Phoenix Medical Sector End Use Study

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Purpose of the Study

The purpose of the study is to identify changes in long-term water consumption patterns among medical type facilities and to explain those changes in terms of specific and manageable end uses categories, otherwise known as “Building Blocks”.

A clear understanding of how these blocks change over time and what we must do, if anything, to facilitate beneficial change is imperative when it comes to building and managing our future water supplies.

In order to do this, we must:

1. Identify the blocks
2. Use site audits to obtain Information on how water is being used
3. Identify trends that are affecting water consumption
4. Quantify Changes that are occurring within each building block
5. Interpret how these changes will ultimately affect utility from a whole system perspective: financially and structurally

The question that is most often asked is “Where do you start?”

The best answer is to start with a good metric.

Metrics

Metrics are common place in our every day lives. We may not be aware of it, but we use them every day.

Some common metrics include:

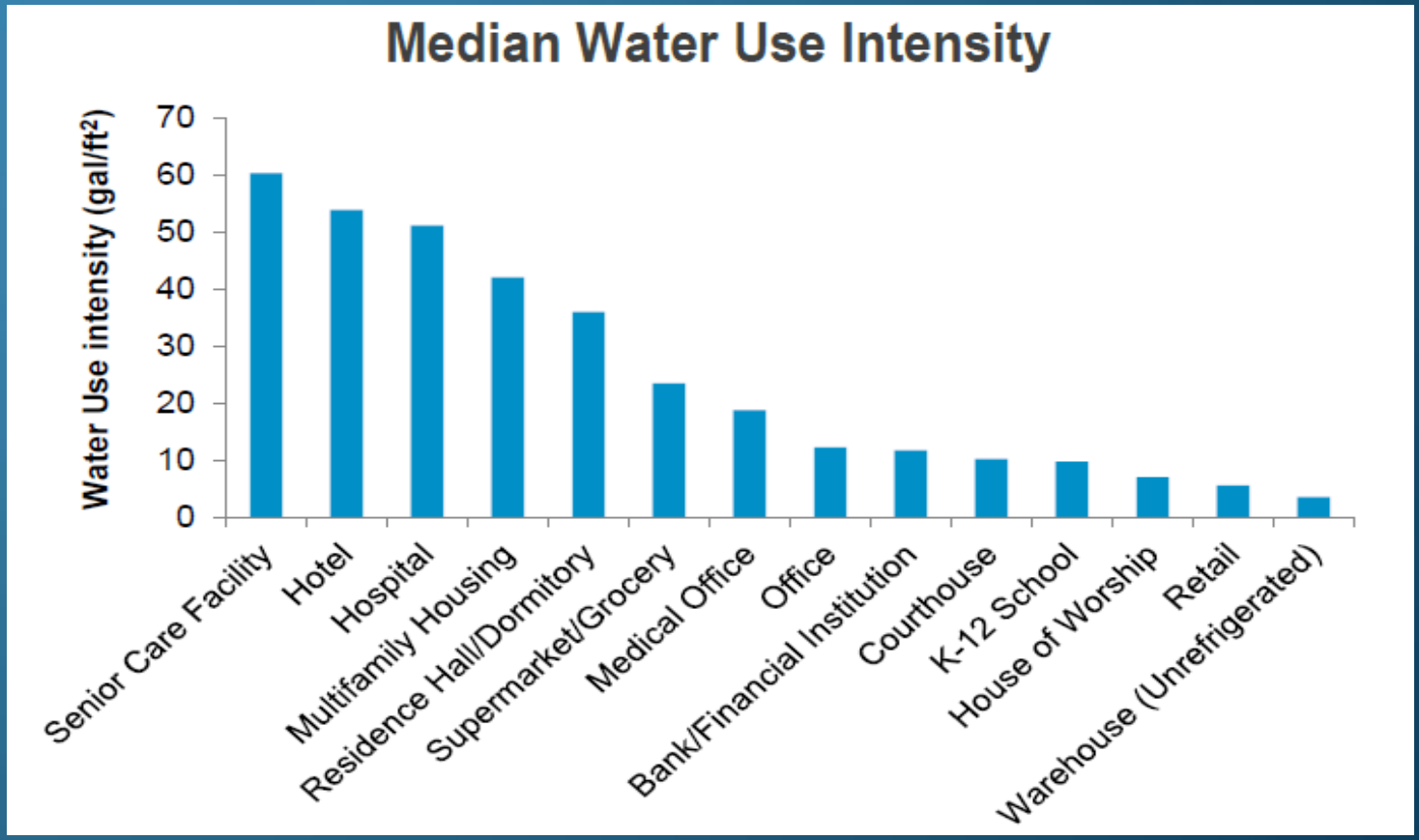
- Miles per Gallon
- Kilowatts per Hour
- Points per Game
- Yards per Carry

But, what is the correct metric when it comes to water consumption?

