

# Measurement, Metering, Benchmarking & Metrics

**International Emerging Technology Symposium – 2016**

**Chicago, Illinois**

Presented by

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

Austin, Texas

The purpose of this presentation is to acquaint you with the many changes that are occurring in how we measure, monitor, meter, benchmark and examine *water use* in America in the 21<sup>st</sup> Century.

# **Measurement, Metering, Benchmarking & Metrics Will Change Many Things.**

- **How we meter and sub-meter buildings**
- **How we estimate flow and thus meter size**
- **How we detect leaks**
- **How government looks at things**
- **How facility managers manage buildings**
- **How utilities look at their own use**

**At the Facility Level**

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 <sup>1</sup> (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

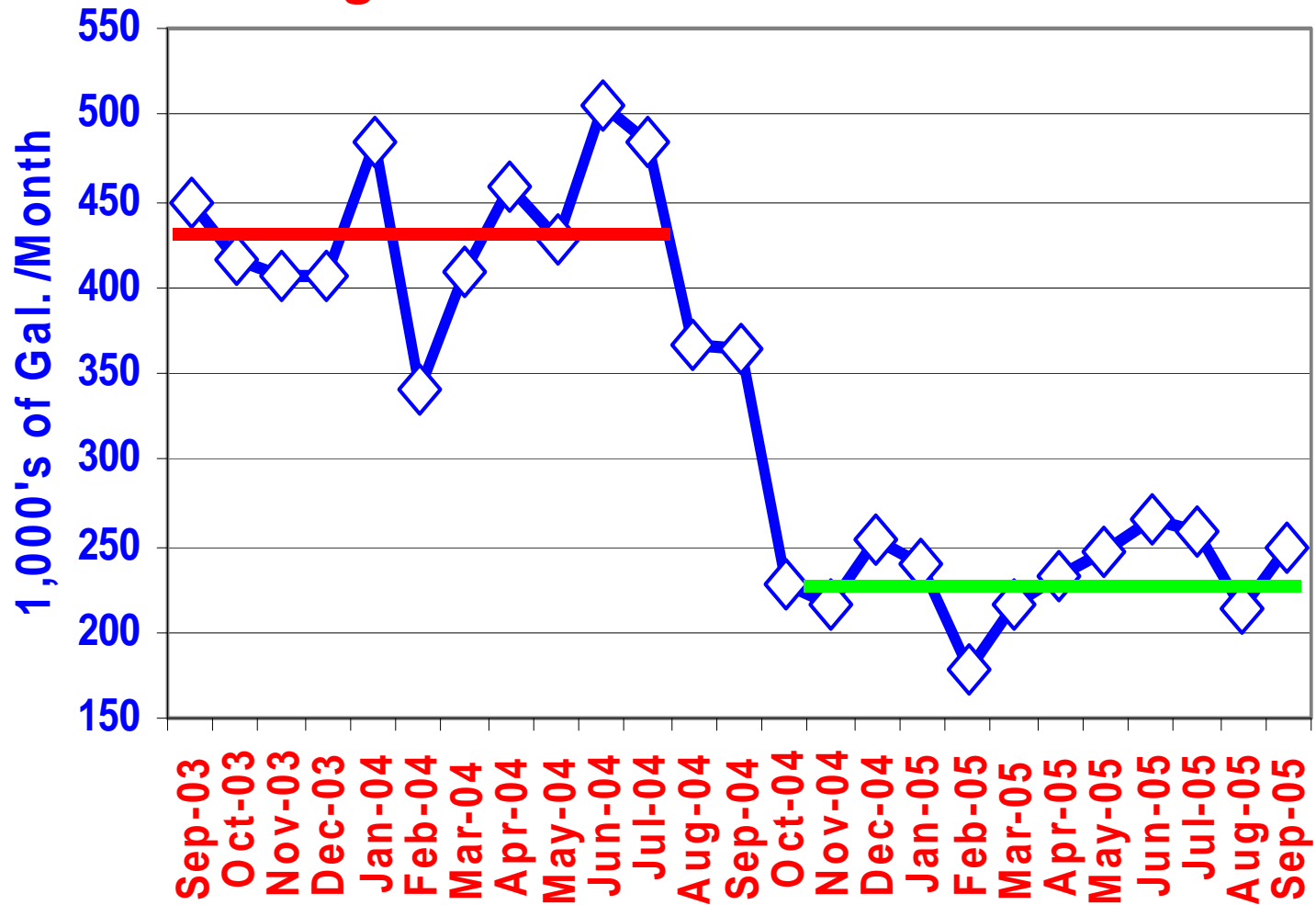
<sup>1</sup> Prescriptive option only

## NATIONAL GREEN BUILDING STANDARDS, GUIDELINES & CODES

### Comparison of specific water use efficiency provisions – maximum water use

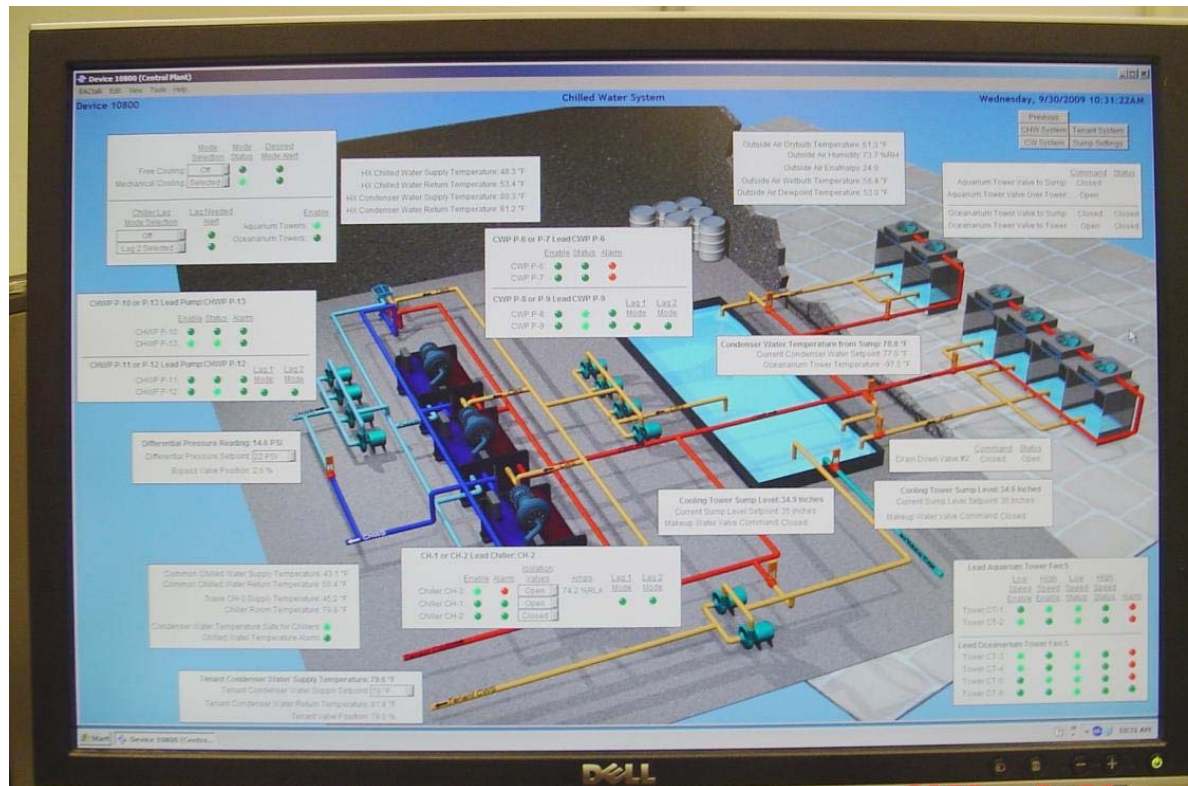
Metering and Sub-metering	CalGREEN (provisions effective Jan 1, 2014)	LEED V.4 July 2014	ASHRAE SS189.1 (v.2-2011, updated with addendum v)	ASHRAE S191P (Public review draft v.1)	ICC 700- 2008 (with NAHB)	IAPMO Green Plumbing & Mech Code Supplement (2015 version)	IgCC Green Code (2015 version)	
Sub-metering 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 &amp; communicating</u> water use data; direct connection to central bldg system not req'd	

## A Large Chinese Buffet Restaurant





# Data Management & Process Control



**What is Driving  
This?**

*The Cost of Water!*

# 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!***

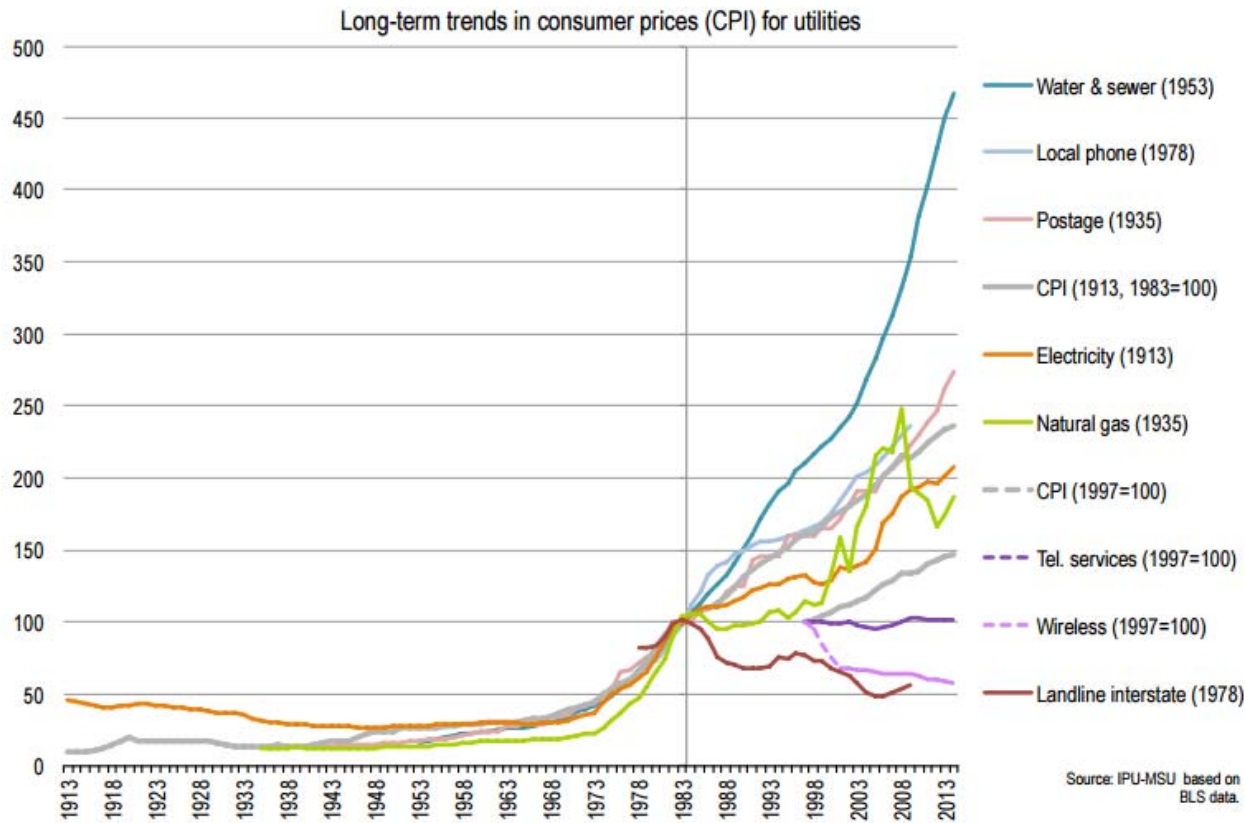
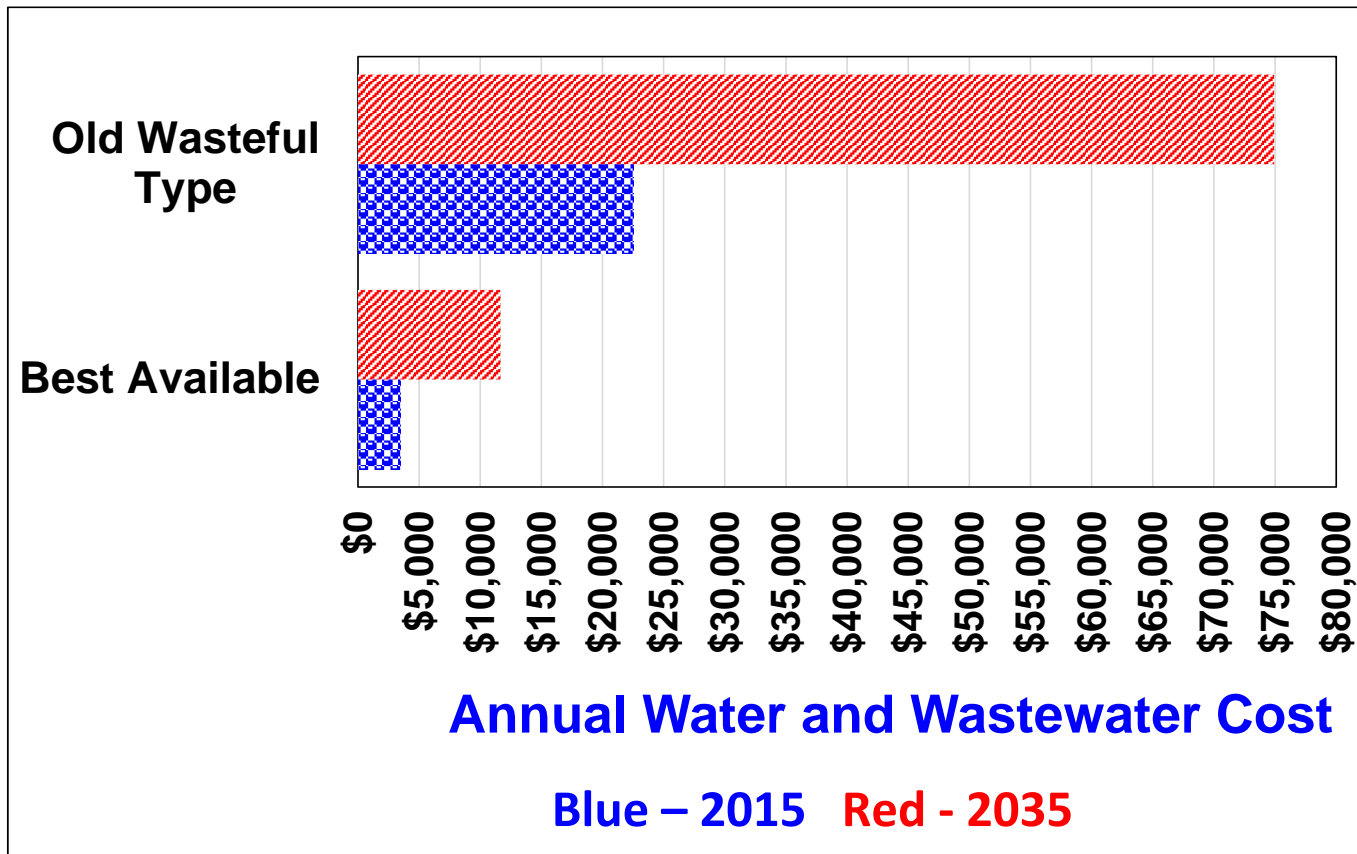


Exhibit 1. Long-term trends in the Consumer Price Index (CPI) for utilities (1913-2014). The index is set to 100 for 1982-1984 except for telephone and wireless services, where the index is set to 100 for 1997. Year (\*) indicates start of series.

