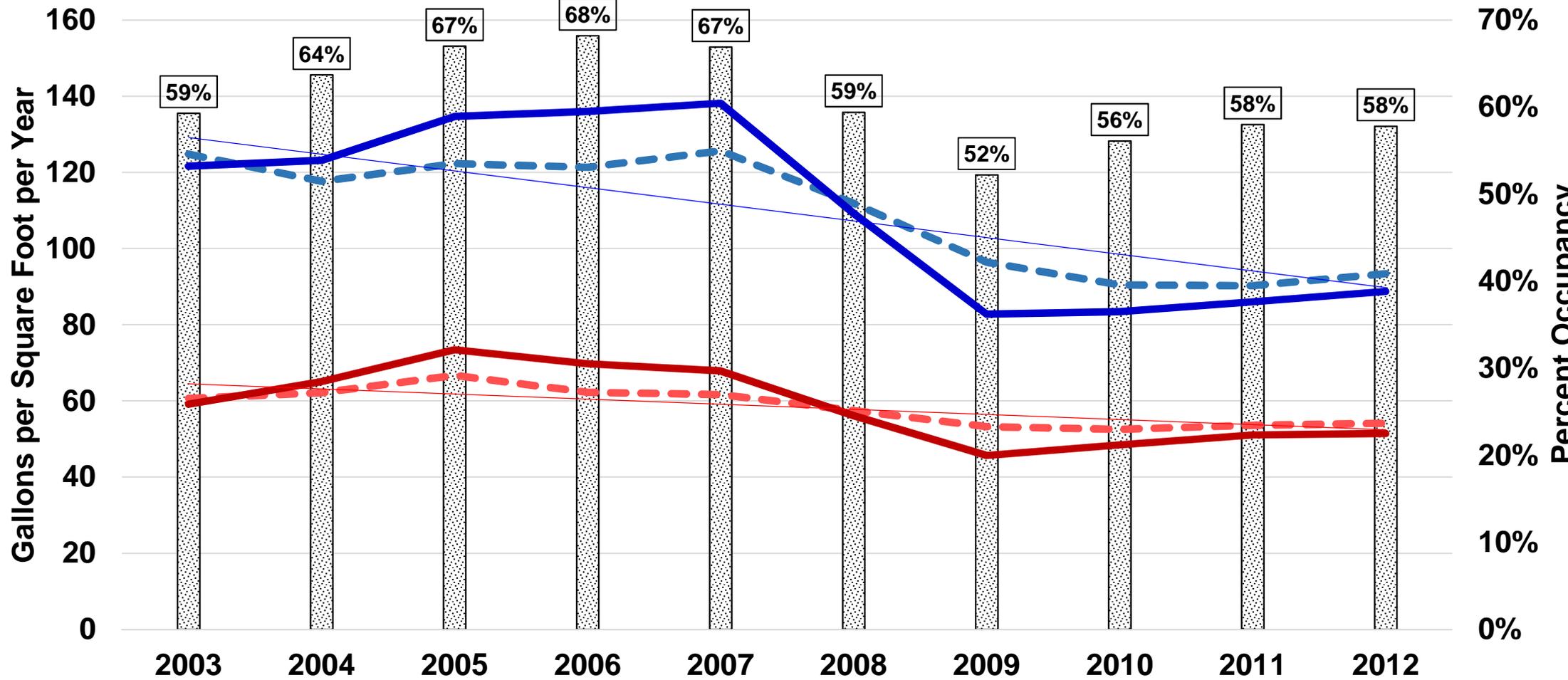
Source: H.W. (Bill) Hoffman & Associates, LLC

Source of Information	Best Gal./ Meal	Avg. Gal./ Meal	Gal./ sq. ft./ Year	Best Gal./ Seat/ Day	Avg. Gal./ Seat/ Day
da (Univ. of Fl.) Restaurant			270		
da (Univ. of Fl.) Fast Food			240		
rado Study (Brendle Group)	9 to 12		192	29	53
(2000 AWWARF CI End Use Study)			130 to 331	20 to 30	
der Colorado	8 to 9		125		49
mark (Canada)					
Kansas (M. Vanschenkhof)		12.8	266		
h Australia study and Sydney Water		9 to 12			
h Carolina ICI BMP					20 to 40
in Study (Full Svc.) 2013			173		31
in Study (Fast Food) 2013			257		39