Identifying the Metric

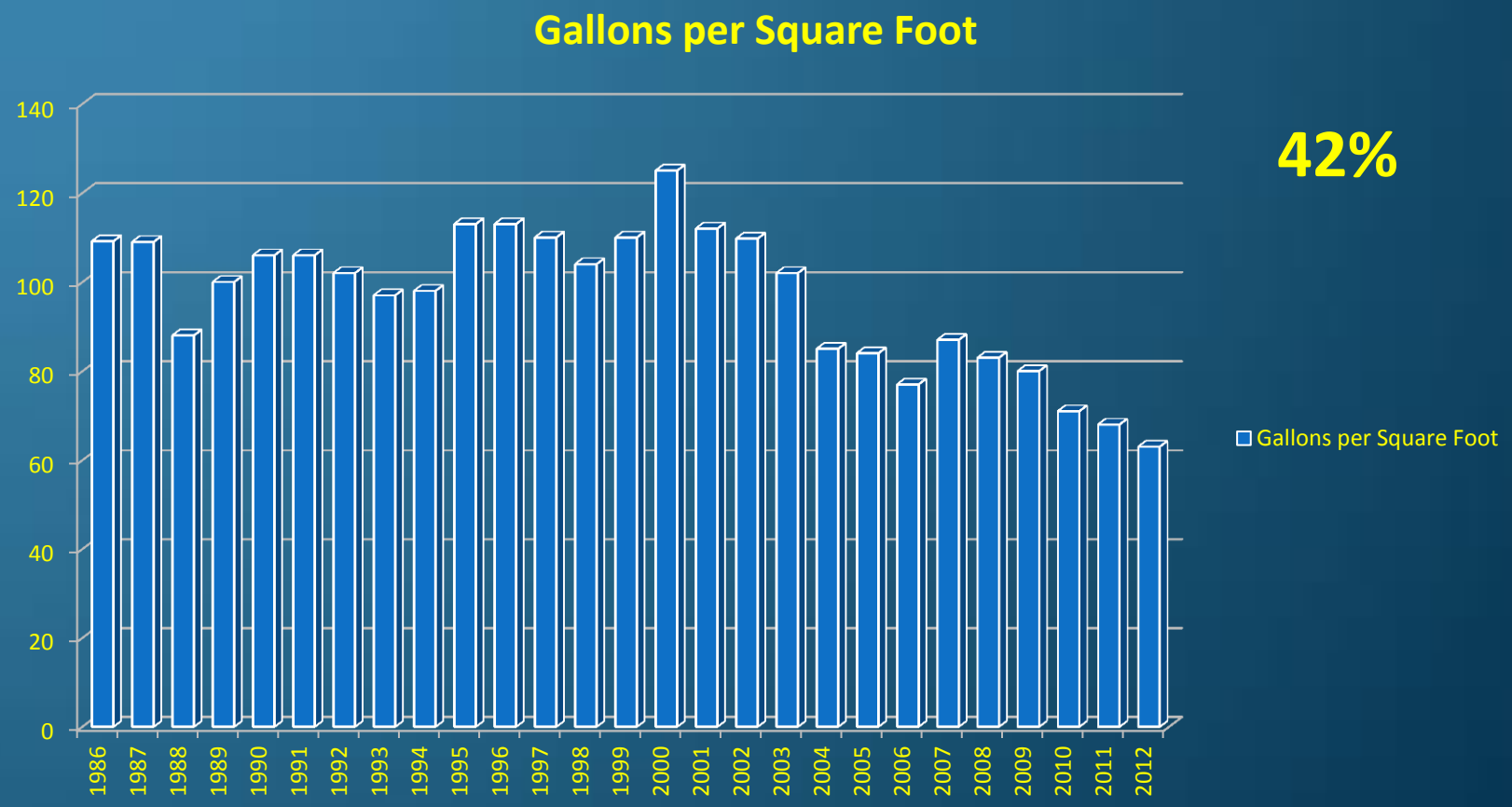
Identifying the metric may not be as easy as you might think. For example, look at the following two houses. Both homes use the same amount of water each month, but which one is more water efficient?