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

Gallons per Flush	Cents per Flush in 2015	Cents per Flush 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

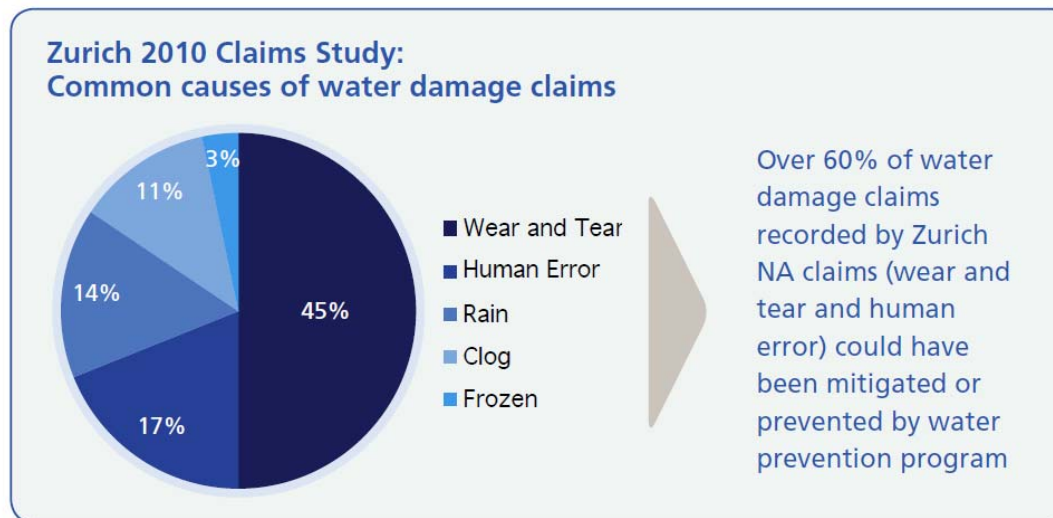
# What 20 Years Means for Total Cost of Water and Sewer for an Office Building with 500 People



**The cost of  
leaks!**

# According to the Zurich Study, 86% of Water Damage Claims are Plumbing Related!

<http://www.zurichna.com/internet/zna/sitecollectiondocuments/en/knowledge%20center/whitepapers/real%20estate/water-damage-prevention.pdf>

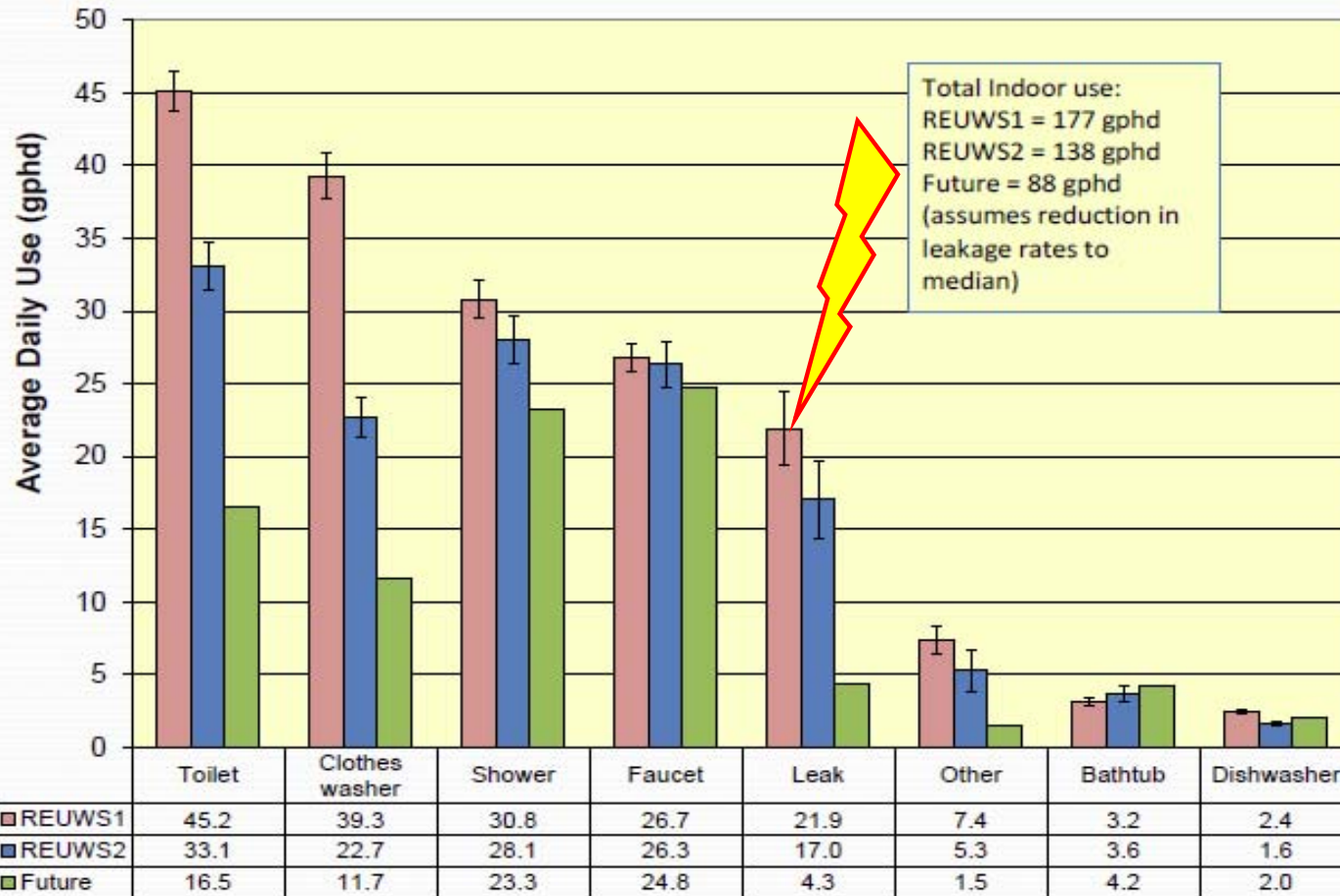


Source: 2010 Zurich claims study

Water damage is the number one source of property claims for owners of high-rise residences, hotels, office buildings, retail establishments and other commercial structures.



# Potential end uses with leak control



10/9/2014, Water Smart Innovations Conference,

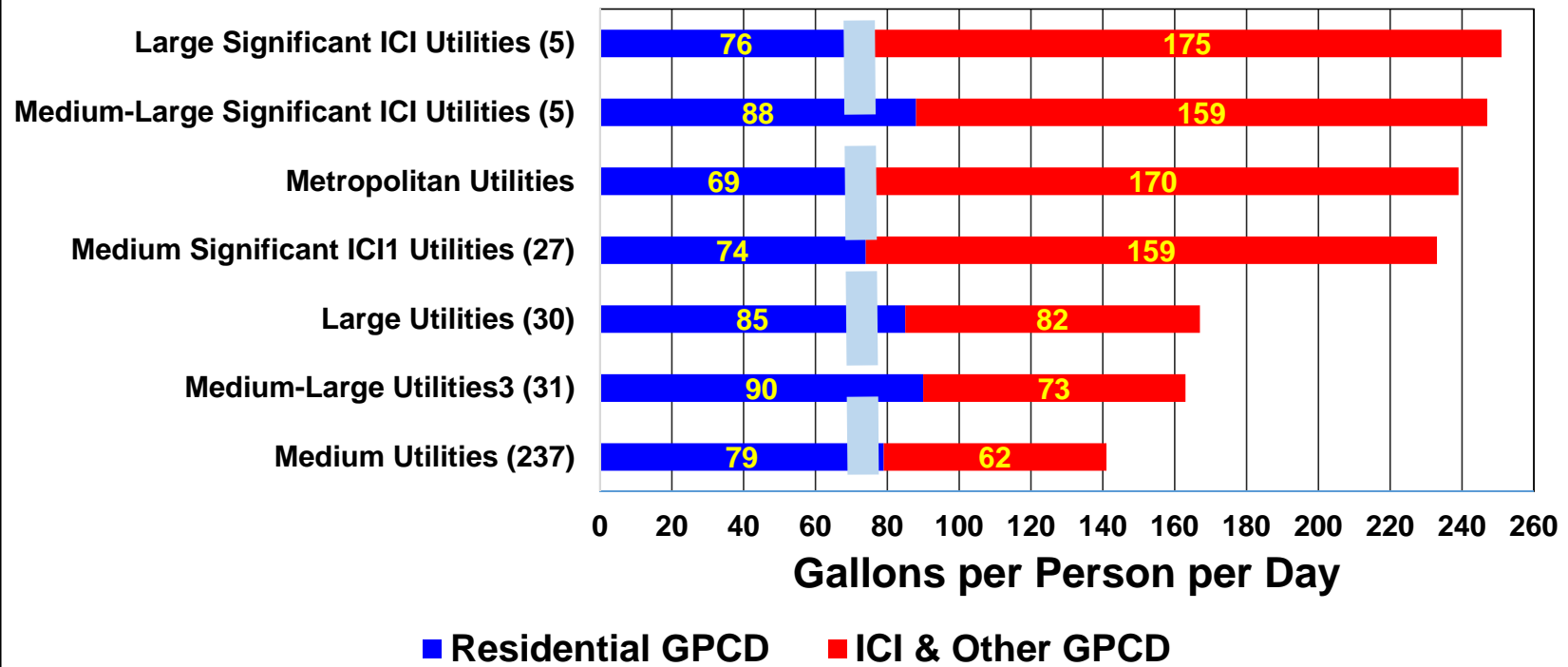
# AWWA Estimates that 15% of Water Lost Through Leaks in Distribution

System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption	Revenue Water
			Billed Un-metered Consumption	
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Non Revenue Water (NRW)
			Unbilled Un-metered Consumption	
	Water Losses	Apparent Losses (Commercial Losses)	Unauthorized Consumption	
			Customer Meter Inaccuracies and Data Handling Errors	
		Real Losses (Physical Losses)	Leakage in Transmission and Distribution Mains	
			Storage Leaks and Overflows from Water Storage Tanks	
		Service Connections Leaks up to the Meter		

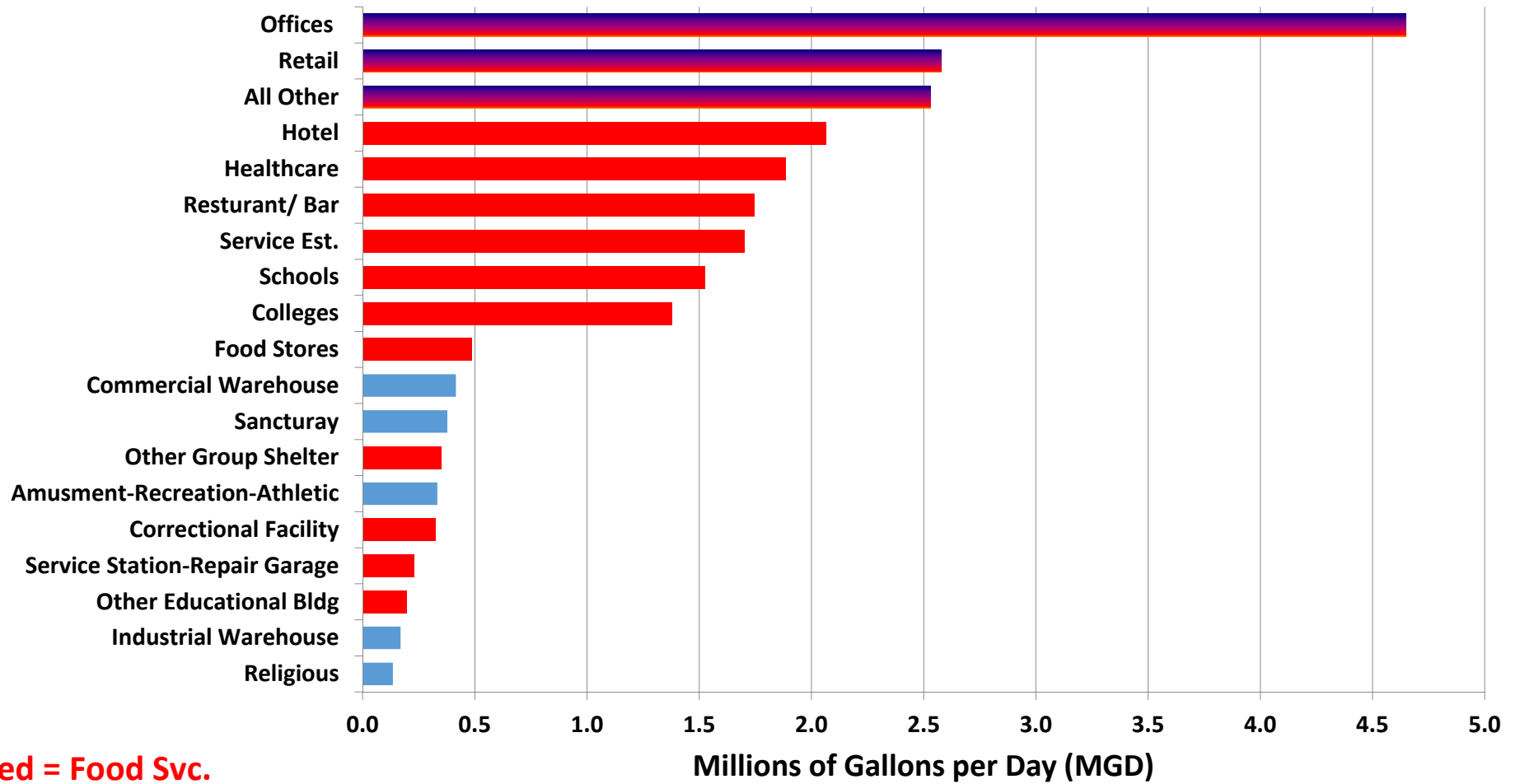
**States and Cities are Looking at  
How Water is Used and by Whom**

