Evaluating CII Cooling Tower Water Use and Potential

Dave Bracciano, Tampa Bay Water

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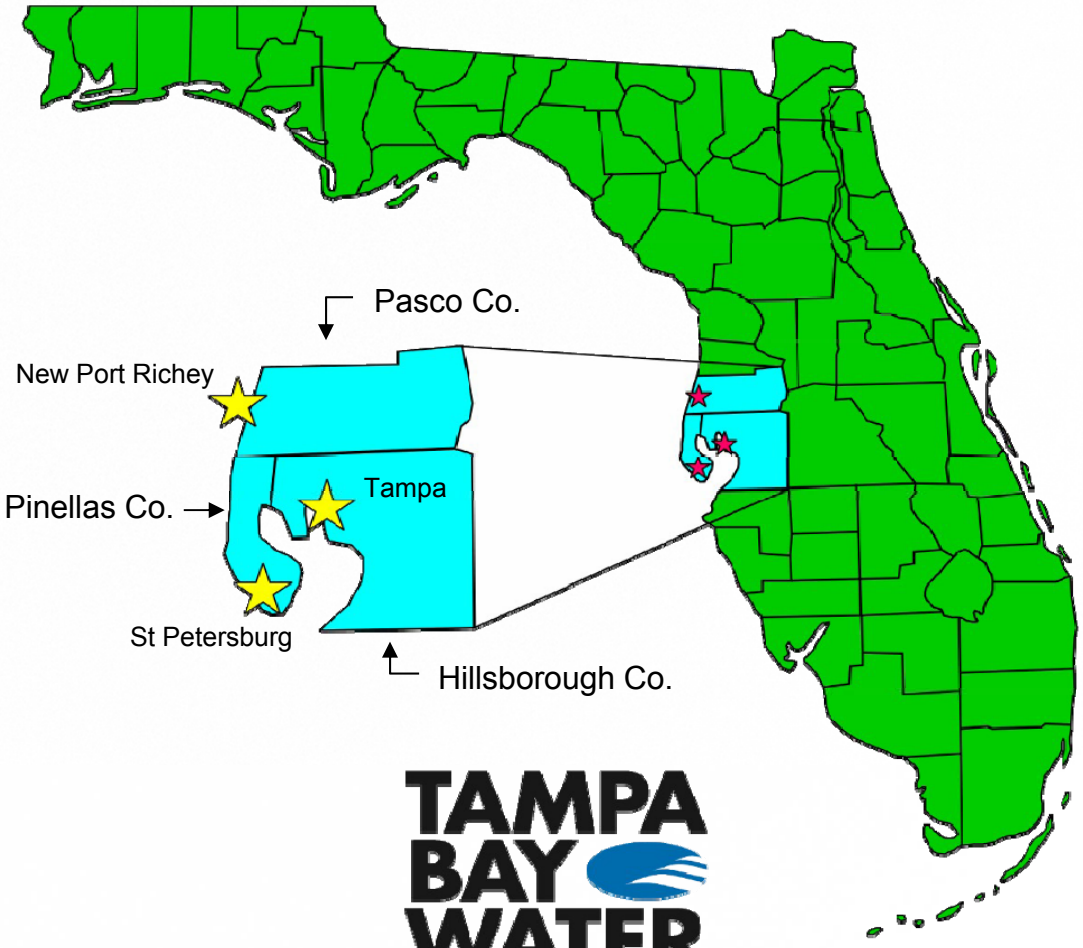
Presentation Outline

- Background
- A Little CII Profiling
- Estimating Market Potential and Water Savings Rates
  - Cooling Towers
- Results / Conclusions
  - Water Savings Potential
  - Cost Effectiveness

Agency Background

- Regional water supply authority serving over 2.3 million customers
- Six member governments, across three counties
- Members historically implemented programs
- Member demands:
  - 2010: 222 MGD
  - 2035: 270 MGD (variability expected)



