



**Better
Buildings®**
U.S. DEPARTMENT OF ENERGY

Beyond Flow Restrictors: Partners Share their Water Saving Strategies

Andre de Fontaine, U.S. Department of Energy
May 10, 2016

Today's Panelists

- Joan Kowal, Senior Director of Energy Strategy and Utilities, Emory University
- Bob Bechtold, President and Founder, Harbec
- Juliette Apicella, Program Manager of Commercial Sustainability Services, Southface



Water Savings Initiative Partners

33 total partners

Industrial	Multifamily	Corporate	Public	Education
Cummins	Aeon	Kohl's	Atlanta	Poudre
Ford	New Bedford Housing	Staples	Fort Worth	Albuquerque Public Schools
GM	Eden Housing	TIAA-CREF	W. Palm Beach	
HARBEC	NHT	Transwestern	North Carolina	
Saint Gobain	Tonti	USAA	Gillette, WY	
UTC	Trinity	Tower		
Nissan	Corcoran	JBG		
Toyota	Keene Housing	Shari's Café & Pies		
	Campus Crest			
	City of Hickory			



EMORY
UNIVERSITY

Campus Services
Division of Finance & Administration

The WaterHub at Emory

A Case Study for Onsite Water
Reclamation

2016 Better Buildings Summit
May 10, 2016



Emory University Overview

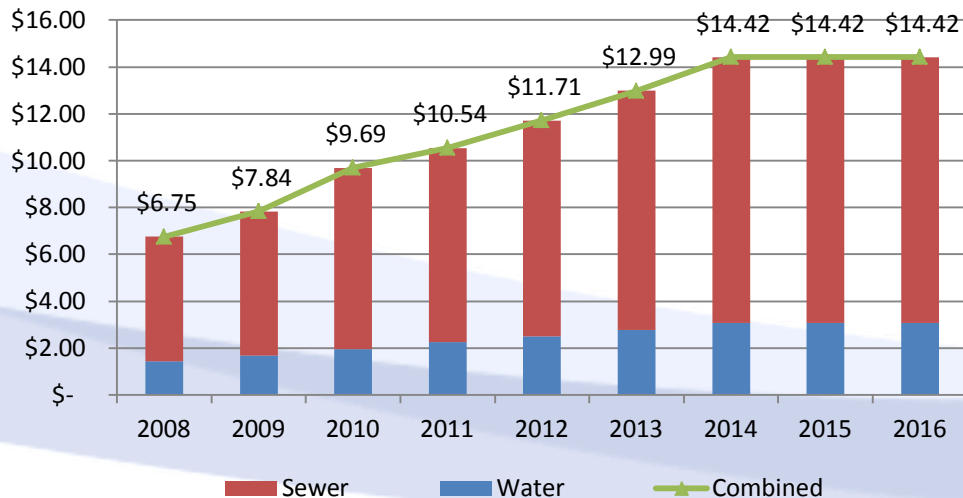


- Located near Atlanta, GA
- 14,724 students
- 29,338 employees
- Approximately 9 million square feet; 130 buildings
- Central Steam Plant; 500,000 pph capacity
- Three Central Chiller Plants; 20,300 tons capacity
- Utility budget of approx. \$35M



Motivation for Water Re-Use

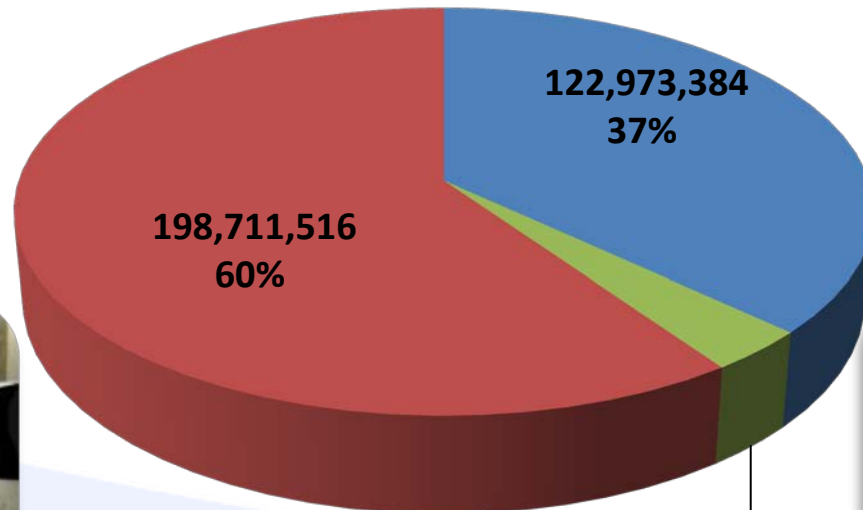
- Water Scarcity
 - Demand
 - Droughts
- Reliability
 - Aging infrastructure
- Sustainability/Conservation
- Economics
 - Rising Water Rates





