Improving Situational Awareness for Utilities Operators and Energy Managers

Presented by:
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Barcelona, Spain

UNIVERSITY OF MARYLAND

University of Maryland, College Park (UMD)

About the Campus

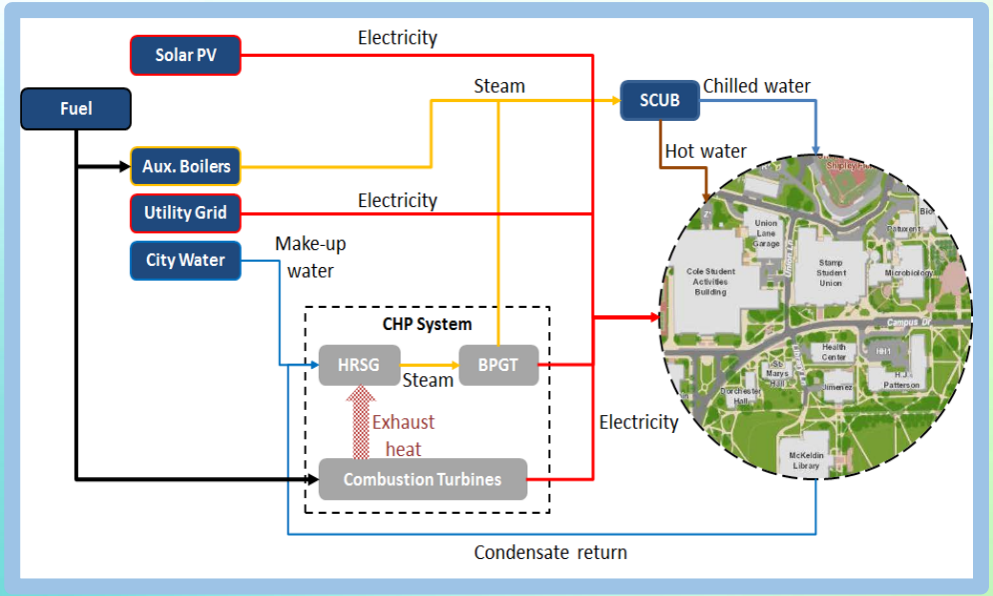
- Original Campus: 420 Acres
- Main Campus Today: 1340 Acres
- Off Campus: 3870 Acres
- Buildings on Main Campus: 254
- 10 M GSF in 1999
- 14 M GSF in 2018
- Projected 19 M SF by 2025

Campus Energy Production

- Combined Steam and Power Plant
  - 27 MW of electricity
  - 280,000 lbs. of 125 psi steam per hour
- 32,000 tons of Chilled Water generation at 15 plants
- 2.5 MW solar array

District Energy System

- District Energy System: College Park Energy (CPE)
- Underground network
  - 10 electrical feeders
  - 15 miles of underground steam and chilled water piping



THE OLD POST

Member of the Associated Press

ILLUSTRATED WEEKLY NEWSPAPER

Est. 1865 | Wednesday April 8, 2015 | Price Free

Power Failure Closes UMD!

Just before noon on April 7, 2015, a electrical station failure 40-miles South of the University of Maryland affected much of the region and knocked the onsite Co-Generation Plant and Substation offline.

This resulted in the University closing early while personnel worked thru the evening to restore power. A post event analysis indicated remote monitoring would have greatly aided the restoration effort.

Background: Evolution of the Situational Awareness Project

National Institute of Standards and Technology
U.S. Department of Commerce

Information Technology Laboratory

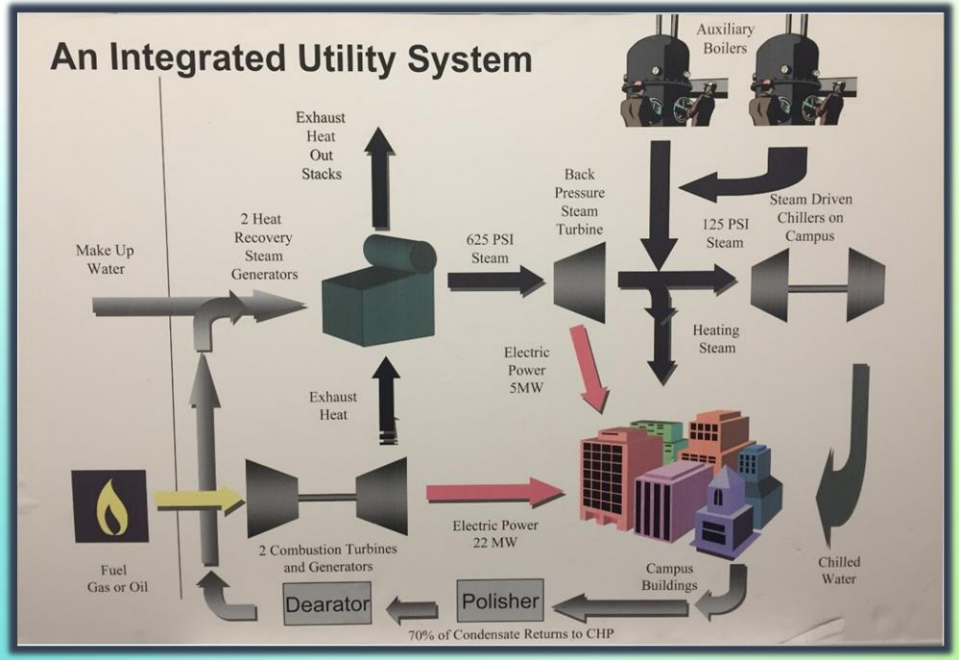
MARYLAND OF OPPORTUNITY.®
Department of Business & Economic Development

Objective: Demonstrate Advanced Technologies to Secure Critical Infrastructure in the Energy Sector – Utilizing the University's CHP as a Test Bed

Result: Exposure to OSIsoft PI, followed by live data demonstration, leads to initial task order to PPC to build out PI Platform as Single Pane of Glass for Energy Data

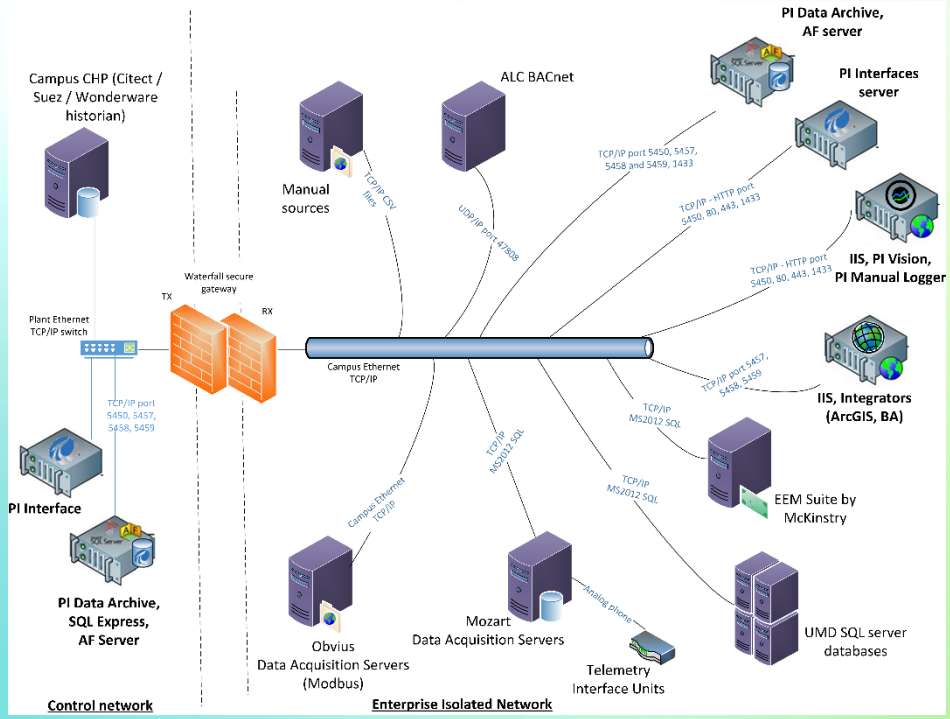
Challenge: Remote Utility Monitoring

- Integrated system completed in 2002
- System hardware and software platforms remained static increasing vulnerability to outside threats
  - To protect systems, outside links to the industrial networks and hardware were severed
- Centralized Plant Data was unavailable