TAMPA BAY WATER
Supplying Water To The Region

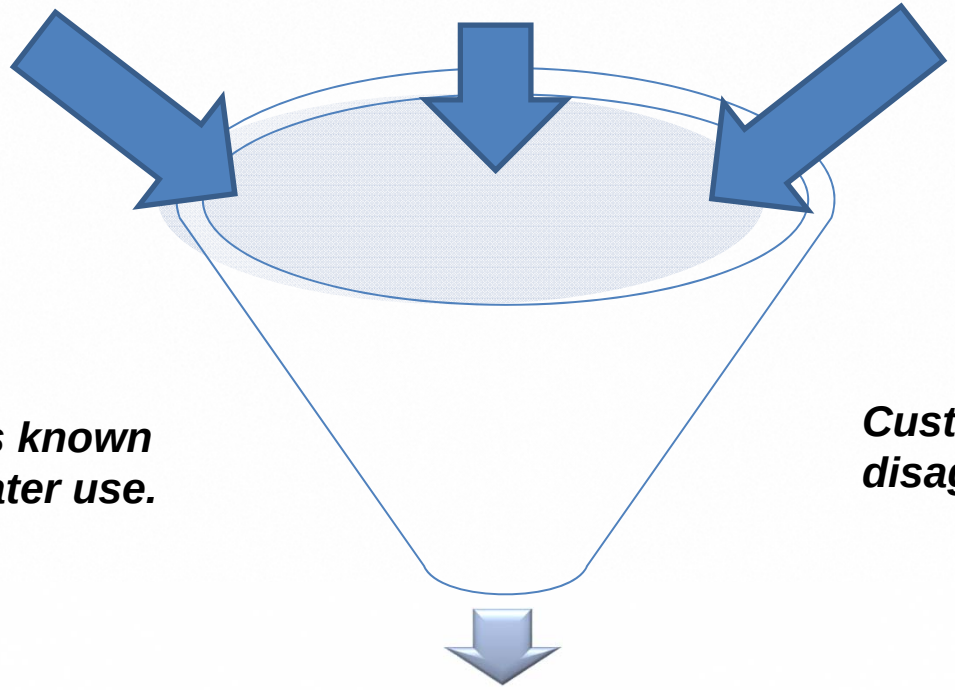
CII Profiling

Good Data Sources = Good Information

Member Water Use / Conservation Data / Single-Family Survey

Property Appraiser / FDOR Property Use Designations

Florida State Government Datasets Seating/Rooms/Students



Characteristics known to influence water use.

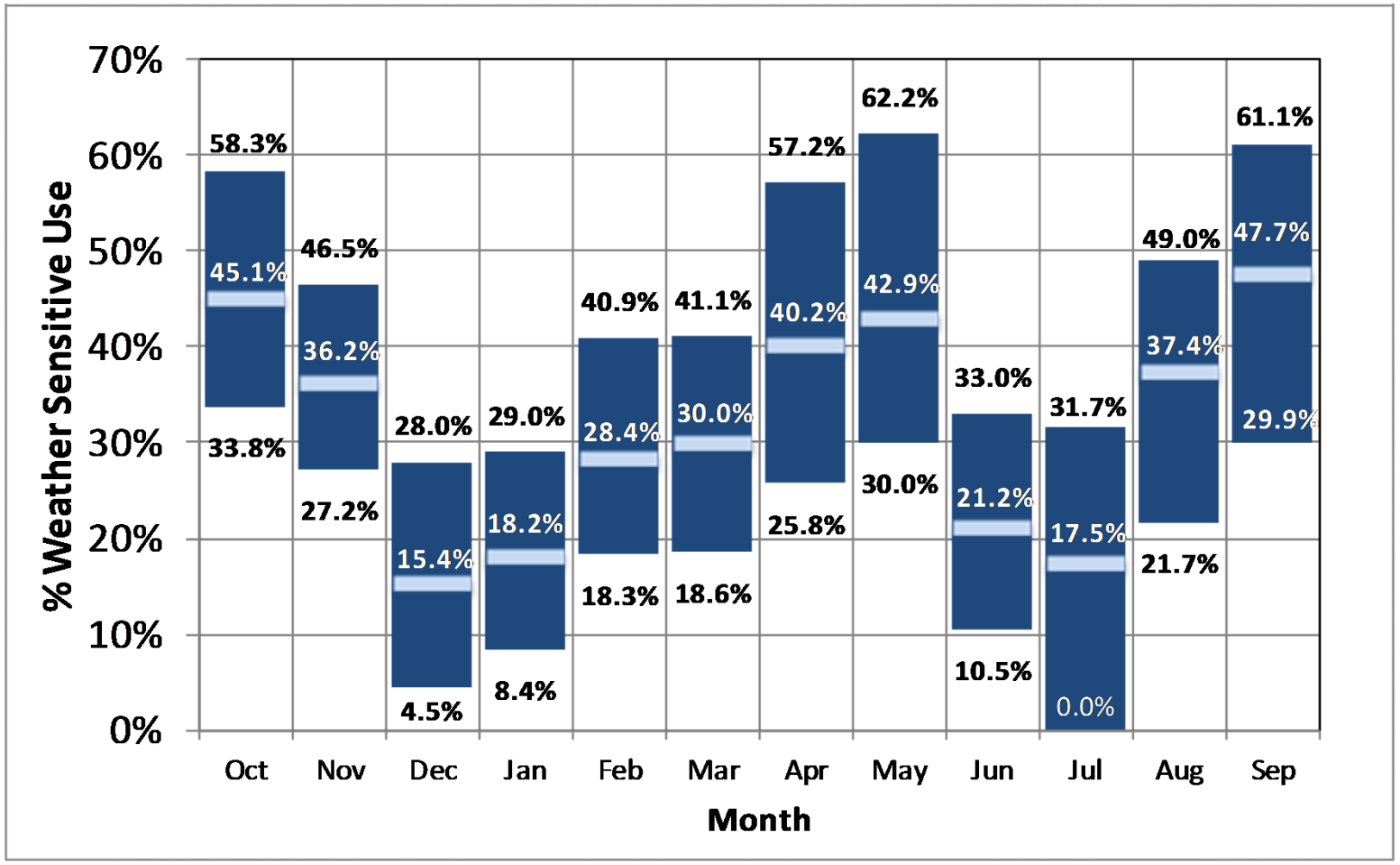
Customer class disaggregation.

