



Soaking up Energy Savings from Water Projects

Better Buildings Summit 2019
Thursday, July 11th 4:00 - 5:30PM



Otto Van Geet
NREL

U.S. DEPARTMENT OF
ENERGY



NREL ESIF Data Center Water Use Reductions

Otto Van Geet, PE - NREL

NREL Data Center Design

■ Showcase Facility

- ESIF 182,000 ft.² research facility
- 10,000 ft.² data center
- 10 MW at full buildout
- LEED Platinum facility, PUE ≤ 1.06
- No mechanical cooling (eliminates expensive and inefficient chillers)



Utilize the bytes and the BTUs!

■ Data Center Features

- Direct, component-level liquid cooling, 24°C (75°F) cooling water supply
- 35-40°C (95-104°F) return water (waste heat), captured and used to heat offices and lab space
- Pumps more efficient than fans
- High voltage 480 VAC power distribution directly to high power density 60-80 kW compute racks

■ Compared to a Typical Data Center

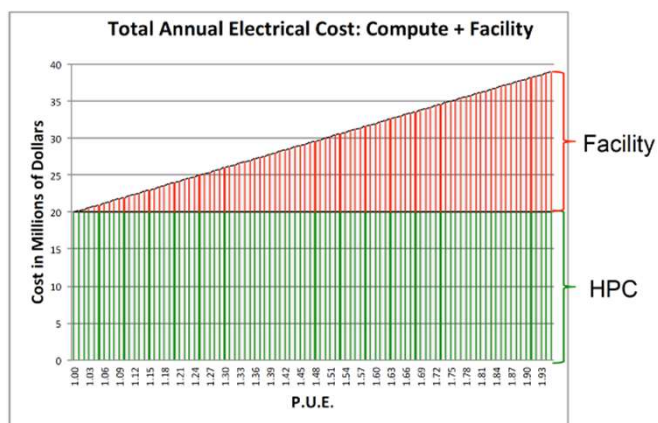
- Lower CapEx—costs less to build
- Lower OpEx—efficiencies save

Integrated “Chips to Bricks” Approach

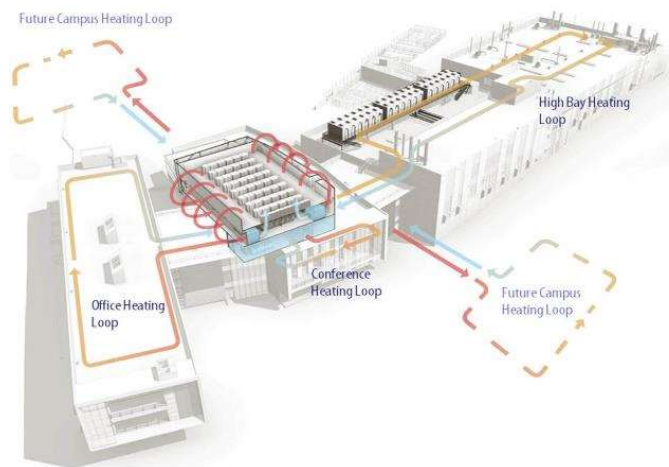
Metrics

$$PUE = \frac{\text{"Facility energy"} + \text{"IT energy"}}{\text{"IT energy"}}$$

$$ERE = \frac{\text{"Facility energy"} + \text{"IT energy"} - \text{"Reuse energy"}}{\text{"IT energy"}}$$



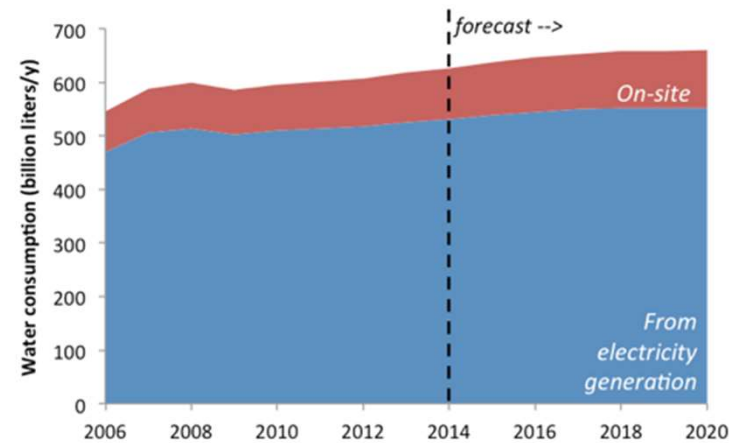
Assume ~20MW HPC system & \$1M per MW year utility cost.



Metrics

$$WUE = \frac{\text{"Annual Site Water Usage"}}{\text{"IT energy"}}$$

the units of WUE are liters/kWh



$$WUE_{SOURCE} = \frac{\text{"Annual Site Water Usage"} + \text{"Annual Source Energy Water Usage"}}{\text{"IT energy"}}$$

$$WUE_{SOURCE} = \frac{\text{"Annual Site Water Usage"}}{\text{"IT energy"}} + [EWIF \times PUE]$$

where EWIF is energy water intensity factor

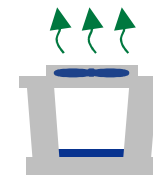
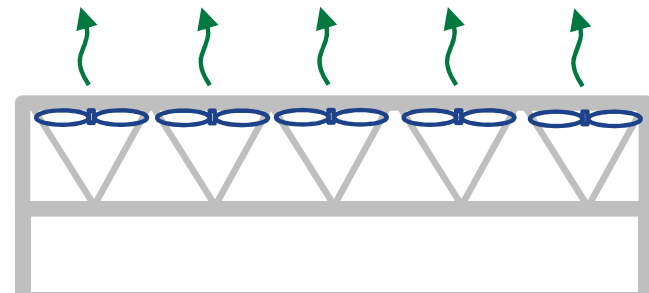
Air- and Water-Cooled System Options

■ Air-Cooled System

- Operation is based on DRY BULB temperature
- Consumes no water (no evaporative cooling)
- Large footprint requires very large airflow rates