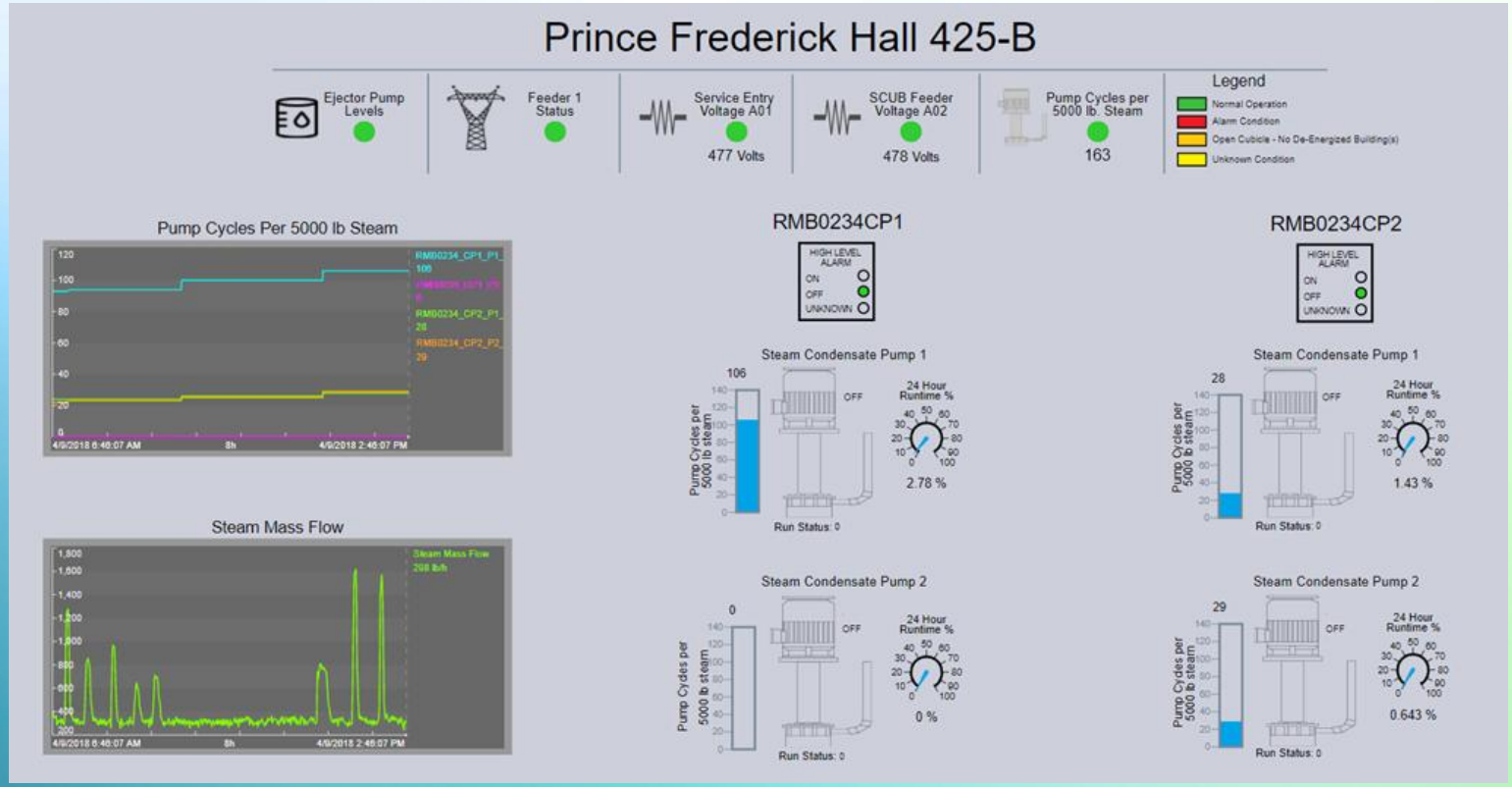


Solution: Secure, Centralized Data

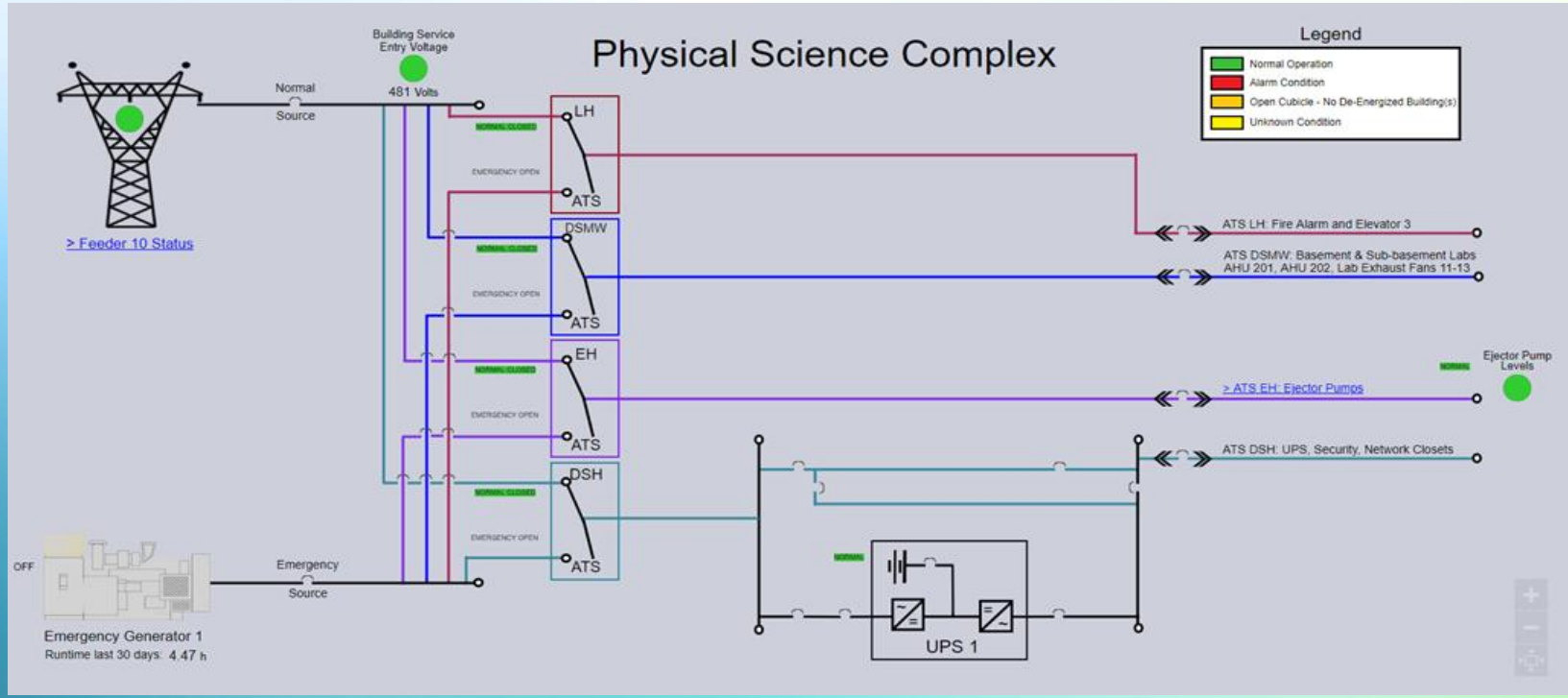
- Waterfall Secure Gateway
- 5 different interfaces
- PI Manual Logger
- Daily tag reports
- Restoration of Remote Access to Operational and Historical Data Feeds