Analysis of Gallons per Room for Hotels in Austin, Texas FY 2011



Hotel and Motel Water Use Factors for Phoenix - 2003 to 2012



■ Percent Occupancy

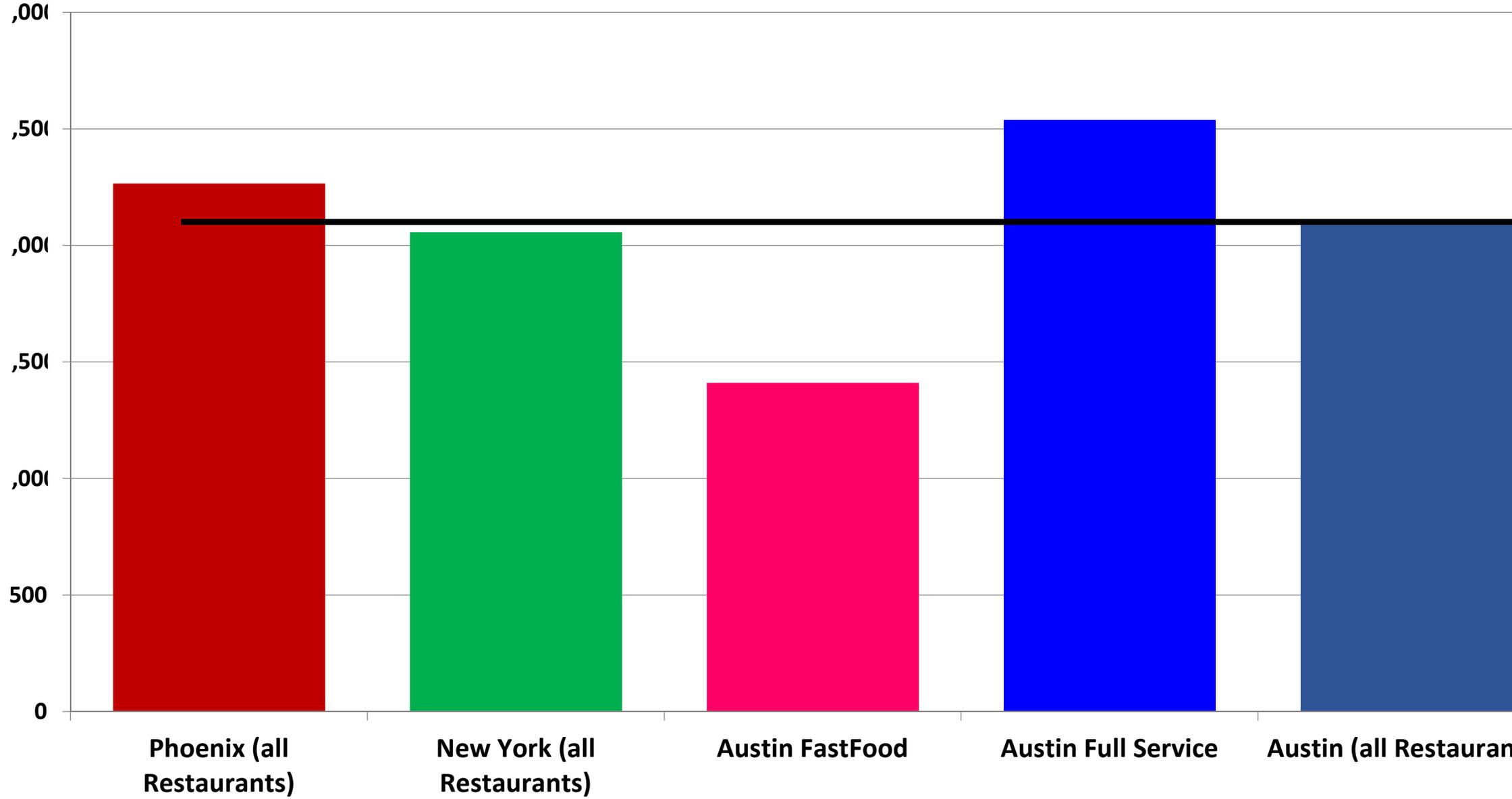
— Motel Adjusted for Occupancy

— Motel Unadjusted for Occupancy

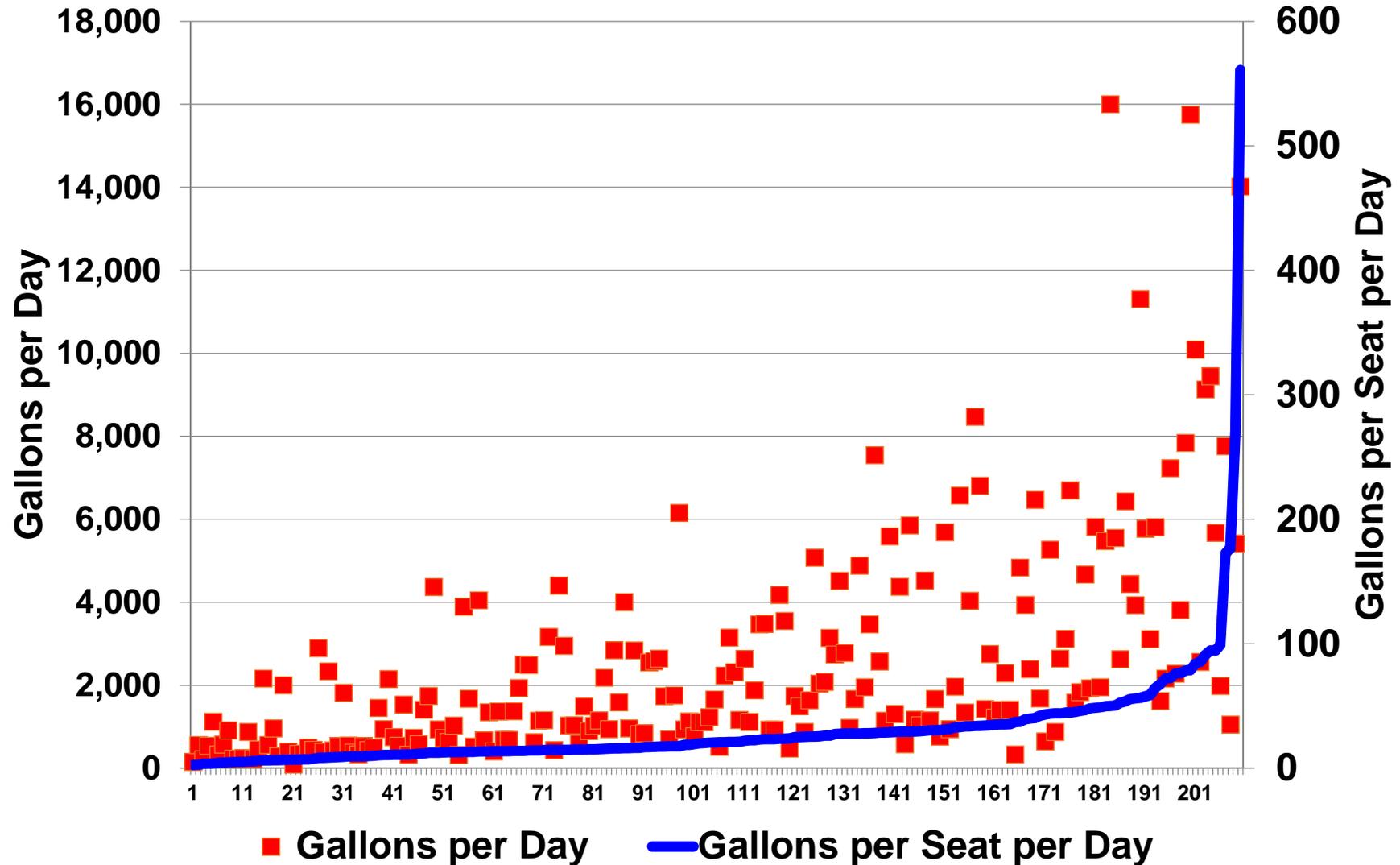
