



**Georgia Institute  
of Technology**

## **Presentation**

# **Guaranteed Energy Savings Performance Project**

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# Agenda

- *Performance Contracting Overview*

  - Guaranteed Energy Savings Performance Contracting*

    - *Statute and background*
    - *Process*
    - *GEFA's role*

- *Benefits to Georgia Tech*

- *Energy Conservation Measure (ECM) Overview*

- *Financial Benefits*

- *Questions*



# Guaranteed Energy Savings Energy Performance Contracting

## Enabling Legislation

**Guaranteed Energy Saving Performance Contracting Act (GESPC Act)**

O.C.G.A. § § 50-37-1 through 50-37-8 (2012)

## Established Policy

**Georgia State Financing and Investment Commission (GSFIC)**

“Fiscal Requirements for Energy Performance Contracts”

## Established Rules, Procedures and Documents

**Georgia Environmental Finance Authority (GEFA)**

“Guaranteed Energy Savings Performance Contracting State Agency Manual”



# Guaranteed Energy Savings Energy Performance Contracting

According to O.C.G.A. § 50-37-2 (5)

## Energy Performance Contract

- A contract for evaluation, recommendation, and implementation of one or more **energy conservation measures** which include, at a minimum, the **Design And Installation Of Equipment** and, if applicable, **Operation And Maintenance** of any of the measures implemented,
- **Guaranteed annual savings** which **must meet or exceed** the **total annual contract payments**, including **financing** charges to be incurred by the governmental unit over the life of the contract.



# Guaranteed Energy Savings Energy Performance Contracting

## Goals:

- Reduce energy, water, operating costs.
- Minimize risk
- Facility improvements that benefit taxpayers, employees, etc.

## Advantages:

- Third party financing
- Budget neutral
- Long-term savings
- Guaranteed work and savings



# Guaranteed Energy Savings Energy Performance Contracting

## Disadvantages of GESPCs:

- Extra cost of the guarantee
- Overall procurement process can be lengthy
- Complexity in Management
- Organizational change and its impact on M&V and the guarantee



# Guaranteed Energy Savings Energy Performance Contracting

## **GEFA's Role in Performance Contracting**

- GEFA established as program manager by statute
- Review applications and set contract value with GSFIC
- Develop standard procedures, pre-qualified list of ESCOs, contracts, and manuals
- Provide technical assistance
- Final contract approval before agency signs contract
- Annual reporting

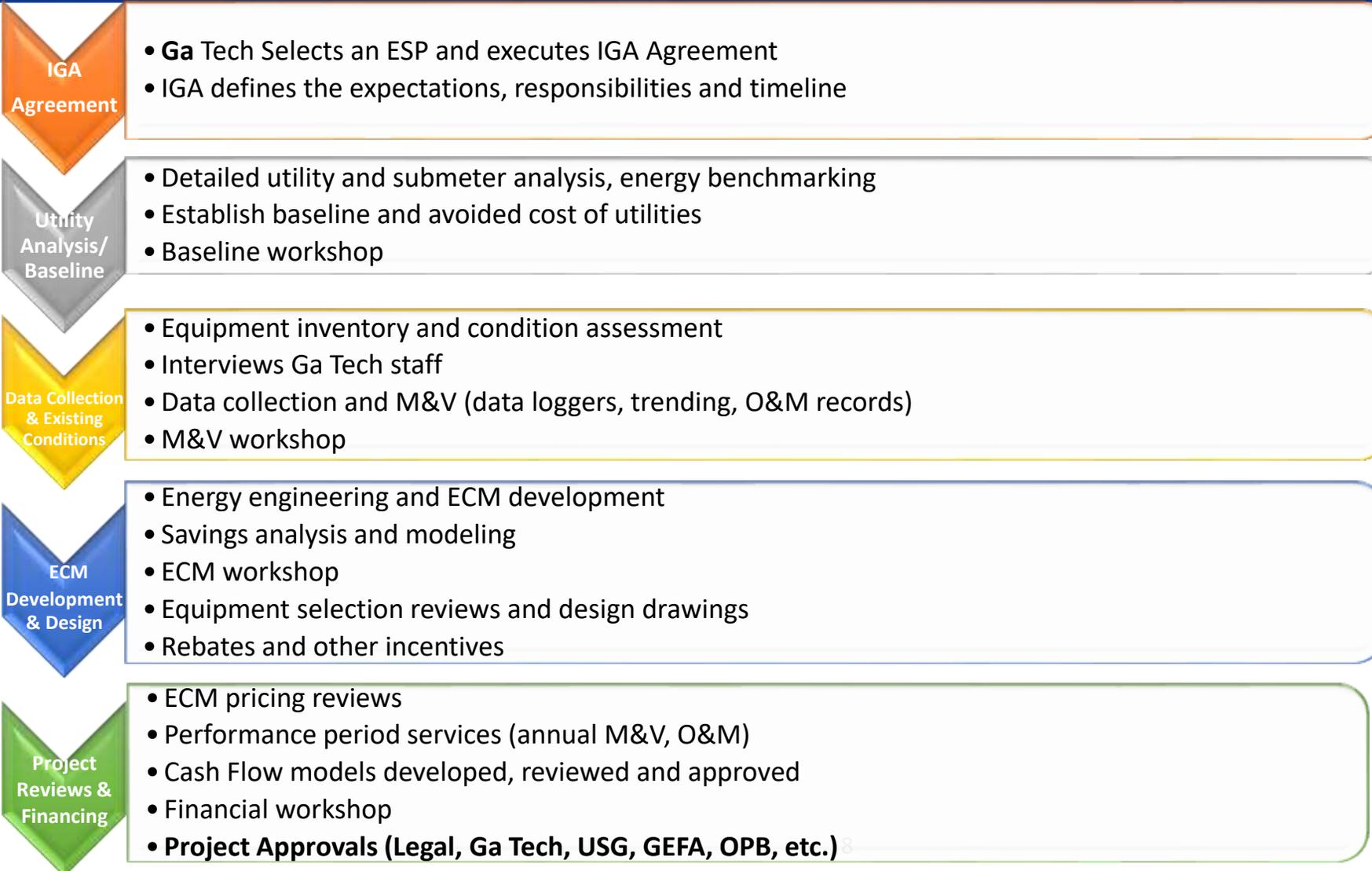


# GESPC Process Steps

- State of Georgia Budget Allocation for GESPC Projects.
- Agencies submits proposals to GEFA to consider for GESPC projects
  - GEFA selects and approves Energy Savings Projects for GESPC.
  - Agencies, Issue an “Expression of Interest” (Eoi) to the State of Georgia Pre-Approved ESCO’s (Energy Saving Companies)
  - Agency advertise proposals for IGA (Investment Grade Audit) from the submitted Expression of Interest ESCOs
  - Agency evaluates and selects the best and most appropriate IGA proposal
  - Agency Signs GESPC contract, Borrows Money from Bank
    - Construction of ECMs
    - Annual M&V and Review any required contractual changes.
      - Evaluation Report of Saving vs Cost
      - Was the Savings equal to or greater than Guaranteed Savings In GESPC
    - Repeat Annual M&V and Review any required contractual changes, until completion of GESPC contract.