Database for water use characterization

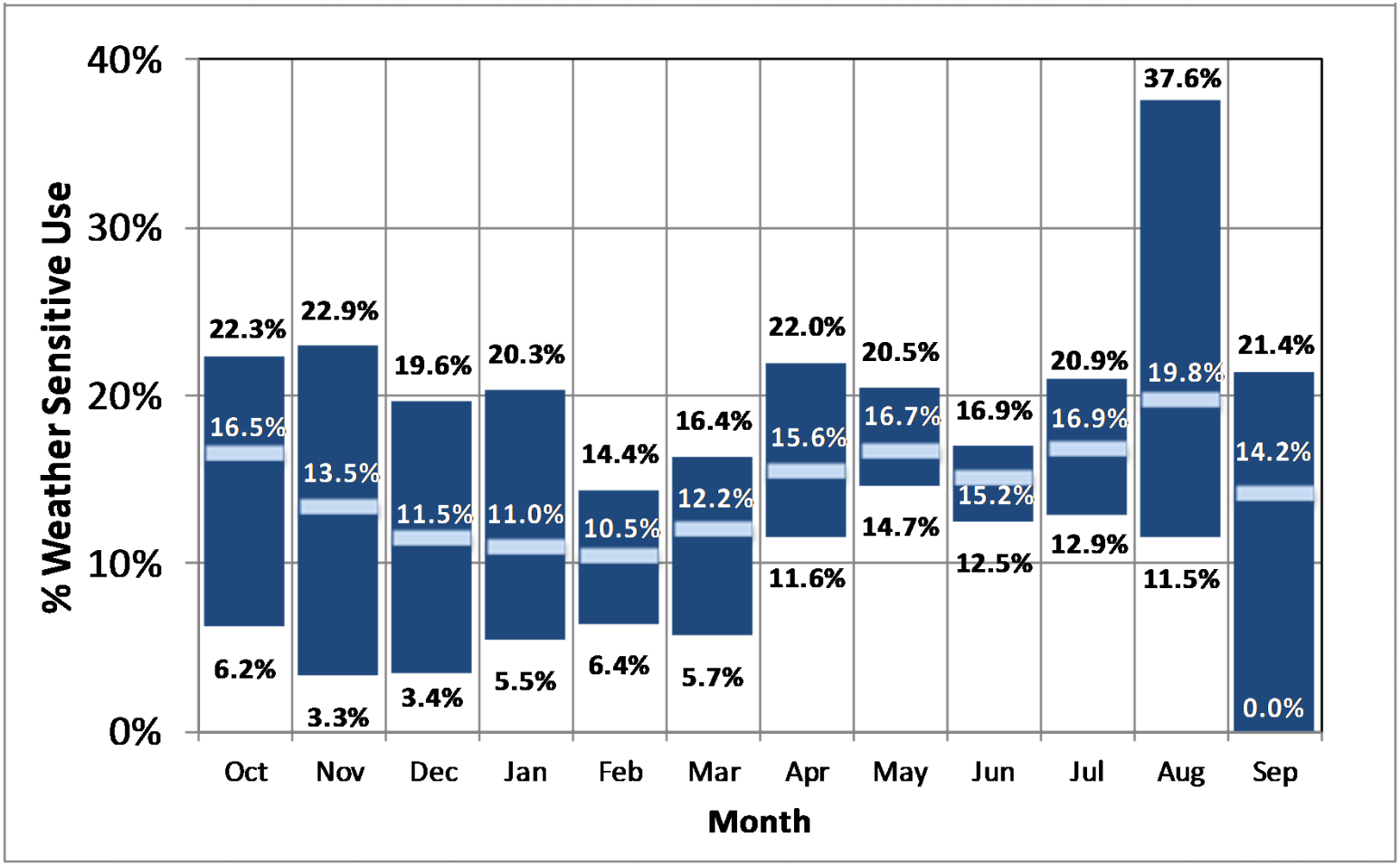
Initial Assessment-
Key Non-residential Sectors

Hotels/Motels	Office Buildings	Restaurants
1/2 use more than national benchmarks	1/3 use more than national benchmarks	1/2 use more than national benchmarks
9% of accounts use 50% of total water use	5% accounts use 60% of total water use	8% of accounts use 32% of total water use
Seasonal factors: Irrigation, Cooling, Spring Break	Seasonal factors: Cooling	Fast food restaurants may have most efficiency potential