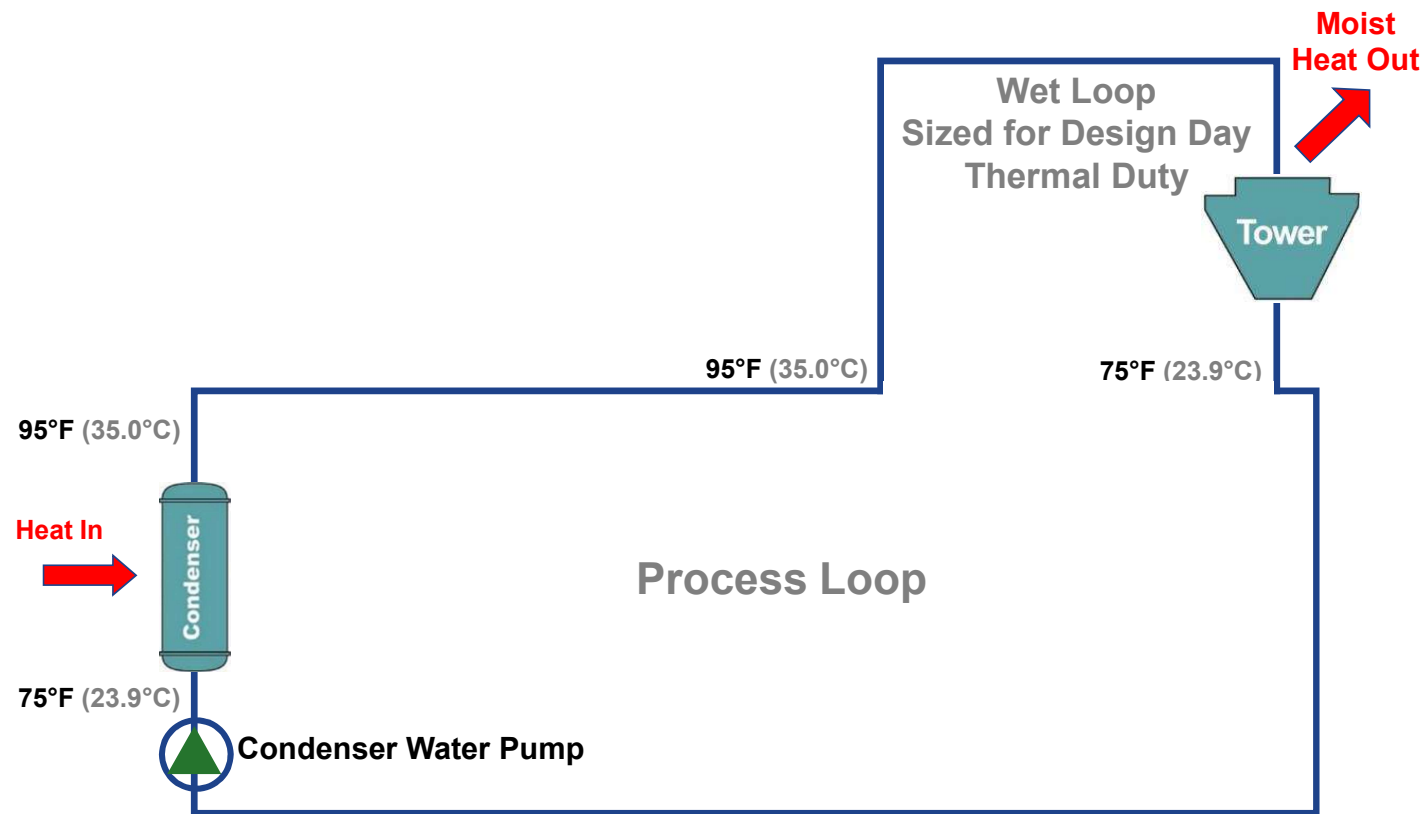
■ Water-Cooled System

- Operation is based on the lower WET BULB temperature
- Evaporative cooling process uses water to improve cooling efficiency
 - 80% LESS AIRFLOW = lower fan energy
 - Lower cost and smaller footprint
- Colder heat rejection temperatures improve system efficiency