— Hotel Adjusted for Occupancy

— Hotel Unadjusted for Occupancy

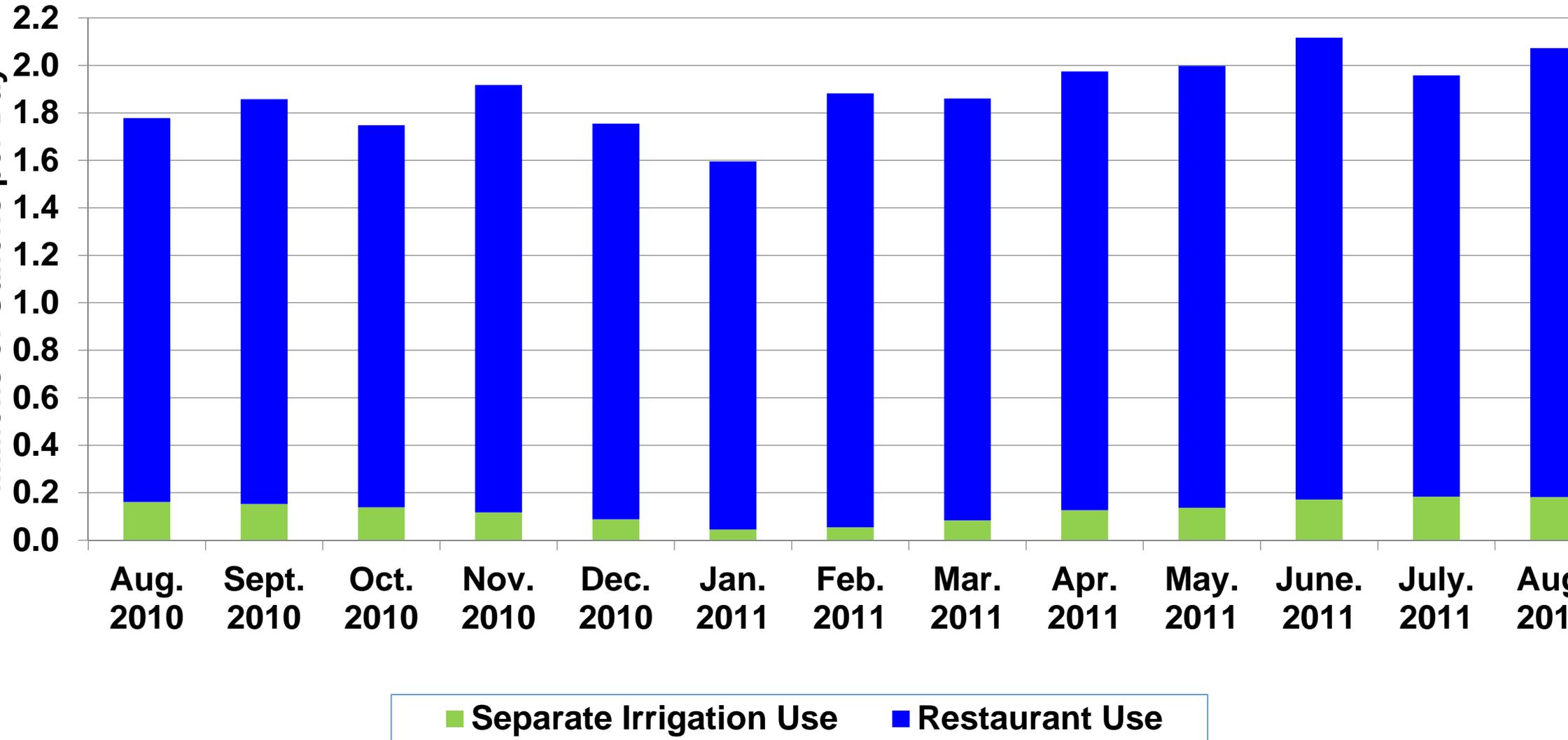
Average Daily Water Use for Restaurants in Different Cities