# Water Use of Texas Utilities

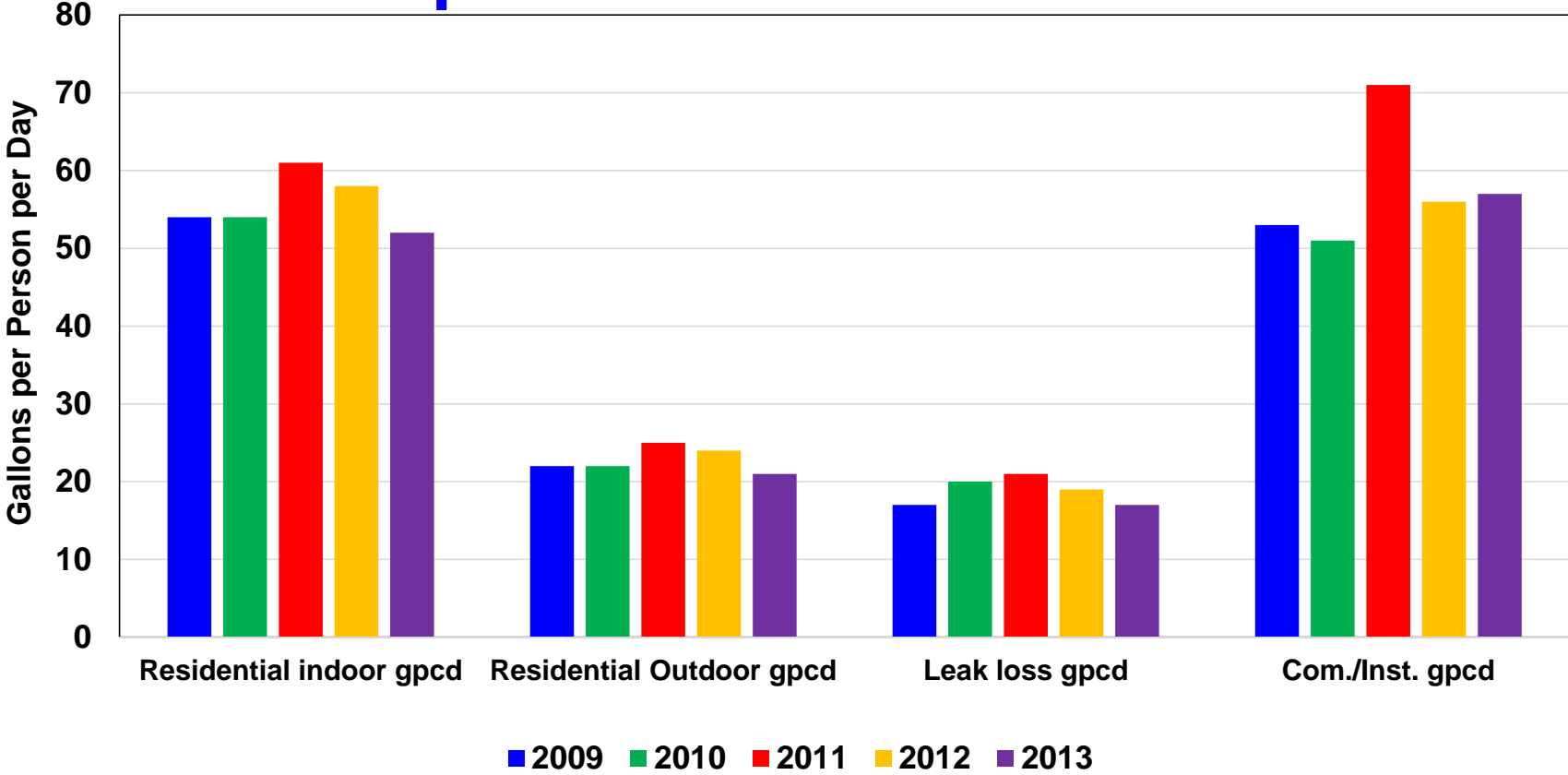
TWDB 2015 - SB 181 Report



# Water Use by Commercial/Institutional Users Austin, Texas Study



# Breakdown of Non-Industrial Municipal Use in 87 Texas Cities



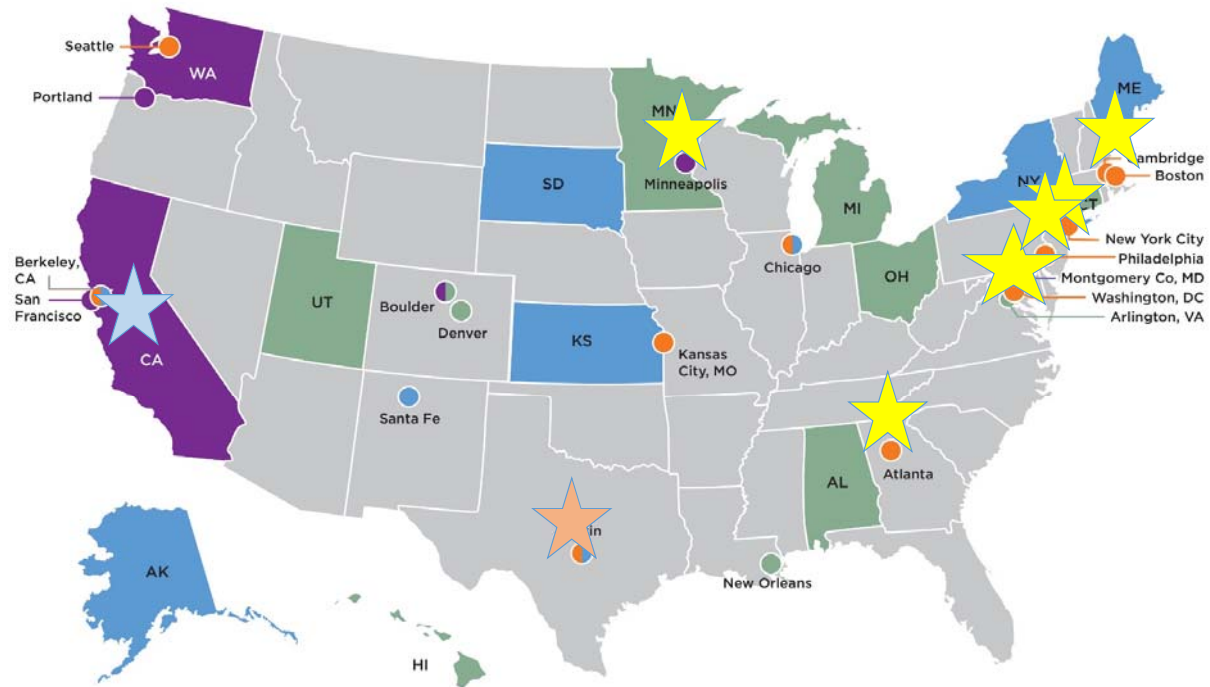
# Energy Star Portfolio Manager

- It now contains water data.
- Many local governments are requiring it for government properties.
- Some are now requiring all commercial property of any size to use it and report it.

# Entities Using EPA Portfolio Manager

## Stars = Water Benchmarking Required

U.S. Building Benchmarking and Transparency Policies

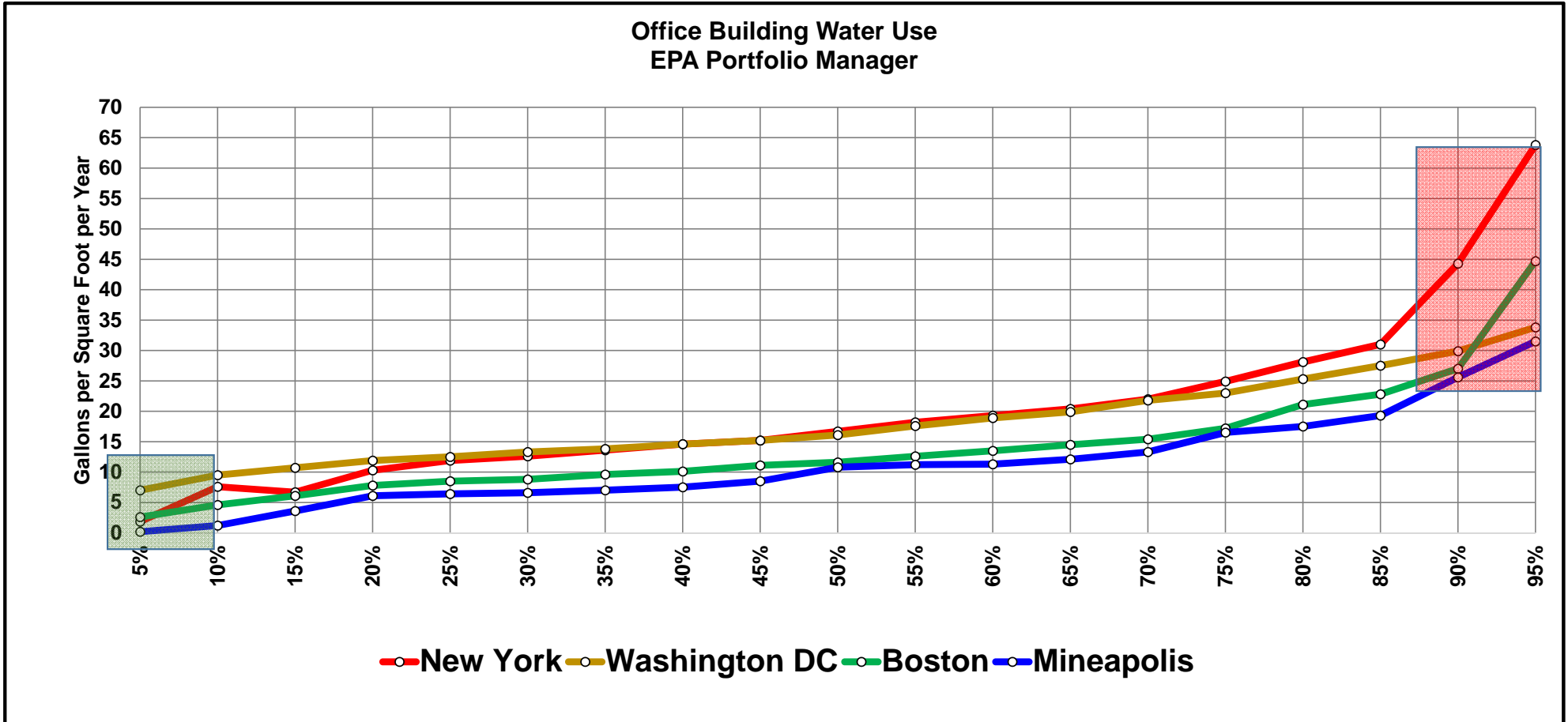




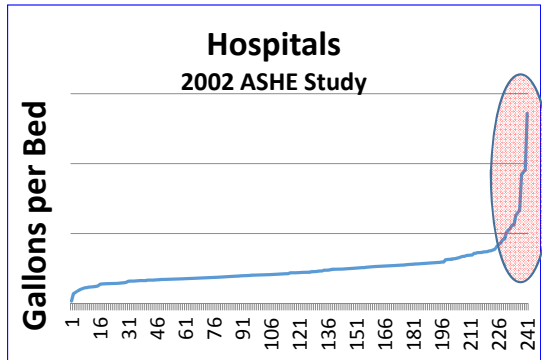
# Examples of Energy Star Portfolio Manager Data for Office Buildings in 2014

Gallons per Square Foot per Year				
City	New York	Washington DC	Boston	Minneapolis
No. of Buildings	(398)	(342)	(218)	(80)
Low (Meter stuck??)	0.01	0.2	0.09	0.01
Median	16.7	16.1	11.6	10.8
Average	45.6	163.7	40.7	12.1
High (Get the meter checked!!!!)	4,821.5	33,917.8	1,552.3	43.6

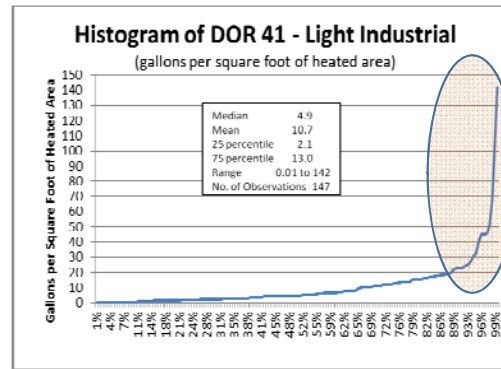
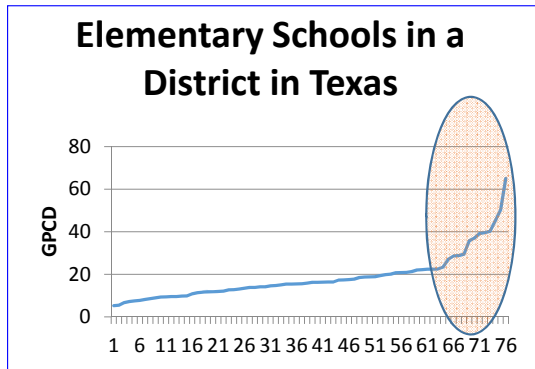
# Same Cities Without High and Low Data



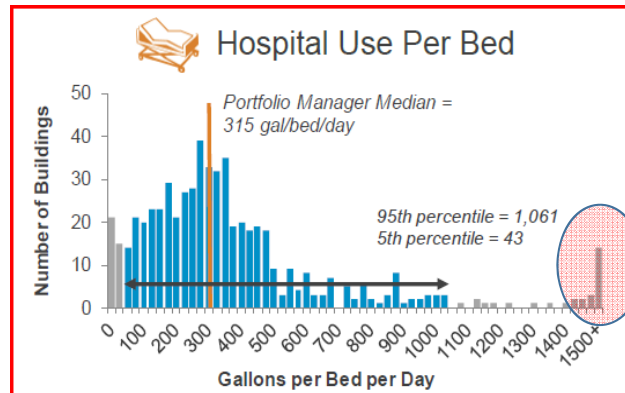
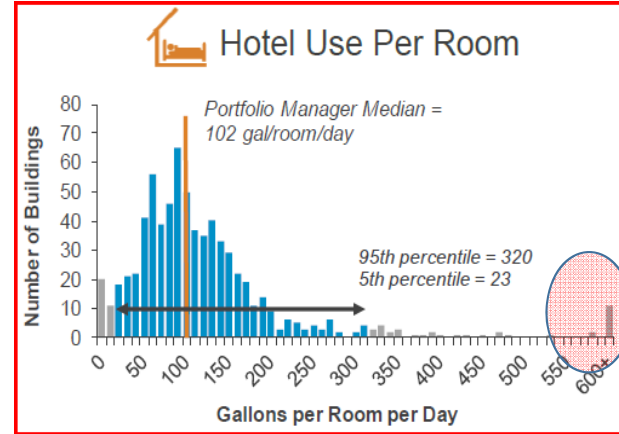
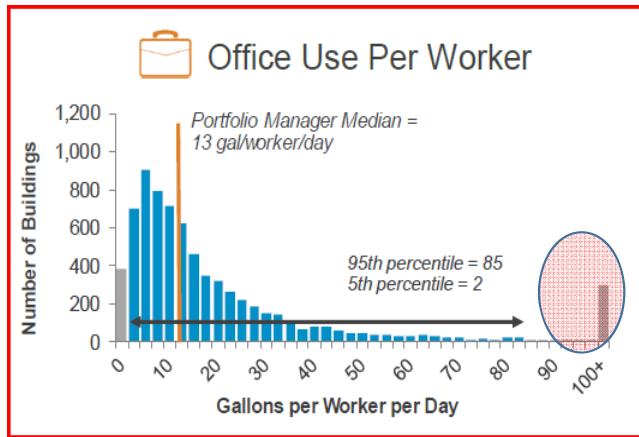
# **Studies Across the Nation**