Water Use Intensity



EPA Energy Star Portfolio Manager, 2012

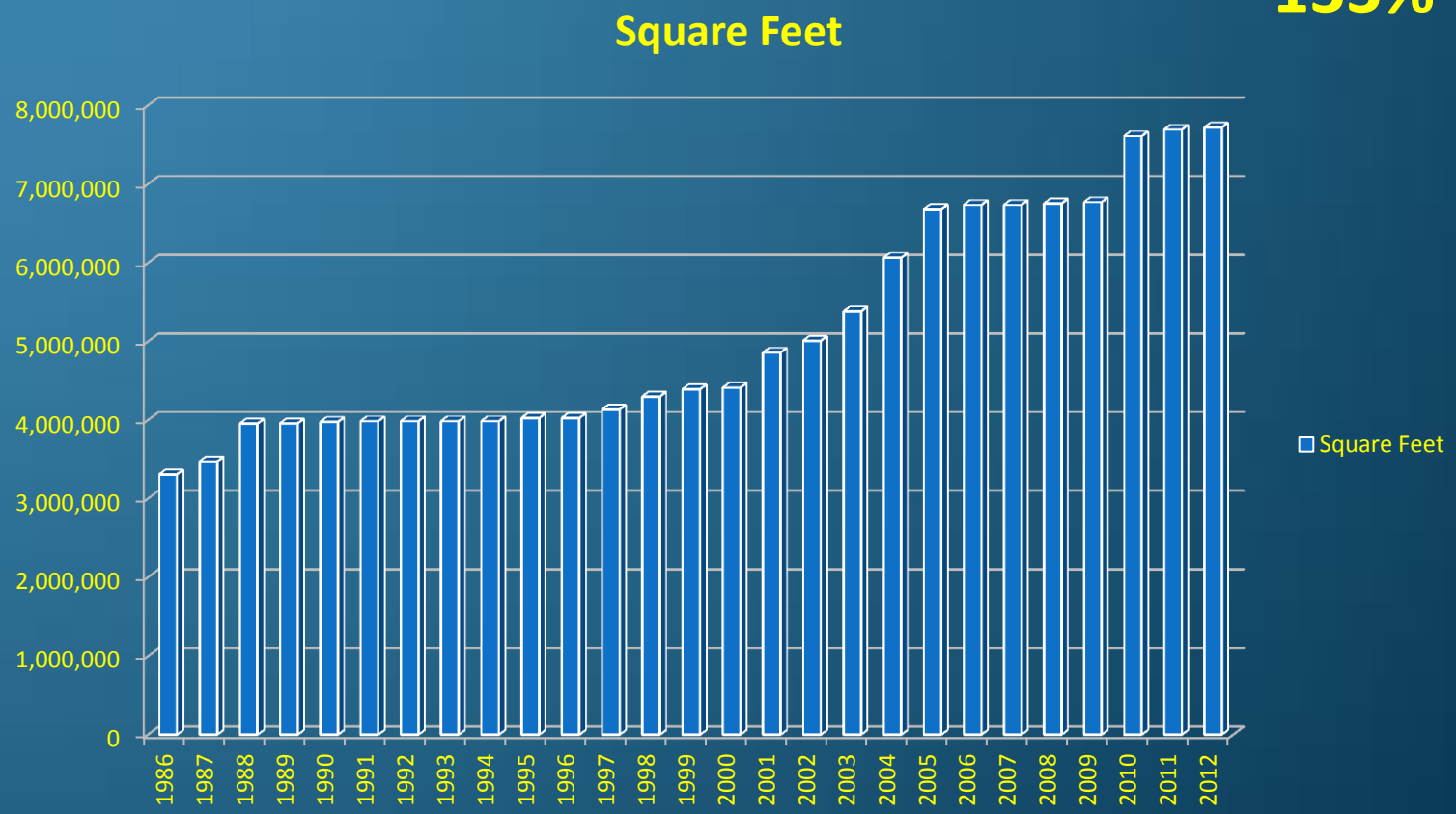
Phoenix Hospital Water Use Intensity



42%

Phoenix Hospital Square Footage by Year

133%

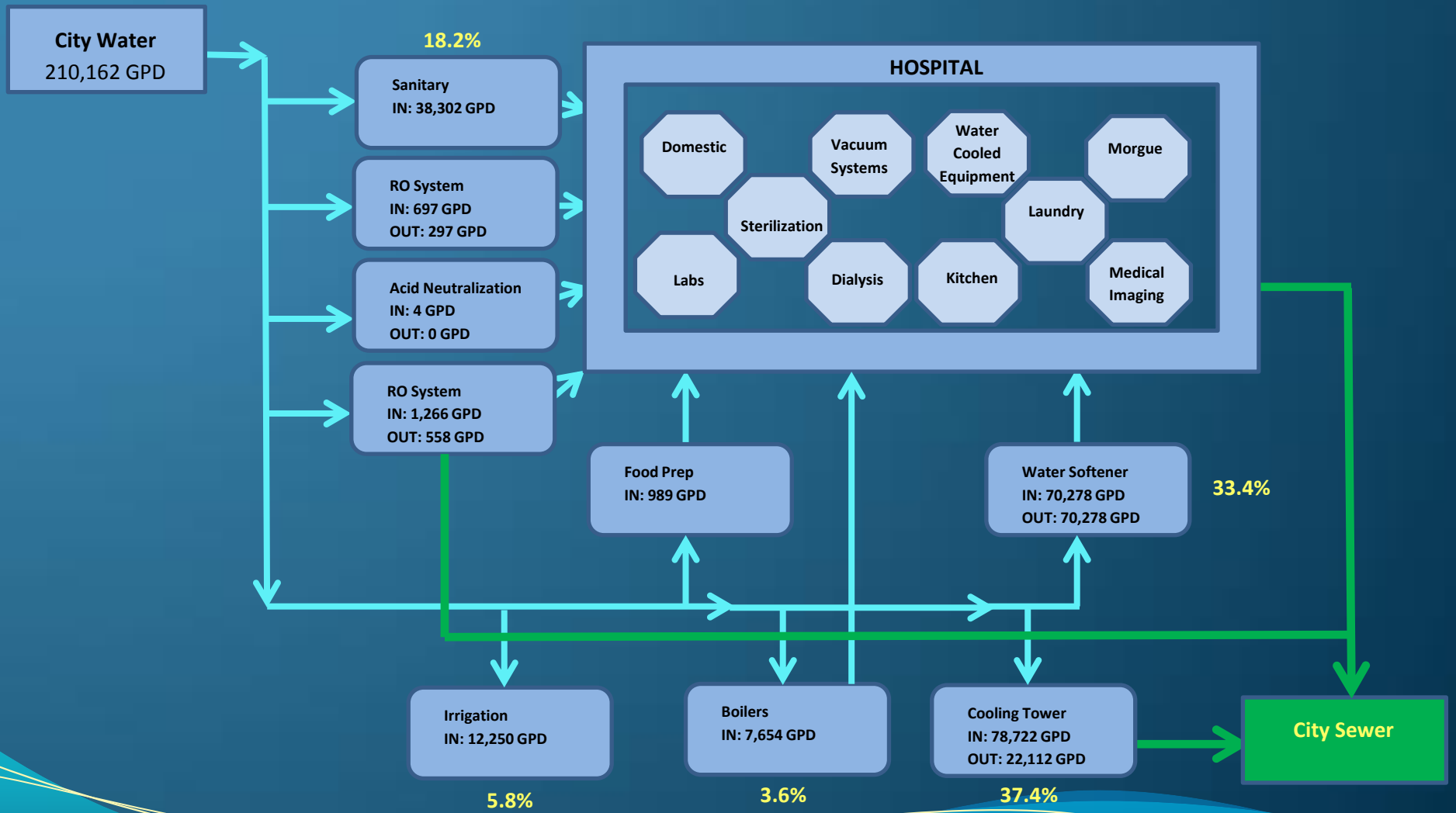


Choosing the Right Metric

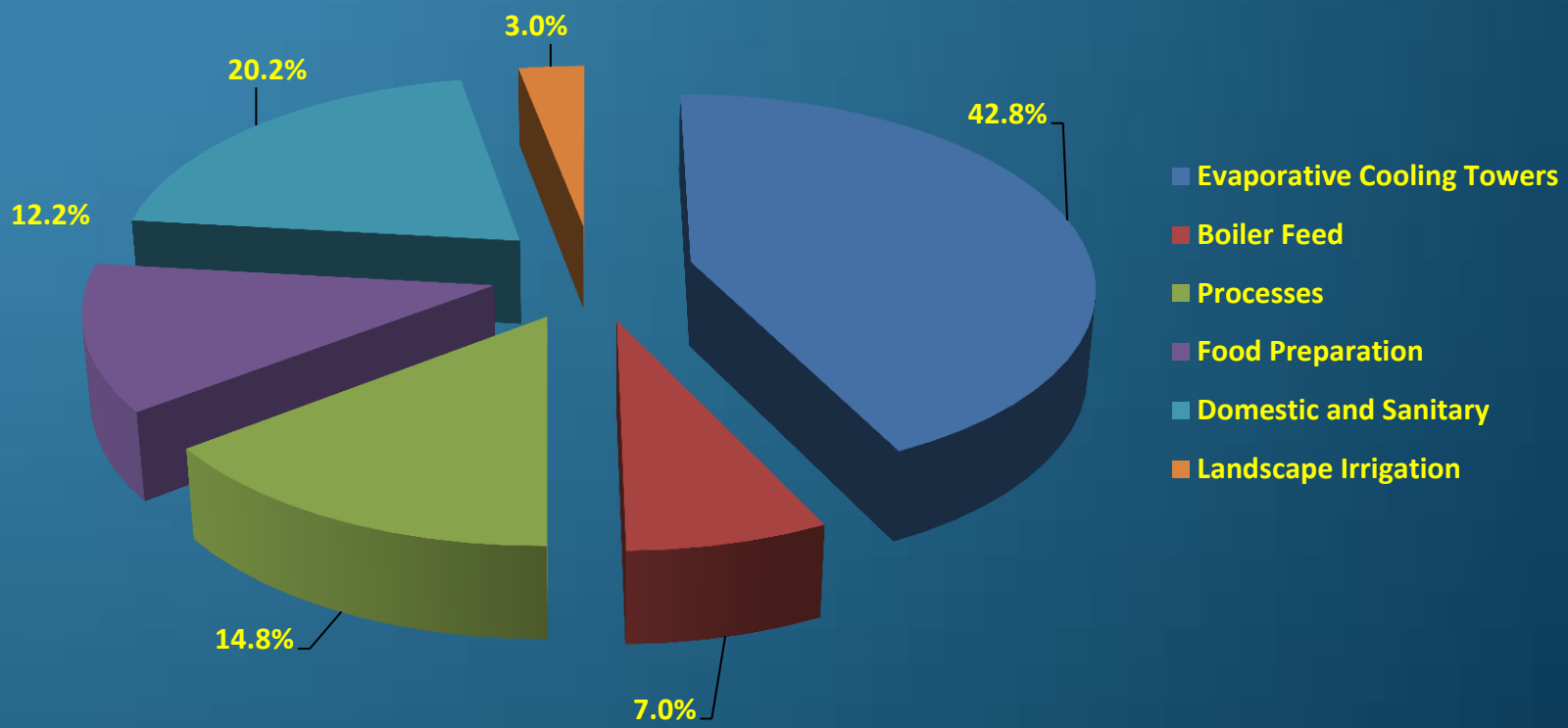
- Gallons per Square Foot of Occupied Space
- Gallons per Day
- Gallons per Employee
- Gallons per Pound of Product
- Gallons per Customer
- Gallons per Meal
- Gallons per Resident
- Gallons per Ton Hour
- Gallons per Bed
- Gallons per Patient
- Gallons per Square Foot of Landscape
- Gallons per Gallon