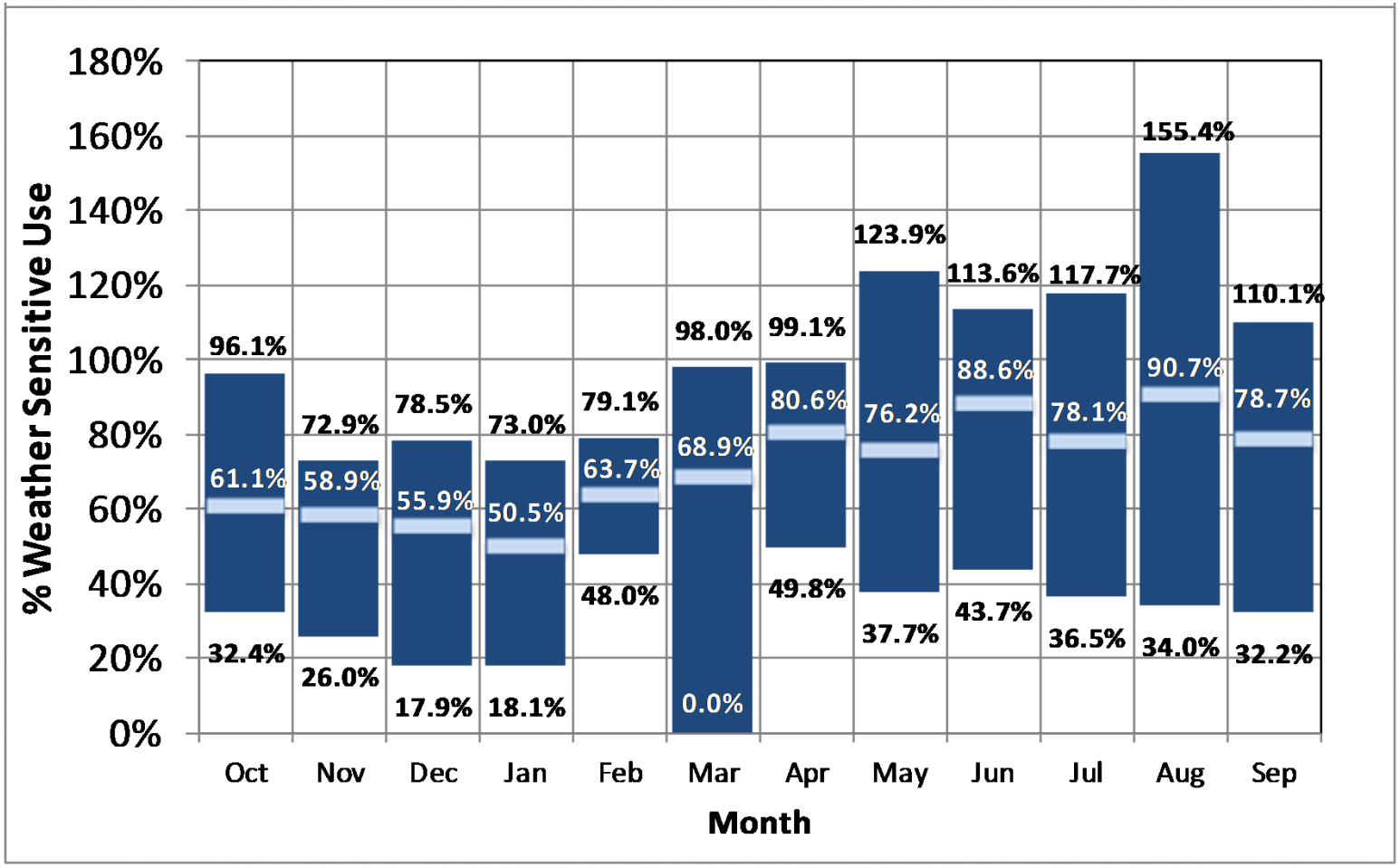
Education Sector Weather-Sensitive and Weather-Insensitive Demands