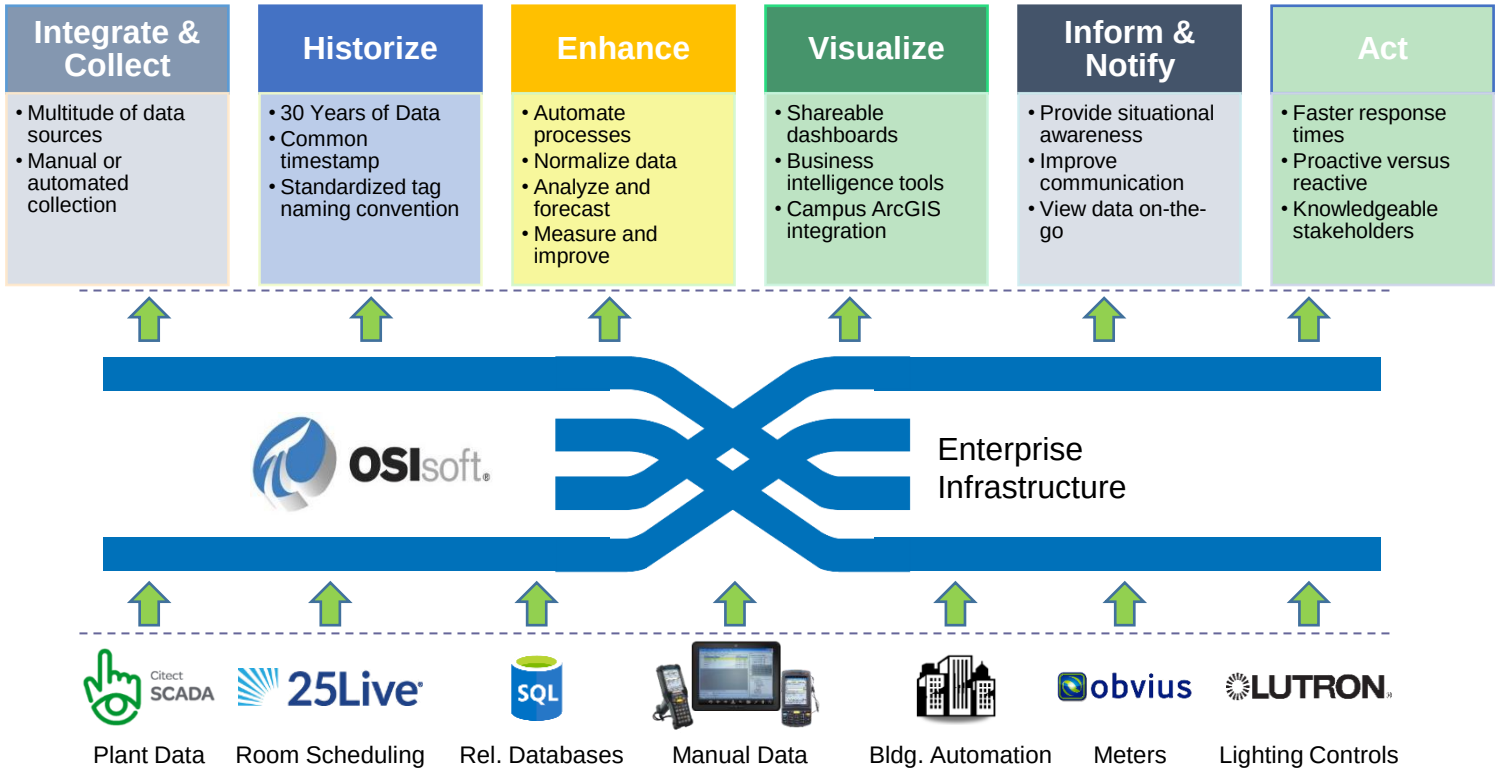
Result 1: Cost Avoidance through Unified Insight



Result 2: “Single Pane of Glass” Views

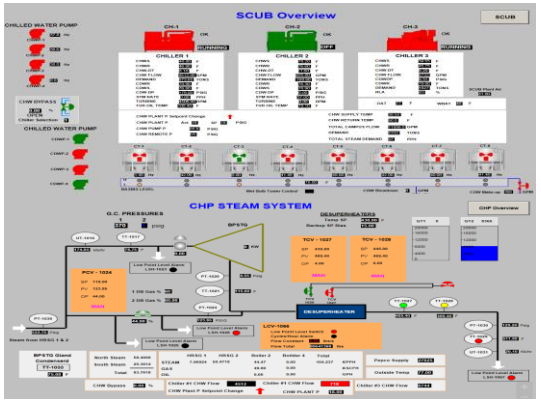


Real-Time Infrastructure Connects the Campus



Bringing Campuses to the Next Generation Sustainable Environment

Notify & Visualize



CHALLENGE

- No visibility into CHP performance of data
- Limited reporting and ability to manage performance
- Limited or no insight into CHP assets and performance
- Service Provider reports lacked ability to provide tactical awareness

SOLUTION

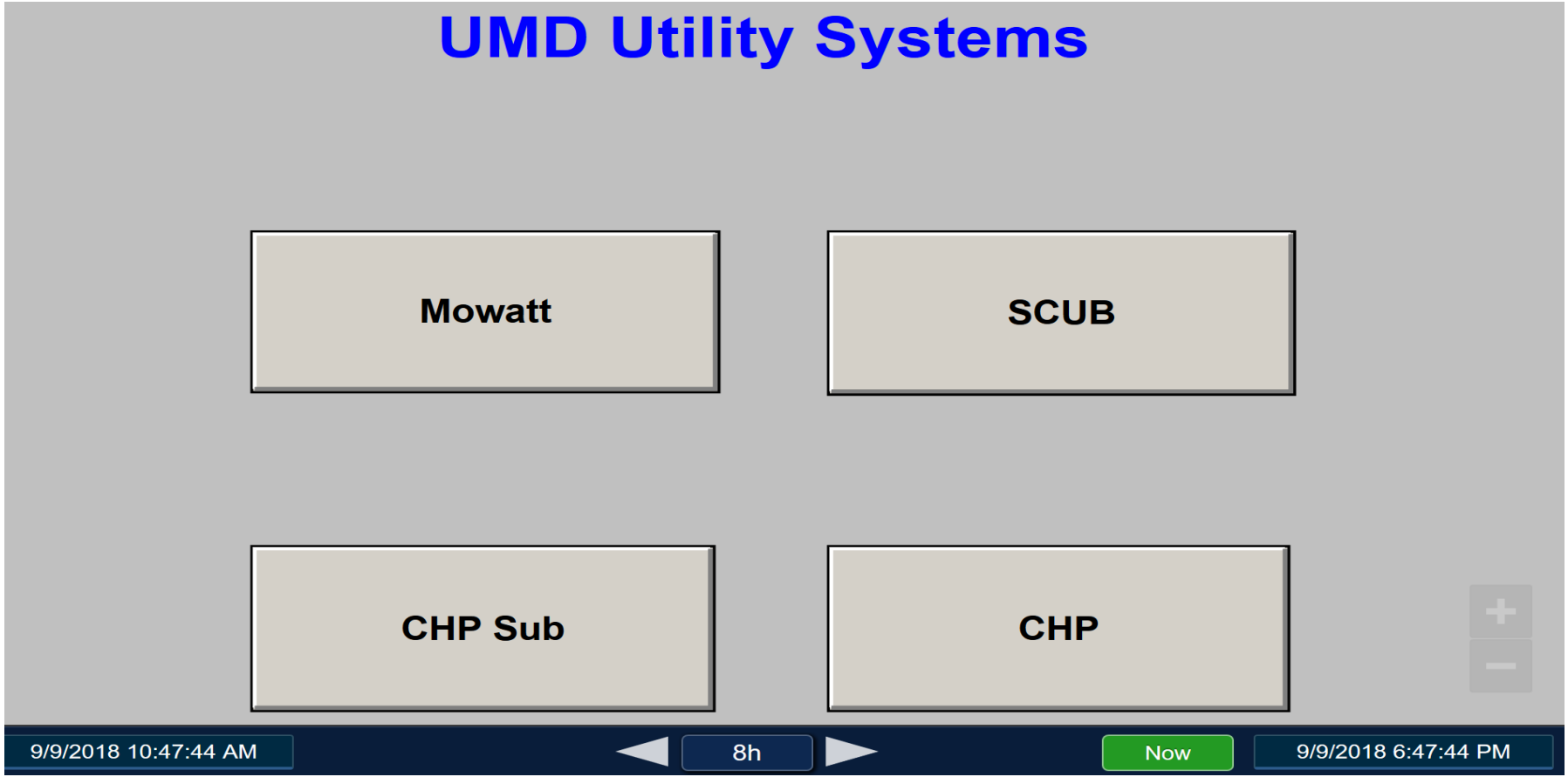
- Centralized monitoring of CHP service levels and performance of CHP and other assets
- Customer Response Center able to isolate locations, model impacts and events and improve response, minimizing impacts