# What to Expect During the IGA





# Georgia Tech's Scope Summary

Description
<b>ECM-1 Holland Chilled Water Plant Optimization to Reduce kw/ton of Cooling Produced</b>
<b>ECM-2 Holland Plant Cooling Tower Water Use Reduction, Added New Well and water treatment</b>
<b>ECM-9 Chilled Water Delta-T Corrections in 3 buildings for Chiller Plant Efficiency Improvement</b>
<b>ECM-12 Replace Water Cooled Bearings on Blower Fan Motors (2)</b>
<b>ECM-13 Compressor Cooling</b>
<b>ECM-14 to Improvements to Evaporation Sewer Credits</b>
<b>ECM-3 10th Street Chilled Water Plant Optimization to Reduce kw/ton of Cooling Produced</b>



# Benefits to be Received from the GESPC

## Financial

- *\$13,176,201 guaranteed savings over the 7 year term*
- *Year 1 savings of \$1,674,895*
- *Net positive cash flow in year 1 of \$204,003 after loan payments*
- *An additional **\$500,000** in utility one time rebate not included in the first year savings*

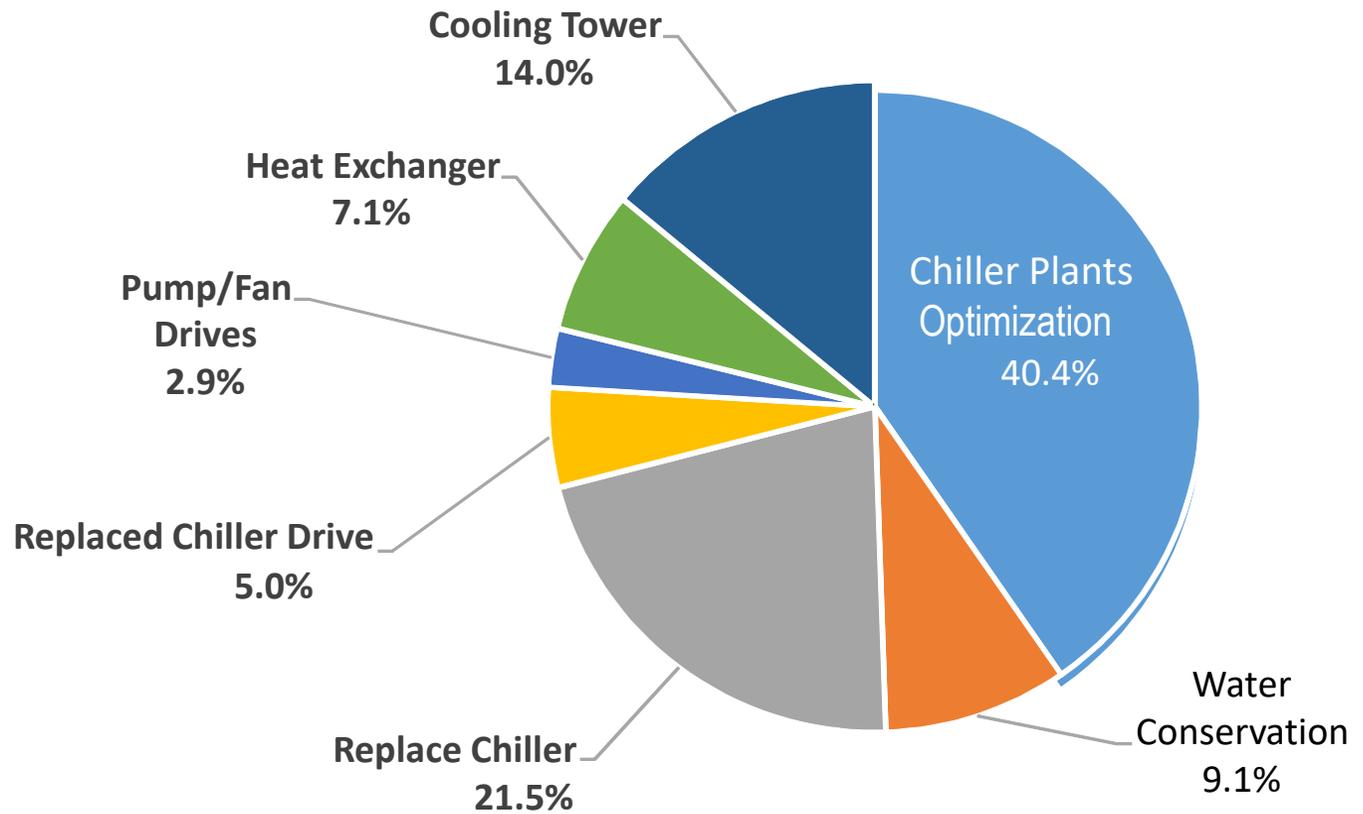
## Operational

- *New chillers at Holland Plant*
- *Installed in Holland Plant and in 10<sup>th</sup> St. Chiller Plant Advanced Optimization control system.*
- *Convert from primary/secondary to variable flow secondary pumping in Holland and 10<sup>th</sup> St. Chiller Plants*
- *Implemented Continuous Remote Monitoring and reporting.*



# Addressing the Needs of Georgia Tech

## Project Cost Breakout





# Annual M&V with Consultant Oversight

- Annual Measurement & Verification of Contract Projected savings vs. Operational Contract Savings.
- **Annual/Quarterly Calibration** of measurement devices/instruments/meters
- Schedule inspections of new/existing equipment.
- **Continuous Monitoring** of Optimization System and Chiller Plant's Operations and Efficiency with **continuous reporting by Consultant.**
- **Continuous monitoring** of Water treatment system for well water treatment by **Consultant**  
**Emailing Monthly Reports**