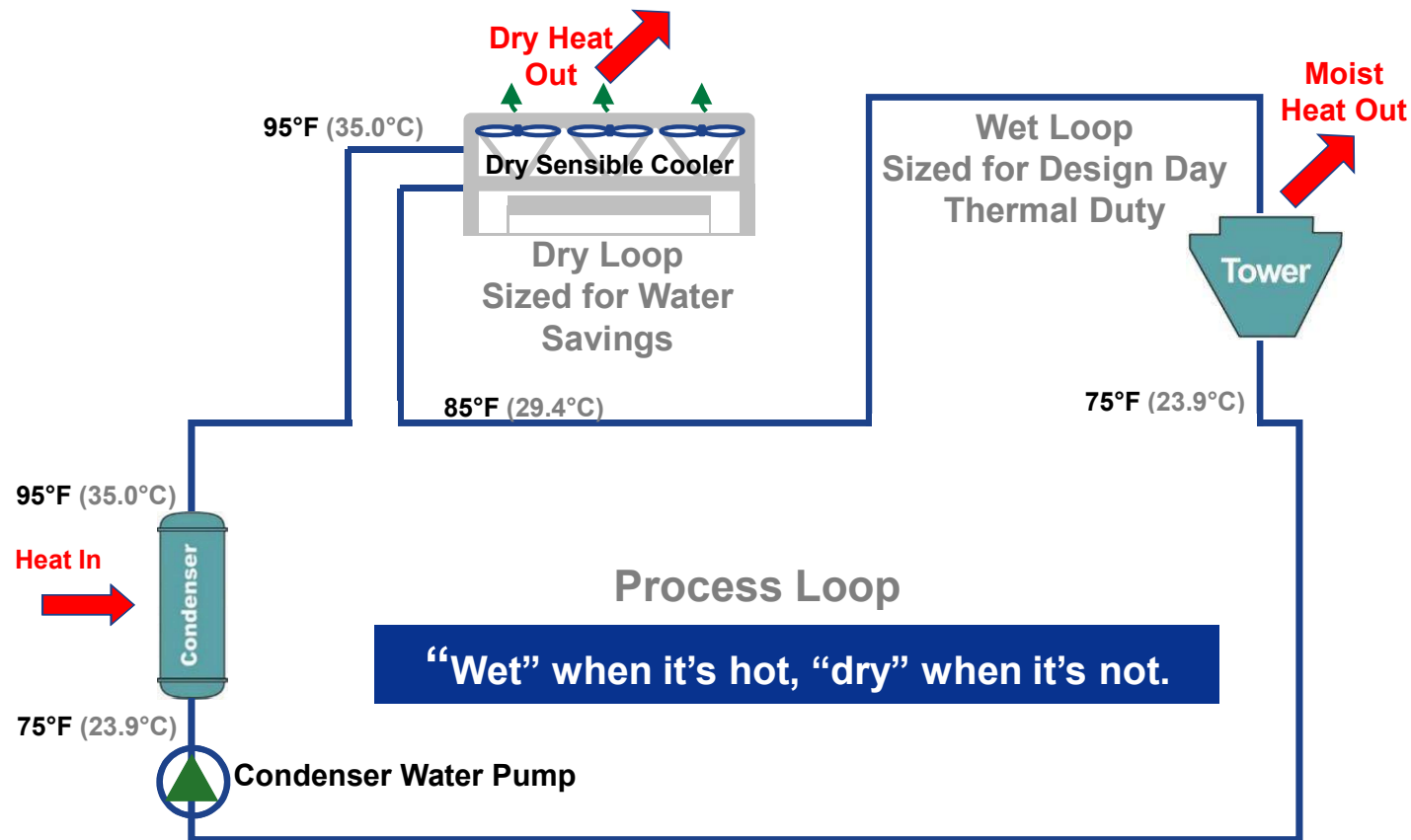


However, water-cooled systems depend on a reliable, continuous source of water.

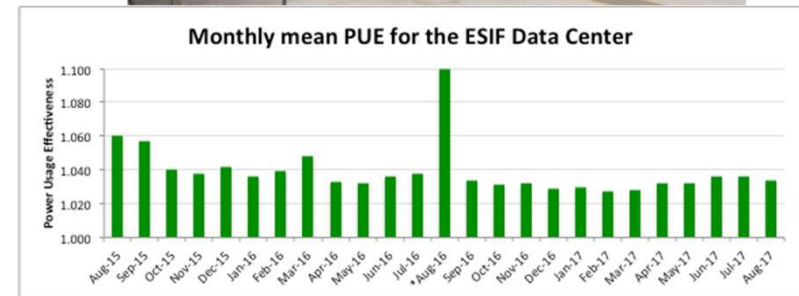
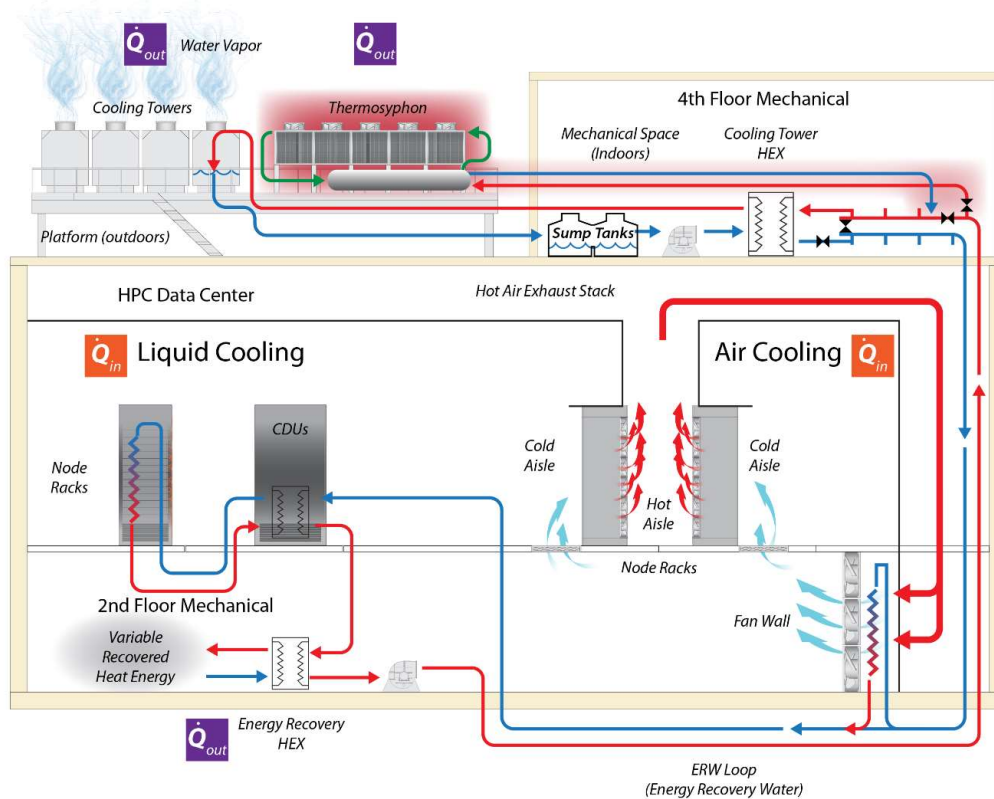
Traditional Wet Cooling System