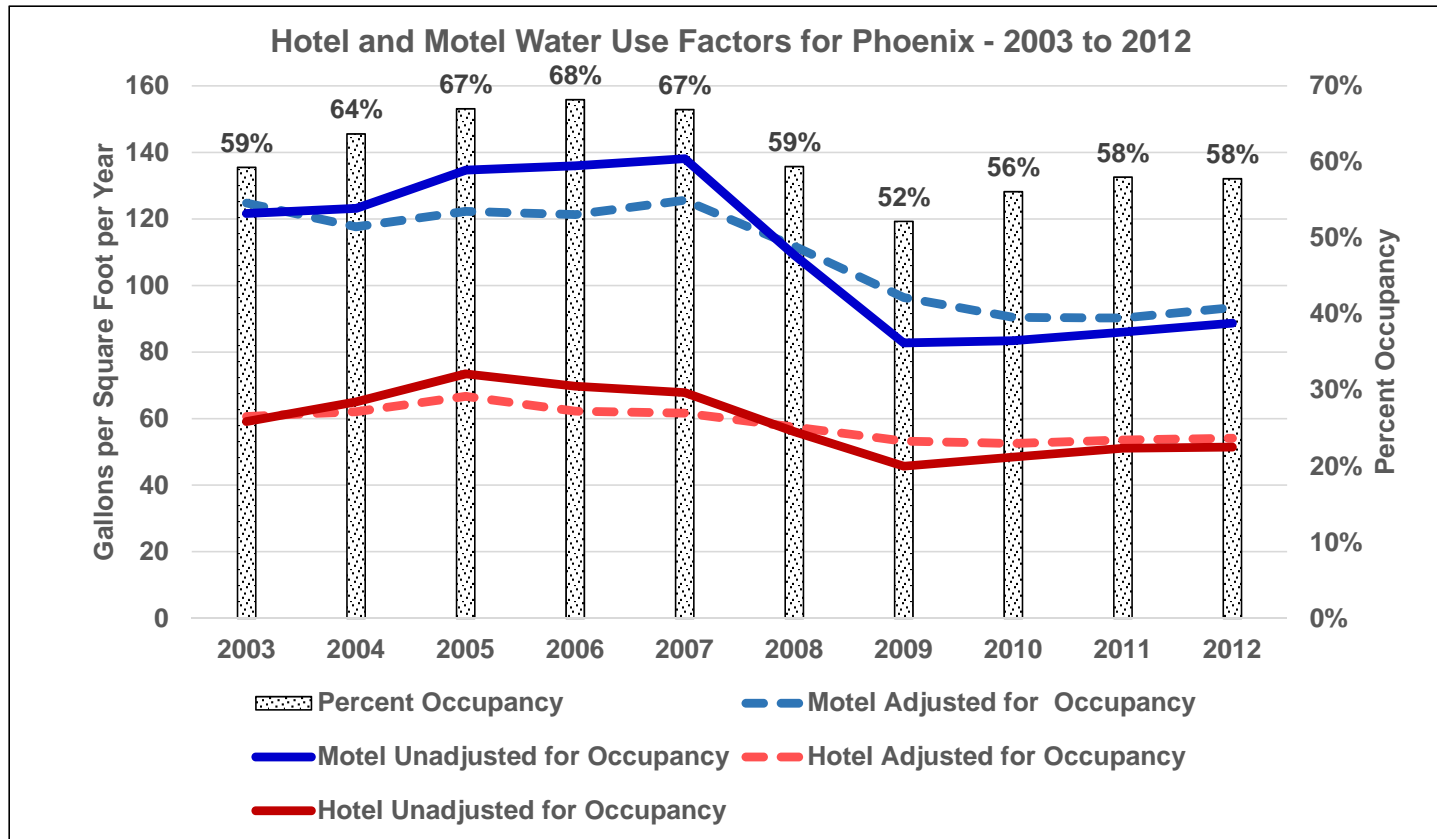
**Do You see  
the same  
Pattern  
Here?**



# EPA Portfolio Manager Information on Water



# Commercial & Institutional Savings Too



## 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
Florida (Univ. of Fl.) Restaurant			270		
Florida (Univ. of Fl.) Fast Food			240		
Colorado Study (Brendle Group)	9 to 12		192	29	53
USA (2000 AWWARF CI End Use Study)			130 to 331	20 to 30	
Boulder Colorado	8 to 9		125		49
Danamark (Canada)					
U of Kansas (M. Vanschenkhof)		12.8	266		
South Australia study and Sydney Water		9 to 12			
North Carolina ICI BMP					20 to 40
Austin Study (Full Svc.) 2013			173		31
Austin Study (Fast Food) 2013			257		39

## Summary of Hospital Water Use Coefficients from Various Studies

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

Study	Gal./Bed/Day	Gal./Sq. Ft/Yr.	
		Average	Best
<b>Federal Facilities Average</b>		<b>125</b>	
<b>Univ. of Florida Study</b>		<b>31</b>	
<b>United Kingdom -Large Teaching</b>		<b>41</b>	<b>34</b>
<b>UK Small Acute or Long Stay</b>		<b>29</b>	<b>22</b>
<b>UK Small Acute or Long Stay With Laundry</b>		<b>39</b>	<b>31</b>
<b>North Carolina Rule of Thumb</b>	<b>300</b>		
<b>ASHE 2002 Study</b>	<b>471</b>		
<b>Energy Star Portfolio Mgr.</b>	<b>315</b>		
<b>Victoria Public Health Service - Australia</b>		<b>39</b>	<b>17</b>
<b>Health Estate Journal - United Kingdom</b>		<b>87</b>	
<b>US Energy Information Adm. 2007 study</b>	<b>395</b>	<b>68</b>	
<b>City of Austin (9 largest medical Facilities)</b>	<b>335</b>	<b>58</b>	<b>18</b>



## 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 2012 <sup>1</sup>	University of Florida <sup>2</sup>	Santa Fe, New Mexico <sup>3</sup>	Colorado Water Wise - Brendle Group. <sup>4</sup>	AWWA End Use Study 2000 <sub>5</sub>	Austin 2013 <sup>6</sup>
	Gallons per Square Foot of Heated Space per Year					
Restaurants		221		173 to 211	130 to 330	215
Senior Care Facilities	61	106		62 to 101		
Hotels	54	85		79 to 165	60 to 115	72
Hospitals	52	31				58
Grocery/Supermarkets	24	95	36		52 to 64	
Medical Offices	19	34	49			
Offices	13	20	26		9 to 15	19
Banking/Financial	12	89				
Court House	11					
K-12 Schools	10	20		12 to 19	8 to 16	
Houses of Worship	7	15				
Retail/Shopping Centers	5	32	20			
Unrefrigerated Warehouses	3	8				

**Big Data is Coming**

*Soon to your city!*

# ***In the Next 20 Years, All Water Utilities Will Be Using AMI***

## **Advanced Metering Infrastructure**



**Utility Organizations are in on  
the act**

# **American Water Works Association**

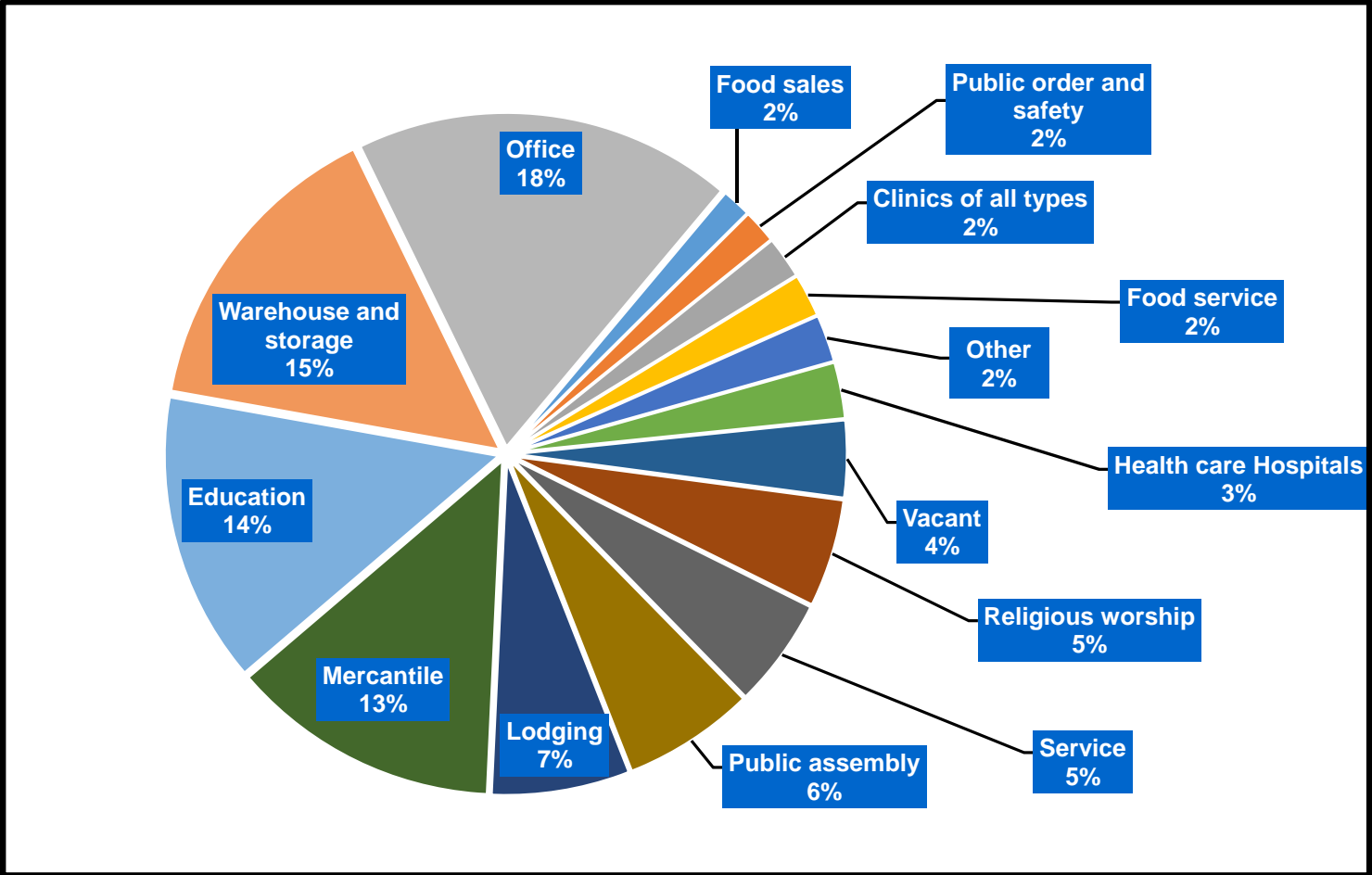
## **Water Research Foundation**

- 2015 Residential End Use Study
- 2016 Commercial – Institutional Methodology Study
- 2018 Commercial Institutional Data Base

# **The Federal Government Activity**

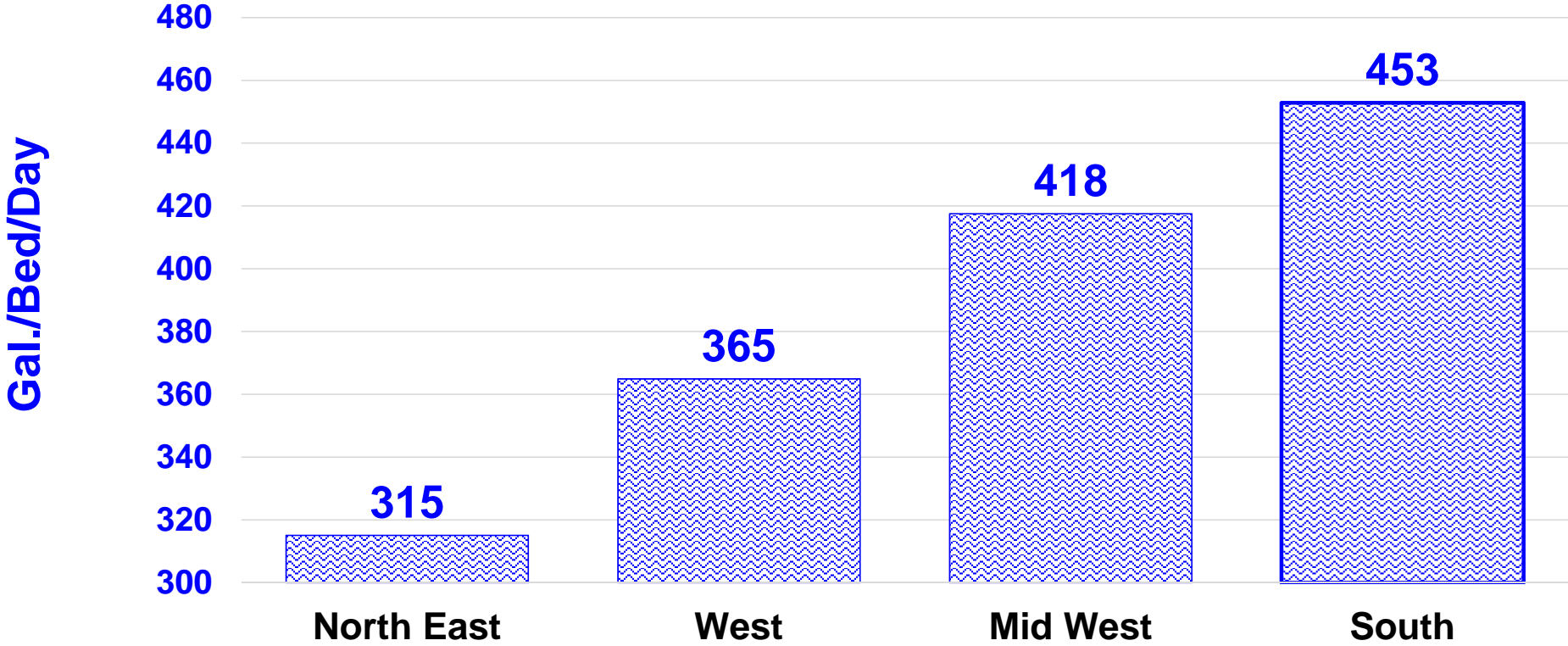
# The US Had 87 Billion Sq. Ft. of Commercial/Institutional Space in 2012