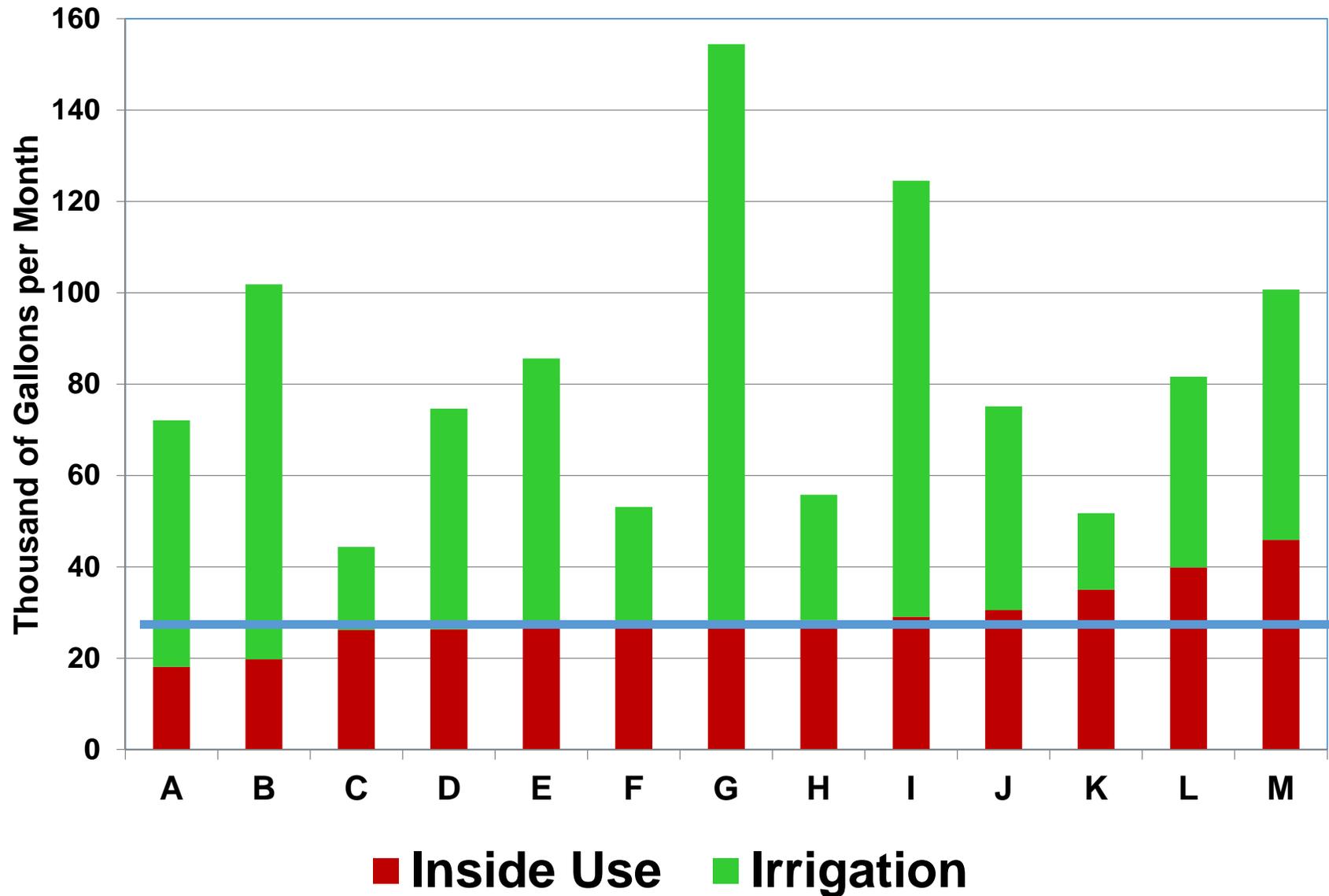
Analysis of 211 Austin Full Service Restaurants