Emory Water Use

333 Million Gallons



Domestic/Sanitary



HVAC



Irrigation

- Utilities
- Irrigation
- Domestic

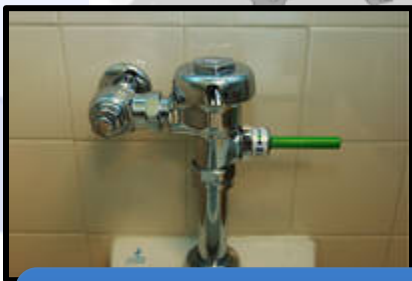
11,141,100
3%



Existing Water Saving Initiatives



Stormwater Reuse



Low-flow Fixtures



Graywater Reuse



Emory's Evolution of Water Conservation

Simple
Solutions

Building-Based
Solutions

Campus-Wide
Solutions

Level of Sophistication and Impact



Reclamation
and Reuse

Low Flow
Fixtures



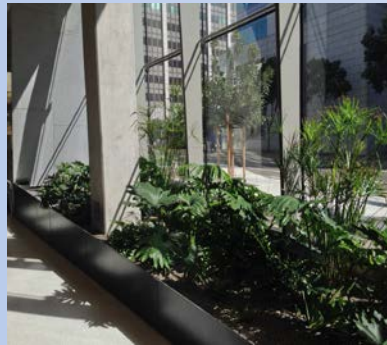
Rain Barrels



Stormwater Reuse



Engineered Wetlands





Design Considerations

- Location
 - On-site vs Off-site
 - Sanitary sewer locations
 - Seasonal sewer volumes
 - Content of sanitary sewer – more industrial than residential(?)
- Size
 - Seasonality of Utility Water make-up
 - Size for base load or peak capacity
 - Storage Capacity; back up storage facility
 - Distribution piping
- Water Quality
 - Treatment at facility or locally at cooling towers and steam plant
 - Keep it similar to potable water or overhaul water treatment plan
- Non-utility considerations:
 - Sustainability Value
 - Educational Value
 - Aesthetics



Georgia/County Requirements

- Existing
 - Georgia Guidelines for Reclaimed Water Systems for Buildings
 - GA EPD Guidelines for Water Reclamation and Urban Water Reuse
- Non-existing
 - Method for obtaining a sewer credit from DeKalb Watershed
 - Clarity regarding Industrial Discharge Permit



Contracting

- Water Purchase Agreement (WPA)
 - Land lease
 - Third party owns and operates
 - No up-front capital
 - Price structure can hedge unpredictable water escalation rates
 - Water quality requirements
 - Availability



Risks associated with WPA

- Third party owns and operates; manageable with good relationship and contract terms
- Price structure may not result in guaranteed savings;
 - Fixed price + escalation vs indexed rate
 - value of sewer credit
- Water quality requirements – need to maintain a back-up water supply; chemical treatment adjustments
- If on your site, may require land-owner hold permits
- Availability; savings calculations should not use overly aggressive volumes



Construction and Start-up

- Design Build – worked well for reclaim facility; utility connections need more design/review
- Air gap requirement harder to achieve for pressurized cooling tower make-up supply
- Coordination of level controls between reclaimed water and potable water supply
- Several month transition period to coordinate water treatment chemicals
- Unexpected delays



Decentralized Reclamation and Reuse

400K GPD and up to 140M GPY Displaced
Up to 40% of Total Campus Demand
90% of Utility Water Demand
3 Chiller Plants/Steam Plant



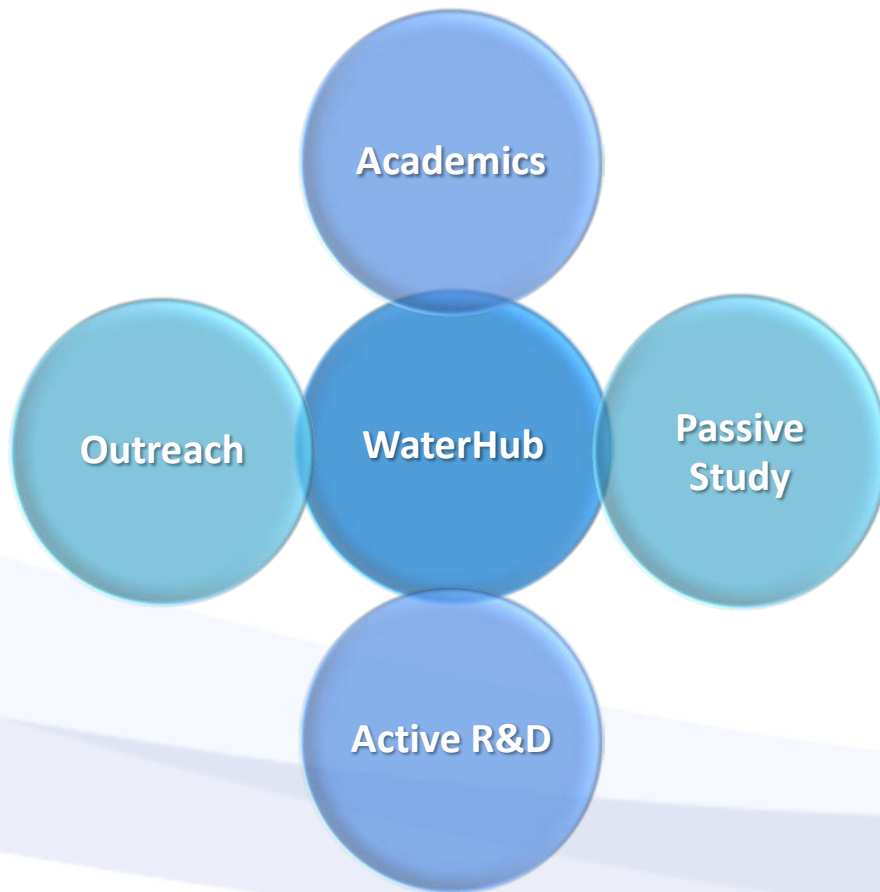


Operations

- Initial reduction in cycles of concentration; still trying to work back up to 8
- Increased chemical costs but not prohibitive
- Blending of make up water at steam plant
- More operator attention for now; working out kinks
- Redirect some things that used to end up in the sanitary sewer
- Revisit by DeKalb of sewer credit



Multifunctional Educational Facility



Academics: Support curriculum design; facilitate the use of Water Hub as an active site for teaching and demonstration.

Passive Study: Will assist research groups interested in conducting tests, experiments etc. that do not impact the process and operations but still require use of the facility and Sustainable Water expertise.

Active R&D: Offer additional research and facilities.

Outreach: Work closely with student groups to change the way we understand sustainability and biodiversity, to change the way we view, use and live with water.