Commercial Buildings Energy Consumption Survey (CBECS)



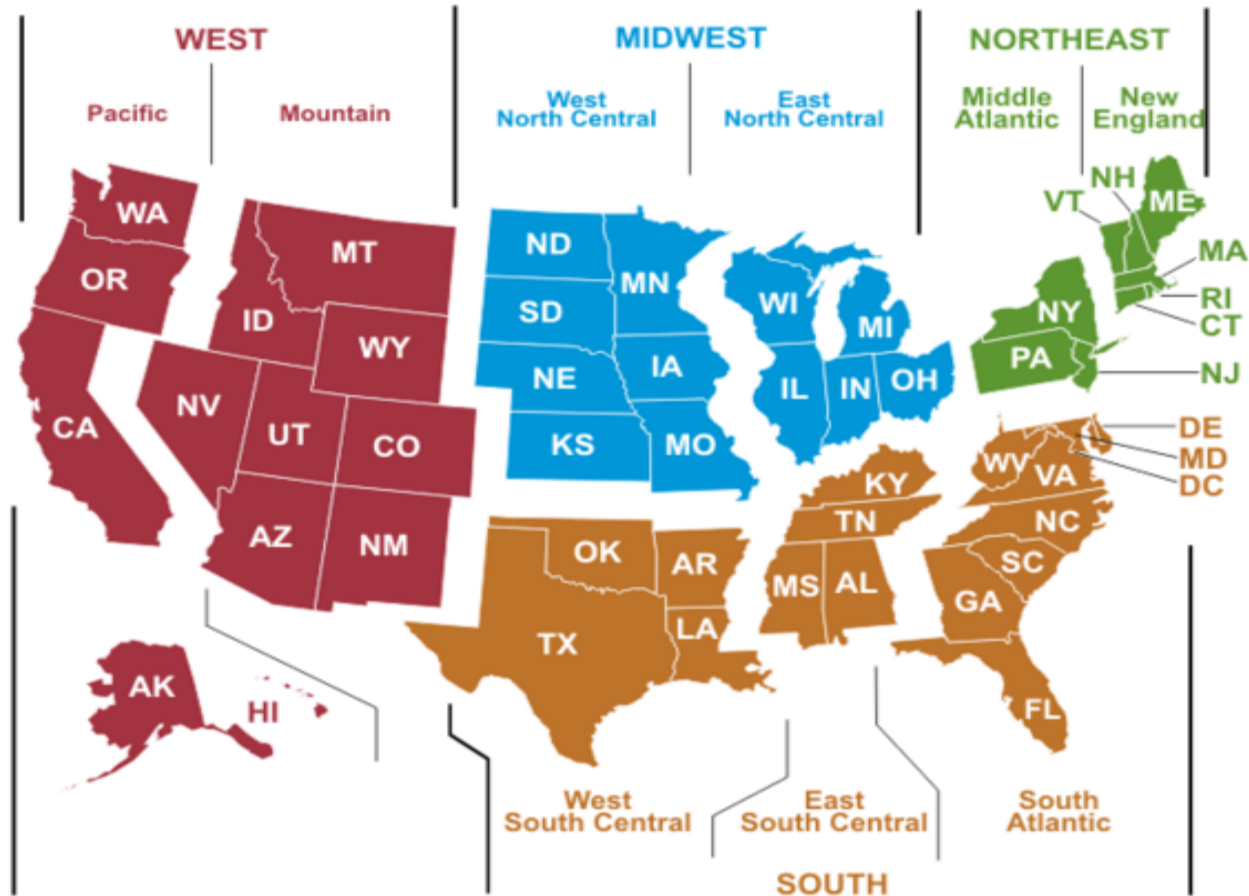
# CBECS 2007 Hospital Use

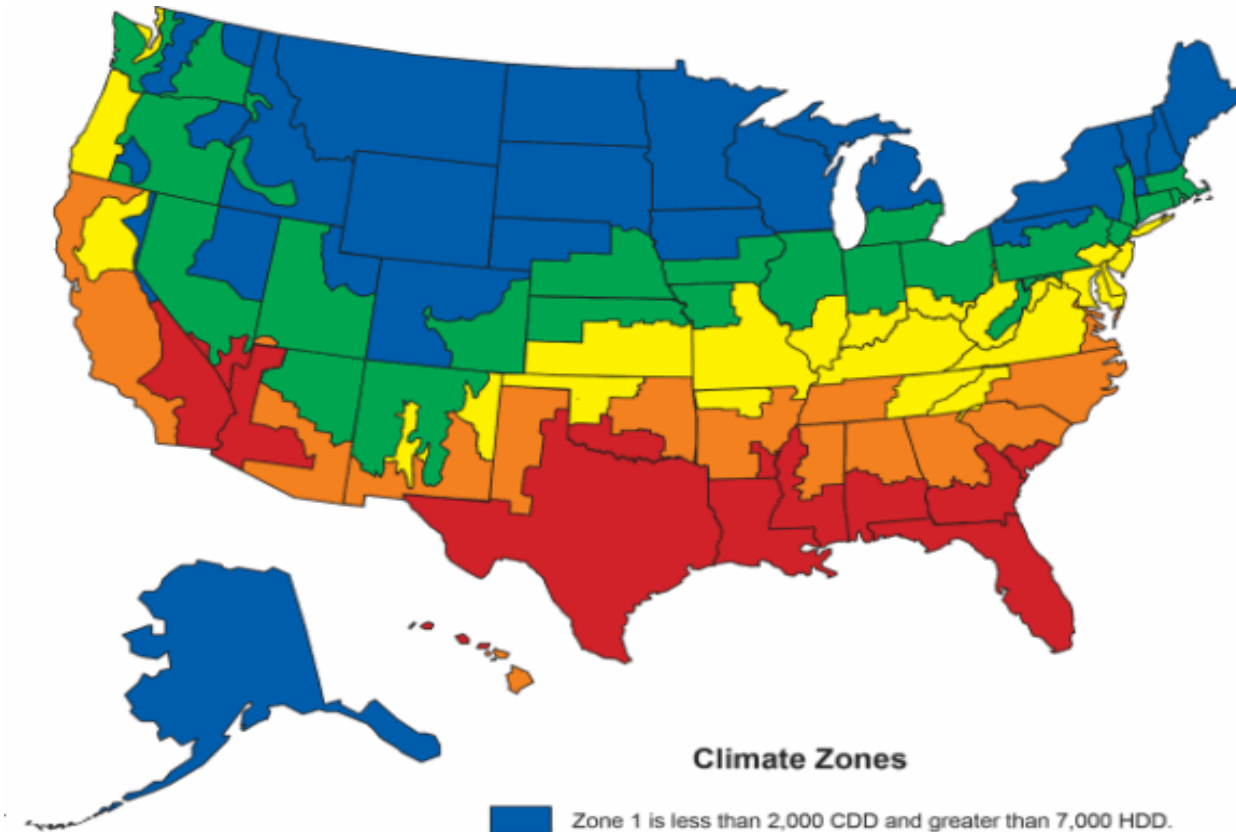
*Gallons per Bed per Day*





# Census Regions Used by CBECS



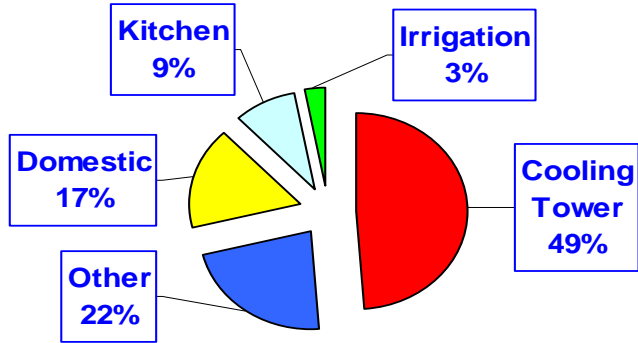


### Climate Zones

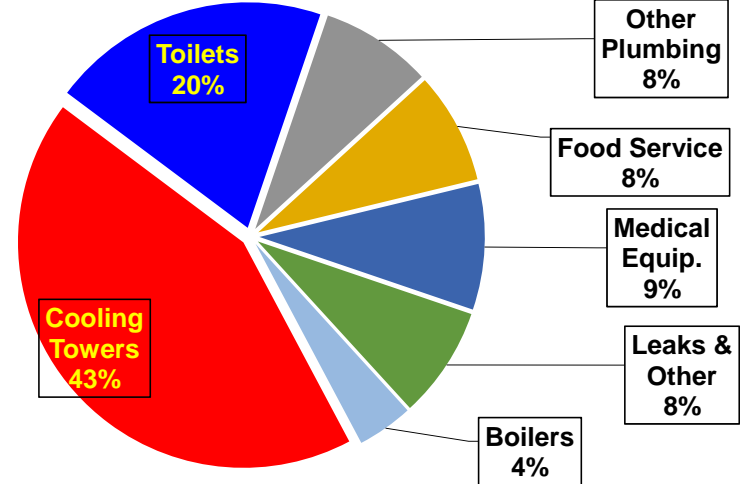
- Zone 1 is less than 2,000 CDD and greater than 7,000 HDD.
- Zone 2 is less than 2,000 CDD and 5,500-7,000 HDD.
- Zone 3 is less than 2,000 CDD and 4,000-5,499 HDD.
- Zone 4 is less than 2,000 CDD and less than 4,000 HDD.
- Zone 5 is 2,000 CDD or more and less than 4,000 HDD.