# Financial Summary

## Contract Projected Savings per Year

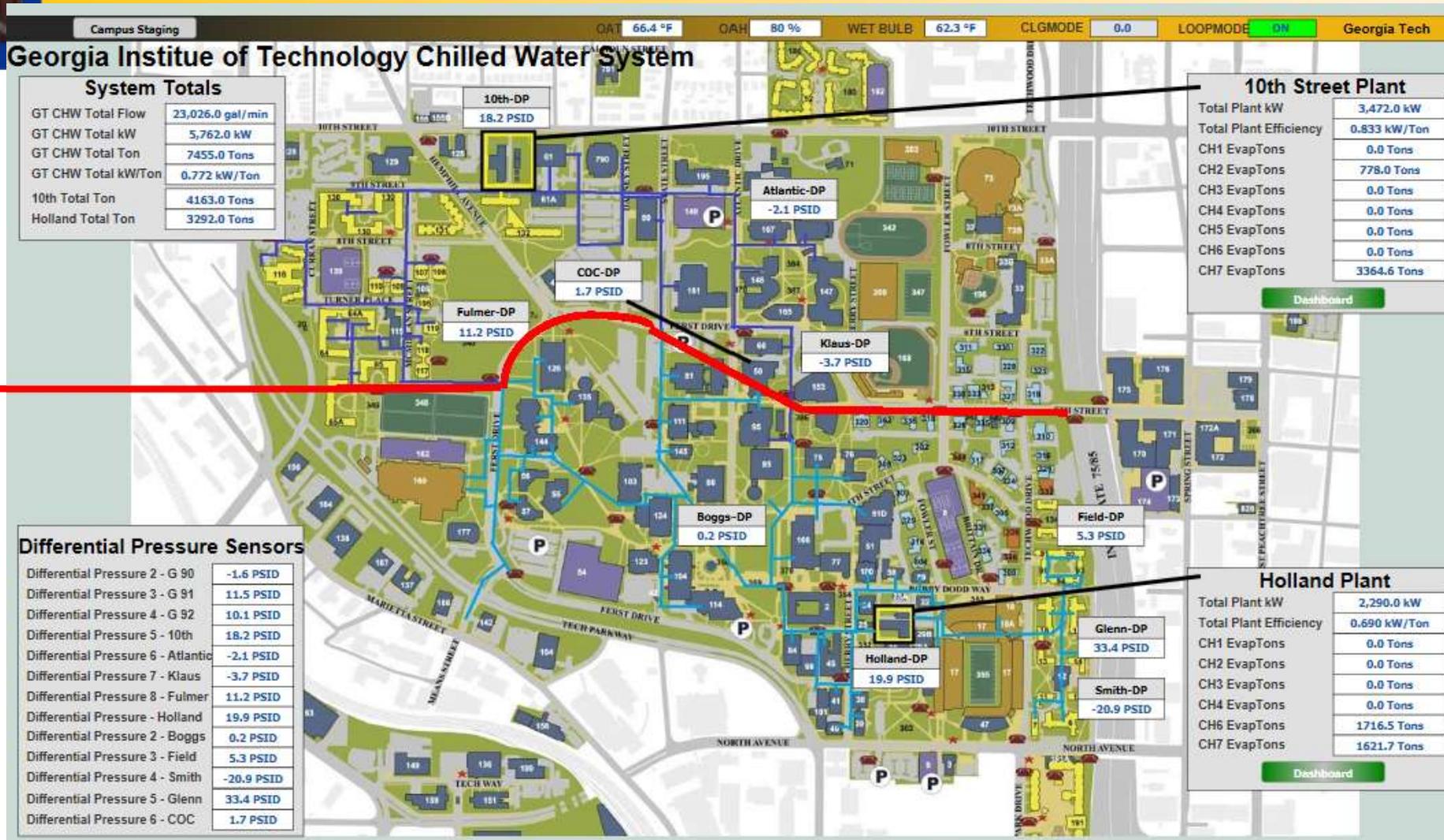
Year <sup>3</sup>	Utility Savings <sup>4</sup>	Operational Savings <sup>5</sup>	Total Projected Savings	Total Guaranteed Savings	ECM Continuing Services <sup>6</sup>	Debt Service Payments	Total Cost	Net Cash Flow <sup>7</sup>
1	\$1,857,828	(\$15,011)	\$1,842,817	\$1,674,895	\$249,812	\$1,221,080	\$1,470,892	\$204,003
2	\$1,929,402	(\$15,311)	\$1,914,091	\$1,739,700	\$257,306	\$1,221,080	\$1,478,387	\$261,314
3	\$2,003,734	(\$15,617)	\$1,988,116	\$1,807,007	\$265,026	\$1,221,080	\$1,486,106	\$320,901
4	\$2,080,929	(\$15,930)	\$2,065,000	\$1,876,913	\$272,976	\$1,221,080	\$1,494,057	\$382,856
5	\$2,161,099	(\$16,248)	\$2,144,850	\$1,949,517	\$281,166	\$1,221,080	\$1,502,246	\$447,271
6	\$2,244,357	(\$16,573)	\$2,227,783	\$2,024,925	\$289,601	\$1,221,080	\$1,510,681	\$514,244
7	\$2,330,822	(\$16,905)	\$2,313,917	\$2,103,244	\$298,289	\$1,221,080	\$1,519,369	\$583,875
<b>TOTAL</b>	<b>\$14,608,171</b>	<b>(\$111,596)</b>	<b>\$14,496,575</b>	<b>\$13,176,201</b>	<b>\$1,914,175</b>	<b>\$8,547,561</b>	<b>\$10,461,736</b>	<b>\$2,714,465</b>

## Contract M&V Savings FY June 1st to Jan 1st

	CONTRACT SAVINGS					COSTS		TOTAL	
Year <sup>3</sup>	Projected Utility Savings <sup>4</sup>	Projected Operational Savings <sup>5</sup>	Total Projected Savings	Total Guaranteed Savings	Total M&V Savings	ECM Continuing Services <sup>6</sup>	Debt Service Payments	Total Cost	Net Cash Flow <sup>7</sup>
FY-17 <sup>11</sup>	\$462,001	(\$4,503)	\$457,498	\$415,739	\$304,724	\$77,368	\$305,270	\$382,638	(\$77,914)
FY-18	\$1,509,203	\$8,370	\$1,517,574	\$1,381,163.07	\$1,152,987	\$124,906	\$610,540	\$735,446	\$417,541
<b>TOTAL</b>	<b>\$1,971,204</b>	<b>\$3,867</b>	<b>\$1,975,072</b>	<b>\$1,796,902</b>		<b>\$202,274</b>	<b>\$915,810</b>	<b>\$1,118,084</b>	<b>\$339,627</b>