Basic Hybrid System Concept



Improved WUE—Thermosyphon



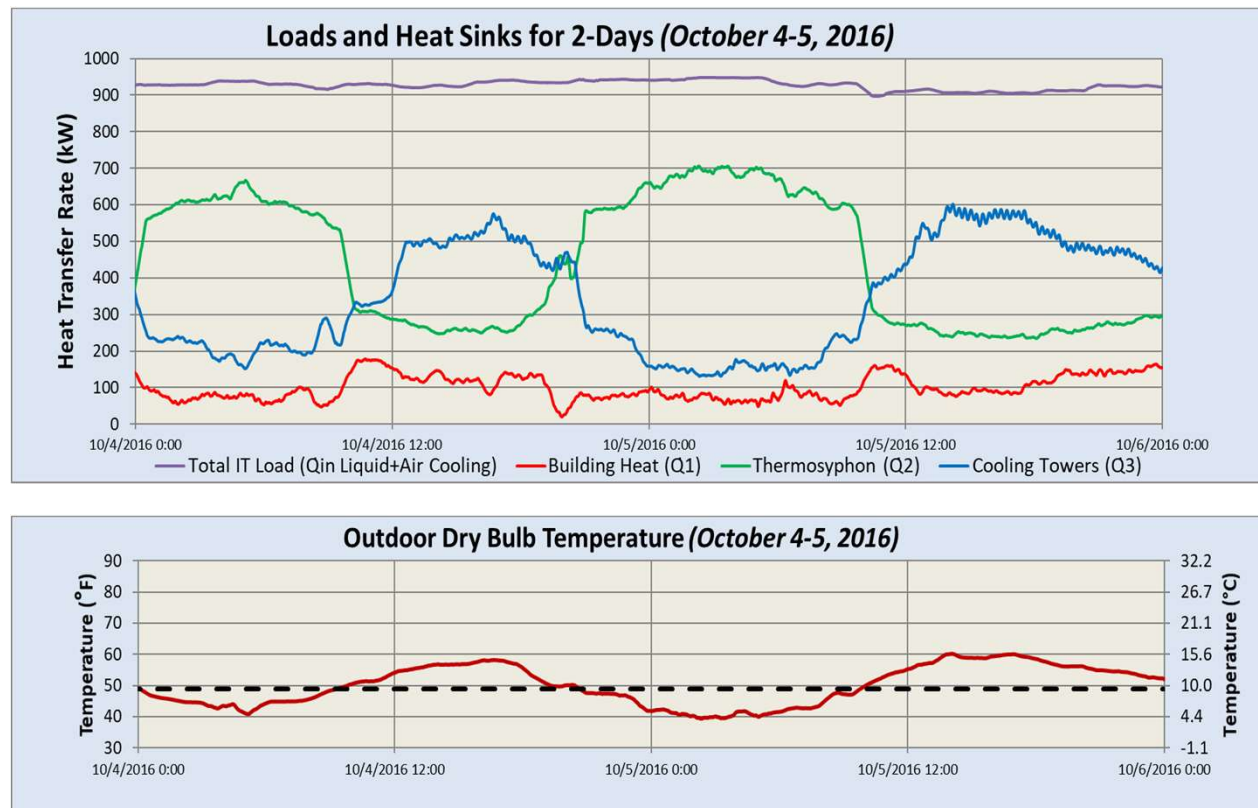
Applications

Any application using an open cooling tower is a potential application for a hybrid cooling system, but certain characteristics will increase the potential for success.

- **Favorable Application Characteristics**

- Year-round heat rejection load (24/7, 365 days is best)
- Higher loop temperatures relative to average ambient temperatures
- High water and wastewater rates or actual water restrictions
- Owner's desire to mitigate risk of future lack of continuous water availability (water resiliency)
- Owner's desire to reduce water footprint to meet water conservation targets

Sample Data: Typical Loads and Heat Sinks



Data Center Metrics

First Year of TSC Operation (9/1/16 - 8/31/17)

Hourly average IT Load = 888 kW

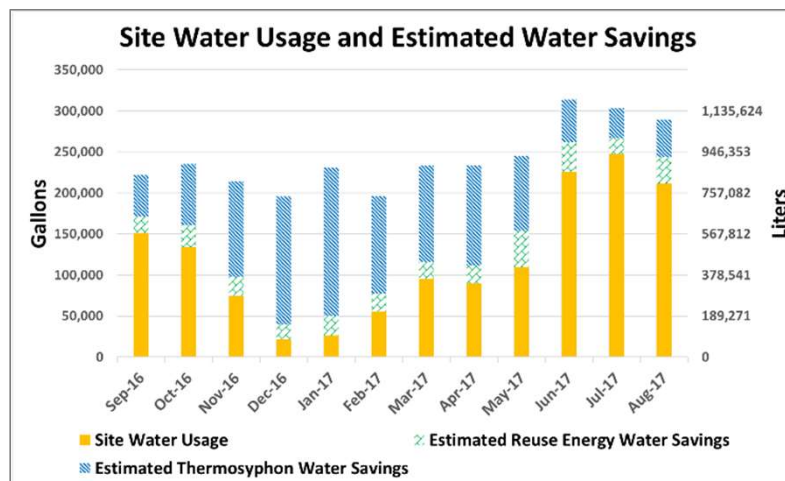
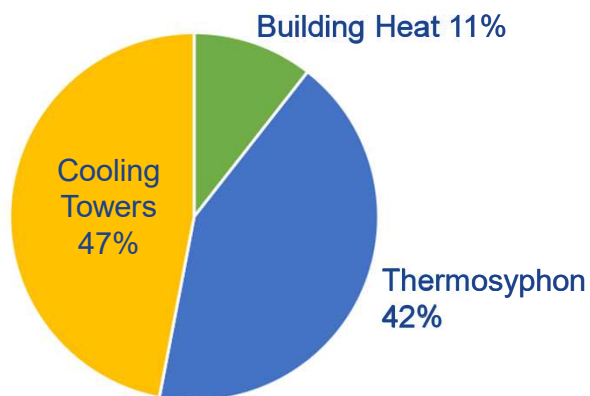
PUE = 1.034