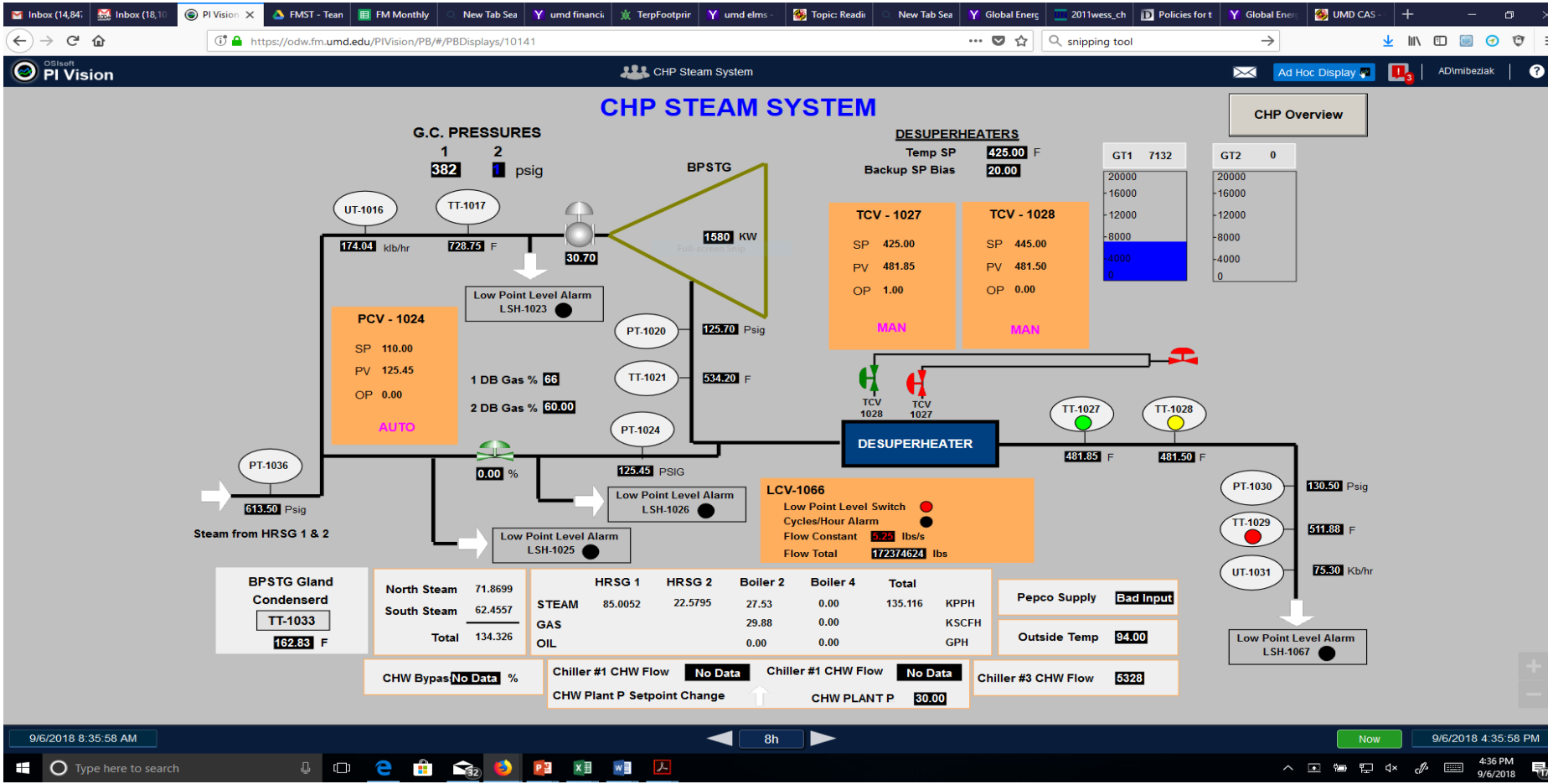
RESULTS

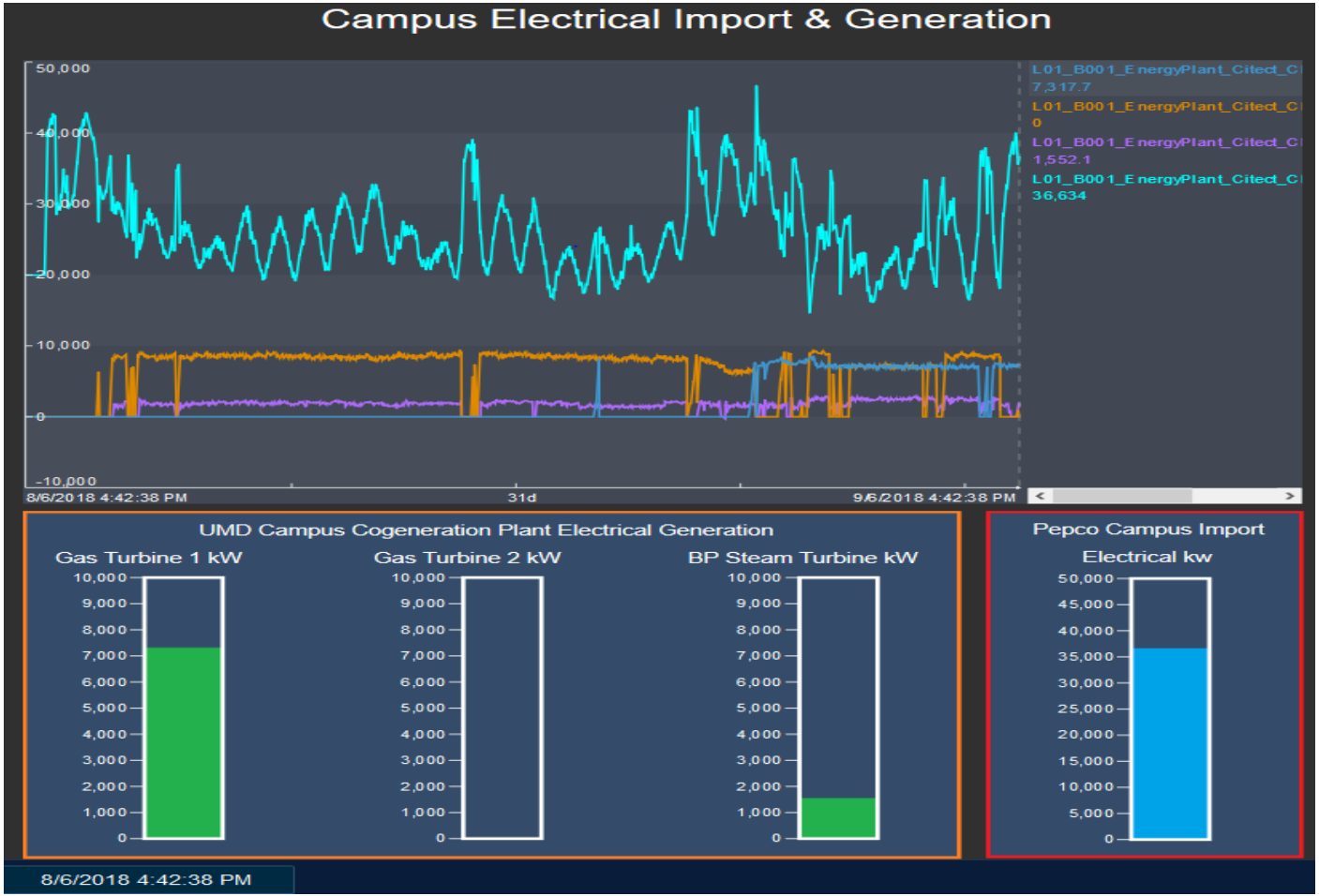
- PI Vision allows users easy way to share displays
- Encourages collaboration across the enterprise
- Gives users secure access