# Ga Tech Chilled Water System



10<sup>th</sup> St. Chiller Plant Zone

Holland Chiller Plant Zone



# ECM 1 - Holland Plant Upgrades

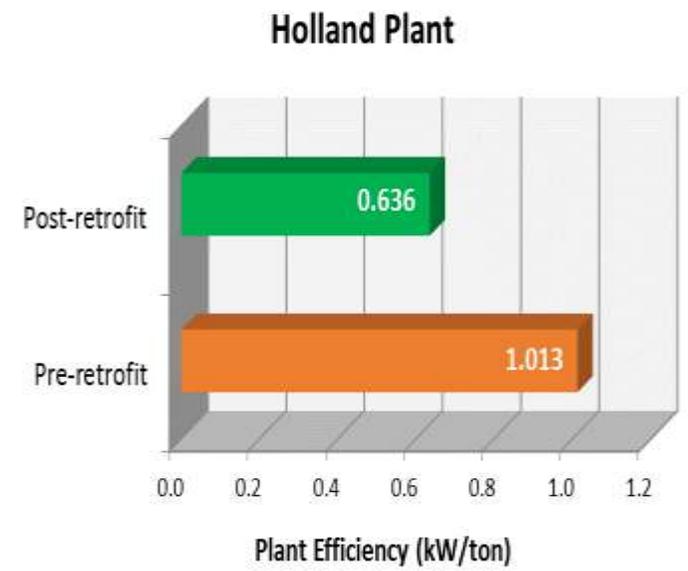


## Observations:

- *Plant Chillers. 4ea-CSD 1000T, 3 ea-CSD 2000T, = total 10,000T*
- *Constant flow primary – variable secondary CHW system design*
- *(2) 1060 ton chillers nearing end of useful life*
- *None of the chillers equipped with a VFD*
- *No water-side economizer currently in place*
- *ABB Infi Bailey 90 PLC based plant control system*

## Proposed Upgrades:

- *Remove (2) existing McQuay chillers (#5 & 6) 2ea CSD1000 Tons*
- *Install (1) new 2000 ton high efficiency chiller with a VFD*
- *Install (1) new 4160V remote mounted VFD on chiller #7*
- *Convert CHW and CW systems to variable flow*
- *Implement chiller, tower, and pumping dispatch strategies*
- *Install new water well and water treatment for cooling towers.*
- *Install Plant Optimization system over existing plant control system*
- *Another project added 1ea-VSD2000T*
- *Chillers: 2ea-CSD1000 Tons, 2ea-VSD2000 Tons, 2ea-CSD 1989Tons,1ea-VSD 1978 Tons,*
- *Total Plant Capacity 11.956 Tons*





# ECM 3 - 10<sup>th</sup> Street Plant Upgrades



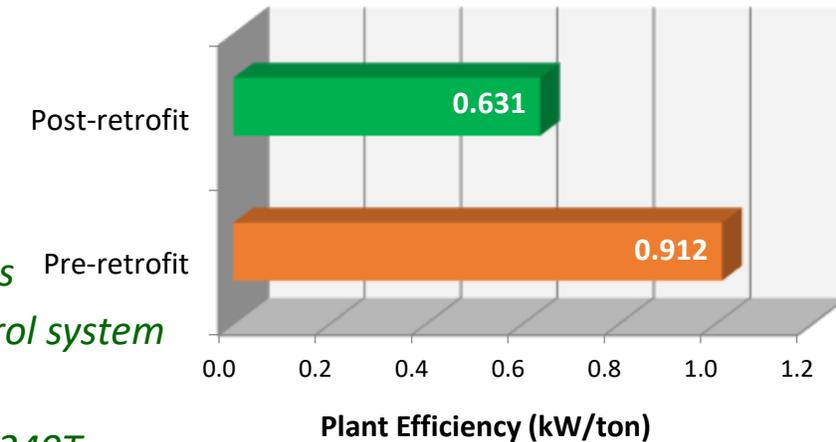
## Observations:

- Constant flow primary – variable secondary CHW system design
- Chiller #7 (3000 ton York) is equipped with a VFD
- (2) 1500 ton York chillers are approaching end of useful life
- Water-side economizer in place
- ABB Infi Bailey 90 PLC based plant control system

## Proposed Upgrades:

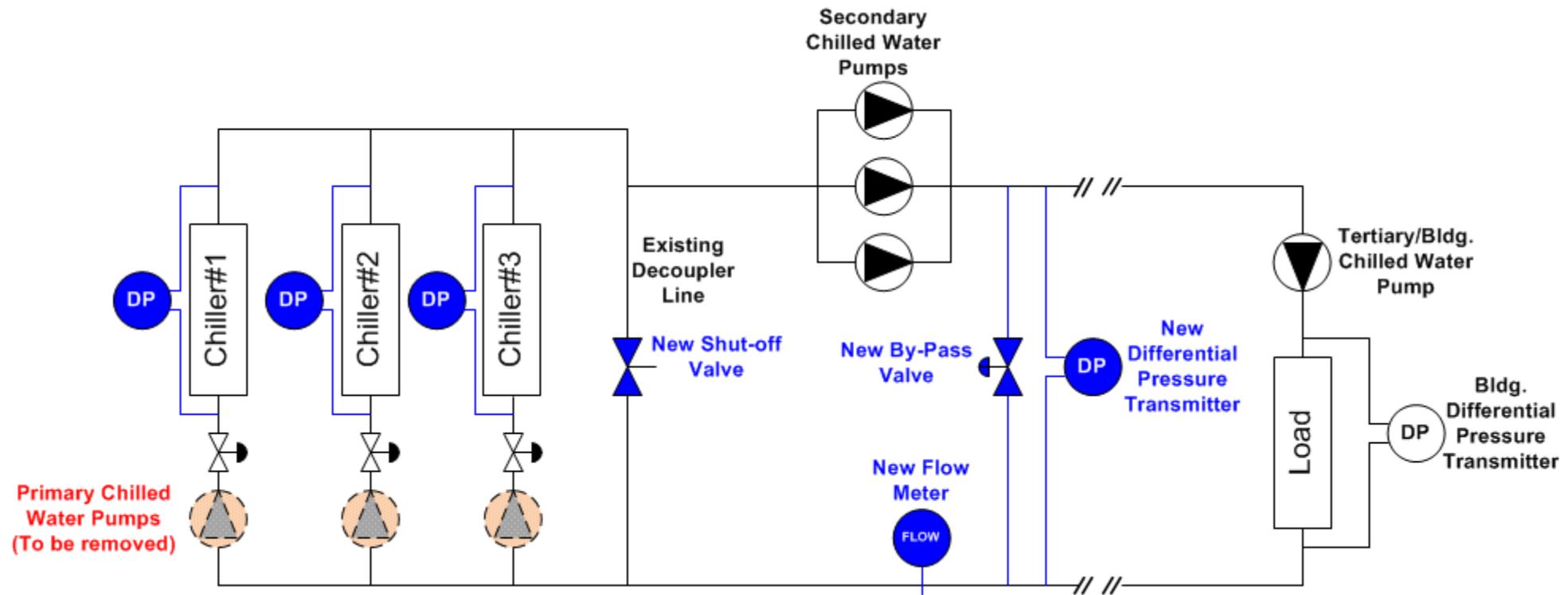
- Convert CHW and CW systems to Variable Flow
- Implement chiller, tower, and pumping dispatch strategies
- Install Plant Optimization system over existing plant control system
- Chillers
  - 2ea-CSD1500 Tons, 2ea-CSD1978 Tons, 1ea-CSD2240T, 1ea-CSD3000 Tons, 1ea-VSD3000 Tons
  - Plant Total 15,196 tons