Conclusion

- Would we do it again – absolutely!
- Are there some things we would do differently – absolutely!
- Our on site water treatment plant is no scarier than having on site power generation
 - Luckily there is no standby charge from the local water authority
 - Sewer credit is like having renewable energy credits; the economics work a lot better if there is that additional revenue stream
 - Need to balance the water quality equation

HARBEC WATER NEUTRAL PROJECT

BEYOND FLOW RESTRICTORS

U.S. DOE

2016 Better Building / Better Plants Conference



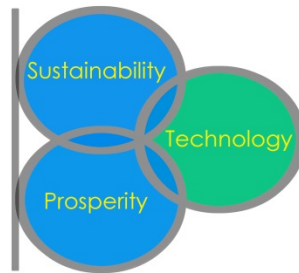
Who is *HARBEC* ?

- ▶ Founded in 1977
- ▶ Located in Ontario, NY near Rochester
- ▶ Precision plastics and metal manufacturer
- ▶ Early adopter of advanced technology
 - ▶ Sustainable manufacturing pioneer
 - ▶ +160 team members (and growing)
 - ▶ 33 electric injection molding presses;
 - ▶ 44 CNC machining centers



Why Water?...2 Events That Heightened HARBEC Water Awareness

- ▶ 9/11 = Catastrophic insurance losses
 - Many NY businesses got surprise payment increases
- ▶ B9 Plastics, Inc.
 - NFP sister company exposed us to world water dilemmas



Plastics, Inc.

Sustainable Prosperity
Through Technology



Alternative to Water Needs for Sprinklers

- ▶ 250k Gallon Storage Tank Requires
 - chemicals and servicing to insure safely balanced water
- VS.
- ▶ 900k Gallon Pond
 - ▶ Naturally balanced with cattail remediation
 - ▶ Rooftops and parking lot provide 1.2MM (+/-10%) gallons of rain water per year



Thermal Transfer Opportunity in Summer

- ▶ 900k gallons of potable city water not evaporated

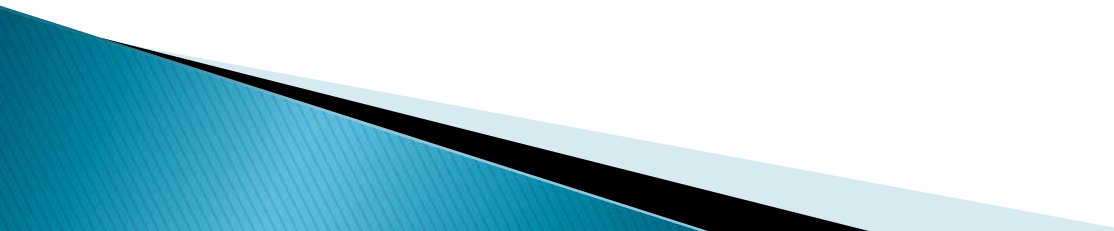


Free Process Water Cooling in Winter

- ▶ Dual feed plate and frame heat exchanger allows for thermal cooling from pond water which is needed for the process water loop.
- ▶ This engineering change resulted in an annual savings of 250,000 gallons of water.

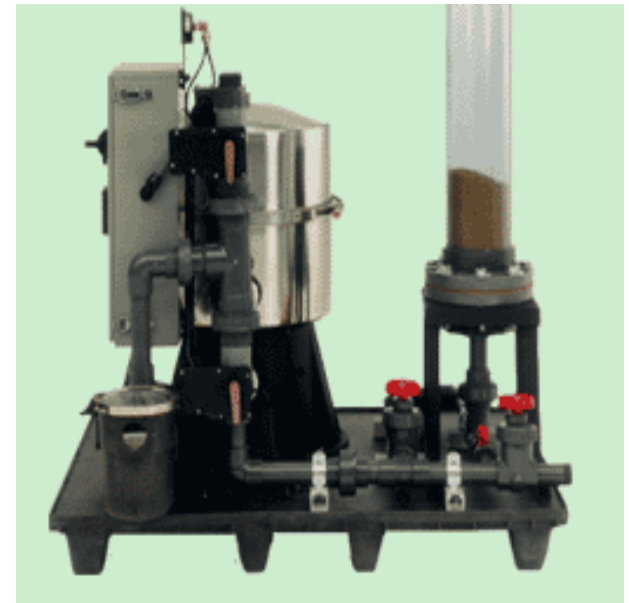


What happens to cooling loop water ?

- ▶ Formations of mineral scale restrict the flow of cooling water, which not only slows production, but increases maintenance expense and stresses process equipment.
 - ▶ Byproducts of corrosion are difficult to control. We tried several suggested methods of improvement with little or no success.
 - ▶ Bugs could grow which can make people sick (Legionnaire's Disease)
- 

Pursuit of a Sustainable Water Solution

- ▶ Two controlled loop water systems required a water management solution
 - ▶ HARBEC needed a better way to manage the cooling water that impacted the environment less
 - ▶ Many years of unsuccessful attempts to find a sustainable operation solution were finally ended by DEC



MONITOR, MEASURE, then MANAGE

HARBEC needed an alternative solution that would use sustainable best practices

++ Mass balance of our water system by controlling the pH of water ++



Special Thanks to:

Dave Carney and the
AQUA-EYE Company

dave@aqua-eye.com

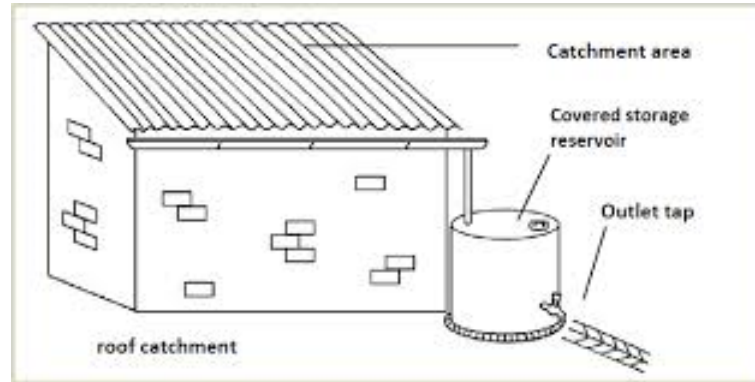
Pond supplied make up water needed by evaporative cooling tower requires:

- ▶ Managing the pond's biological (bacteria) conditions through aeration
- ▶ Using real time sensors to measure conductivity, temperature, pH, etc.
- ▶ Using mild acid solution to control the pH that is discharged back to the pond



Future Management and Continuous Reduction Potentials of Potable Water Use in Manufacturing

- ▶ Improve the use of rain and gray water for all but drinking and hand washing



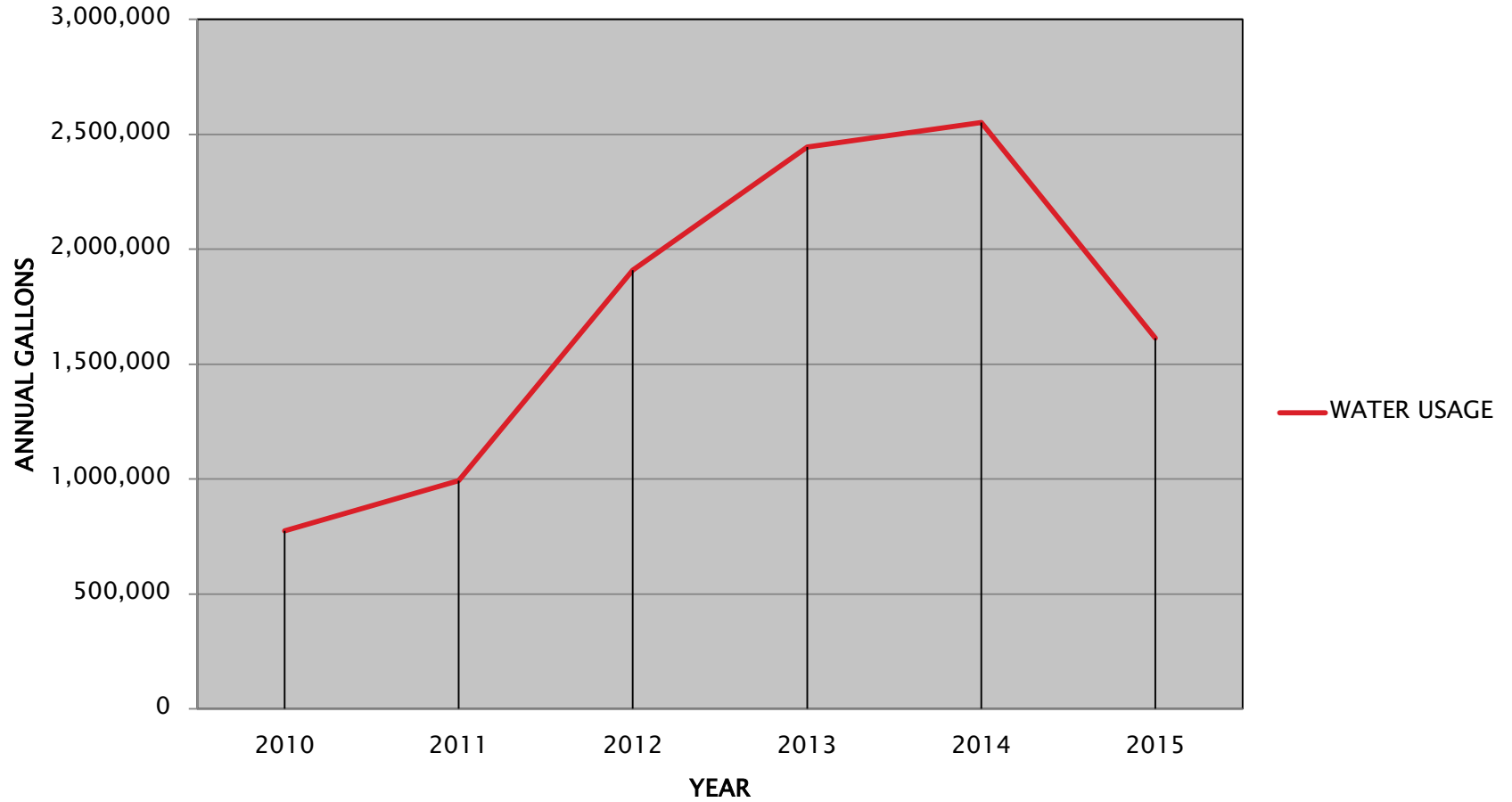
Replace standard toilets with water saver types



HARBEC Priorities and Goals

- ▶ HARBEC has a fundamental desire:
 - ▶ To produce products with the least amount of negative environmental impact
 - ▶ To implement best practices that provide eco-economic positive results
 - ▶ To assume responsibility for our impact on the environment, the community, our employees and our bottom line
 - ▶ To constantly strive for neutral impact or 'footprint' in required resources such as energy, water and materials, either directly through our efforts or through 3rd party facilitators who provide carbon and water credits

HARBEC ANNUAL WATER USAGE



Unexpected Benefits

- ▶ Energy and water reductions that resulted from the process water upgrade:
 - +50hp (pumps and fans) reduced to 6hp– 88% decrease in energy saved 17000kwh/month
 - +20k gallons reduced to 500 gallons per month– 97% decrease in water consumption by eliminating or reducing evaporation
 - +Chiller Tower/Pond utilization– 4k/gallons/day = 120,000 gallons/month saved by ‘free cooling’
 - +Total monthly water savings with pond water and new water loop= Over 145,000gal/month
 - +Total Water Reduction/year 850,000 gallons or 45% decrease in facility water consumption