# Grocery Store Water Use in California

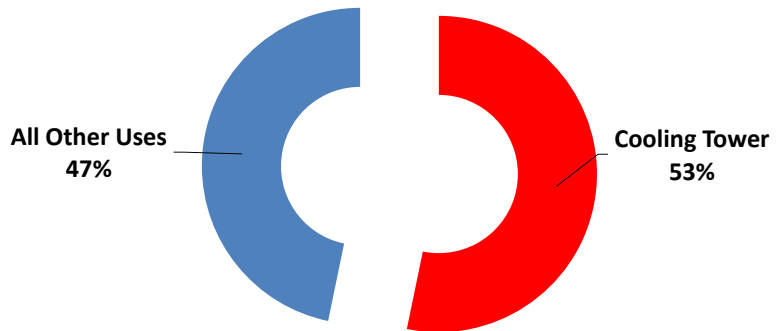
*Pacific Institute*



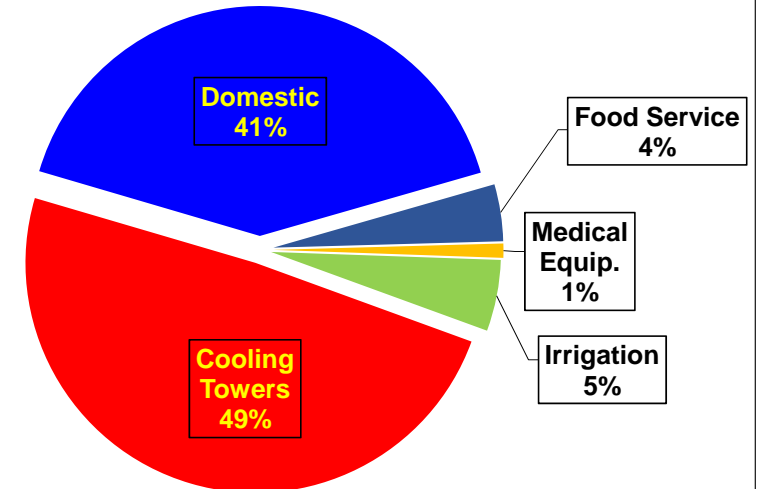
# A Large Hospital in Florida



# Eleven Office Buildings in Austin, Texas



# A Large Hospital in Arizona

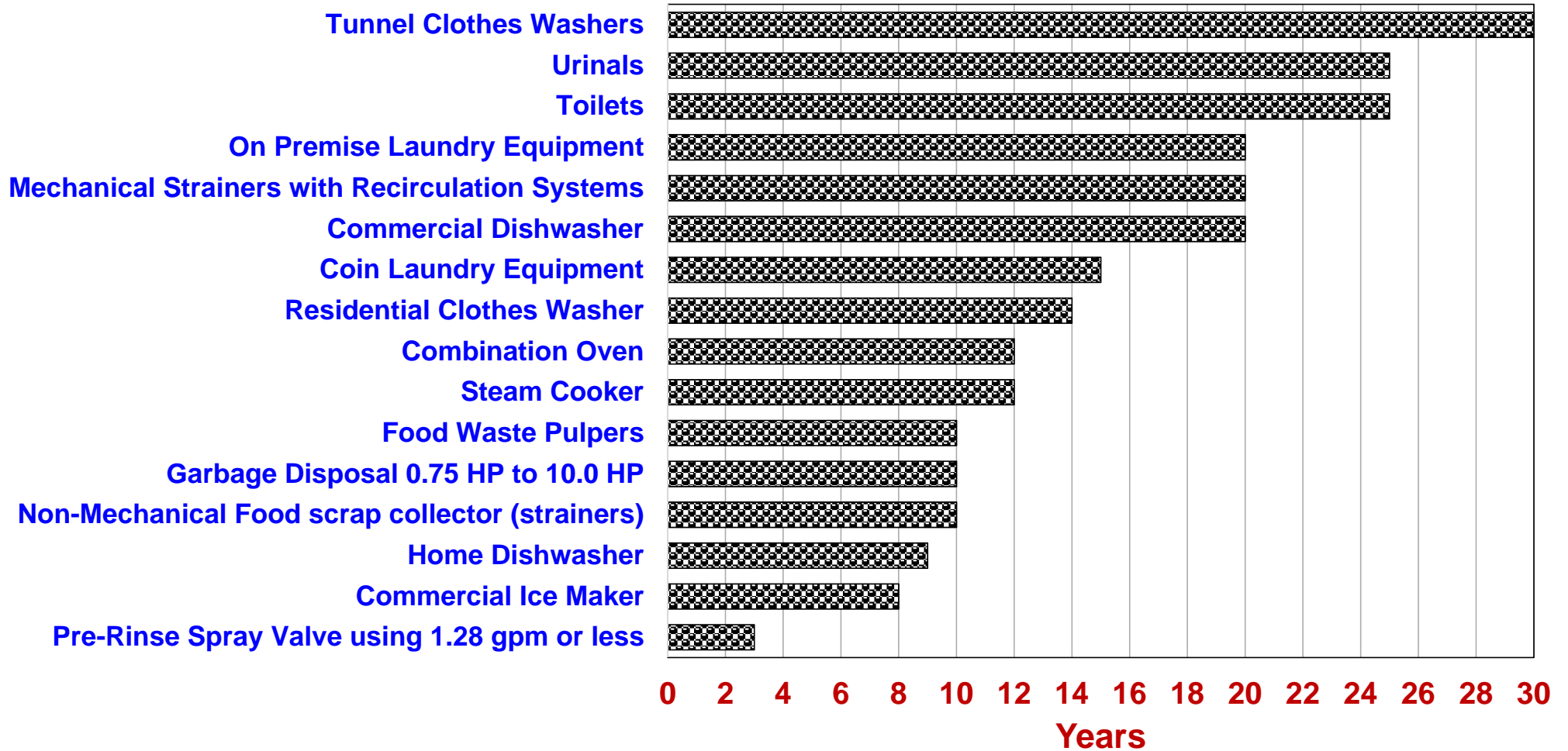


**So is it working?**

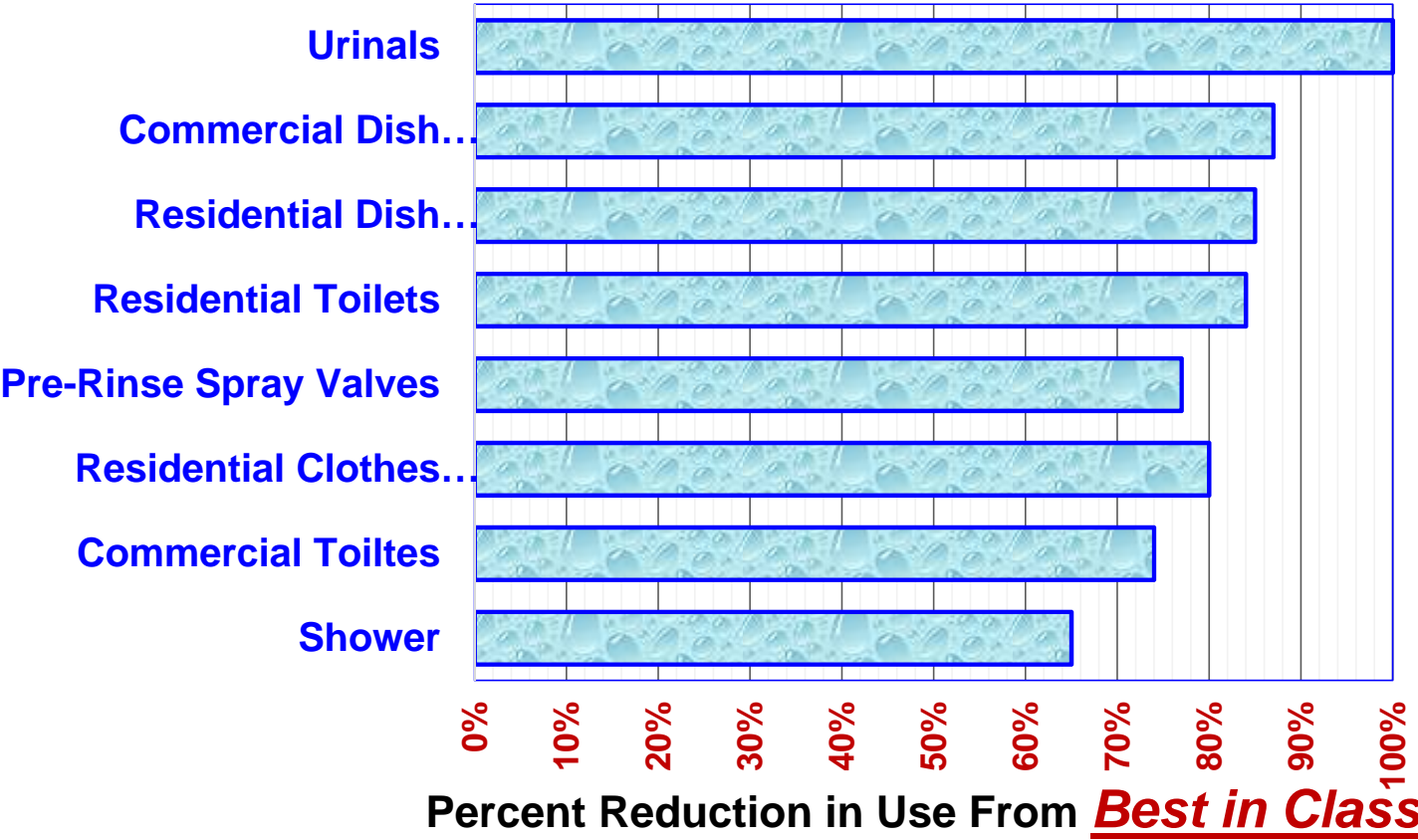
# Texas Water Development Board Water Use Projection Tables

Year of Implementation in Texas							
Action	1993	2007	2010	2013	3014	2015	2018
Energy Policy Act							
1.28 gpf toilets							
Dishwashers							
Front Load Washers							
Top Load Washers							

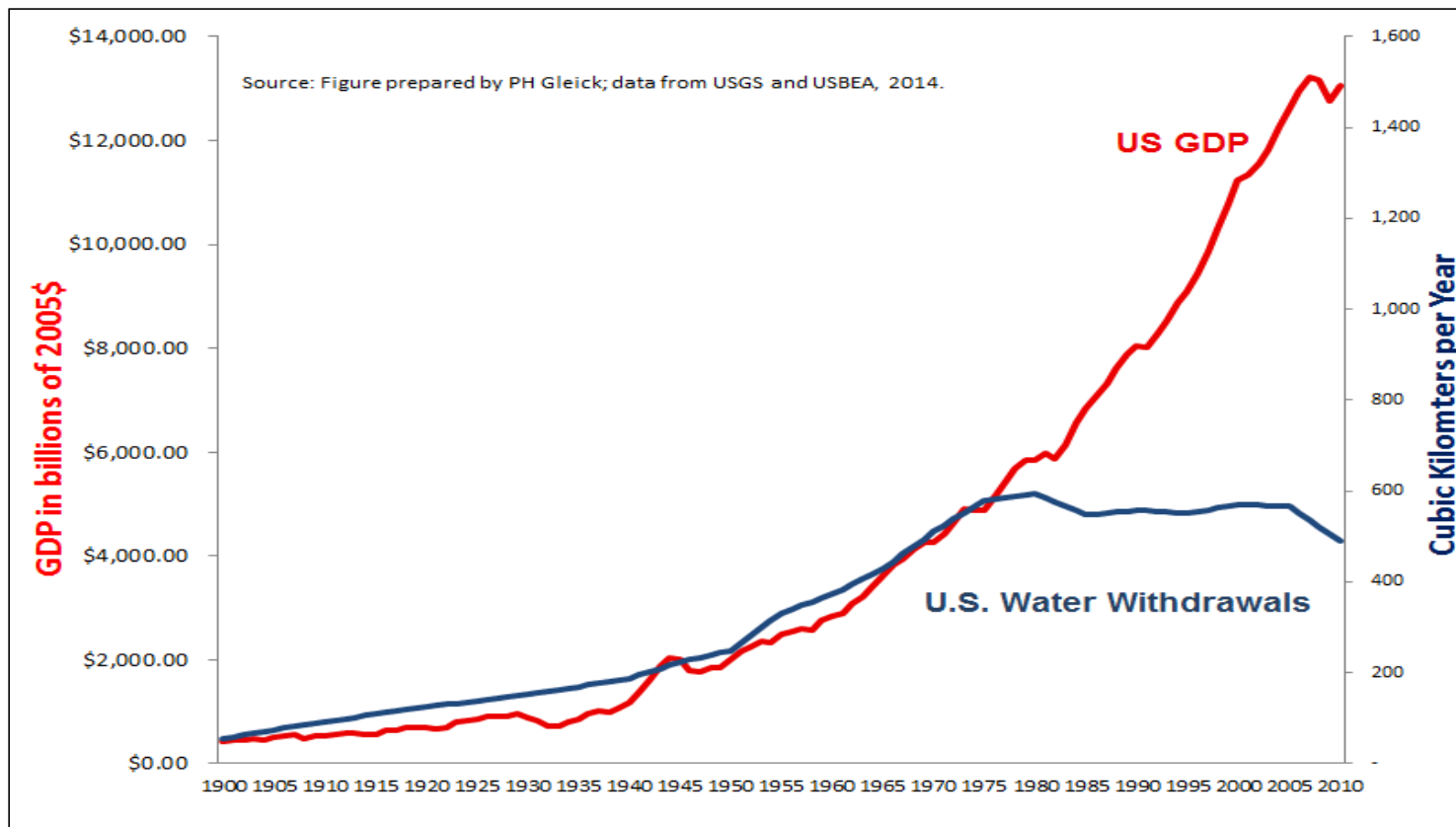
# Average Life of Appliances



All of this has had a real impact on water use across the Nation



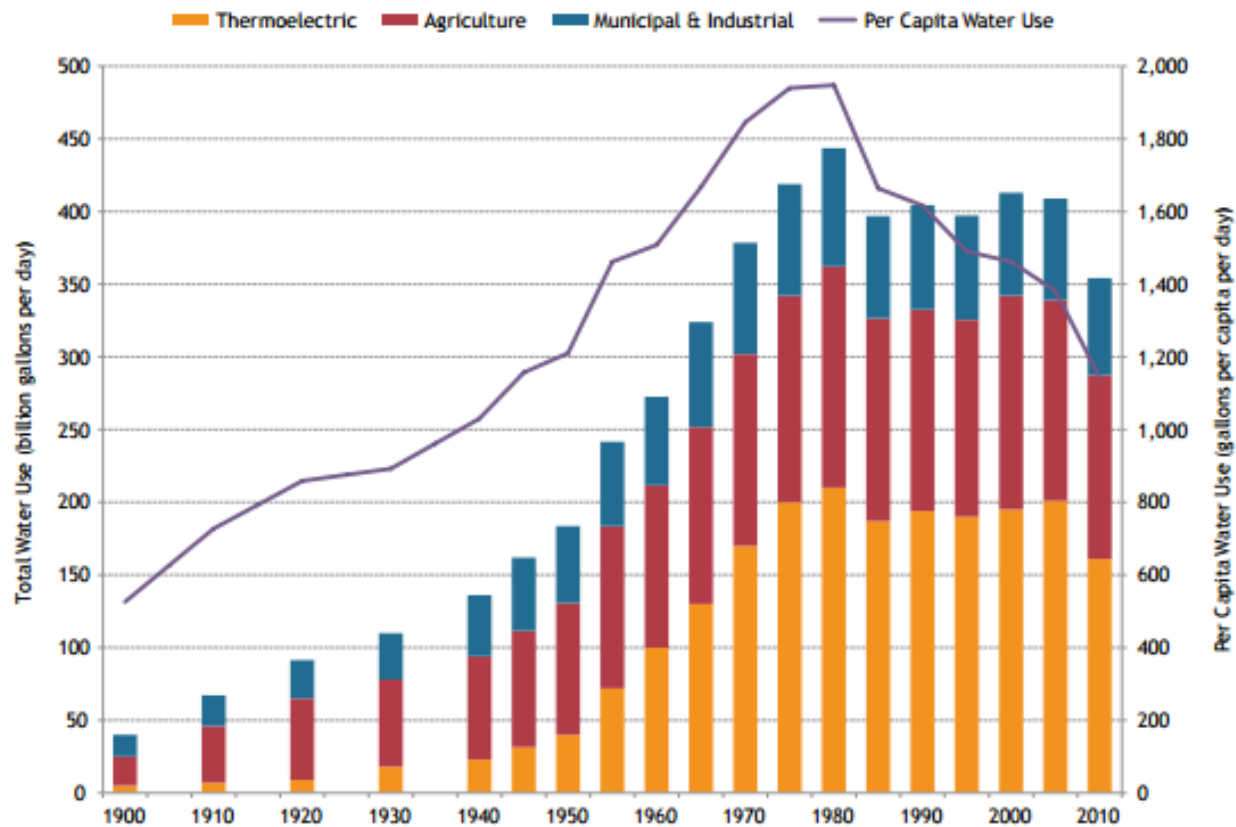
# US GDP vs. Water Withdrawals



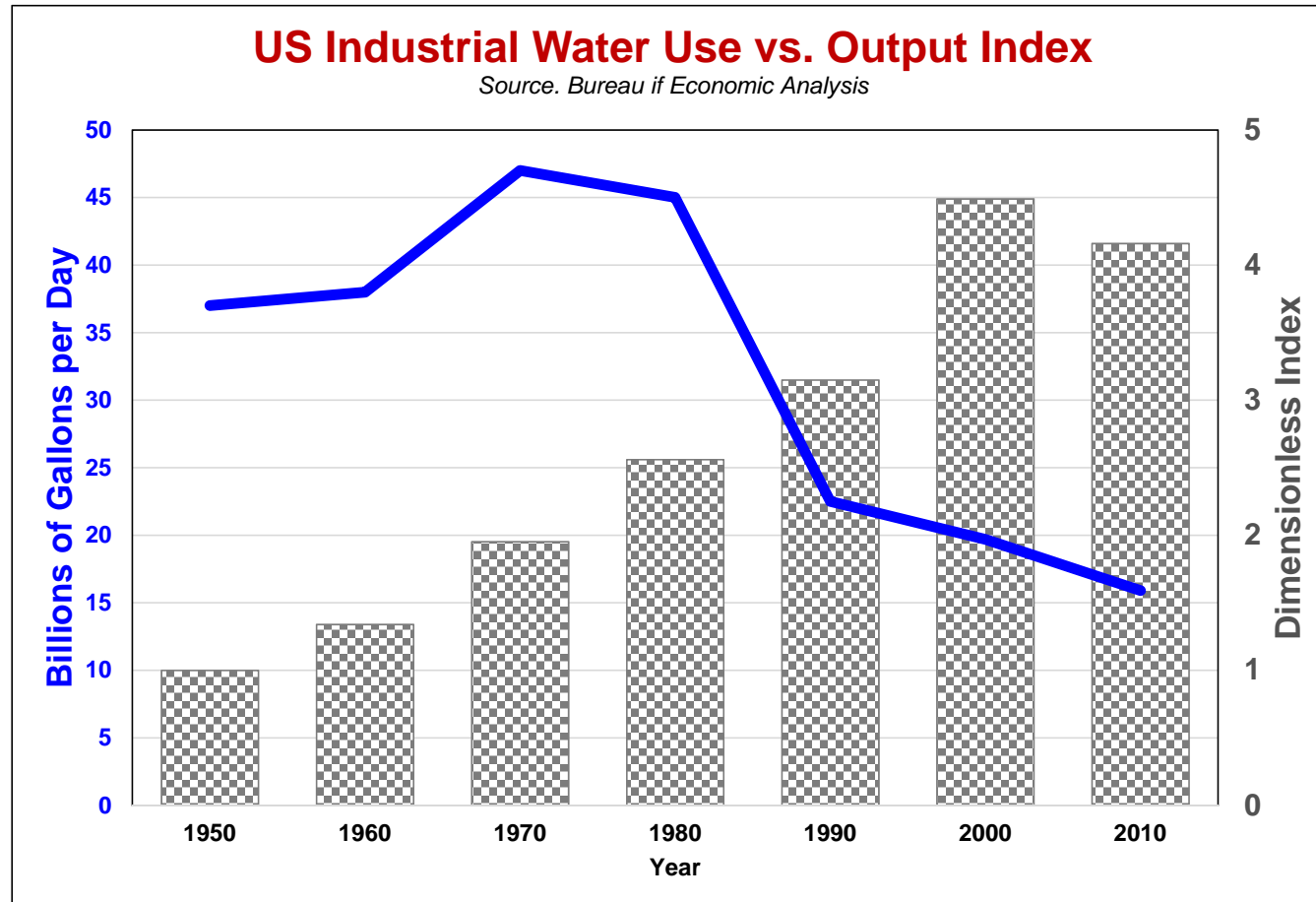


# All Water Use in USA – USGS

After Peter Glick [Water Use Trends in the United States - Pacific Institute](#)