10th Street Plant



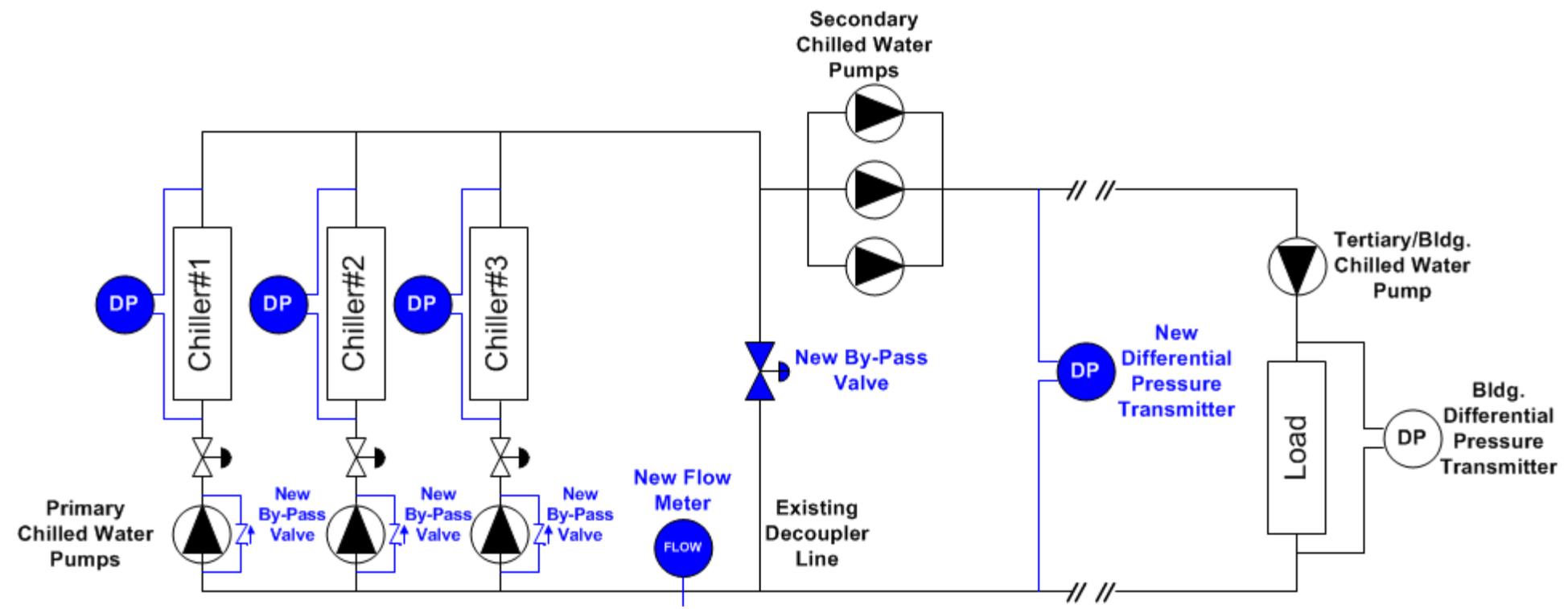


# Variable Primary CHW System



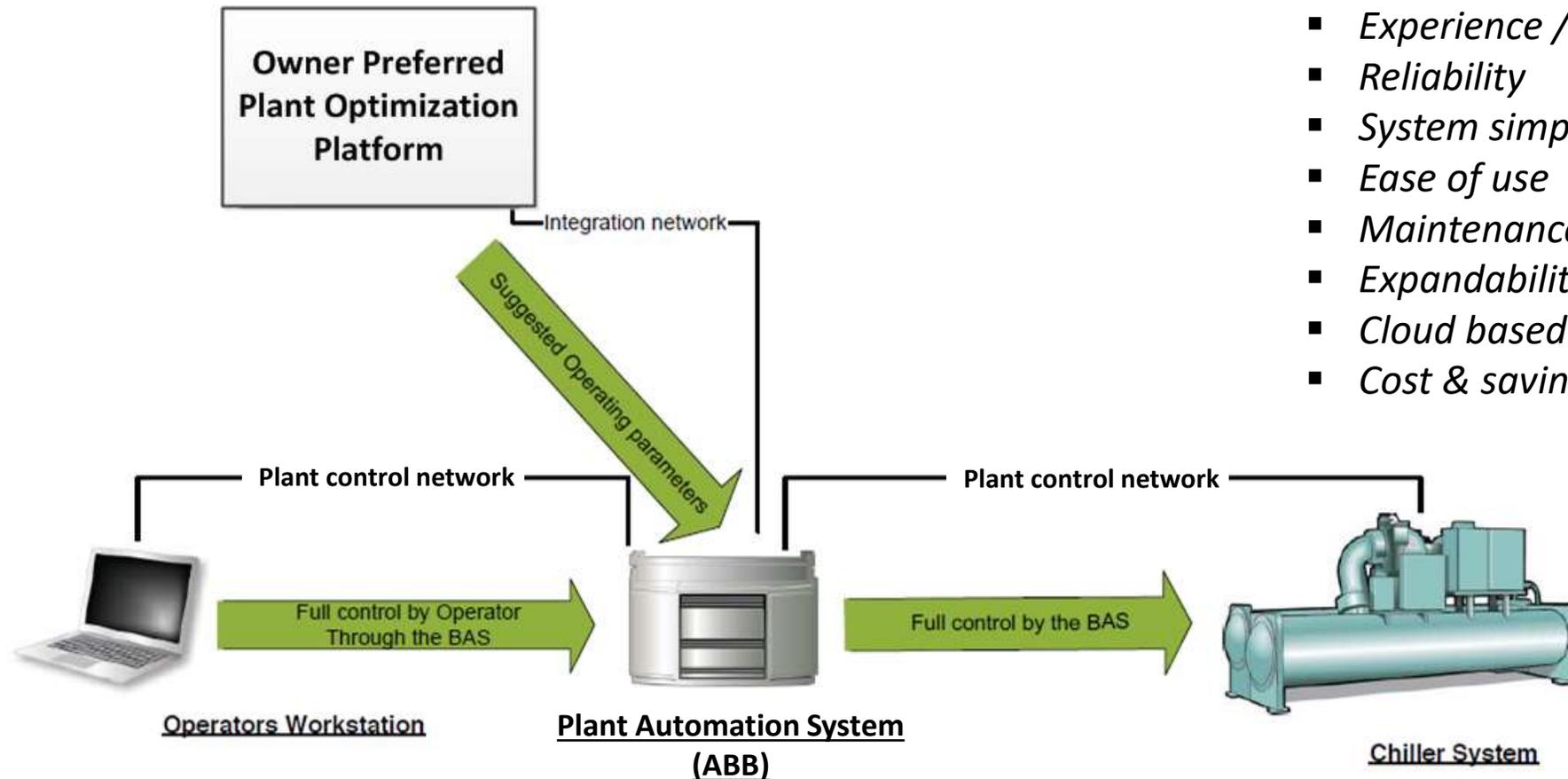


# Hybrid Variable Primary CHW System





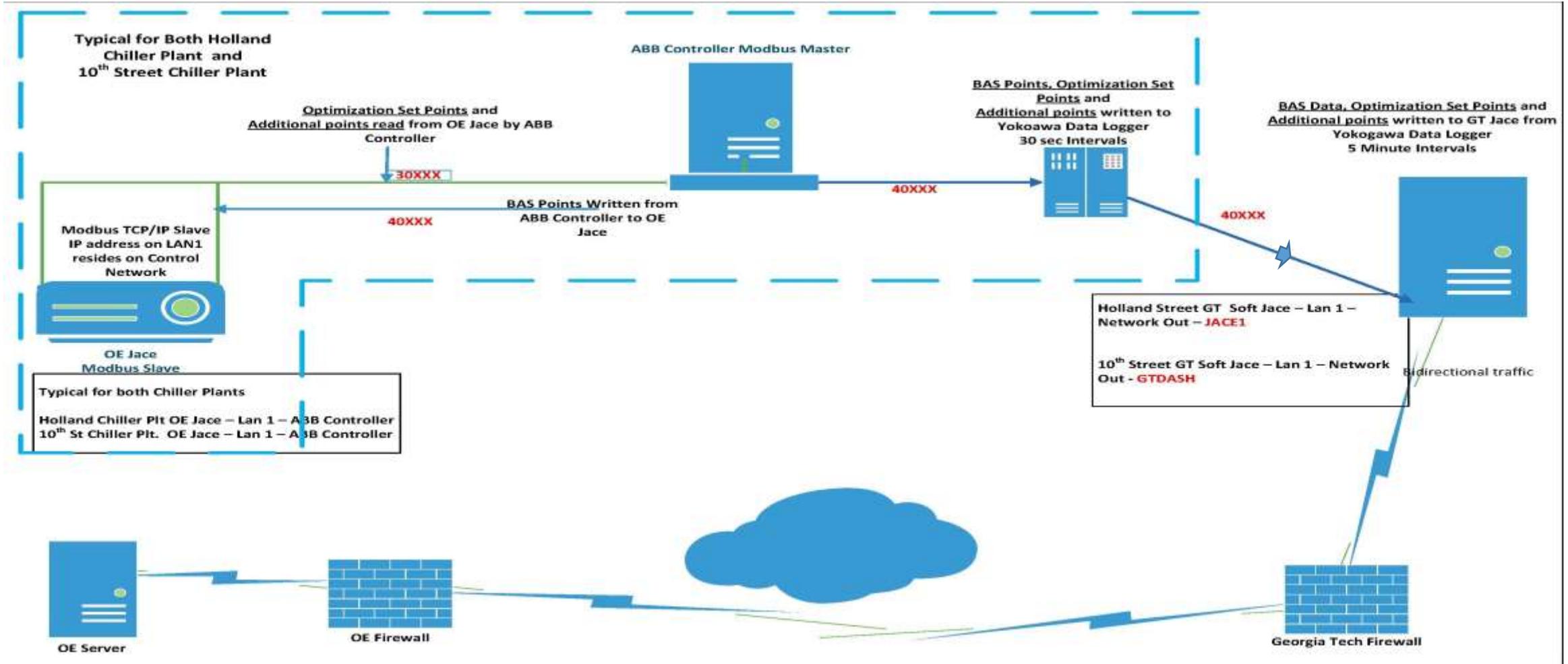
# Plant Optimization Platform Selection



- *Experience / track record*
- *Reliability*
- *System simplicity*
- *Ease of use*
- *Maintenance requirements*
- *Expandability*
- *Cloud based / onsite solution*
- *Cost & savings*



# Continuous Remote Monitoring without Direct Communications.



Typical for both Chiller Plants  
Holland Chiller Plt. OE Jace – Lan 1 – ABB Controller  
10<sup>th</sup> St Chiller Plt. OE Jace – Lan 1 – ABB Controller



# Remote Monitoring & Reporting

OptiCx Platform | Georgia Tech | User Options