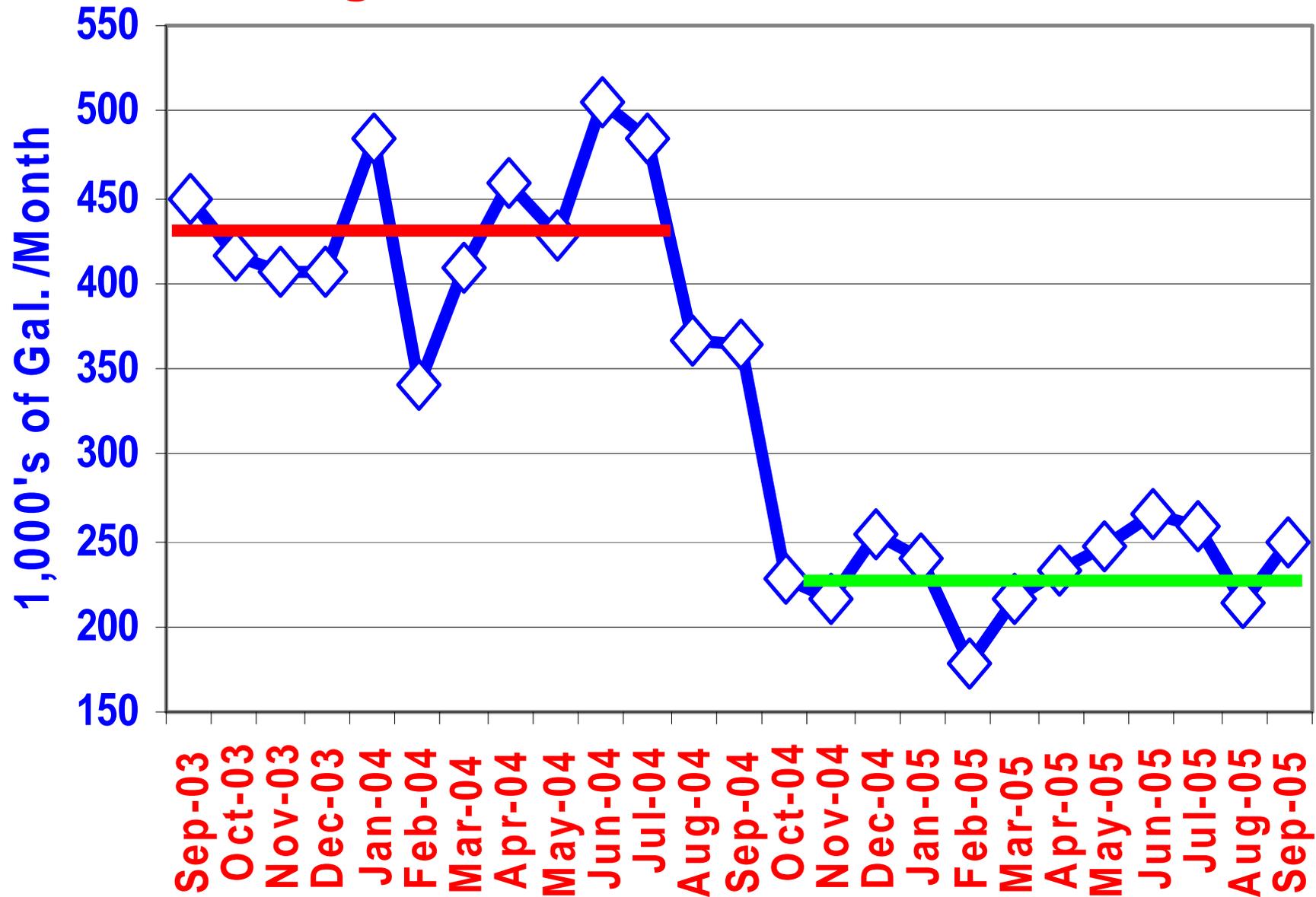
Restaurant Total Water Use in Austin, Texas from August 2010 through August 2011