HARBEC conviction to Eco-economic Sustainable Manufacturing

At **HARBEC** we regard Eco-economic Sustainability as absolutely critical to the future of our business, and we believe that our success in the pursuit of it, will improve our competitive advantage by insuring our efficiency.



a **Carbon and Water Neutral** manufacturing company



ISO 50001/SEP Platinum - Nov. 2013
DOE - Better Plants – Challenge - Jan. 2014

HARBEC, Inc.
585-265-0010

Thank You

Ontario, NY
www.harbec.com

ATLANTA BETTER BUILDINGS CHALLENGE

Voluntary Community-scale Water Efficiency Program



- Juliette Apicella, LEED AP
- Program Manager, Southface, Atlanta Better Building Challenge



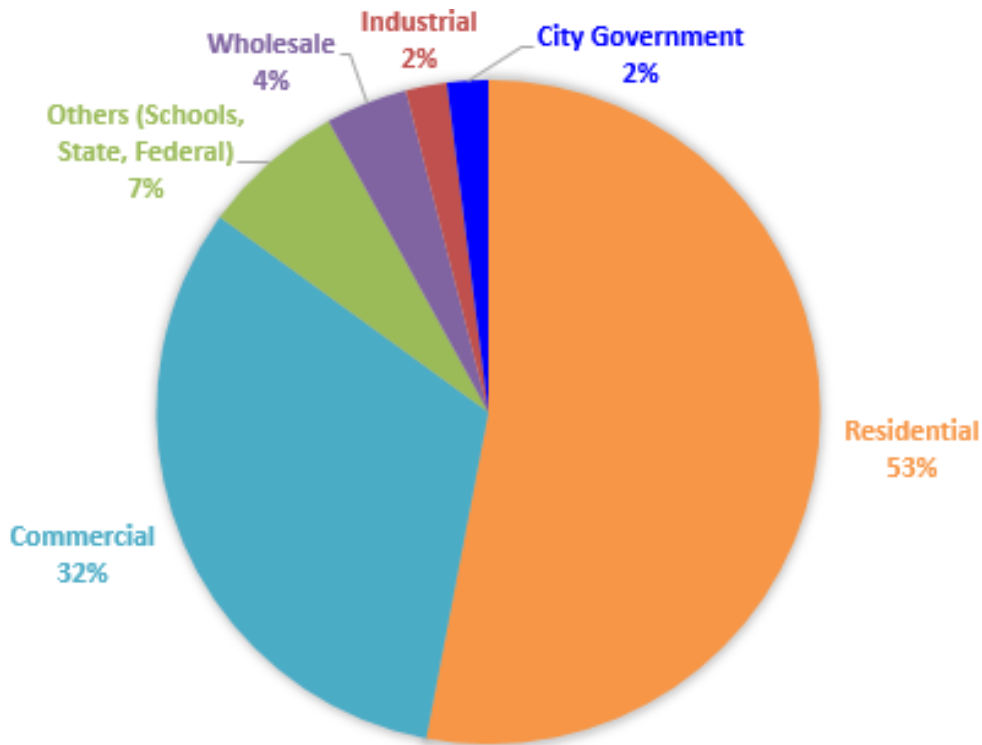
2015 SAVINGS compared to baseline year

Energy 17% savings

Water 20% savings

Close to 104 million square feet
400+ Properties

2013 City of Atlanta: Percentage Water Consumption by Sectors



Percentage of water consumption by sectors (2011-2013) source: City of Atlanta Department of Watershed Management