Best Practices Summary Charts **Plant Overview** Optimization Compliance Equipment Points List Operation Summary

**Plant Overview: 10th Street Plant**

Time Frame: Today | by Minute | 10th Street Plant Overview

OptimumLOOP®

**10th St. Cooling Towers**

SPD	kW	44.0 °F
44.0 °F	2.2 MW	
42.7 °F	2.2 MW	

**10th St. Condenser Water Pumps**

SPD	kW	43.0 °F
43.0 °F	2.2 MW	
43.1 °F	2.2 MW	

**10th St. Chillers**

Chiller 1 (1,500 Ton Ca York)	Chiller 2 (1,500 Ton Ca York)	Chiller 3 (1,978 Ton Ca York)	Chiller 4 (1,978 Ton Ca York)	Chiller 5 (2,240 Ton Ca York)	Chiller 6 (3,000 Ton Ca York)	Chiller 7 (3,000 Ton Va York)
SS: Disabled						
AVAIL: Avail						
IGV: 8%	IGV: 25%					
Tons: 0.0 Tons	Tons: 1097.0 Tons					
kW: 0.0 kW	kW: 0.0 kW	kW: 0.0 kW	kW: 0.0 kW	kW: 2.1 kW	kW: 2.1 kW	kW: 2.1 kW
FLA: 0%	FLA: 3%					
MW/Ton: 0.000 kW/Ton	MW/Ton: 0.002 kW/Ton					