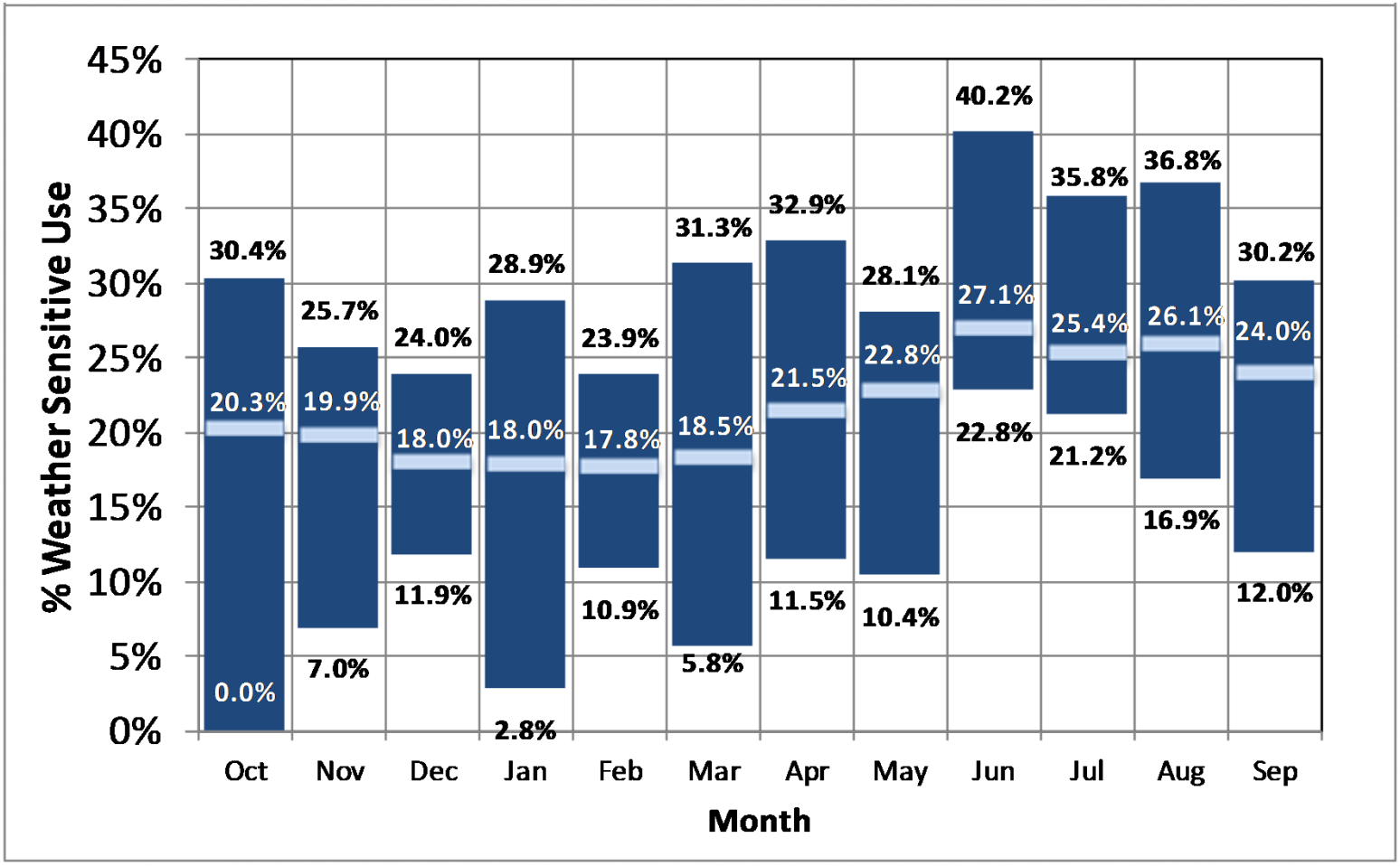
Retirement Sector Weather-Sensitive and Weather-Insensitive Demands



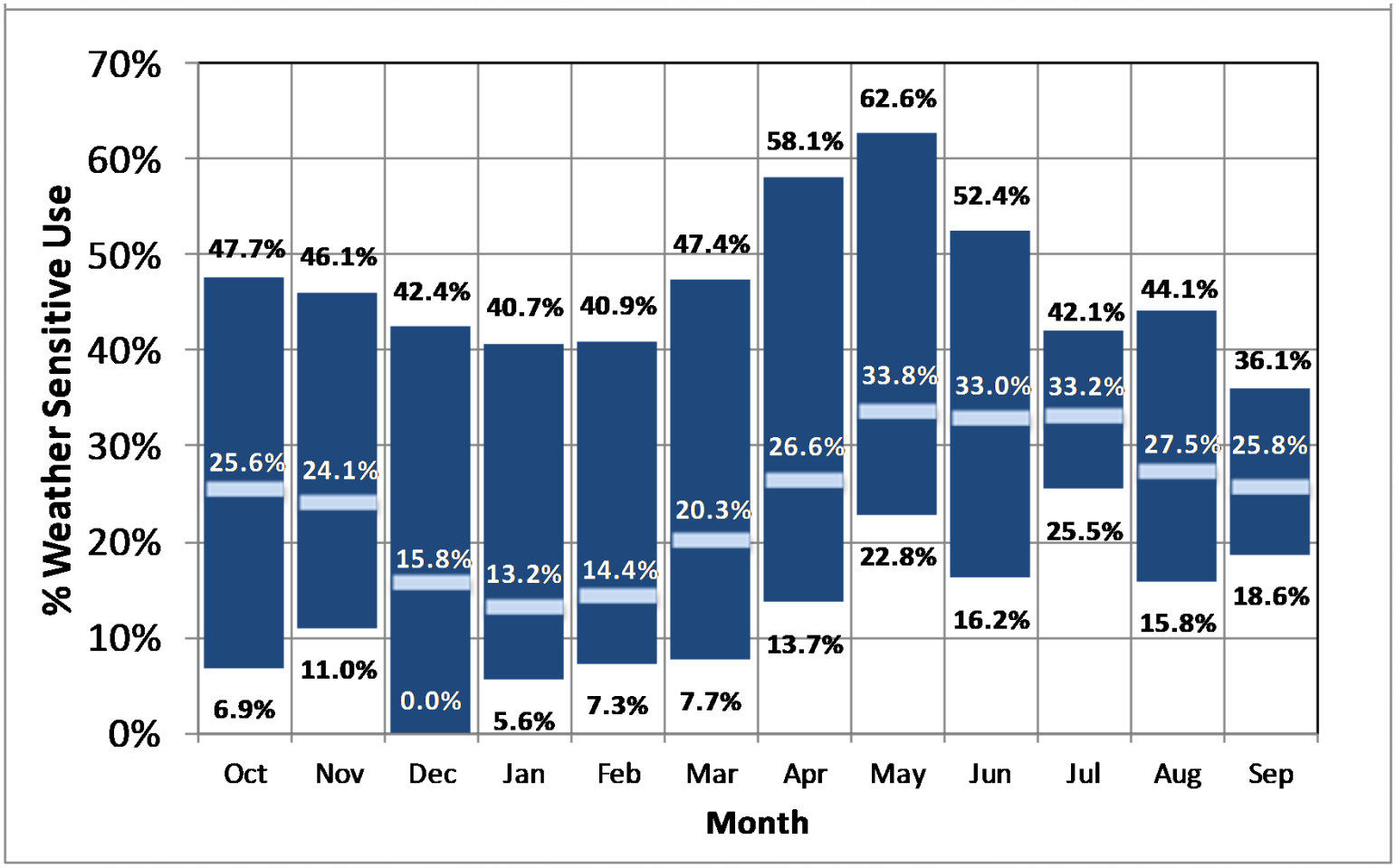
Hospital Sector Type Weather-Sensitive and Weather-Insensitive Demands