PI Vision Improves Root Cause Analysis

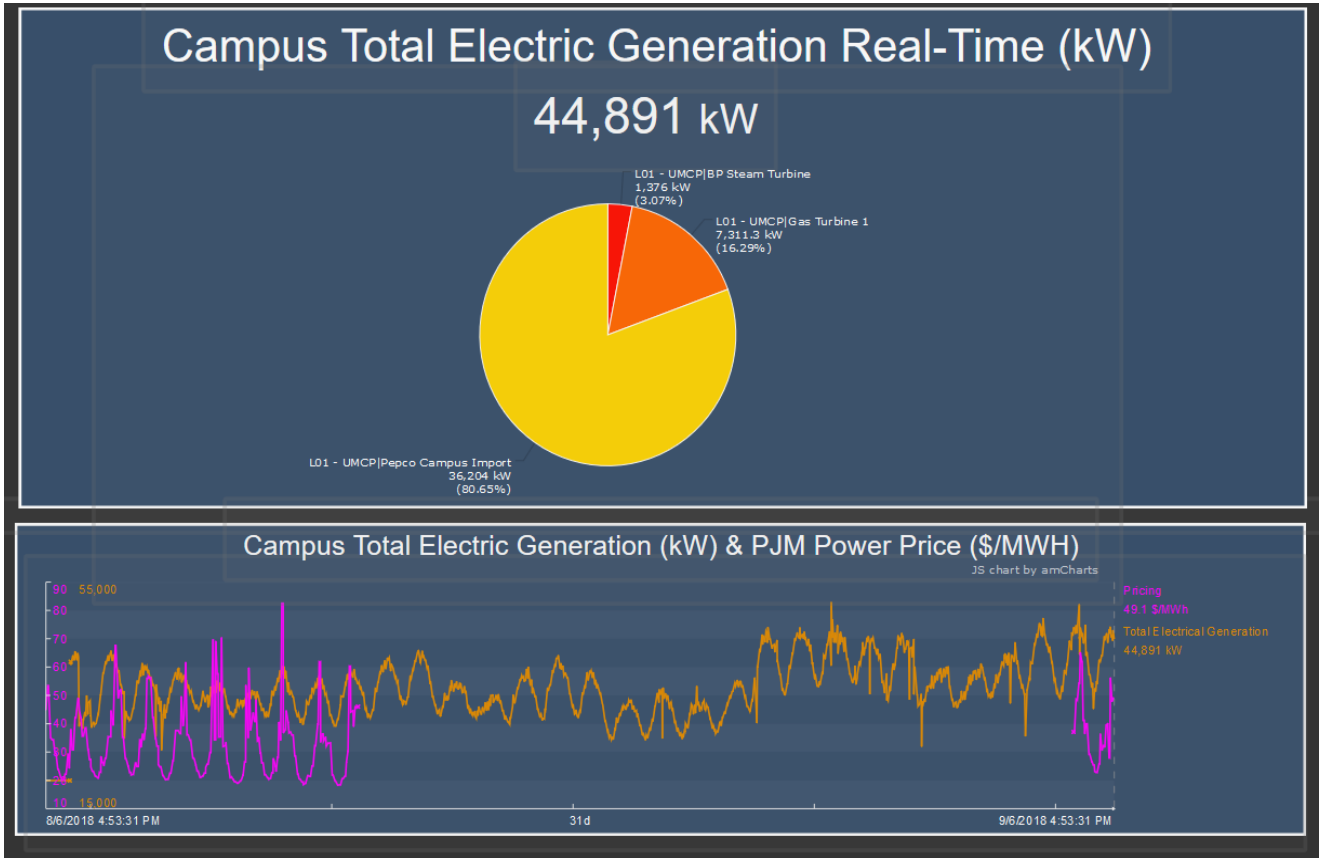
UMD Utility Systems







Multiple Assets Accessed From One System



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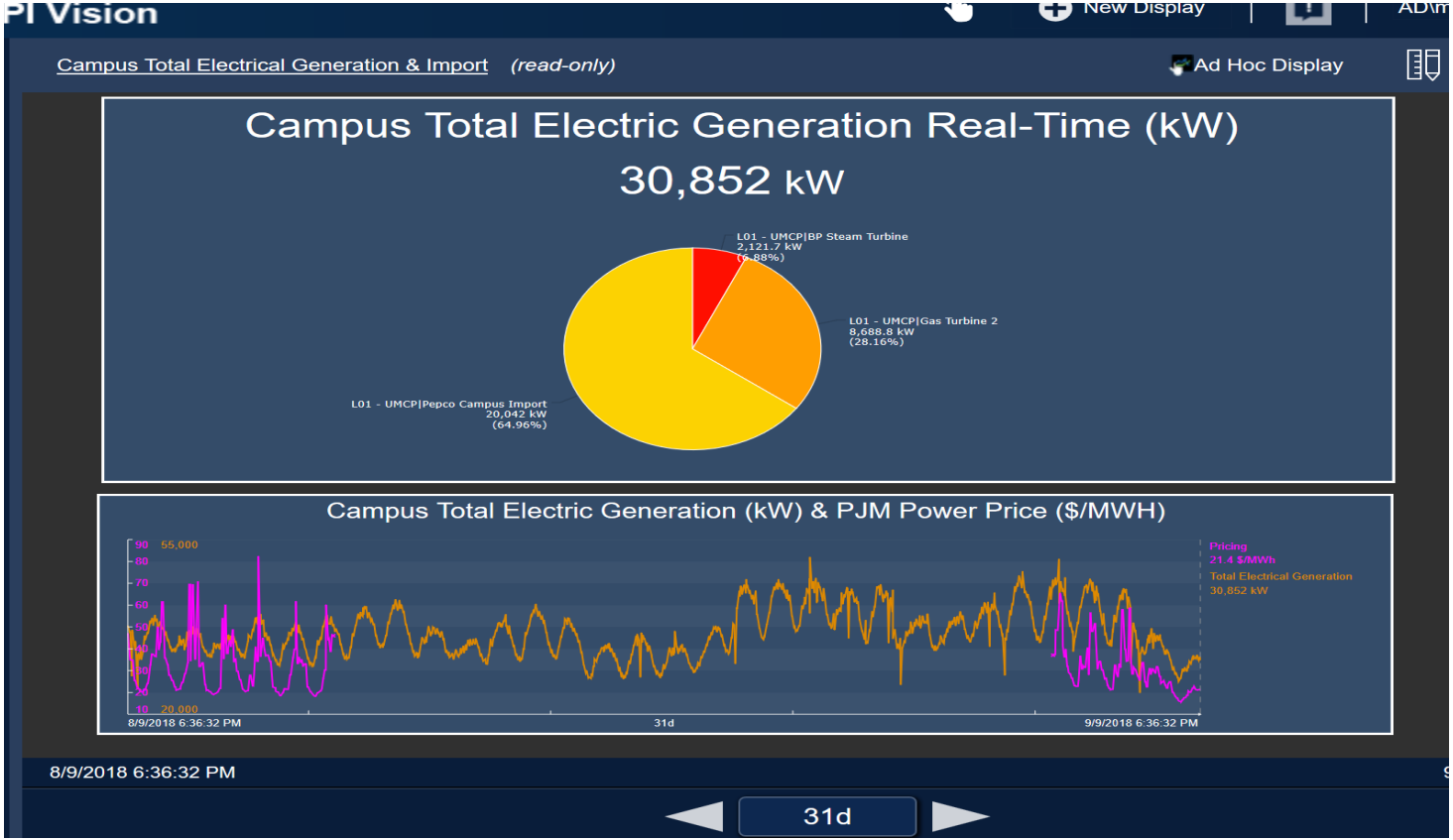
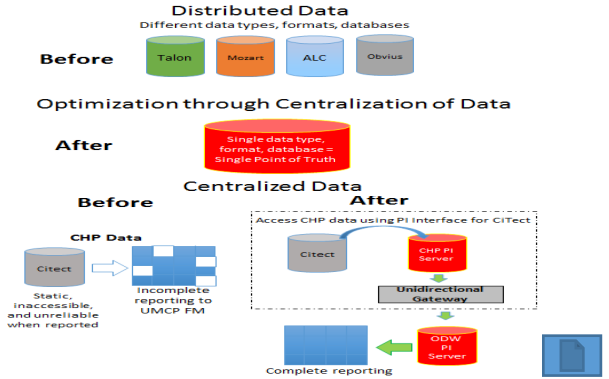


Collect & Historize



CHALLENGE

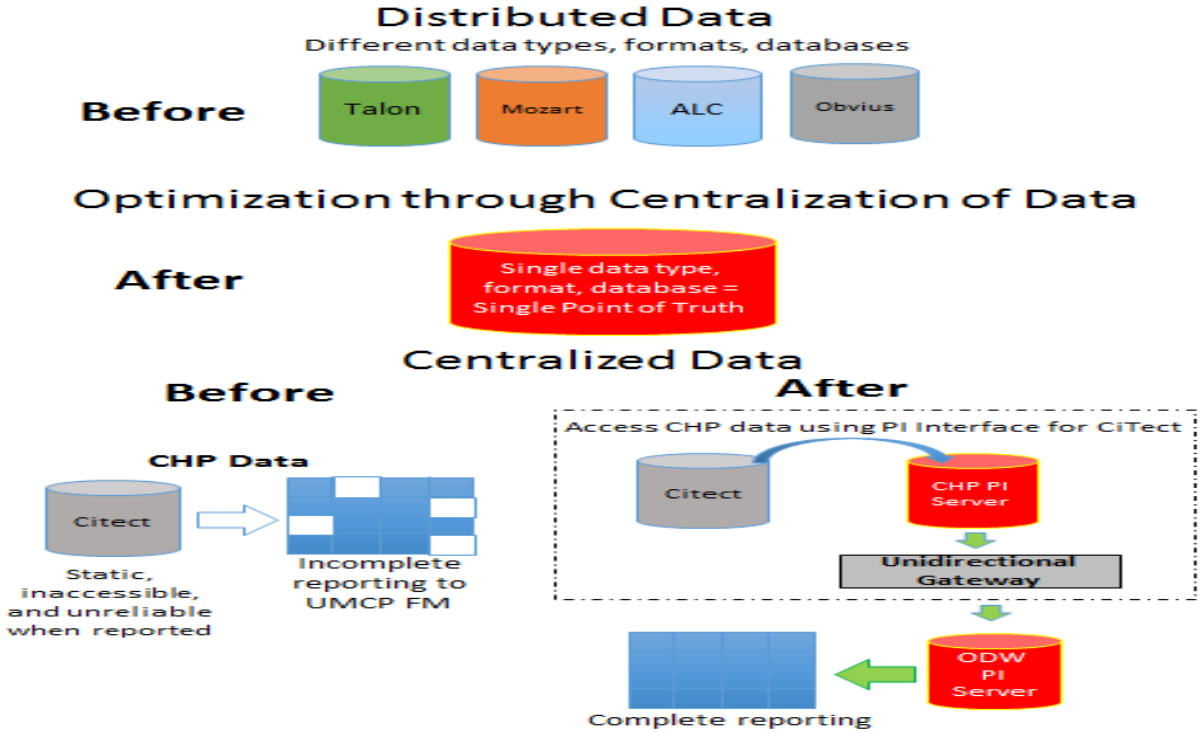
- Limited or no insight into CHP assets and performance
- Limited reports and tactical awareness