ERE = 0.929

WUE = 0.7 liters/kWh

with only cooling towers, WUE = 1.42 liters/kWh

Annual Heat Rejection

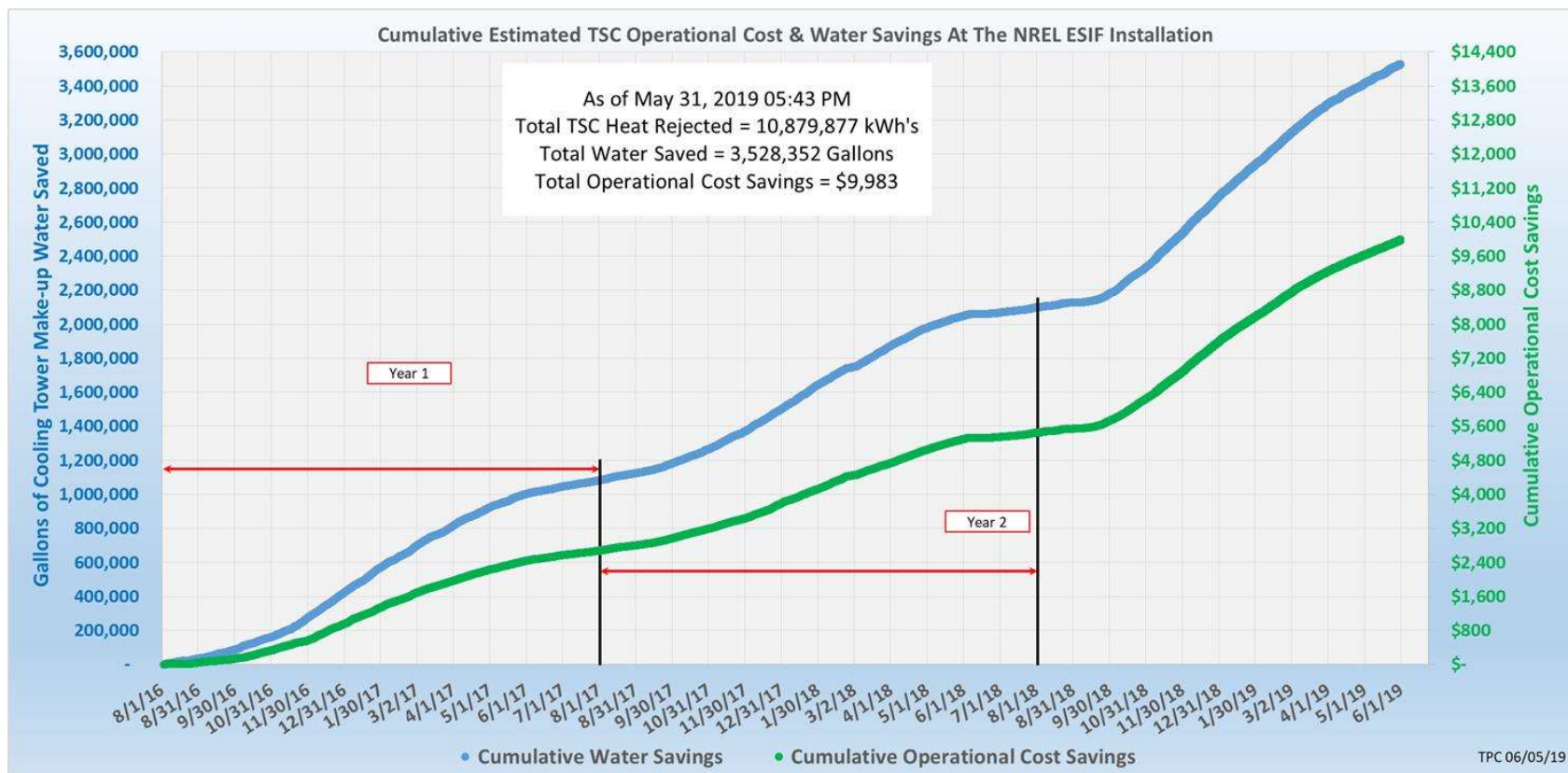


$WUE_{SOURCE} = 5.4$ liters/kWh

$WUE_{SOURCE} = 4.9$ liters/kWh if energy from 720 kW PV (10.5%) is included

using EWIF 4.542 liters/kWh for Colorado

Cost and Water Savings



Questions?



Notice

This research was performed using computational resources sponsored by the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy and located at the National Renewable Energy Laboratory under Contract No. DE-AC36-08GO28308. Funding provided by the Federal Energy Management Program. The views expressed in the presentation do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the presentation for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.

Mark Campbell

MGM Resorts

U.S. DEPARTMENT OF
ENERGY



Soaking up Energy Savings from Water Projects: MGM's Experience

Better Buildings Summit
July 11, 2019

Mark Campbell
Executive Director of Sustainability

MGM RESORTS INTERNATIONAL



- 30 Unique hotel offerings
- 740 Acres on the Las Vegas Strip
- 48,000+ Guest rooms and suites
- 400+ Restaurants
- 83,000+ Employees
- 3 Million+ sq. ft. Convention space

**Annual Domestic
Electricity Consumption:
1.3 Million MWh**

**Annual Domestic Utility
Water Consumption:
4.5 Billion Gal.**

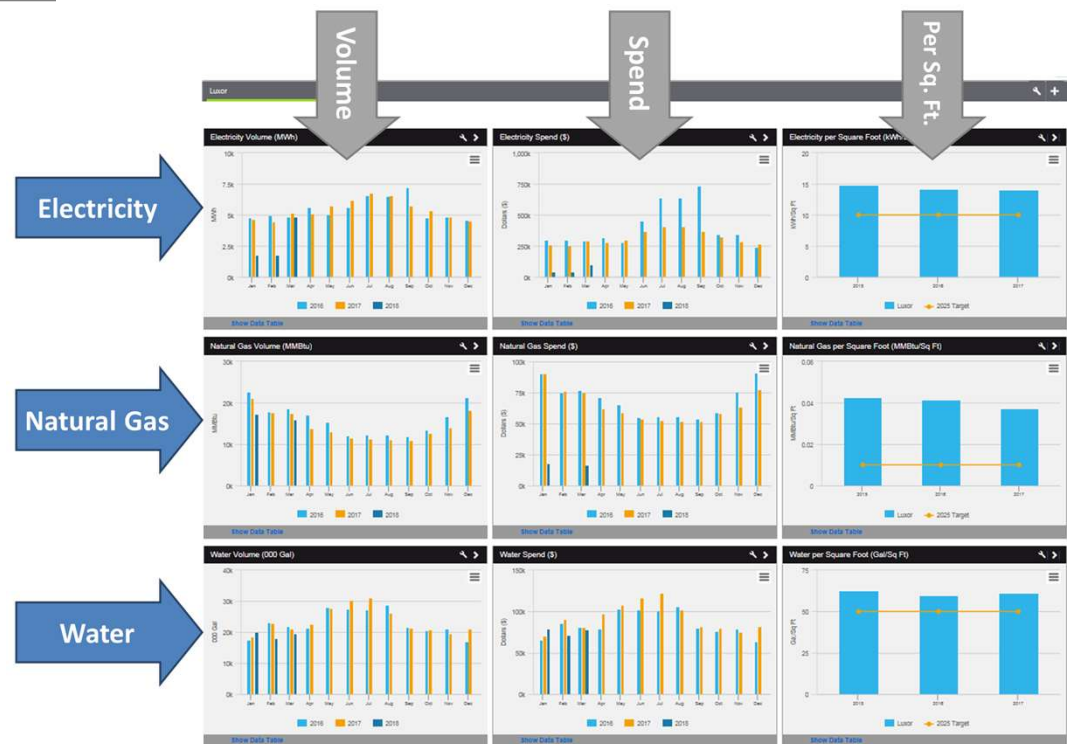
Addressing Water Consumption

Opportunities

- ❑ Energy conservation
- ❑ Landscaping & equipment choices
- ❑ LEED & MGM Resorts' development standards
- ❑ Measurement, analytics, action