Nursing Home Sector Type Weather-Sensitive and Weather-Insensitive Demands



Office Building Sector Weather-Sensitive and Weather-Insensitive Demands



Cooling Tower Potential

Determining Cooling Towers and Estimating Existing Efficiency

Where: larger commercial and industrial facilities

What: Heat removal

How: By a central refrigeration system and compressor, and water cooled. Water cooled systems are connected with a circulating loop to a **cooling tower**-exchange occurs with atmosphere through evaporative cooling.

How to assess cooling tower technology and programs?

- Identify tools necessary to determine if they are in your system/sectors
- Calculate average cooling hour loads
- Determine average cycles of concentration of water use
- How long do programs last
- What is the average savings rate

Cooling Tower Screening and Water Use Determination

- Screening: ASHRAE - buildings square footage>25,000 ft.^{2} or 4 stories of heated area in database
- Conducted visual evaluation of all sites to estimate cooling towers (coop student)
  - 569 in 2008 (conservative number based on discussions with cooling tower contracting firm)

- Increase at same rate as residential accounts- 801 in 2035
- City of Tampa- reclaimed master plan provided numbers and estimated COC's

Cooling Tower Screening and Water Use Determination

- All cooling towers considered eligible
  - 25% program penetration by 2035 (~10/year)
  - Savings rate based on median (2.5 to 6 COC's)
  - Program costs and savings consistent nationally (conservative for Florida)
  - Program costs- submetering, financial incentive for treatment technology
  - Govt. cost/retrofit- $1000
    - Submetering
    - Treatment technology
    - Agreements to implement and track

Ex: Estimating Cooling Load

Ex: Schools

- AAAAA School size 250,000 ft.^{2}

ASHRAE EFLH Table	Occupancy Assumptions	Sectors	Equivalent Full Load Hours			Capacity (Ft^2/ Ton)			Unit Load (Tons/Ft^2)	
			MIN	MAX	Average	MIN	MAX	Average	ASHRAE	Tampa[1]
Table 17. EFLH for Typical School	9 months, 8 am-4 pm	Education Miscellaneous Seasonal	1050	1100	**1075**	268	315	**292**	**0.0032**	**0.0054**
Table 18. EFLH for Typical Office	year-round, weekdays, 8 am-5 pm	Office <10 stories Government Medical Services	1800	2000	1900	349	425	387	0.0024	0.0036
Table 19. EFLH Office Extended Retail Type Occupancy	year-round, weekdays, 8 am-10 pm	Office >10 stories	2170	2580	2375	349	425	387	0.0024	0.0036

Ex: Calculate Cooling Tons and Ton-hours Cooling for School

COOLING TONS

$CT = L_f * A$ (0.0032*250,000)

- *CT= 800 Tons*

Where

CT = Cooling Tons L_f = Unit Load (tons/ ft^2) by facility type A = Building Area

Ton-Hours of Cooling

$H = CT * E_f$ (800*1075)

- H=860,000

Where

H= Ton-Hours of Cooling (annual) CT= Cooling Tons E_f = Equivalent Full Load Hours per Year by Facility Type

Cooling Tower Water Use/Year

Existing Water Use at 2.5 COC

$Q = H * WU_c$ (860,000*3.15)

- Q_1=2,709,000 gallons/year

Where

Q= Total Cooling Water Use (gpy) H= Ton-Hours of Cooling (annual)
WU_c= Water Use per TON at specified COC