SOLUTION

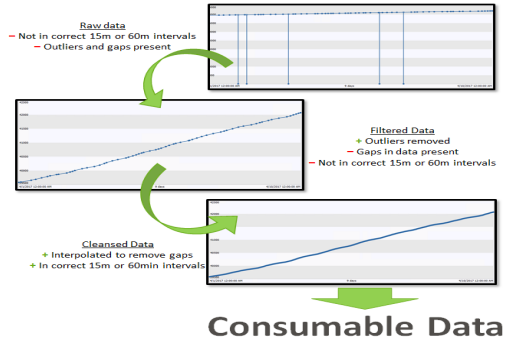
- Proper format and time stamp of data (Mozart, ALC, Obvius, Citect, Manual) into EEM Suite
- Highly customized scripts to capture, calculate, backfill, and publish to EEM.

RESULTS

- Centralization improves data integrity, standardization, and support. Legacy Systems can be retired.
- Real-time access provides performance management data for service provider service level measurement.



Find & Analyze Data



CHALLENGE

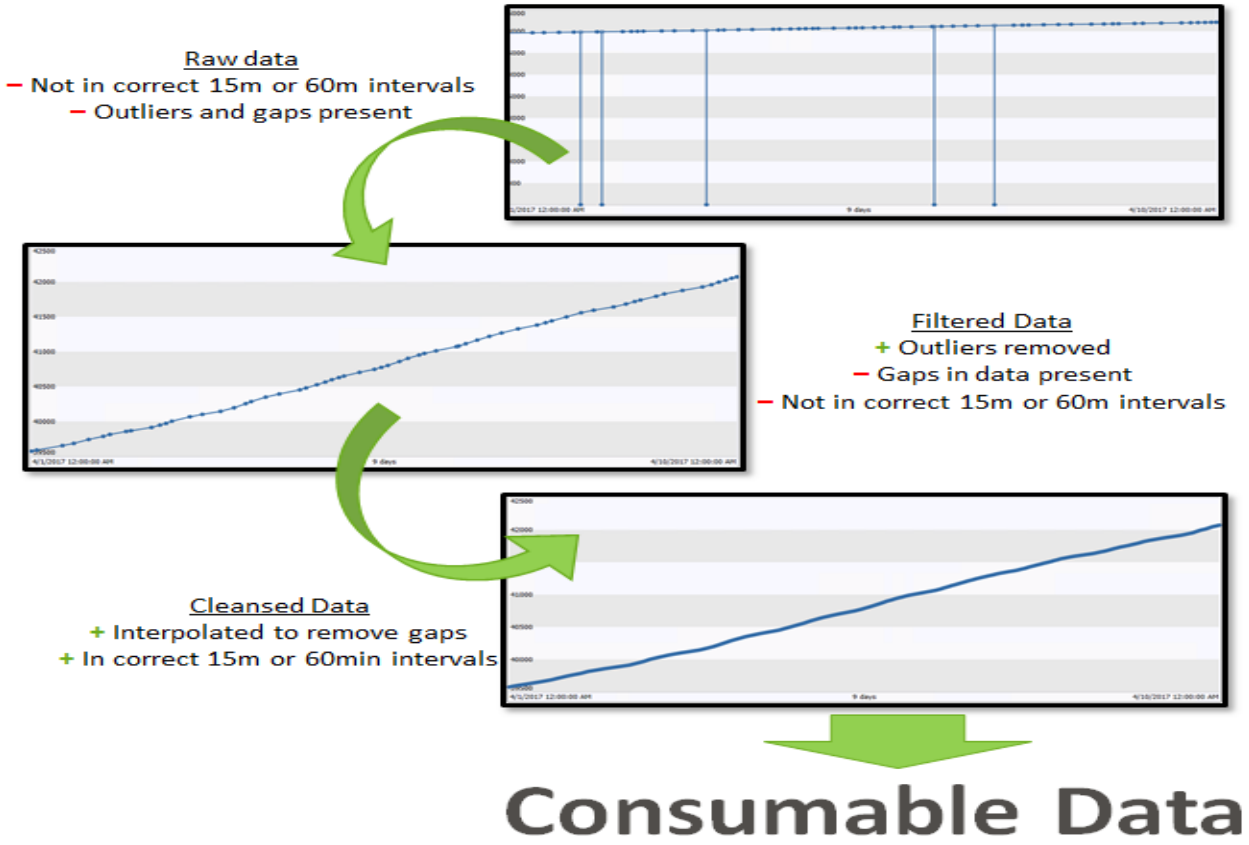
- Inconsistent operational data

SOLUTION

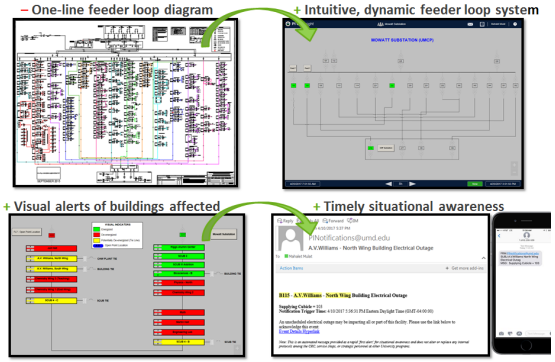
- Collected Data will need to be normalized, verified and packaged for UMCP's EEM

RESULTS

- Eliminates need for custom form to generate interval data
- Analyze and create reports with data in one archive (single point of access) that uses a common timestamp format.
- More consistent interval data allows for insight into usage and impact of external influencers .
- ODW can be made accessible to a variety of stakeholders, with varying degrees of permissions.



Notify & Visualize



CHALLENGE

- No timely awareness of outages; no method of notifying stakeholders
- Delayed maintenance actions.
- Manual data collection into Excel.

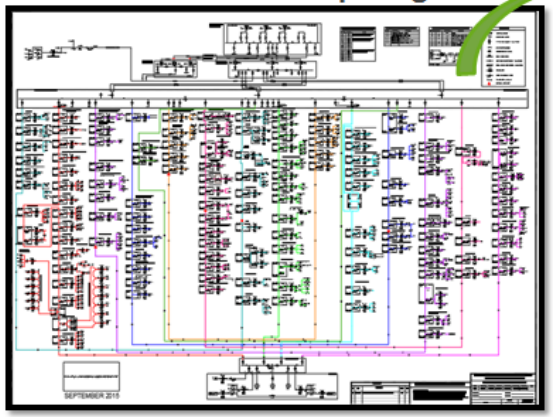
SOLUTION

- Created ProcessBook screen(s) to show feeder loop system
- Built intuitive models with status indicators
- Created way for operators to report ‘Open’ point locations
- Developed processes for use of PI Manual logger and Data Entry Sheet
- Generated alerts and notifications for electrical events
- Forced notifications to be sent based on triggering event
- Built event frames to capture historical performance

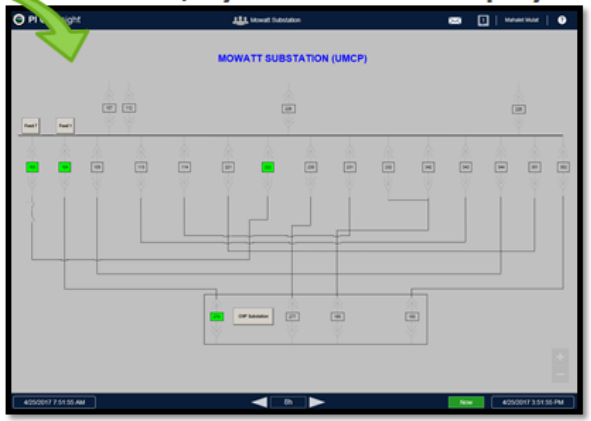
RESULTS

- Share “Open” locations
- Provide head start for arising issues
- Intuitive interface
- Provide Customer Response Center with timely information