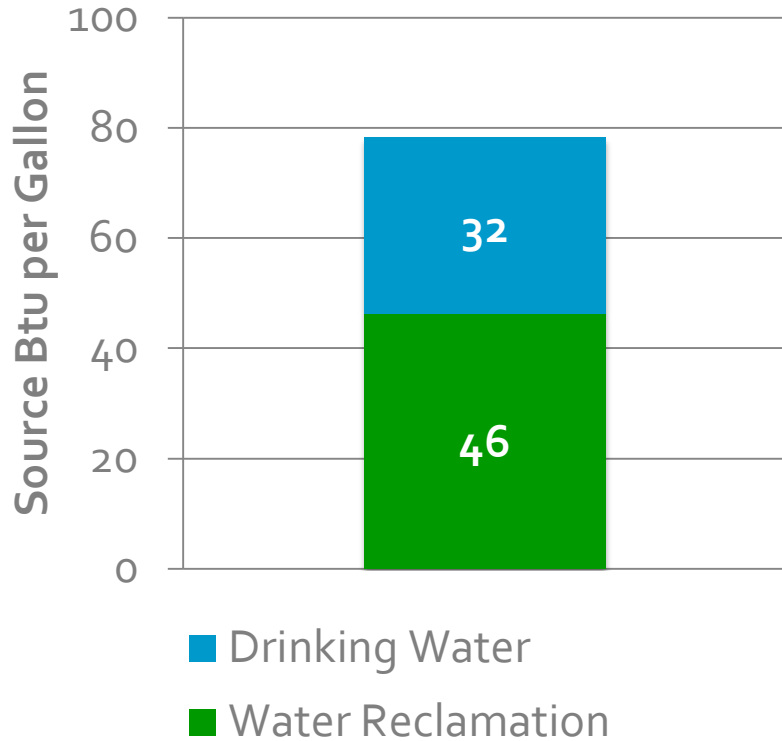
2015 water savings equaled

7.4 days

total water used by City Government and Commercial Sectors in 2013*



System-Wide Energy Use in Treatment & Conveyance



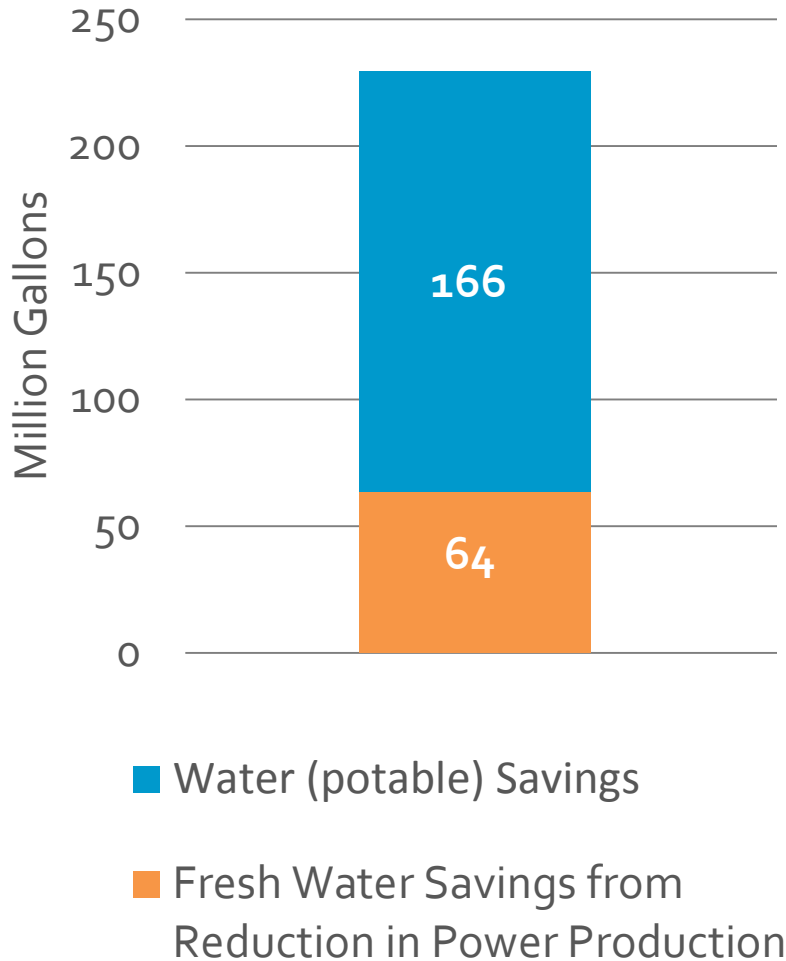
78 million source Btu per million gallons treated & conveyed

Impact of 2015 water savings estimated to be up to

13 billion
source Btu



2015 Water Savings Impact



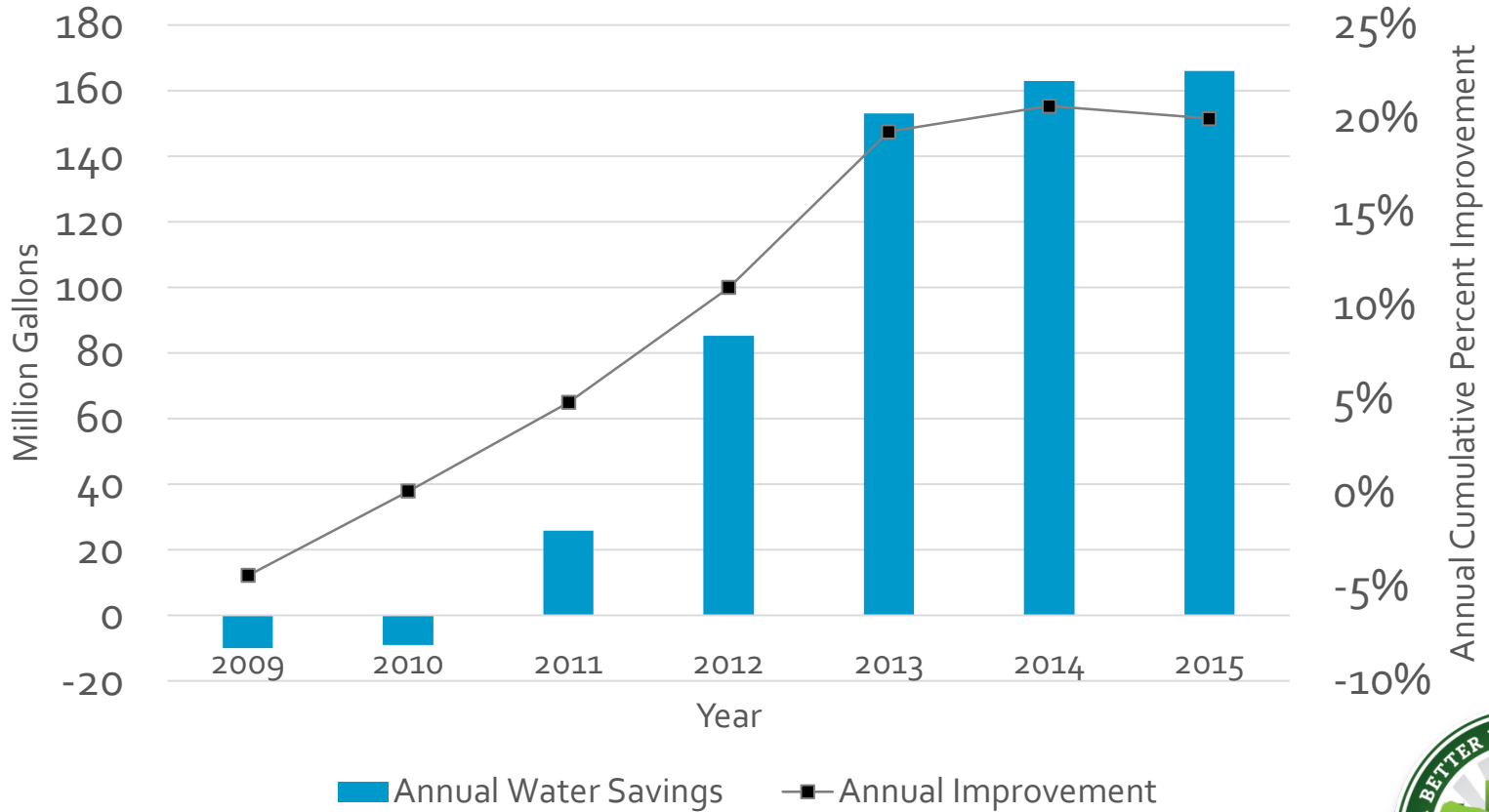
0.52 gallon (est) per kWh in
consumptive fresh water use
for thermoelectric power production