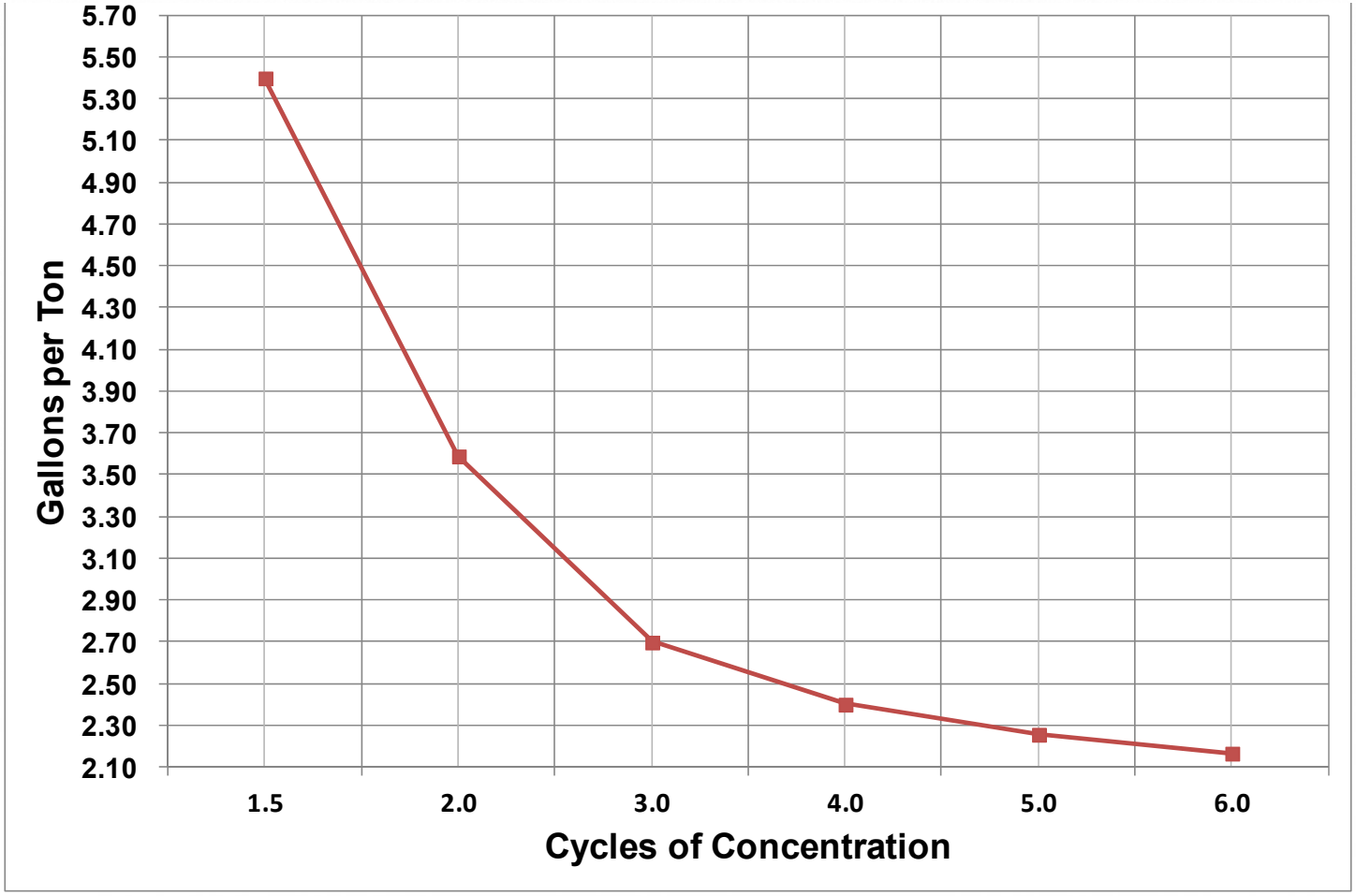
Existing Water Use at 6 COC

Q = 860,000*2.17

- Q_2=1,866,200 gallons/year

*Water Saved **842,800** gallons/year or **2309** gallons/day*

Cooling Tower Water Use per Cycle of Concentration



Koeller, J. (2006). CUWCC Potential Best Management Practice for Commercial-Industrial Cooling Water Efficiency.

Percent Reduction in Water Use vs. COC Change

COC's Before Increasing Cycles	COC's After Increasing Cycles											
	2	3	4	5	6	7	8	9	10	12	15	20
1.5	33%	50%	56%	58%	60%	61%	62%	63%	63%	64%	64%	65%
2		25%	33%	38%	40%	42%	43%	44%	44%	45%	46%	47%
3			11%	17%	20%	22%	24%	25%	26%	27%	29%	30%
4				6%	10%	13%	14%	16%	17%	18%	20%	21%
5					4%	7%	9%	10%	11%	13%	14%	16%
6						3%	5%	6%	7%	9%	11%	12%
7							2%	4%	5%	6%	8%	10%
8								2%	3%	5%	6%	8%
9									1%	3%	5%	6%
10										2%	4%	5%
11											2%	4%
12												2%