– One-line feeder loop diagram

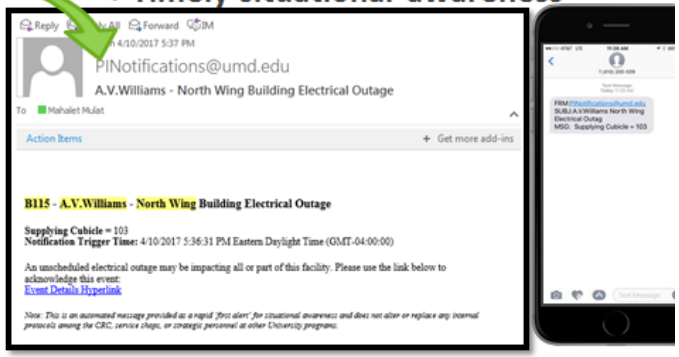


+ Intuitive, dynamic feeder loop system



+ Visual alerts of buildings affected

+ Timely situational awareness



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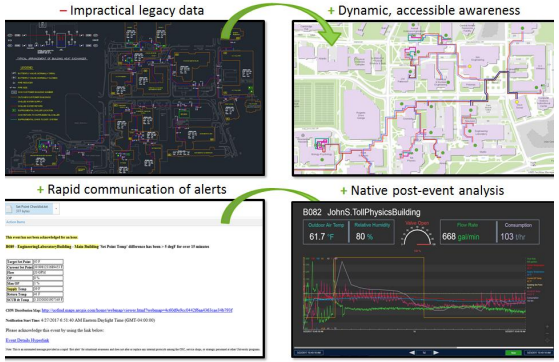


CHALLENGE

- No dynamic visual of geographically accurate situational awareness
- Limited or no insight of parameters outside of thresholds

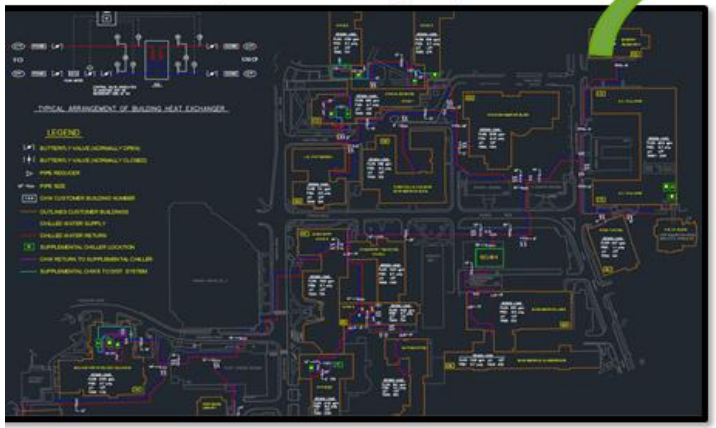
SOLUTION

- PPC connected PI to UMD's ArcGIS system; create an intuitive visual of the SCUB4 CHW system; create alerts/notifications for potential problem situations
- PPC built intuitive visualization in ArcGIS which pulls monitoring data from PI to provide situational awareness
- PPC designed trigger notifications in the event that performance falls outside of thresholds.
- We integrated PI data with the Campus ArcGIS platform to provide a multi layered set of features which can inform multiple groups of stakeholders.

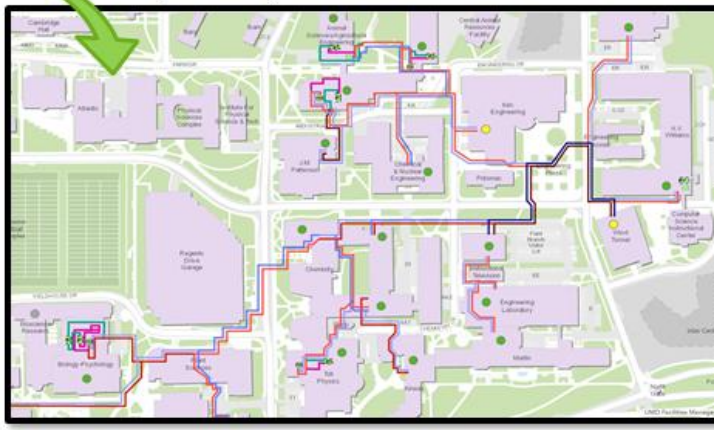
RESULTS

- Solution provides situational awareness to multiple sets of stakeholders
- Quicker reaction times, greater insight into "Hot Spots"
- Integrate operational data with the campus

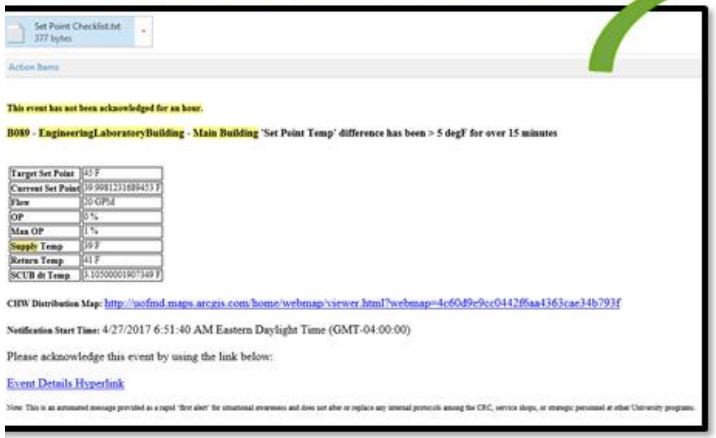
– Impractical legacy data



+ Dynamic, accessible awareness



+ Rapid communication of alerts



+ Native post-event analysis

CHW CAMPUS BUILDINGS

SCUB

		BLDG SPTS	SP (F)	Bld Sup (F)	Bld Ret (F)	Flow (GPM)	dT SCUB side (F)	UMD BLDG PUMPS	Chiller (BTU)	Control	Winter Bldg 55F SP	OP (%)	Man OP (%) send	PID OK	Batt Low	Local/ Remote
Kim Eng	HX-1 HX-2 *Backup*	42	41	40 43	52 54	1003	7.78		Hx-1 Hx-2 *Backup*	AUTO		35 0	40		HX-1 HX-2 *Backup*	Remote
Animal Science 3		44	42	42	46	762	7.27	OFF	0.00	AUTO		22	Configure			Remote
Animal Science 5		45	43	43	49	360	9.48	ON		AUTO		13	0			Remote
Chem Nuclear		45	45	45	54	140	15.02	ON		No Data		17	0			
Animal Science 1		44	43	43	45	264	6.61	ON		AUTO		15	Configure			Remote
JM Patterson		42	42	42	45	323	6.28	ON		AUTO		27	Configure			Remote
Eng Labs		45	42	42	47	88	9.50			AUTO		10	0			Remote
Eng Class		45	45	39	42	3	3.77	ON		MAN		0	Configure			Remote
Wind Tunnel		46	85	81	83	0	0.00	ON		AUTO		0	Configure			Remote
Energy Research		45	42	41	45	294	6.08			AUTO		21	0			Remote
AV Williams		42	41	41	47	1024	7.24			AUTO		15	Configure			Remote
Chem Teach		45	45	44	54	305	16.85			AUTO		13	0			Remote
Math		45	45	44	51	114	11.86	ON		AUTO		27	0			Remote
Chem W-2		45	45	45	48	252	10.36			AUTO		18	0			Remote
Physics		42	42	41	44	399	3.75			AUTO		7	0			Remote
Chem W-5		42	42	41	50	553	9.93			AUTO		17	0			Remote
Hornbake		42	42	43	49	916	8.62			AUTO		25	0			Remote
Geology		45	45	45	47	45	7.24			AUTO		21	0			Remote
Bio & Psych		42	42	42	53	404	11.04			AUTO		20	0			Remote
Microbiology		42	41	41	56	356	9.64			MAN	50	20	Configure			Remote
Bioscience		45	45	20	20	0	0.00			MAN		0	0			Remote

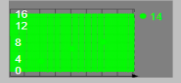
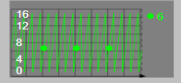
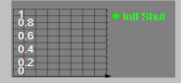
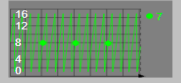
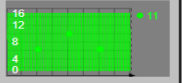
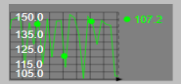
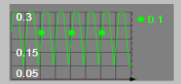
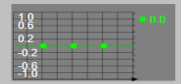
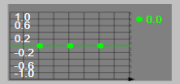
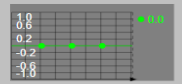
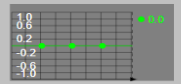
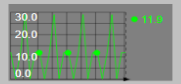
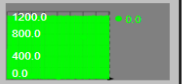
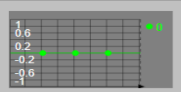
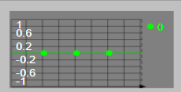
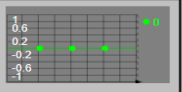
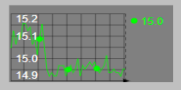
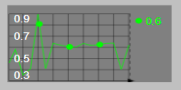
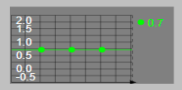
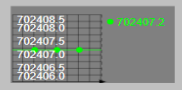
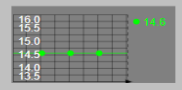
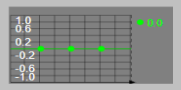
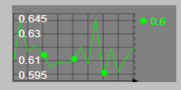
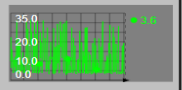
	ASW 3	*Micro*
dP (psi)	11	0