Impact of 2015 electricity
savings estimated to be up to

64,000,000
gallons
water



Water Performance - Annual Average Cumulative Improvement



WATER MEASURES USED BY PARTICIPANTS

Sanitary Fixtures and Equipment

Replace toilets and urinals

Domestic hot water equipment
and fixture upgrades

Mechanical Systems

Cooling tower upgrades

Commercial Pool and Spa Equipment

Pool covers

Outdoor Water Use

Irrigation upgrades

Water Use Monitoring

Leak detection

Onsite Alternative Water Sources

Condensate capture

Rainwater Harvesting

Water Reuse



Bank of America Plaza

Office, 1.49 million sq. ft.

Project Overview: Plumbing fixture retrofit, condensate capture, irrigation

Water Savings: 63% - 13.7 MM gallons, Energy savings: 14%

Water Cost Savings: 56%





Georgia World Congress Center

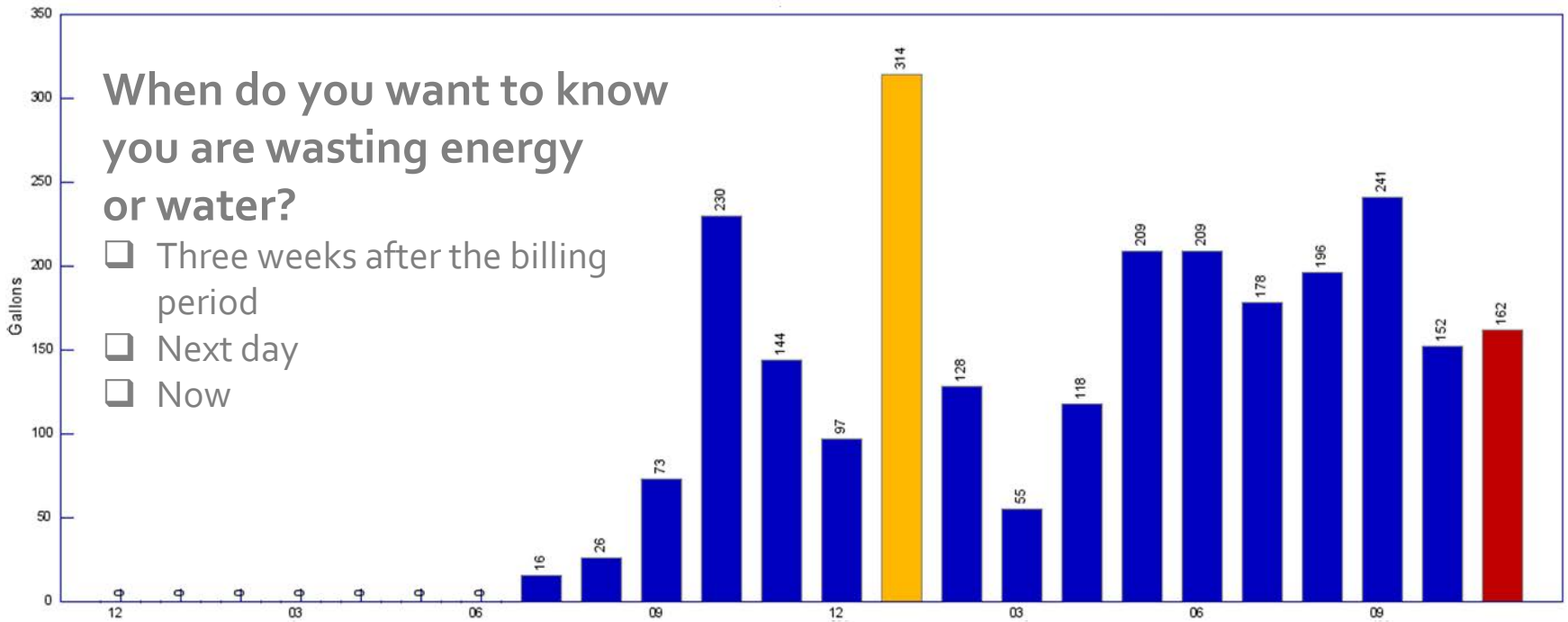
Worlds largest LEED certified convention center, 3.9 MM sq. ft.

Project Overview: Plumbing fixture retrofit

Water Savings: 29% - 22.4 MM gallons, Energy Savings: 2%

Water Cost Savings: 32%





MANAGEMENT	PROPERTY	STATE	ZIP	SQ.FT	ALERTS ⁽¹⁾	KGAL MTD	ACTUAL COST	PREV. DAY LOWEST USAGE/HR	PREV. DAY HIGHEST USAGE/HR
Fulton County Schools	Lake Windward Elementary School	GA	30005	126,500	5	78	\$659	0	618
Fulton County Schools	Langston Hughes High School	GA	30213	355,000	15	29	\$450	48	61
Fulton County Schools	Milton High School	GA	30004	343,450		65	\$583	7	320
Fulton County Schools	North Springs High School	GA	30328	314,530	98	280	\$4,403	130	1,395



Grand Hyatt Hotel Atlanta in Buckhead

Luxury Hotel, 439 Guest rooms

Project Overview: Onsite alternative water sources for cooling tower make-up water rainwater harvesting, condensate capture from air handler, recycled water from ice machines, shower head retrofit





Southface Main Campus

Office, 14,368 sq. ft.