Overall Results and Conclusions

Penetration and Savings

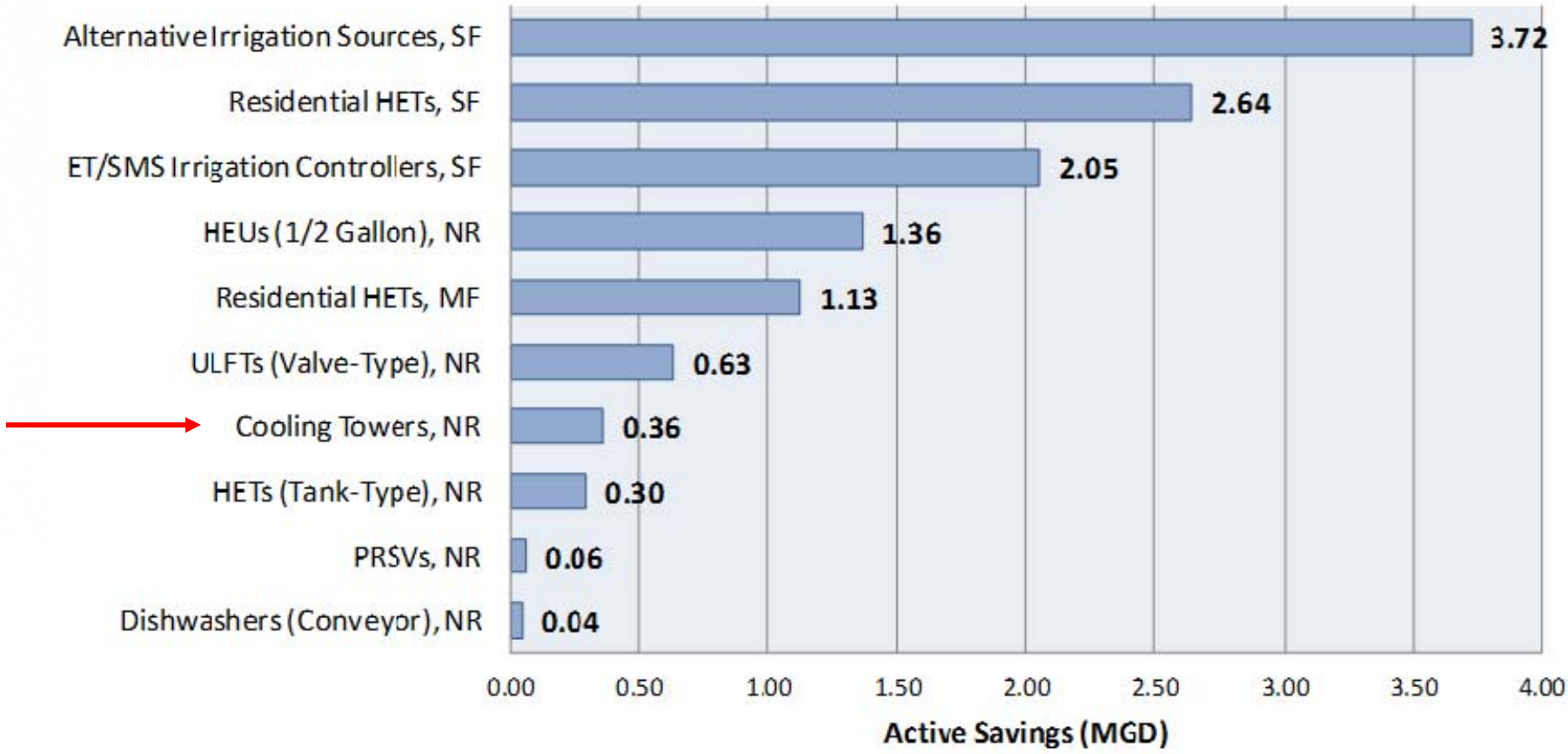
Cooling Tower Intervention Market Potential

Variable	2015	2020	2025	2030	2035
Eligible Measures	610	638	676	730	801
Cumulative Planned Interventions	10	57	105	153	200
Eligible Measures After Planned Interventions	600	580	571	577	601

Cooling Tower Rebate Estimated Savings Potential

Variable	Total GPD	Median GPY
Water Use @ 2.5 COC	10,386,840	4,449,743
Water Use @ 6.0 COC	7,152,752	3,063,214
Savings Potential	3,234,089	1,386,530

Anticipated Low Penetration Rate



Most Cost Effective- Top Ten Potential Programs

Activity Name	Class	$ per 1000 gal
Cooling Tower	Non-Residential	$ 0.07
Pre-Rinse Spray Valve	Non-Residential	$ 0.11
Valve-Type ULFT Rebate	Non-Residential	$ 0.22
1/2 Gallon Urinal	Non-Residential	$ 0.23
Alternative Irrigation Source	Single-Family	$ 0.32
Tank-Type HE Toilet	Non-Residential	$ 0.32
Residential HE Toilets	Multi-Family	$ 0.35
ET Irrigation Controller	Single-Family	$ 0.35
Residential HE Toilets	Single-Family	$ 0.36
Dishwasher Conveyor	Non-Residential	$ 0.42
Irrigation Evaluations	Single-Family	$ 1.35
Landscape/Irrigation Modifications	Single-Family	$ 1.50
Residential HE Washer	Single-Family	$ 2.03
Residential HE Washer	Multi-Family	$ 2.26

Conclusions

- Cooling tower programs need to be developed and canned for use by conservation coordinators
- Potential savings rates are high but low penetration rates/lack of data nationally preclude high expectations
- Sub-metering (with AMI) of cooling tower water use should be in utility purview or credits given for reduced wastewater or stormwater flows
- Reclaimed water programs provide additional potential

Thank you!

Questions?

Dave Bracciano
dbracciano@tampabaywater.org