**10th St. Chilled Water Pumps**

SPD	gpm	16.0 PSD
16.0 PSD	0.0 gpm	
50.7 °F	4,315.0 gal/min	

**Secondary Chilled Water System**

SPD	MW	15.0 PSD
15.0 PSD	0.0 MW	
42.2 °F	120.0 gal/min	
42.2 °F	1.4 kW	
42.2 °F	120.0 gal/min	

**Chiller Availability**

Chiller	Status
Chiller 1	True
Chiller 2	True
Chiller 3	True
Chiller 4	True
Chiller 5	True
Chiller 6	True
Chiller 7	True

**10th St. Chilled Water Pumps**

SPD	MW	15.0 PSD
15.0 PSD	0.0 MW	
42.2 °F	120.0 gal/min	
42.2 °F	1.4 kW	
42.2 °F	120.0 gal/min	

**Secondary Chilled Water System**

SPD	MW	15.0 PSD
15.0 PSD	0.0 MW	
42.2 °F	120.0 gal/min	
42.2 °F	1.4 kW	
42.2 °F	120.0 gal/min	

**Chiller Availability**

Chiller	Status
Chiller 1	True
Chiller 2	True
Chiller 3	True
Chiller 4	True
Chiller 5	True
Chiller 6	True
Chiller 7	True

**DP Number**: 3  
**DP Set Point**: 15.0 PSD

**Plant**: CHWDP6: 15.0 PSD  
**Atlantic**: CHWDP5: 6.7 PSD  
**Klaus**: CHWDP7: 6.1 PSD  
**Palmer**: CHWDP8: 10.0 PSD

LOOP Request	OE READY	BA3 Mode
On	On	Off

OE Watchdog	OE Watchdog	Watchdog Count
134.0	134.0	0.0

CLG MODE	FREECALGHEIT	Total Flow
0.0	OFF	5,511.0 gal/min

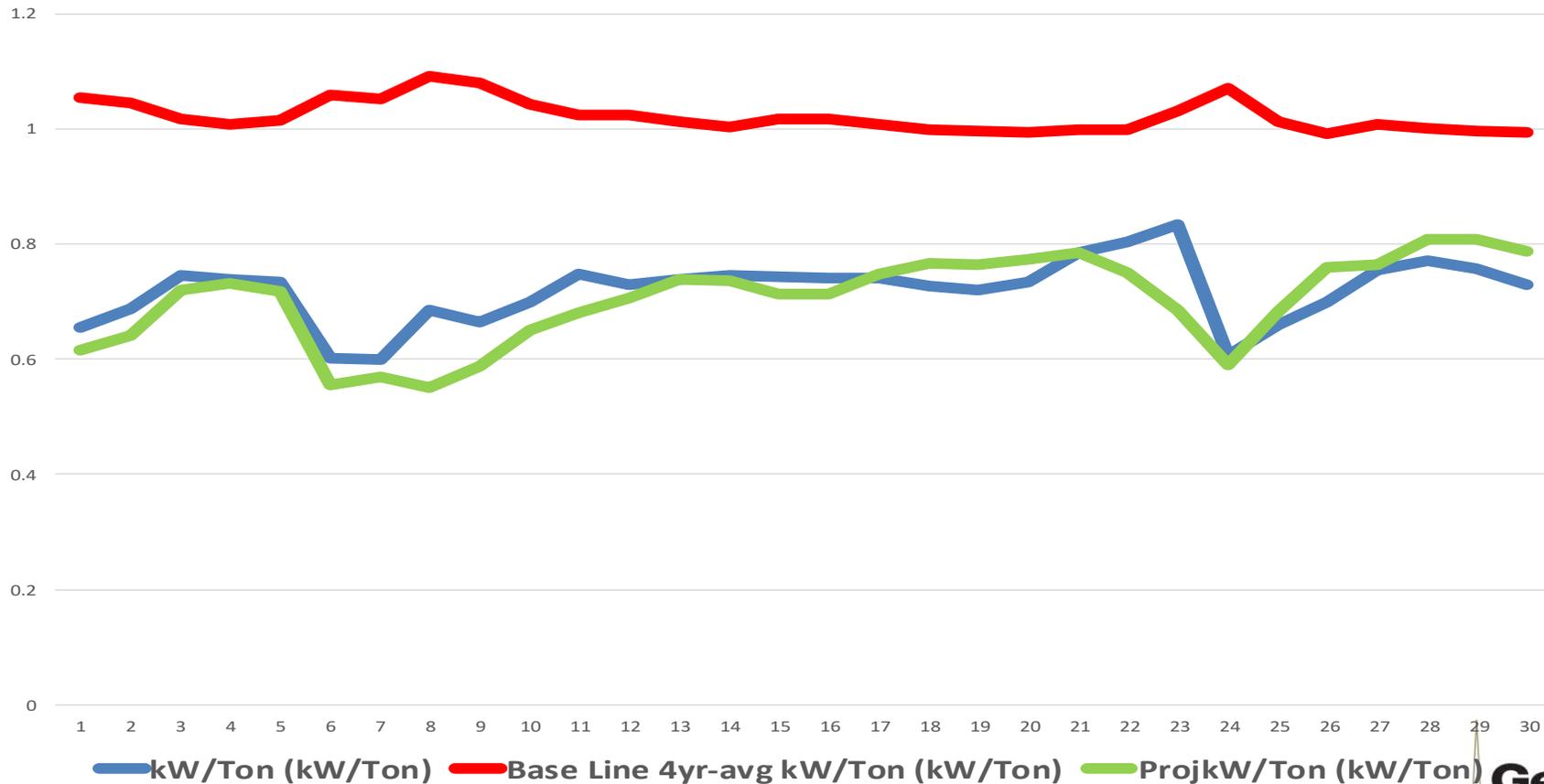
Following OE Setpoints

Plant Tons	OAT	CT kW/Ton
1504.0 Tons	38.7 °F	0.000 kW/Ton
Plant kW/Ton	OAR	CDWP kW/Ton
0.400 kW/Ton	20%	0.041 kW/Ton
Plant kW	OATWS	CHWP kW/Ton
777.0 kW	29.4 °F	0.517 kW/Ton



# Online Monitoring & Reporting

GIT GESPC Operating Efficiency  
Month of April 2017





# ECM 9 - Delta-T Improvements

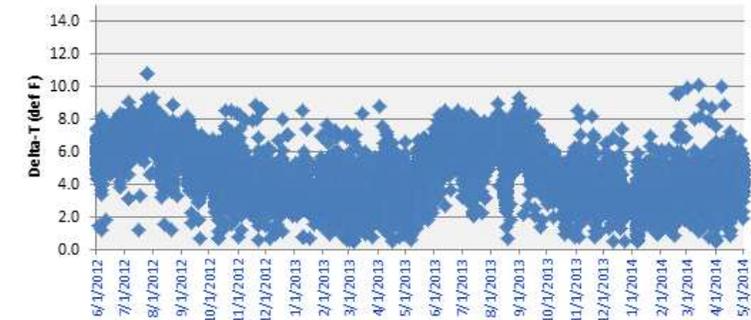
## Observations:

- Low Delta-T prevents full loading of operating chillers and causes premature staging of chillers
- Low Delta-T could be caused by a combination of:
  - Chilled water flow through the chiller plant de-coupler line
  - Insufficient heat transfer through AHU chilled water coils
  - 3-way chilled water valves / wild coils with no valves
  - High building chilled water differential pressure lifting valves
  - Other controls issues (setpoints, sensor calibration etc.)