Project Overview: Behavior Change

Water Savings: 54% - 56,400 gallons, Energy Savings: 23%

Water Cost: 52%



Assign

Engage

Educate

Evaluate

Share



Southface Main Campus

Reduced potable water use by 46% compared to year prior to study

20% of the water used during the study was rainwater

Staff awareness of impact on campus water use increased 17% to 69%

Staff changed water use behaviors at home 46%

Staff changed behaviors at work 83%





Wesley Woods Senior Living, Asbury Harris Epworth Tower
Multifamily, 182,000 sq. ft.

Project Overview: toilet, shower head, faucet aerator retrofit

Water Savings: 58% - 4.4 MM gallons, Energy Savings: 24%

Water Cost Savings: 39%





Technology Square Resource Building

Office, 210,000 sq. ft.

Project Overview: Condensate recovery, increased cycles of concentration, water sub-metering

Water Savings: 9% - 328,500 gallons, Energy Savings: 32%

Water Cost Savings: 11% - \$13,000



WE'RE WORKING ON...

Increasing Water Reporting

Building Case Studies

Education

www.AtlantaBBC.com

TECHNOLOGY SQUARE RESEARCH BLDG.

WE TOOK THE CHALLENGE
20% WATER & ENERGY REDUCTION BY 2020

Georgia Tech Research Institute has had a long commitment to high performance buildings and sustainability, and joined the Atlanta Better Buildings Challenge in November 2011. Joining the Atlanta BBC was a commitment not only to the University's performance, but also to the community as a good citizen helping to carry Atlanta forward. Georgia Tech Research Institute hopes to lead other universities to join the Atlanta BBC and support the effort to help Atlanta become a top-tier sustainable city.

PROJECTED SAVINGS:

- WATER:** 1,250 GALLONS saved annually (represented by 12 trees) vs. 31 BATH TUBS filled each year (represented by 31 tubs).
- ENERGY:** 1,536 kWh saved annually (represented by 1536 light bulbs) vs. 644 HOMES powered for one year (represented by 644 houses).
- DOLLARS:** \$100,190 saved annually (represented by 100 stacks of bills) vs. HIRING 2 NEW EMPLOYEES each year (represented by 2 people icons).
- CARBON:** 0.508 METRIC TONS saved annually (represented by 508 trees) vs. 746 PASSENGER CARS removed from the road for one year (represented by 746 cars).

BUILDING SPECS:
Owner: TL&F Yanceyrow LLC
Year Built: 2009
Square Feet: 205,459
Floors: 5
Structure: Steel, Glass & Cladding
Building Use: Office & Research
No. Of Occupants: 400
ENERGY STAR Score: 43
www.tlrf.gatech.edu

*"Working with the Atlanta BBC has helped us learn & discover some of the latest technologies & innovations that are available in the energy & water efficiency & sustainability space. We have been able to implement a number of strategies that have resulted in significant financial savings, as well as allowing us to be better environmental stewards of our community."
Victor R. Clements,
The University Financing
Foundation, Inc.*



Campus Benchmarking Guide

Manage Campus Building Performance through Benchmarking to Save Energy and Water

OVERVIEW

College campuses spend nearly \$2 billion every year on utility costs, a figure that is forecast to rise as energy and water costs become increasingly volatile in the future¹. On average, **30% of the energy entering campus buildings is wasted** due to inefficient building systems, inadequate building operations and wasteful occupant behavior². By improving the efficiency of existing buildings on your campus, strengthening building operations and engaging building occupants in resource conservation, energy and water consumption, operations costs and greenhouse gas emissions can be drastically reduced. In fact, **Emory University was able to reduce the energy consumption of campus buildings (excluding healthcare facilities) by 23% between 2005 and 2012 through building efficiency improvements and operational changes**. In addition to focusing

on energy conservation measures, **implementing water efficiency practices can decrease operating costs by 11%, energy use by 10% and water use by 15%**³. Georgia Institute of Technology achieved annual savings of \$123,000 from energy and water efficiency measures **deployed on a single building**. Efficiency improvements produce cost savings that can be reinvested into core academic programs, while significantly reducing your institution's carbon footprint and improving your institution's resiliency to fluctuating energy and water pricing.

College and university campuses' diverse mix of property types and sizes coupled with expansive square footage can make identifying savings opportunities a challenge. Historically, the largest buildings and those consuming the most energy have been the primary focus for energy and water savings efforts, while smaller buildings (≤50,000 square feet) have been overlooked, leaving a wealth of savings opportunities untapped. **Considering that a typical college campus is characterized by a higher percentage of small buildings than large buildings, continuing to let smaller buildings fall through the cracks is a clear misstep in energy management**. By shifting the paradigm to include small commercial buildings as targets for energy and water efficiency improvements on college campuses, considerable reductions in energy and water usage and costs can be achieved nationwide.

The *Campus Benchmarking Guide* was developed by Southface to help colleges assess the energy and water usage of both small and large buildings and compare them to ENERGY STAR's index of average energy usage for over 80 relevant

Technology Square Research Building

"Georgia Tech's Technology Square Research Building began its retrofit effort just before joining the Atlanta Better Buildings Challenge in late 2011, but quickly benefited from the Atlanta BBC assessment. The Atlanta BBC assessment provided 15 additional energy and water saving solutions that spanned from lighting retrofits to additional controls. The building moved quickly into implementation and has completed upgrades saving \$123,000 annually on electricity and water costs"

—Vic Clements, TUFF



MANAGE CAMPUS ENERGY AND WATER USE THROUGH BENCHMARKING

Webinar: June 15, 2016

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404-604-3590