Water Balance

All numbers in estimated average gallons per day



Hospital Water Uses



Medical Building Blocks

Medical Building Blocks

- Domestic Fixtures
- Kitchen Equipment
- Laundry Equipment
- Heating, Ventilation and Cooling (HVAC)
- Sanitation
- Vacuum Equipment
- Medical Imagery
- Hydro-Therapy
- Sterilization
- Medical Procedure Equipment
- Irrigation
- Aesthetics
- Leaks & Losses
- Water Treatment

Domestic Fixtures

Toilets – Old from 3.5 Gallons to 5 Gallons per Flush
New from 0.8 Gallons to 1.6 Gallons per Flush

Urinals – Old from 1 Gallon to 3 Gallons per Flush
New from Waterless to 0.5 Gallons per Flush

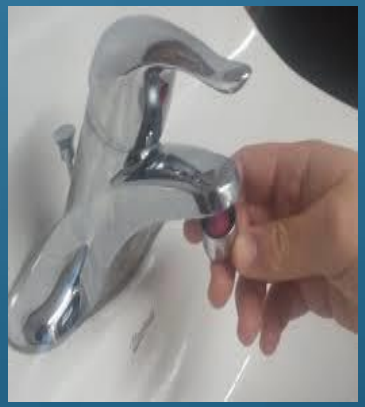
Lavatory Faucets – Old from 2.2 Gallons per Minute to Unrestricted
New from 0.5 Gallons per Minute to 1.5 Gallons per Minute

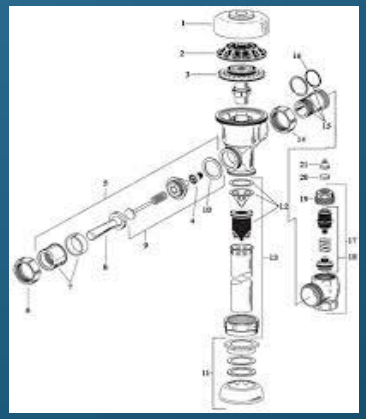
Showerheads – Old from 2.5 Gallons per Minute and Up
New from 1 Gallon per Minute to 2 Gallons per Minute

Domestic Fixtures

What have we observed?

1. Toilets are often changed in the public areas, but less often in the patient rooms.
2. New industrial style toilets can be made to flush at higher volumes simply by replacing the flush valve diaphragm.
3. The payback associated with a given retrofit may be too high.
4. Hospitals generally do not use aerators.
5. Waterless urinals are probably not the best option.
6. High efficiency showerheads may result in significant heat loss.





Kitchen Equipment

What have we observed?

1. High Efficiency Pre Rinse Spray Valves
2. Air Cooled Ice Machines have become the norm
3. Some Pulpers, but Disposers are still the norm
4. Air Cooled Walk in Coolers have become the norm
5. You will never stop large kitchens from thawing frozen food under running water
6. Manual Fill Steamers are becoming the norm
7. Dishwashing machines continue to become more and more efficient

Laundry Equipment

What have we observed?

1. The Majority of Hospitals, not only in Phoenix, but across the United States have already or will outsource their laundry operations.

2. Small scale laundry operations are being conducted with extractor washers that can handle larger loads and are more efficient.

3. Older top load washing machines may occasionally be found in a custodial room. However, even these are being phased out over time.

Vacuum Equipment

What have we observed?

1. At one time, water cooled medical vacuum systems were more common place. These systems, often referred to as “wet ring” vacuum pumps, can use as much as one to two gallons of single pass water per horsepower per minute. It is very rare to find one of these in a hospital setting, as they have generally been replaced by dry vacuum systems that rely on an air-cooled oil sealed ring system.

2. It is more common to find water cooled vacuum systems in dental offices. However, these are typically being replaced with new air cooled units that offer water savings, energy savings, lower maintenance costs, longer service life, and an improved ability to separate out contaminants such as dental amalgams from the wastewater stream.

Autoclaves

1. An autoclave is used in medical, biological waste, and research applications to sterilize instruments, glassware, liquids, textiles, and other materials. High-pressure steam is inserted into the chamber and sterilizes surfaces with which it comes into contact. Because steam can penetrate porous surface and enter recessed spaces such as needles and test tubes, autoclaves are often used to sterilize textiles such as bedding and uniforms, medical and dental instruments, and medical waste.