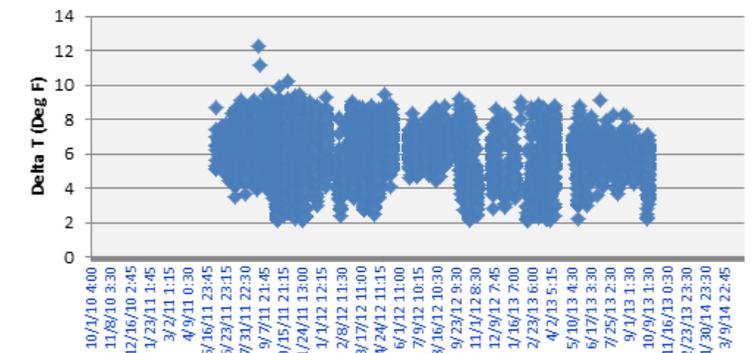
## Proposed Upgrades:

- Investigate and address underlying issues on the chilled water load side that are responsible for Low Delta-T syndrome for the comprehensive optimization of the campus chilled water system

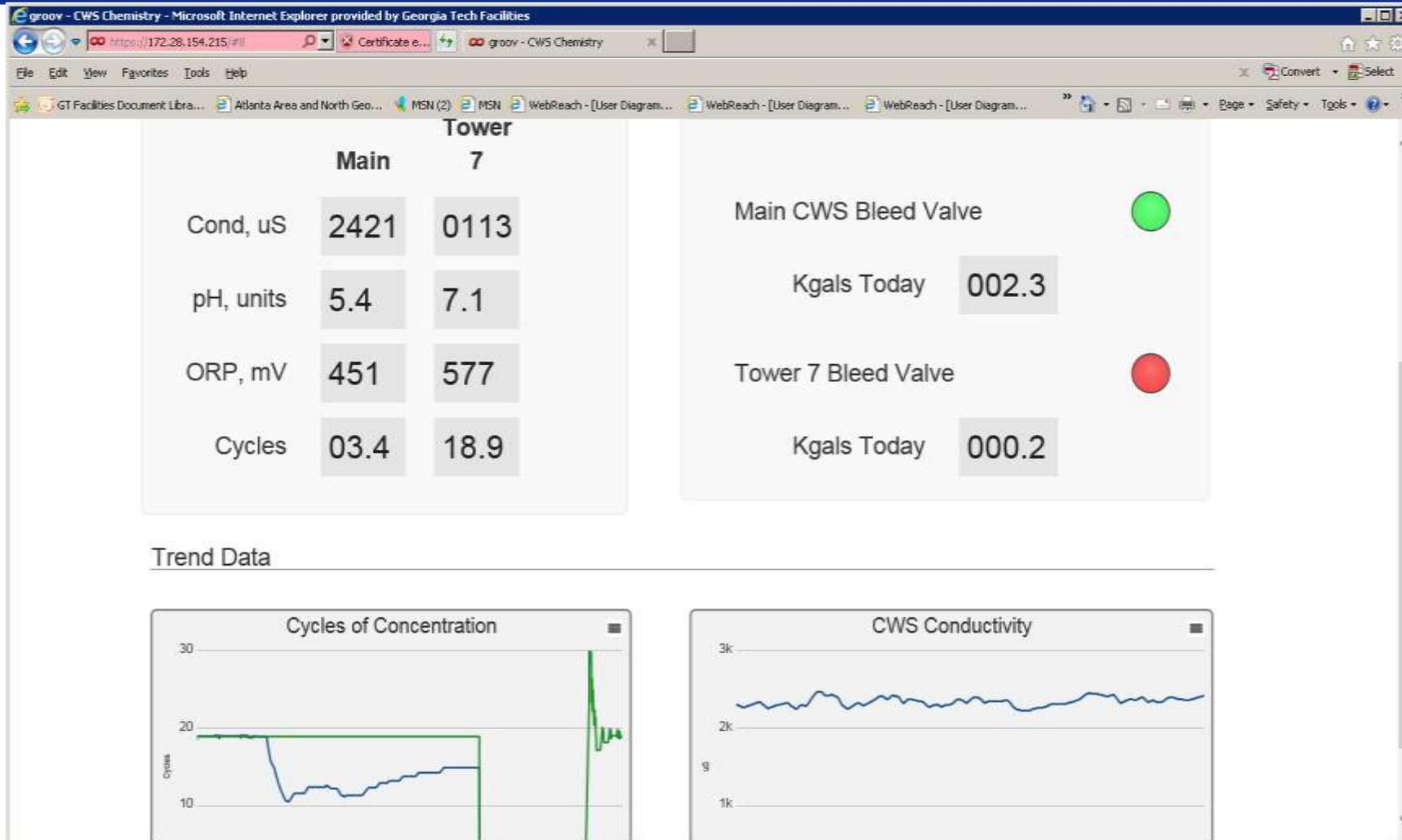
Holland Plant East Loop Delta-T



10th Street Plant - Chiller#1 Evaporator Delta-T



# Online Monitoring & Reporting





# Annual M&V with Consultant Oversight

## With Change comes Challenge, Lessons Learned

- Adjustments required to the Baseline due to lack of well water and chiller addition
- Running the plant in hand got more difficult
- Keeping the plant in OE mode
- Finding latent issues when running the chillers more dynamically
- Use of waterside economizer at 10<sup>th</sup> St

## Conclusion's:

- GESPC
  - Provided means & methods to finance a large project over mutable years.
  - Provided validated savings of energy and money.
  - *\$13,176,201 guaranteed savings over the 7 year term*
  - *Net positive cash flow in year 1 of \$ 204,003 after loan payments*