Example of Water Use 13 Almost Identical Fast Food Restaurants in the Same Chain

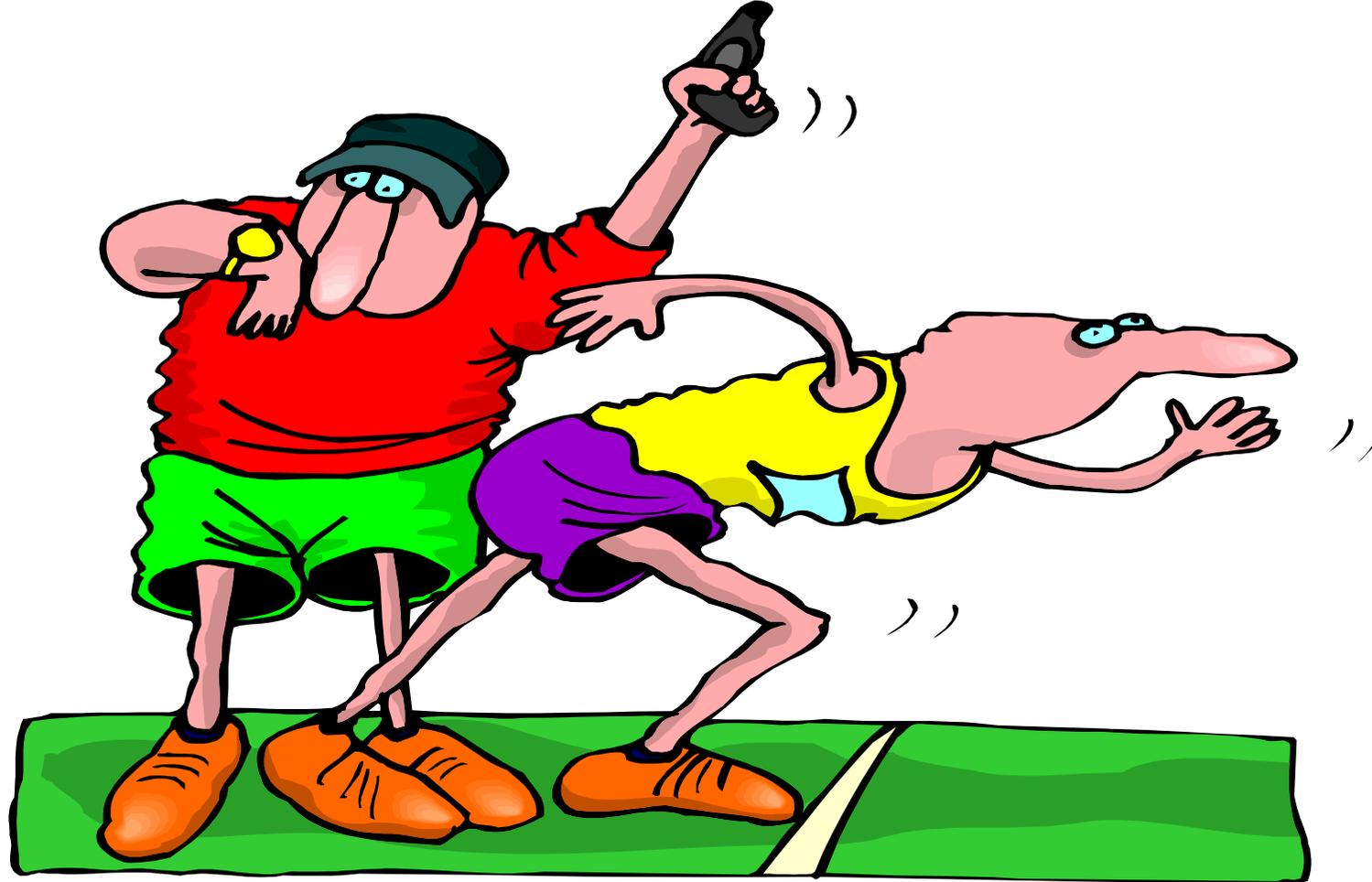


A Large Chinese Buffet Restaurant



**The Cheapest Water
You Will Ever Have
Is The Water You
Already Have!**

So Let's Get Started!



Questions?

A Look at the Bottom Line

Advances in Commercial and Institutional Water Efficiency

Presented by
H.W.(Bill) Hoffman, P.E.
H.W. (Bill) Hoffman and Associates, LLC
512-294-7193



Presented at the 2015 ICI Technical Workshop for Austin Water.