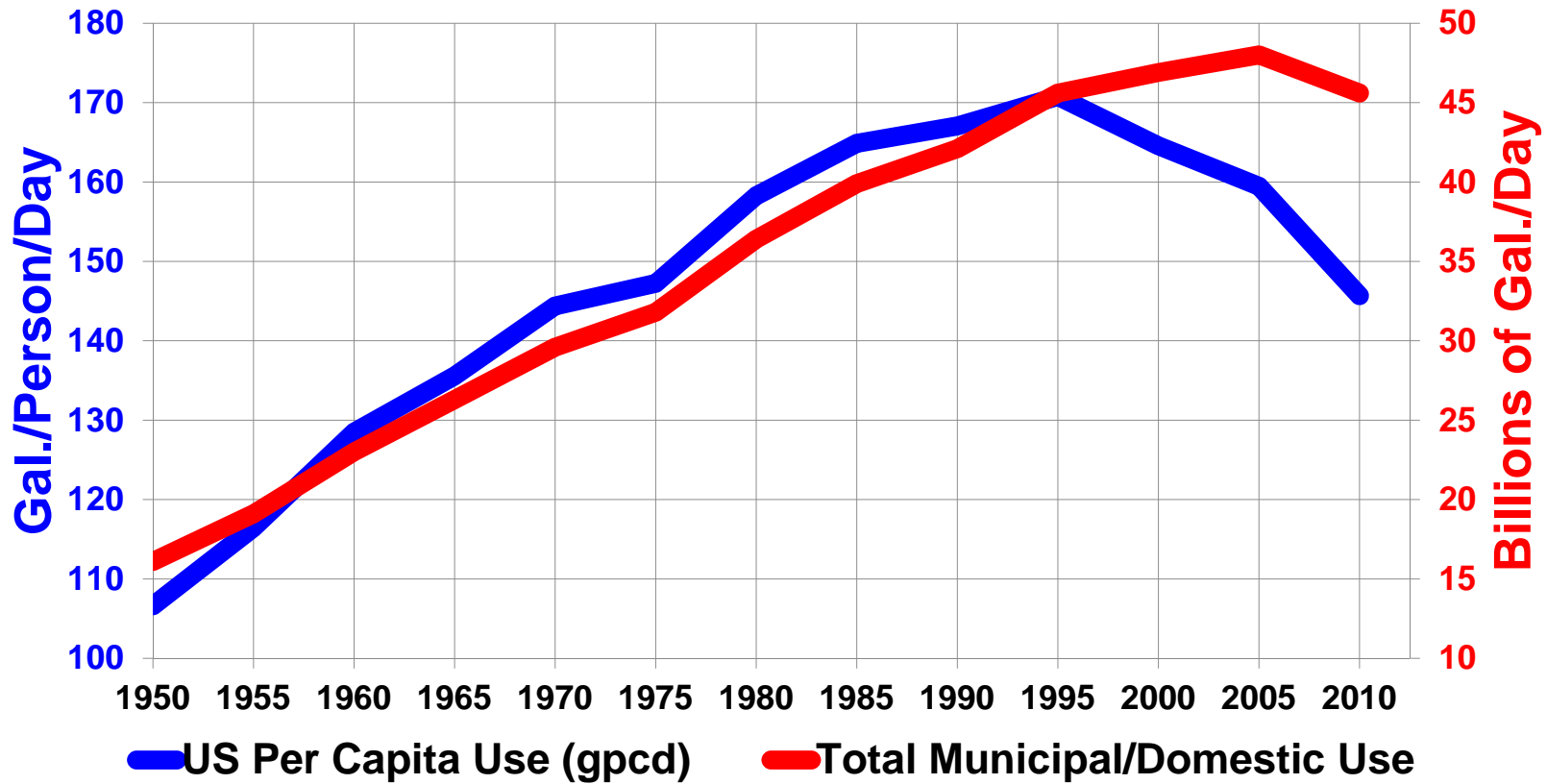


# Industry way down

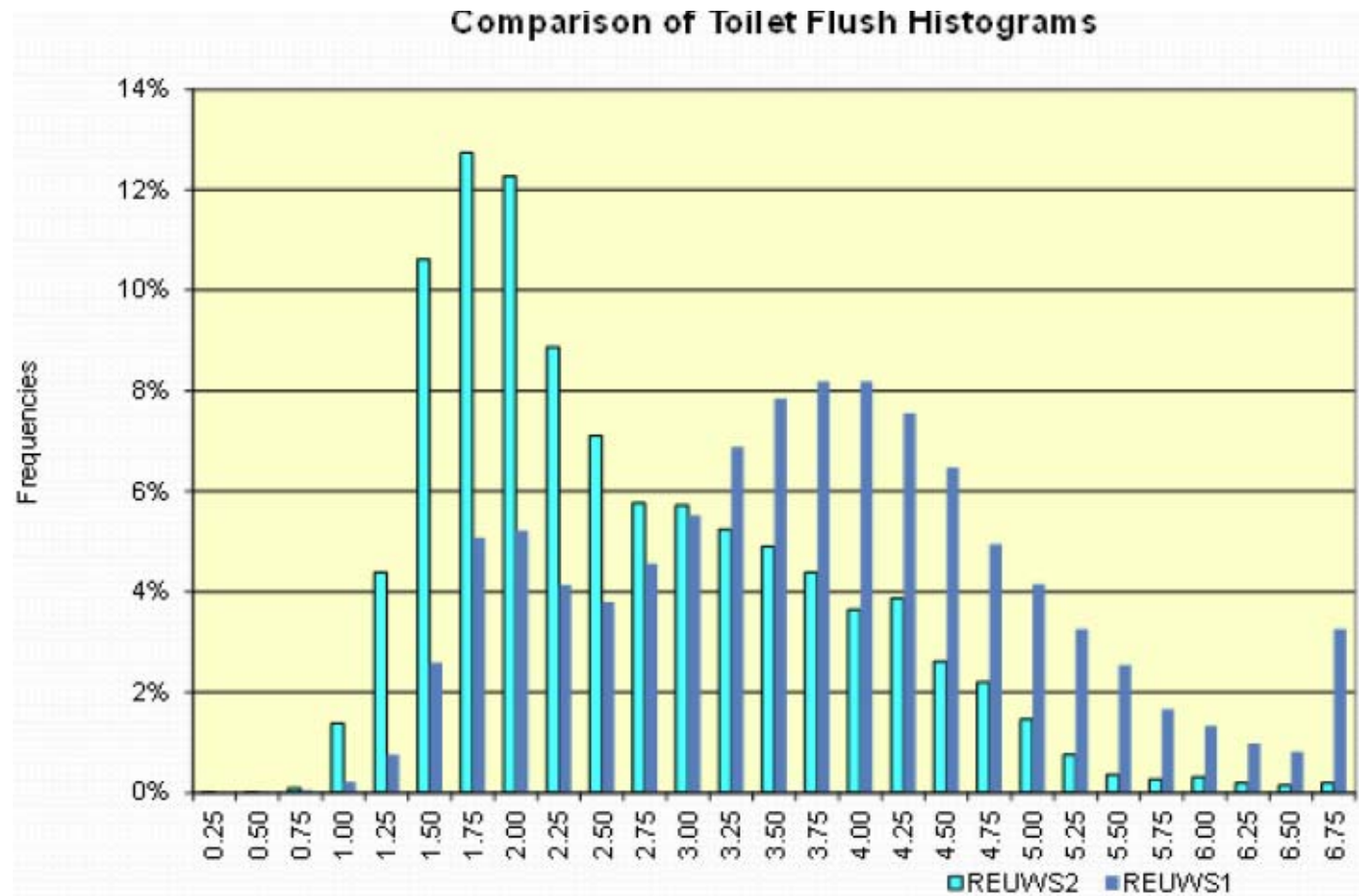


# And it is showing up in real municipal water use data

US Geological Survey Report – 2014  
<http://water.usgs.gov/watuse/>

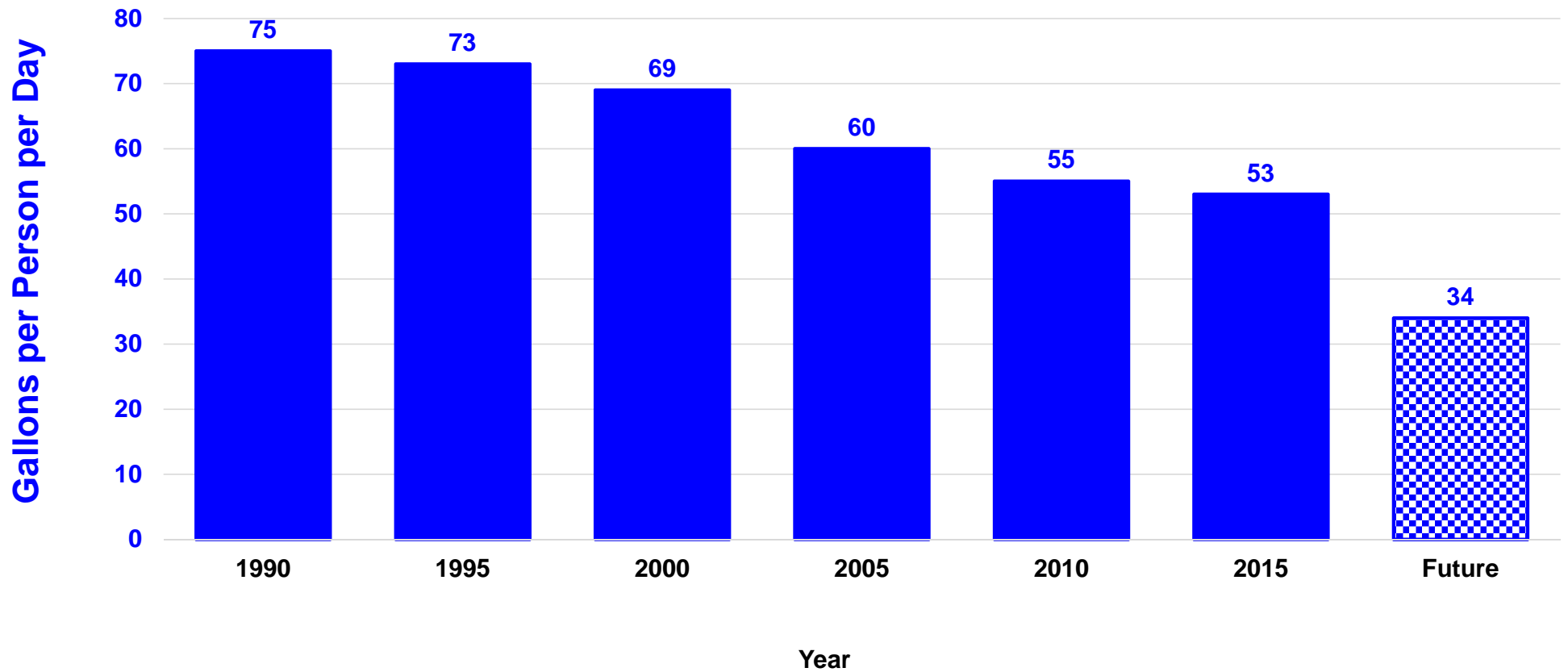


# Residential End Use Study - AWWA



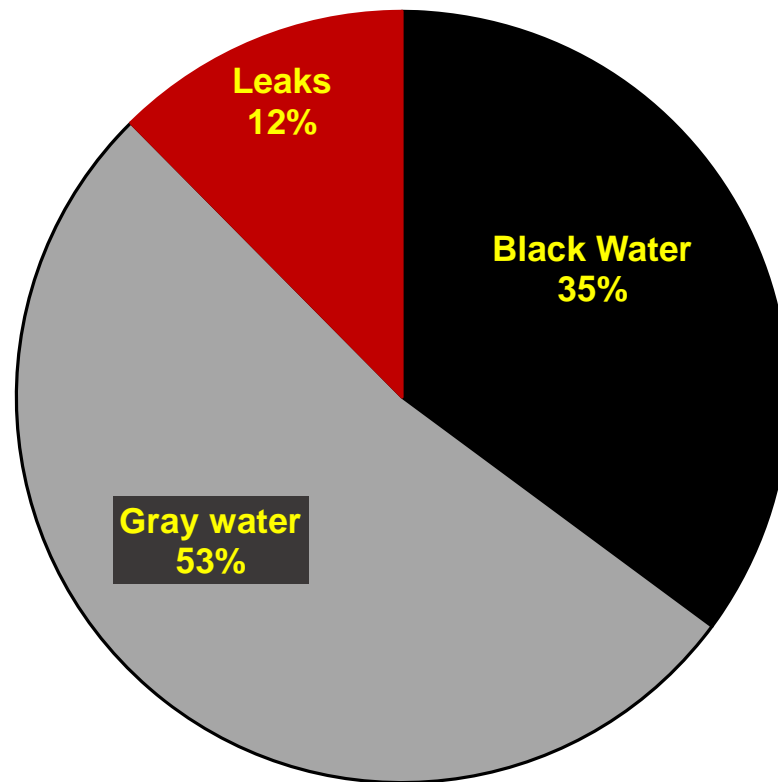
# Estimated Change in Residential Per Capita Use in USA *a 55% Decrease*