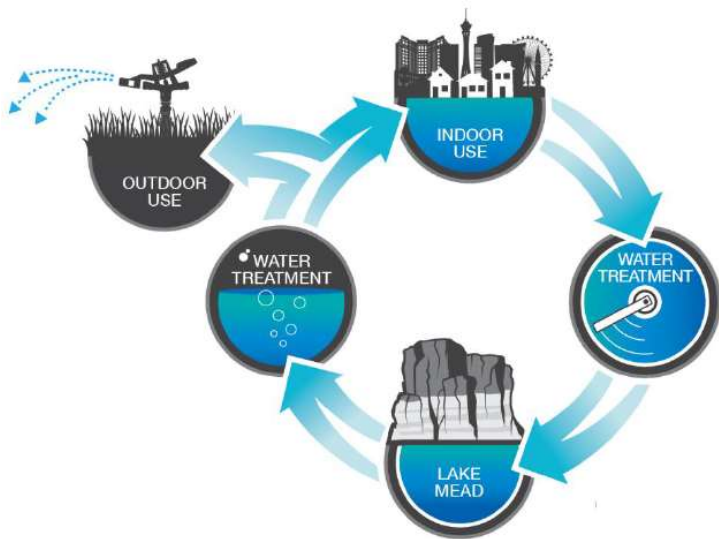


MGM RESORTS INTERNATIONAL



Water in Las Vegas

- ❑ 99% of the water used indoors in the Las Vegas Valley is recovered
- ❑ 80-90% of the water used for MGM's Las Vegas properties is used indoors



MGM RESORTS INTERNATIONAL



Opportunities for Water Conservation

ENERGY CONSERVATION

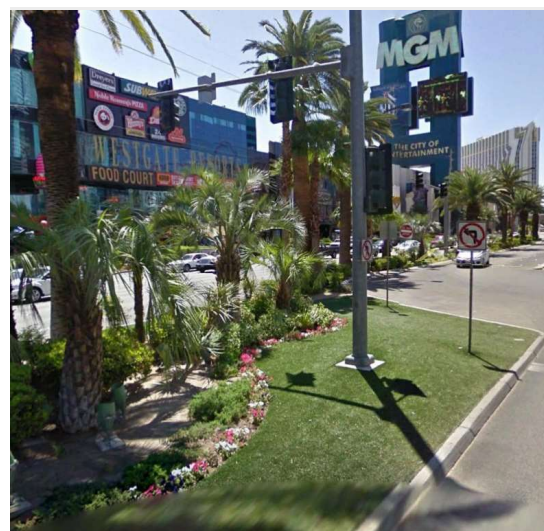
- ❑ **Lighting** retrofits across the portfolio and every area
- ❑ Upgrades to **HVAC** hardware and controls systems
- ❑ **Replacement** of major mechanical equipment & use of high efficiency filters



MGM RESORTS INTERNATIONAL

CONSUMPTIVE AREAS

- ❑ Over 200,000 sq. ft. of grass **converted** to water-smart landscaping
- ❑ Drought-tolerant, native plant choices
- ❑ **Upgraded** cooling towers



Opportunities for Water Conservation

MGM National Harbor

FEATURES

- ❑ LEED **Gold** Certification
- ❑ Highly efficient Combined Heat and Power (CHP) plant onsite – feeds **absorption** chiller
- ❑ 700K gallon water cistern **stores rainwater** for multiple purposes
- ❑ High efficiency fixtures save over 30M gal/year



Opportunities for Water Conservation

The Park

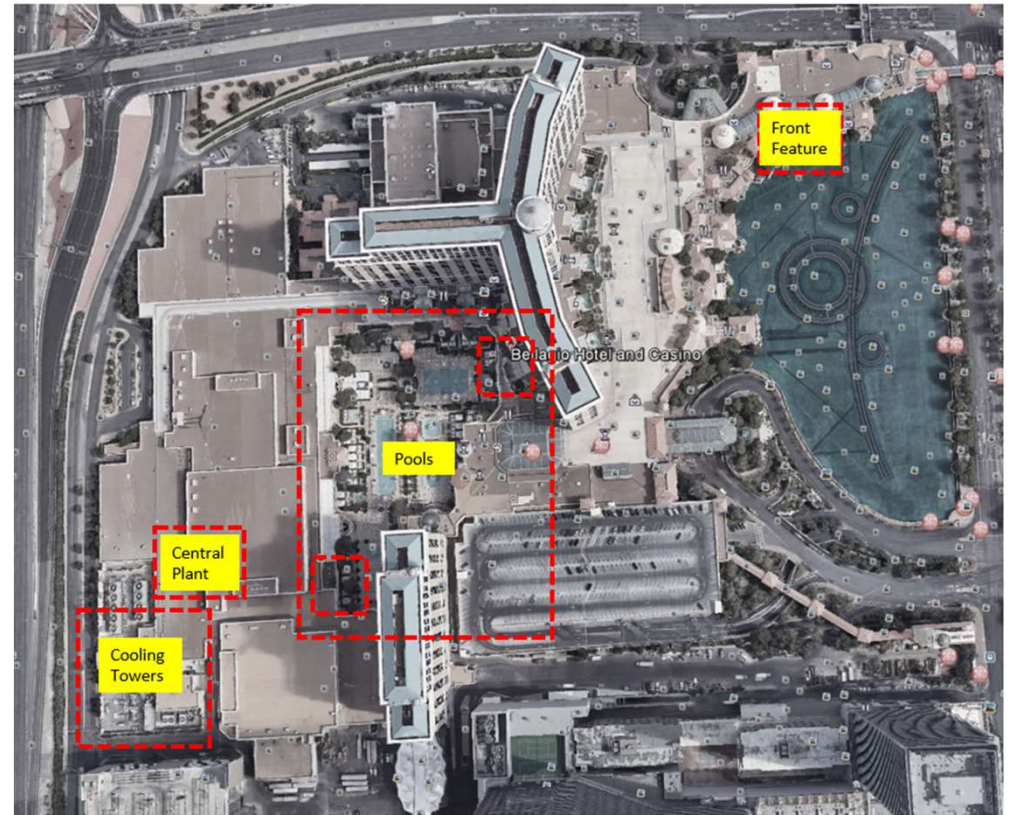


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Opportunities for Water Conservation

- ❑ Goal: Offer the **leading guest experience** while continuing to reduce consumption
- ❑ Partnership with **WaterStart** in Las Vegas
 - ❑ Focus: Drive **innovative** water conservation solutions to market, while bringing **new business** operations to Las Vegas
 - ❑ Mechanism: RFP/Interview process and pilot testing
- ❑ Result: **Implementation** of an **intelligent** water management platform at Bellagio Hotel & Casino in 2018