2. Autoclaves are often left in standby mode and will generate high temp condensate. This condensate has to be cooled to below 140 degrees Fahrenheit. To accomplish this, many older autoclaves are equipped with a continuous cold water supply that can range from one to three gallons per minute or more. This continuous stream is simply used for cooling the high temp condensate.

Autoclaves

3. There are two types of retrofits that can be accomplished to reduce unnecessary water use. The first option is to install a tempering water control valve that measures the condensate production and supplies cold water only as needed. The second option is to add a reservoir where condensate can be stored until it has cooled to under 140 degrees.

4. Most new autoclaves come equipped with built in systems that address the condensate issue.

5. Other new systems being introduced to the market today involve low temperature vaporized hydrogen peroxide sterilization.

Evaporative Cooling Towers

1. Several evaporative cooling towers were surveyed. Most towers operated between 2.5 to 3.5 cycles of concentration.

2. Evaporative cooling towers are not going away anytime soon. The best options for increasing water use efficiency are:
   a. Increased energy efficiency, which can result in reduced heating loads.
   b. Load shifting
   c. Increased cycles of concentration based on improved water treatment.

Evaporative Cooling Towers

Cycles	Evaporation (gph)	Blowdown (gph)	Make-Up (gph)
Single Pass	0	18,000	18,000
1.2	180	900	1,080
1.5	180	360	540
2	180	180	360
2.5	180	120	300
3	180	90	270
4	180	60	240
5	180	45	225
6	180	36	216
7	180	30	210
8	180	26	206
10	180	20	200

New Energy Efficient Technologies

Medical Imagery

Some older large frame X-ray units can use significant amounts of single pass water for cooling the film developers. Hospitals can eliminate between 75% and 95% of this water use by installing a specialized kit on the cooling water loops of the film developers to eliminate continuously flowing cooling water.

Digital X-ray equipment eliminates all water use associated with film development. Most hospitals have already converted to digital X-ray equipment.

Irrigation

Irrigation for associated with Phoenix hospitals accounted for 0% to 17% of total water consumption for an average of 5.2% across all 13 hospitals included in the study.

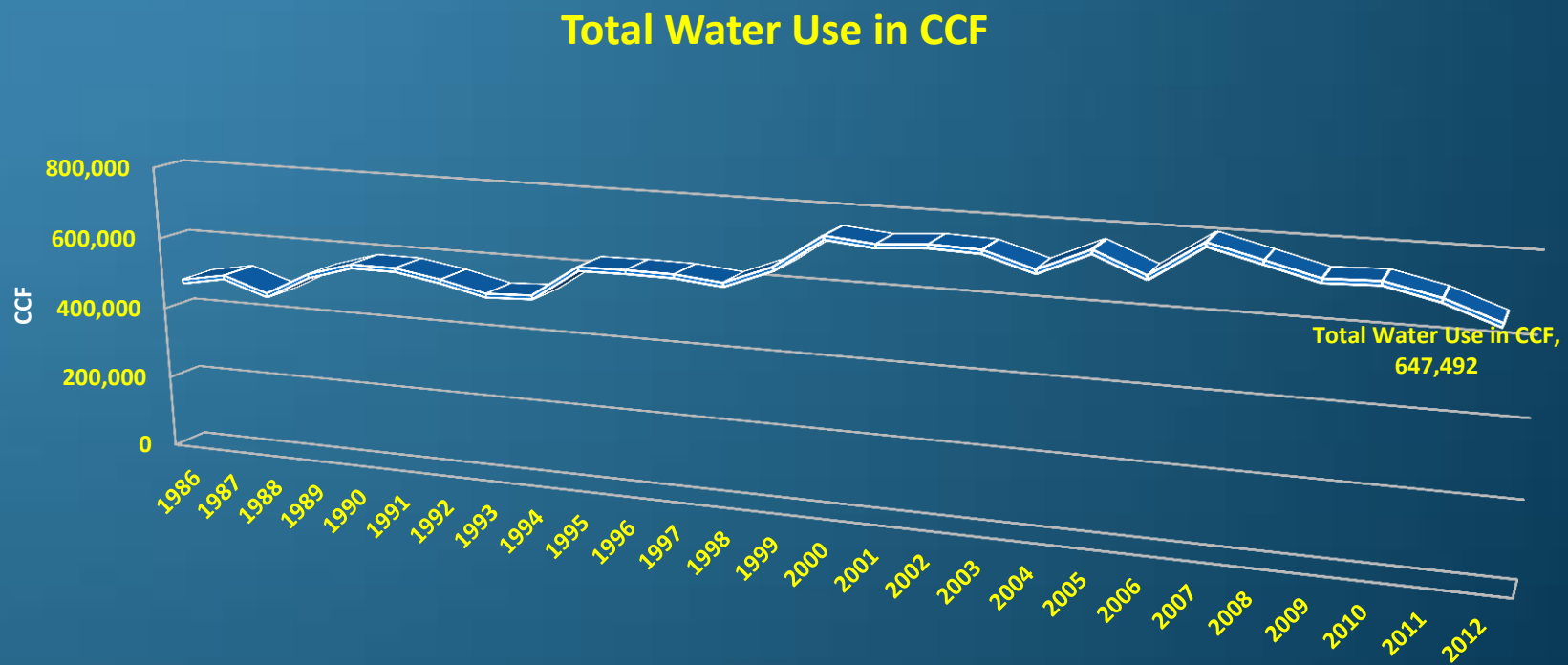
Irrigation as a percentage of total consumption for dental offices and senior care facilities.