Sources: AWWARF Studies

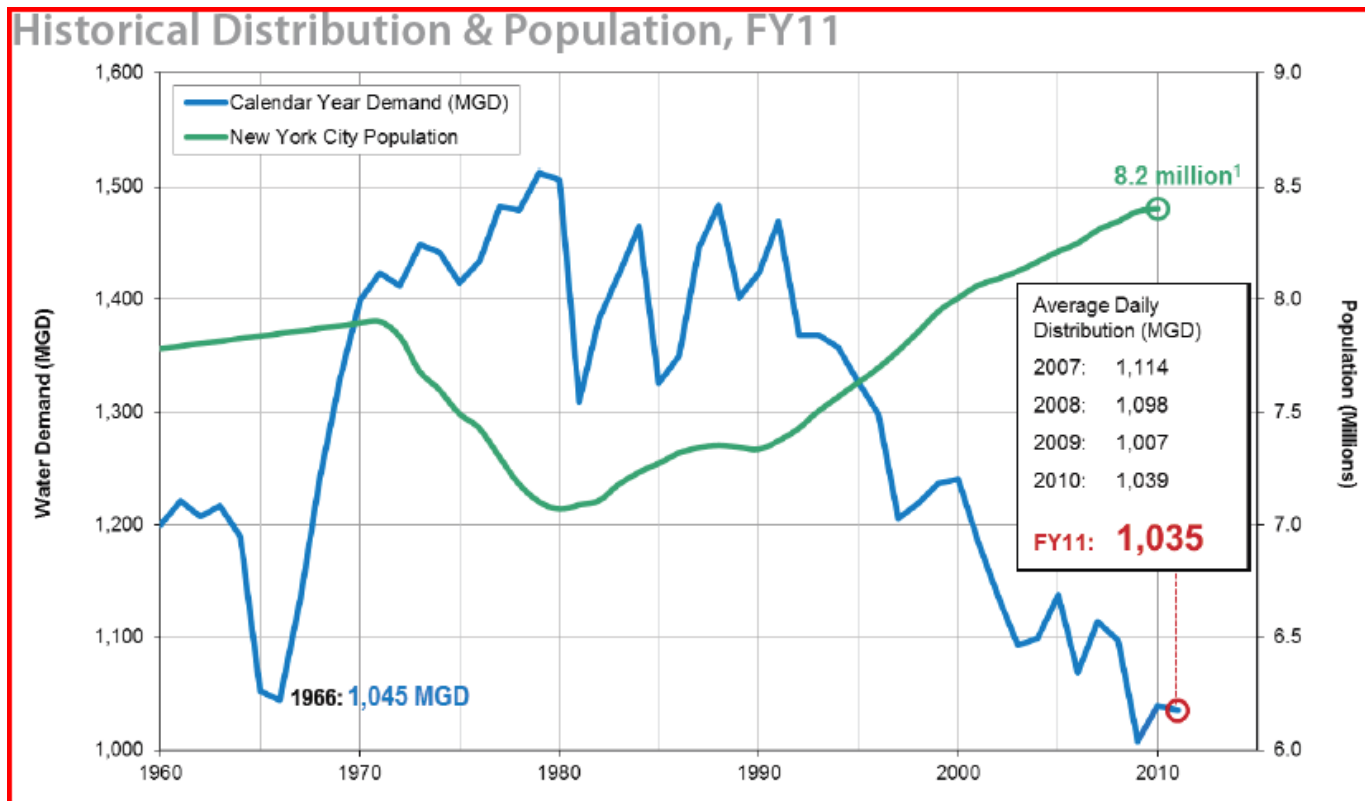


## Average American Household Indoor Use

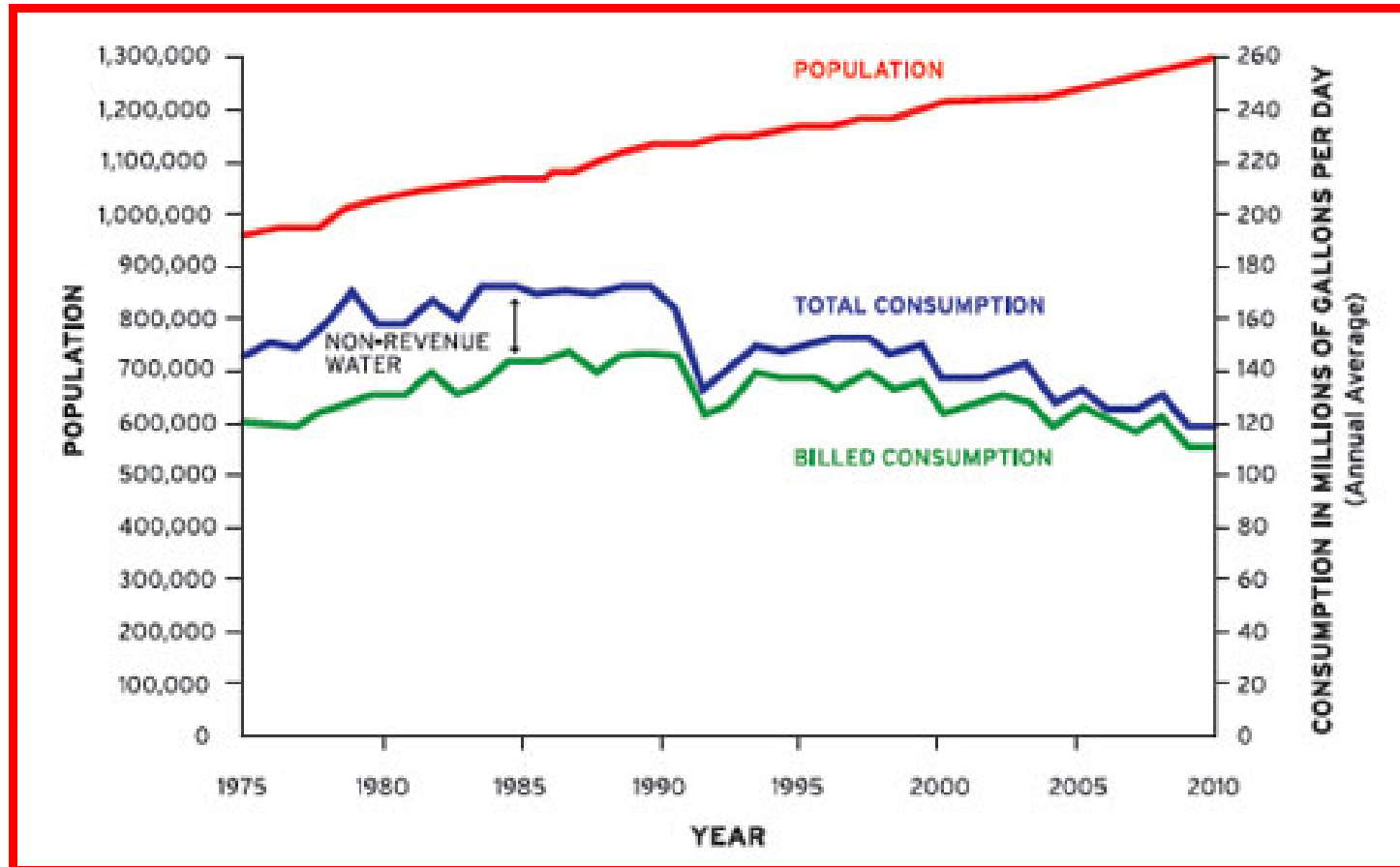
*EPA estimates that about 1/3 of residential use is outdoor*



# New York City



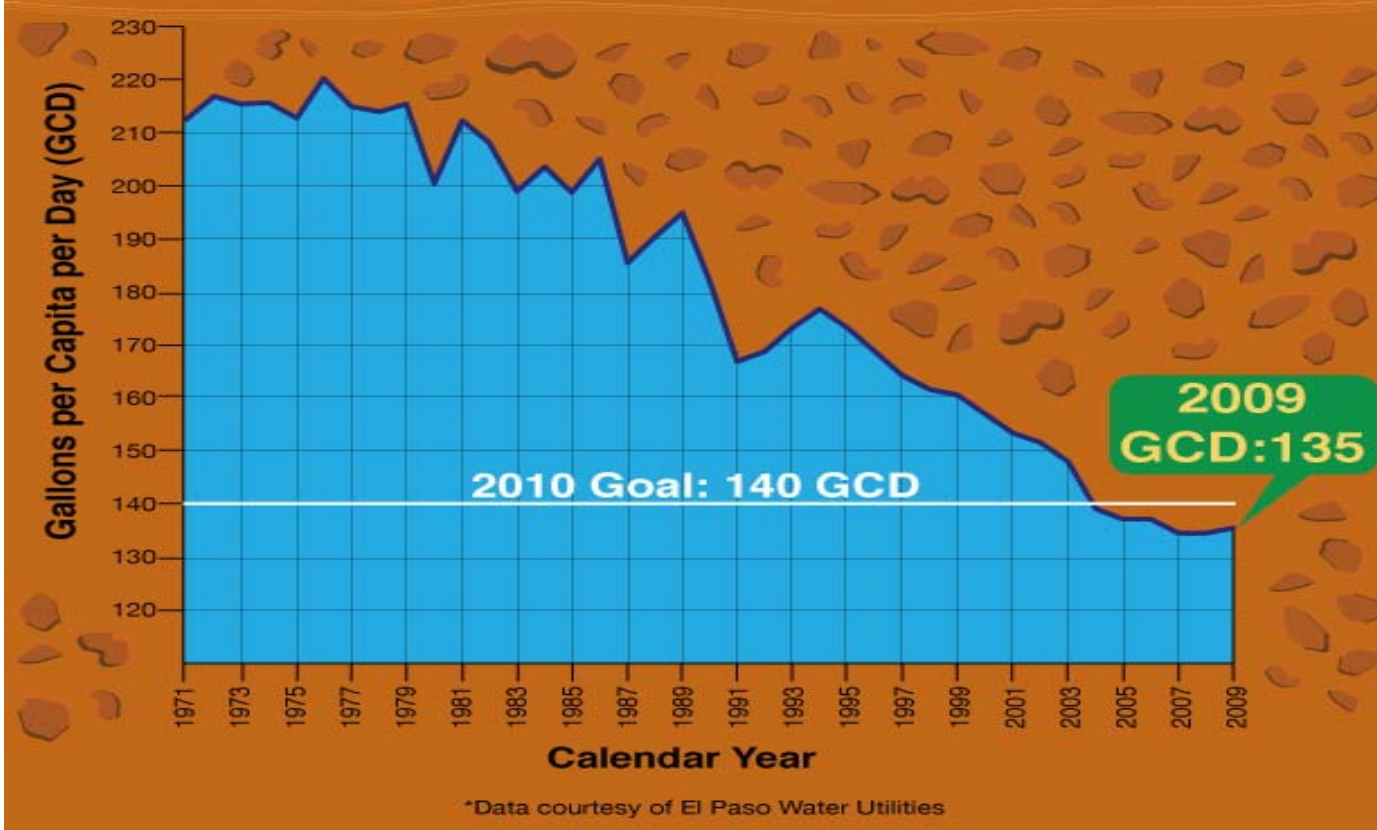
# Seattle Washington

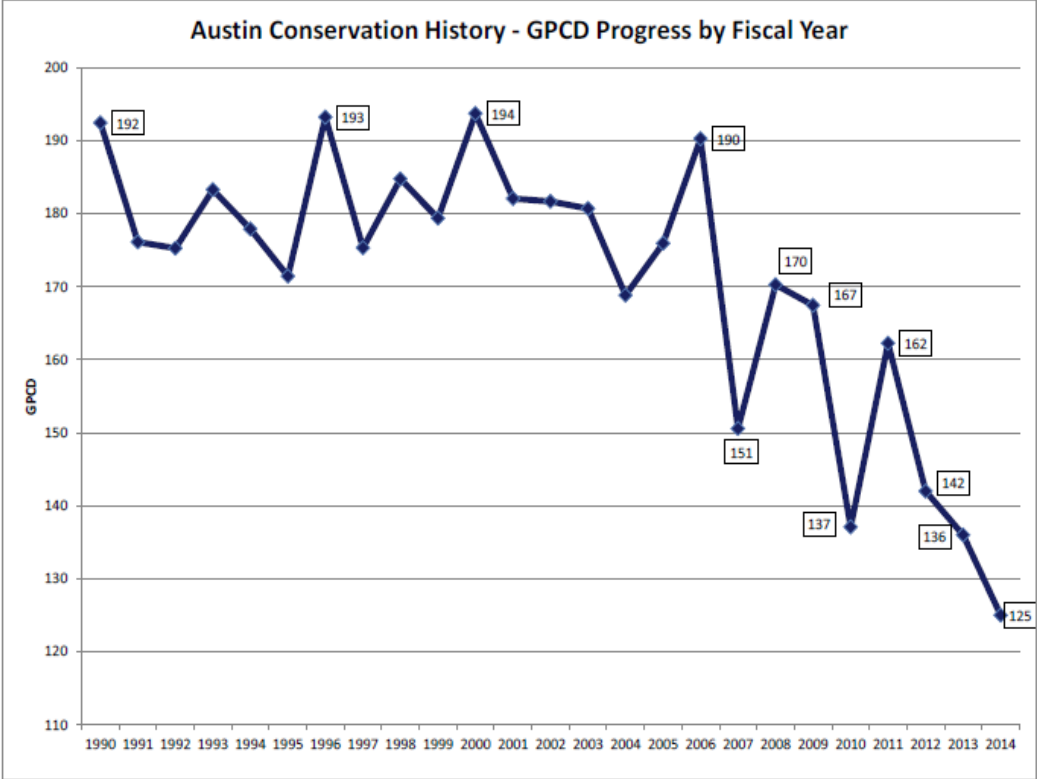




# El Paso Water Consumption

grist





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

# Conclusions

- We have entered the age of Big Data!
- The price of water and wastewater will ensure that enhanced metering, measurement and monitoring are here to stay!
- Codes, Standards, Design and our *Thinking* will need to change!
- We are just at the beginning!

*We covered a lot!*



**Questions?**

# Measurement, Metering, Benchmarking & Metrics

**International Emerging Technology Symposium – 2016**  
**Chicago, Illinois**

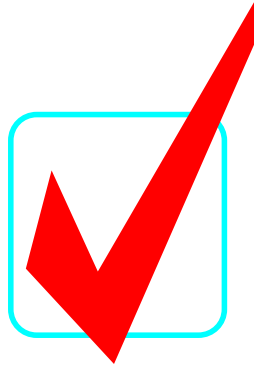
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***The***



***End***