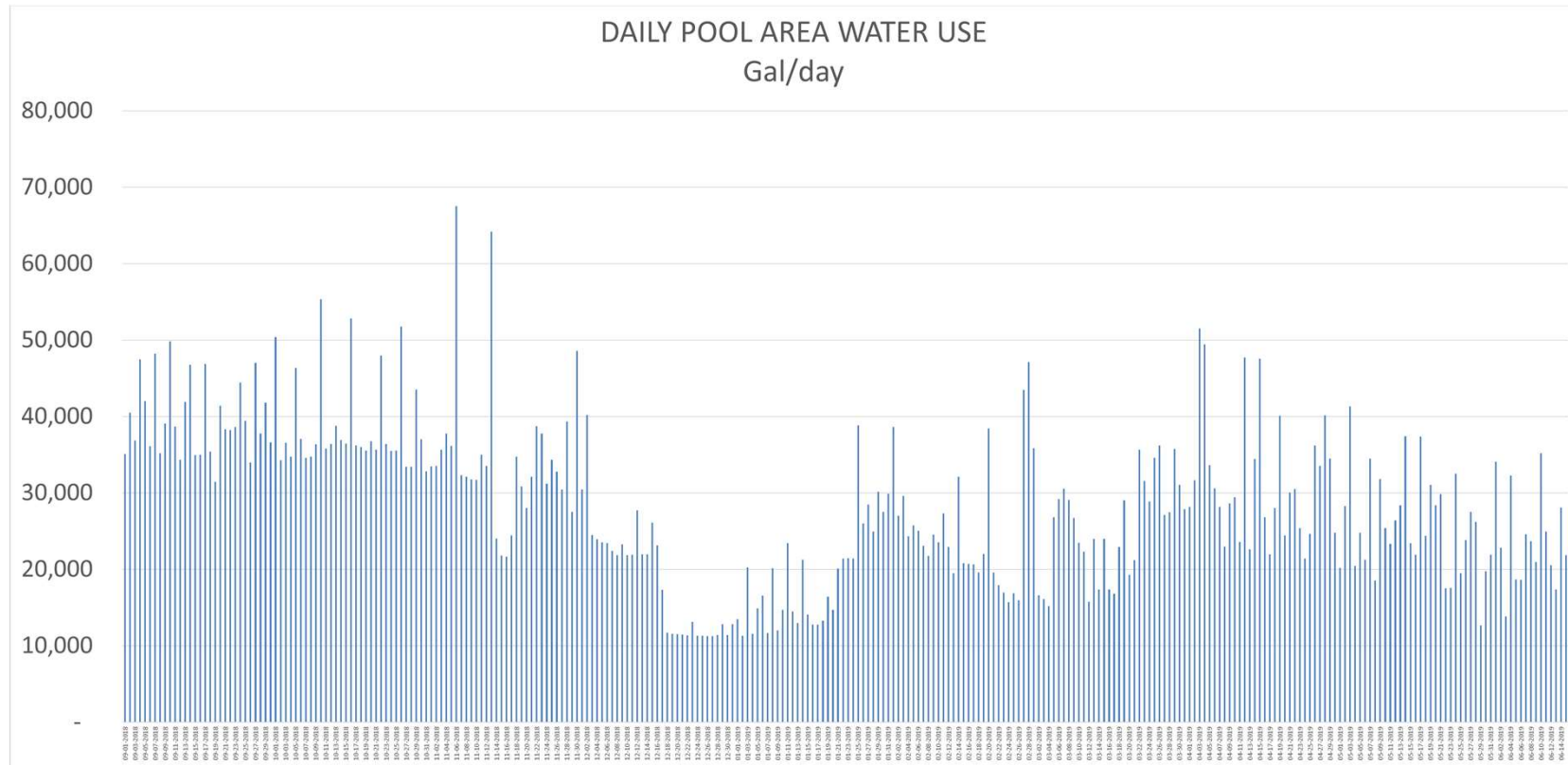


Intelligent Water Management - Apana



MGM RESORTS INTERNATIONAL

Intelligent Water Management - Apana



Intelligent Water Management - Apana

RESULTS SUMMARY

- ❑ Reduced pool water consumption by almost 14,400 gallons per day (37%)
- ❑ Resulting annual savings from reduced heating requirements: 900 MMBtu
- ❑ Embedded system energy savings: over 36,000 kWh
- ❑ Hot water loops have high baseload usage – further investigation needed



Continuous Improvement

ONGOING EFFORTS

- ❑ **Apana**
 - ❑ Further analysis on hot loops and cooling towers
 - ❑ Additional sub-meters & sensors at Bellagio will further detail water consumption & provide opportunity
- ❑ **Fixtures** – Testing smart fixtures that operate more efficiently
- ❑ **Cooling towers** – Considering multiple technologies to reduce chemical usage & blowdown

ACTIVATING OUR EMPLOYEE BASE

- ❑ **Employees at every level encouraged to submit ideas** for all areas of MGM's operations
- ❑ **Energy & water management programs** instituted to inform staff, create teams, set roles and share best practices
- ❑ **MGM leadership sets ambitious annual goals** for properties focused on energy & water efficiency



Thank You!

Mark Campbell
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Jodenne Scott

Shari's Café and Pies

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Soaking Up Water Savings from Water Projects

*July 11, 2019, 3:30 pm to 5:00 pm
Department of Energy's Better Building Summit
Washington, DC*

A little history of our Energy Program

- Challenge: Reduce Expenses during tough economic times
 - Needed to find ways to add value to the Company
 - Utilities 3rd highest Operating Cost behind Labor & Food
 - Implemented what is now considered an industry-leading **Strategic Energy Management (SEM)** program
 - Goal of the Program
 - Reduce expenses (usage) without interfering with our guests dining experience

Executive Buy-in Key

Adopt an Energy Plan that becomes part of the core values.



Strategic Energy Management Plan – Why have one?

Improve Performance

- Reduce energy, water and other waste costs

Best Practices

- Standard operating practices
- Set points
- Equipment purchasing guidelines

True Hospitality

- Seamless to our guests
- Reduces our carbon footprint in the communities we serve

SEM Employee Engagement

- Survey District and General managers to gather operational practices, equipment set points and equipment condition.
- Communication to the field important - Bi-monthly newsletter facilitating awareness of best practices as well as how we are doing reaching our goals.
- New employee – energy video
- Veteran employees – annual review



Everyone can add value!