Some hospitals like the Mayo Clinic Hospital have converted or are converting to native landscape with drip irrigation.

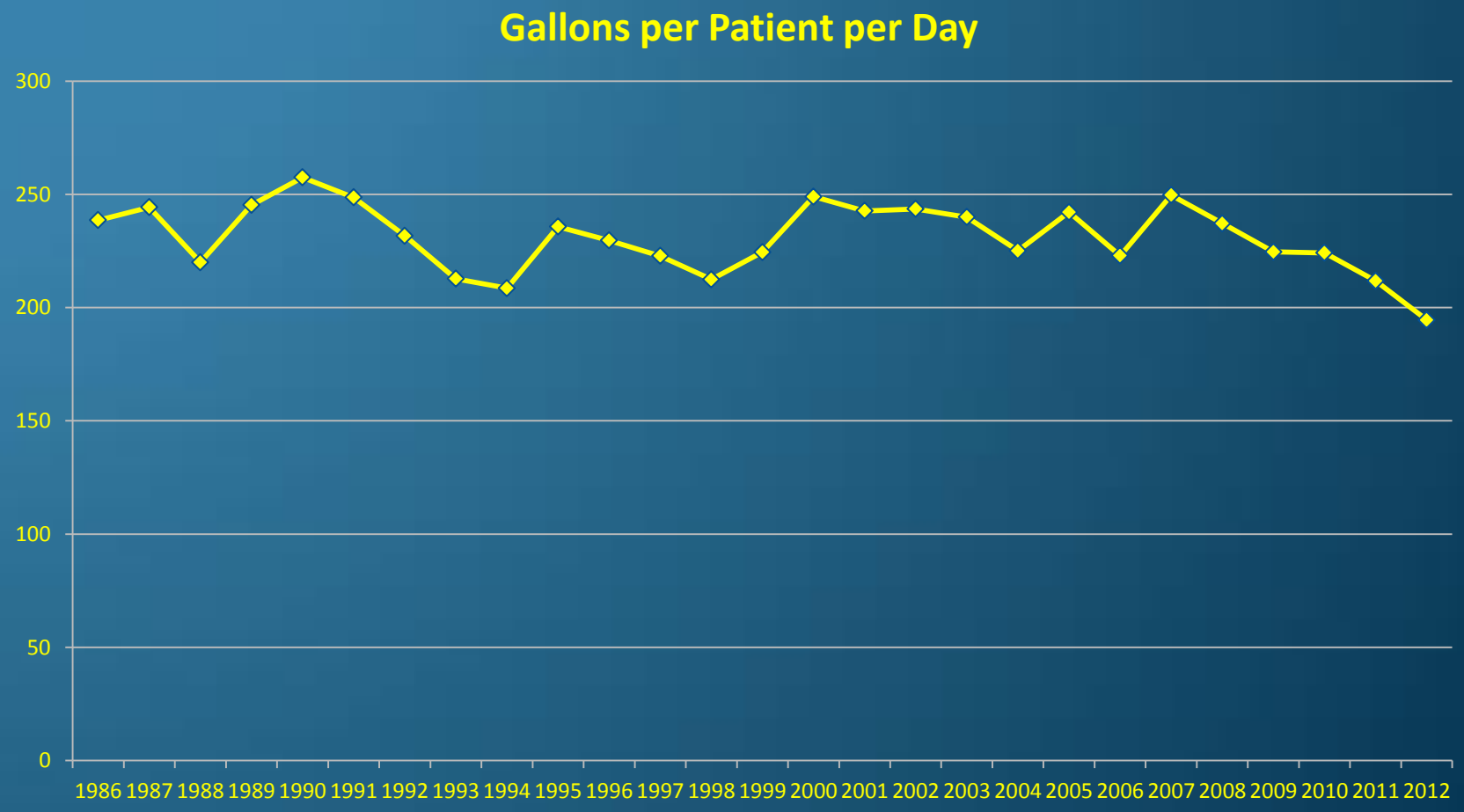
Other hospitals, like St Joseph's Hospital are converting to artificial turf or other type of landscape material.

As Hospitals increase in size, the size of the irrigable landscape is reduced.