Every team
member plays a
role in saving
energy

Breaking it down
for each position.

- # of burgers to cook
- # of dishes to wash
- # of pies to sell

Created "Shari's
Easy Savings"
posters

Shari's Easy Savings
for Team Members

Because Shari's Cares, we're committed to
reducing wasted energy and water every day.

YOUR TEAM CAN DO THEIR PART BY TAKING THESE EASY ACTIONS EVERY DAY:

What?	Why?	Why?
Turn Off 3rd Cook Line	During pre-opening hours?	\$1,000
Turn Off Boiler Burners	During non-peak and pre-opening hours?	\$600
Turn on the hot water at your restaurant to warm		
Reduce Dripwater Flow	When this flow is much than needed to collect	\$95
Turn Off Dishwashers	During slow periods	\$100
Turn Off Egg Burners	When eggs are not being cooked consistently	\$50
Load Dishes Completely and only Wash Full Loads	Always	\$15
DO NOT force flow under running water	Never. All draining should be done in the sink or refrigerator	\$50
Turn off Lighting in BOH Rooms	You're the last to leave a BOH room	\$25
	Total Savings	\$4,145

THE AMOUNT WE SAVE IS THE SAME AS SELLING
120 ALUDES OF PE DO SO SUGGEST EACH WEEK

Sustainability Goals



- Shari's becomes the first full-service restaurant chain to join the Better Buildings Challenge
December 2015
 - 20% by 2025 (electric/gas)
 - 35% by 2022 (water)
- *baseline year of 2012



14 SEM Projects implemented...

- Retrofitted Gas Broilers
- Automatic Door Closers
- ECM Motors in Freezers/Coolers
- **Aerators on Faucets**
- LED Interior/Exterior Lighting & Signage
- **Heated Dipper Wells**
- Demand Control Ventilation Systems
- **Smart Irrigation Meters & Rain Sensors**
- Energy Management Systems
- Energy Efficient Equipment
- Equipment Purchasing Guide
- SOP's: Set Points, Landscape Watering, HVAC Maintenance
- Behavioral Changes
- Recycling and Right-Sizing of Waste Bins

Retrofitting Gas Broilers



Upgrading Equipment

- First project implemented
- Rebate incentives offset the costs
 - *Custom rebate through utilities*
- Changed the orifice size on gas grills from #49 (Standard) to #54
- Transitioned from 6 burners to 4 burners
- New/updated broiler incorporation
 - *Changed to a standard size and immediately saw an impact*

Indoor and Outdoor LEDs



Upgrading Equipment

LED lights are not only clearer, they reduce energy consumption by 146,000 kWh/year for a typical restaurant. Shari's installed LEDs in:

- Interior lighting
- Exterior sign lighting
- Pole Pylon sign

Custom programs leveraged 35% - 70% rebates

Gained \$23,000 in rebates

Ability to apply for custom grants

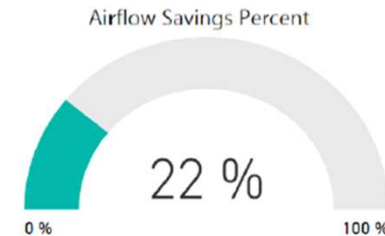
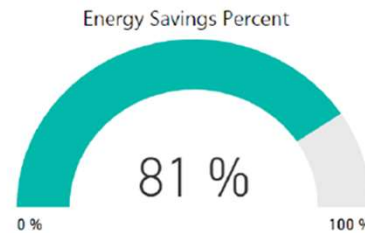
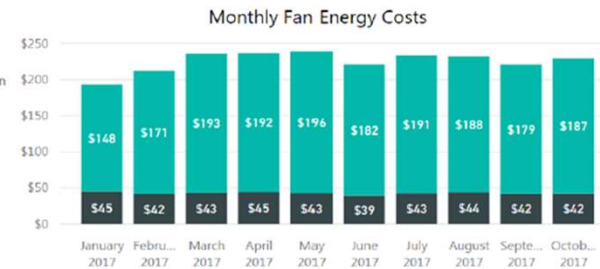
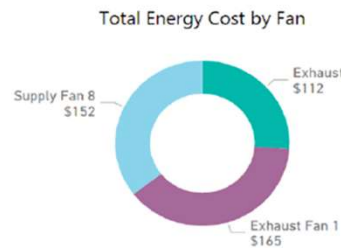
Saved over \$10,000 in electrical cost

Adopted as part of our rebrand/site refresh strategy – the “new normal”

Demand Control Ventilation Systems

Upgrading Equipment

- **45 restaurants** – retrofitted existing hoods
- **Two cook lines** – side by side *(including two exhaust hoods)*
- **DCV sensors** to slow down the systems when one hood is not being leveraged
- **7-15% reduction**



Heated Dipperwells - water, sewer and gas savings!

Upgrading Equipment



DIPPERWELLS

4-5 dipperwells per location



SAVES WATER

300 million gallons of
water between 2008-2016



Electric heat uses

6 CUPS OF WATER PER FILL

(refilled 4 – 5 times per day)



50% REDUCTION

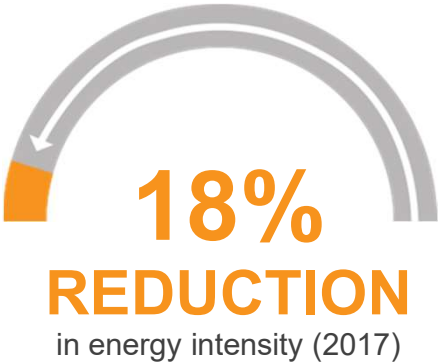
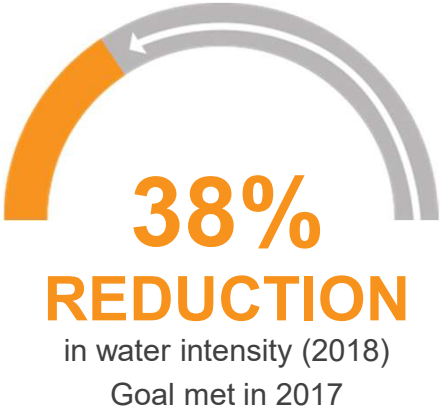
in water usage saves \$615,000 in
annual water and sewer costs

Irrigation controls, aerators, pre-rinse sprayers

Upgrading Equipment



Currently trending to meet 2025 GOAL (Using 2012 as a baseline)



Questions?

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Thank You

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