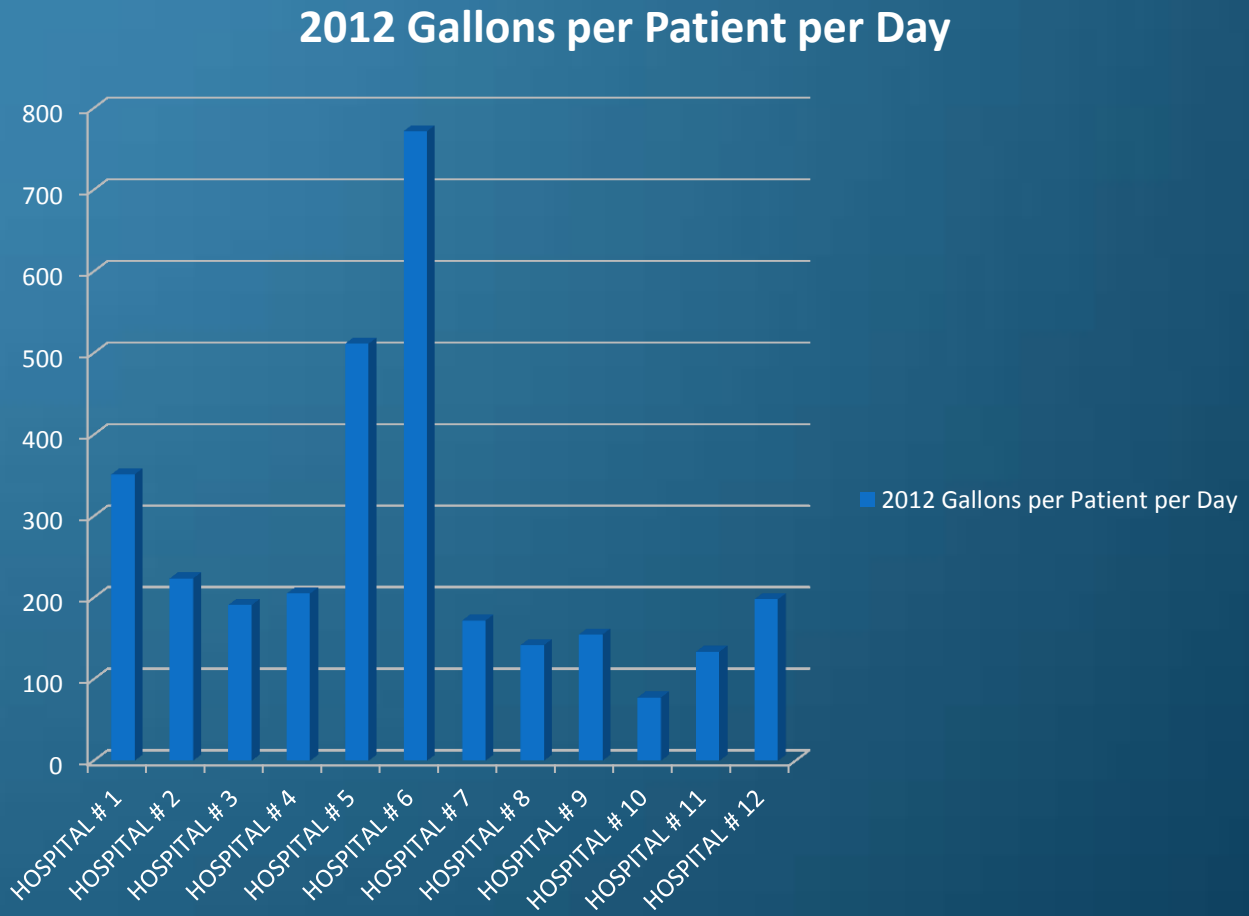
Total Hospital Consumption over Time



Gallons per Patient per Day



Phoenix Hospitals Gallons per Patient



Other Important Data

Business/DBA Name	Square Feet	Number of Beds	Square Feet per Bed	Square Feet per Patient per Day	2012 Annual Gallons per Square Foot	2012 Patients per Day	2012 Gallons per Patient per Day	2012 Gallons per Bed	2012 Employees per Patient	Teaching Hospital ?
HOSPITAL # 1	610,177	313	1,949	2,034	63	300	351	337	2.83	No
HOSPITAL # 2	1,173,543	650	1,805	994	82	1,181	224	406	3.23	Yes
HOSPITAL # 3	1,334,881	1,200	1,112	1,797	4	743	18	11	4.61	Yes
HOSPITAL # 4	7,048	15	470	641	109	11	191	140	4.64	No
HOSPITAL # 5	1,615,073	697	2,317	1,159	65	1,394	205	410	3.43	Yes
HOSPITAL # 6	73,196	58	1,262	1,830	102	40	511	353	5.28	No
HOSPITAL # 7	695,431	268	2,595	3,037	93	229	772	659	15.23	Yes
HOSPITAL # 8	164,521	164	1,003	731	86	225	172	236	3.11	No
HOSPITAL # 9	271,208	100	2,712	919	56	295	142	418	1.24	No
HOSPITAL # 10	441,257	213	2,072	713	79	619	155	450	2.17	No
HOSPITAL # 11	294,580	204	1,444	761	37	387	77	147	2.82	No
HOSPITAL # 12	319,952	216	1,481	835	58	383	134	237	2.46	Yes
HOSPITAL # 13	718,244	522	1,376	707	102	1,016	198	386	3.70	Yes

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