Chiller #1 CHW Flow No Data Chiller #2 CHW Flow No Data Chiller #3 CHW Flow No Data CHW Bypass No Data %

CHW PLANT ΔP Setpoint change ↓ CHP PLANT Δ 18

2018 10:25:33 AM ◀ 8h ▶ Now 9/9/2018 6:25

Interface Health Monitoring

	BACnet (Obvius)	PI HTML1 (PJM Pricing)	PI HTML3 (Weather)	RDBMSPI1 (Mozart)	RDBMSPI2 (ALC UMD_Trend)	RDBMSPI4 (ALC Cons_Trends)	RDBMSPI6 (PII4BA)	CITECT (CHP)
Device Status(s)	3	1	4 | Intf Shutdown	99 | Intf Shutdown	99 | Intf Shutdown	99 | Intf Shutdown	0 | Good	Pt Created
Heartbeat (sec)								
IO Rate								
Scan Class Skipped								
Performance Point (sec)								
Point Count	610	1	Intf Shut	Intf Shut	Intf Shut	Intf Shut	666	1130

Device Status: Stores communication information about the interface and the foreign device

Heartbeat: Primary tag used to determine if the interface is running, if value is updating, then the interface is running but not necessary connected to the source

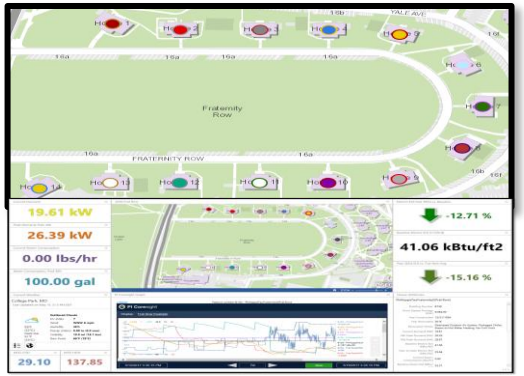
IO Rate: Counts number of all values (inputs, outputs, triggered inputs) being sent to PI before exception processing occurs

Scan Class Scans Skipped: The value written to the Scan Skipped tag is the total number of scans skipped since the last reporting period

Performance Point: Monitors the amount of time in seconds that it takes an interface to complete a scan for a particular scan class

Interface Point Count: Counts number of PI tags loaded by the interface

Academic Integration and Partnership



CHALLENGE

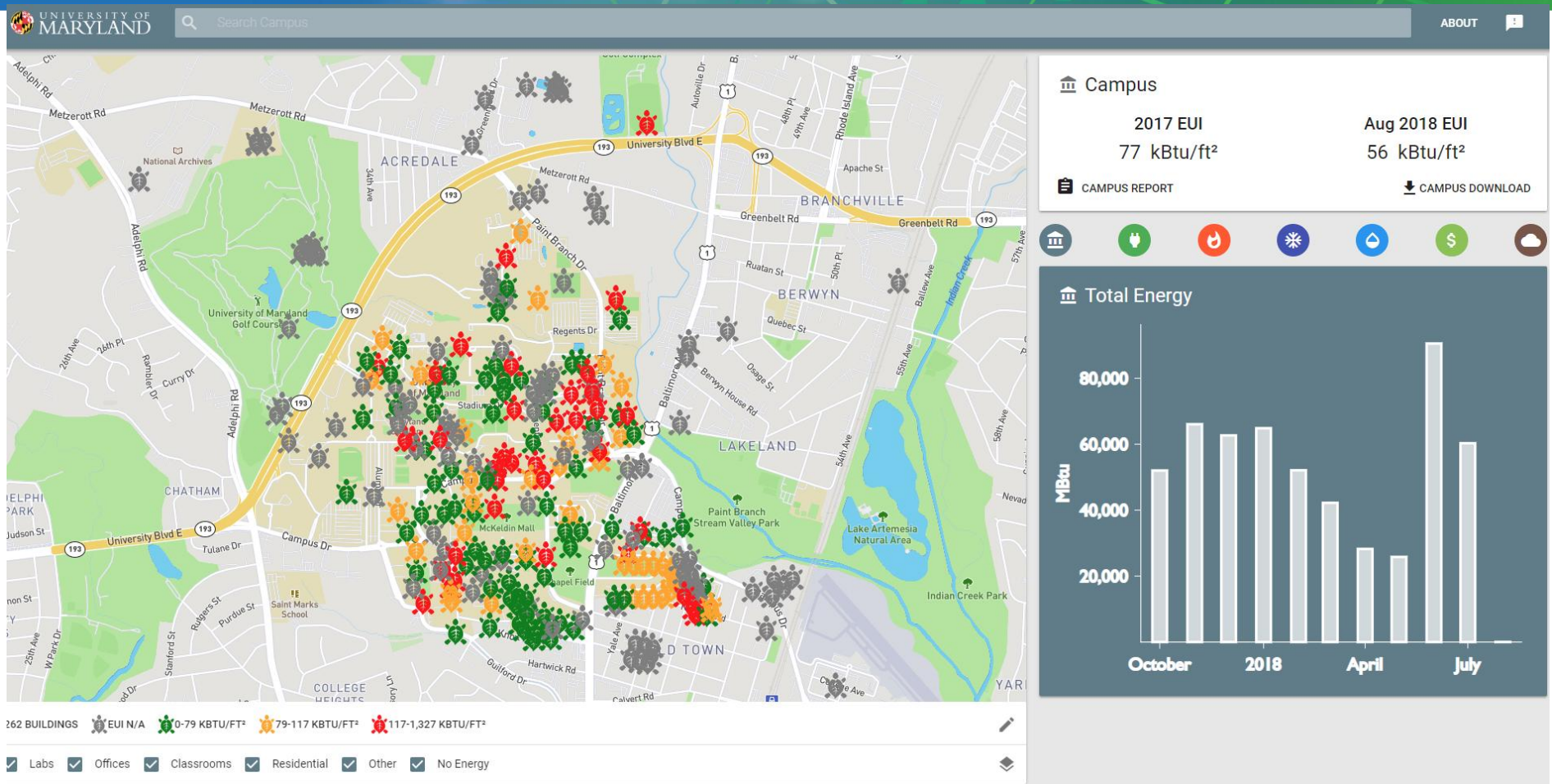
- Several hours in the past attending to faculty and student utility and plant performance data requests
- Had no functional energy dashboard for campus engagement

SOLUTION

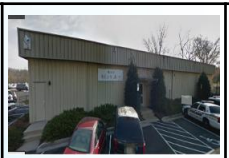
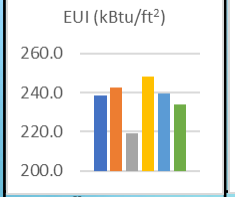
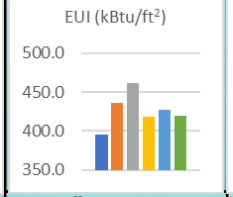
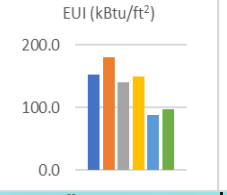
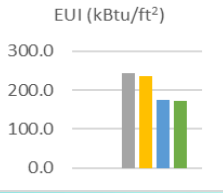
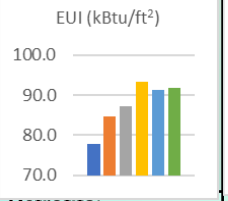
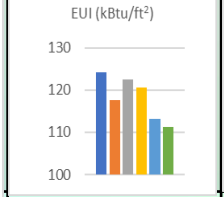
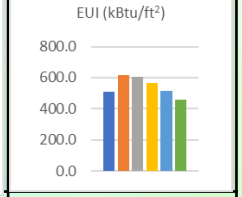
- Restoration of Remote Access to Operational and Historical Data Feeds

RESULTS

- Drive a culture of efficiency
- Provides insight into total building consumption
- Track use of energy at each campus building
- Sustainable personal lifestyles consistent with the Universities future energy realities
- Drive a culture of Innovation and Research



Academic Integration - Retrofit Analysis Case Study Buildings

						
Name: IBBR Carb-1 (#976) **Area:** 77,000 ft² **Bldg Type:** Lab **2017 EUI:** 234 kBtu/ft²	**Name:** IBBR Carb-2 (#977) **Area:** 126,000 ft² **Bldg Type:** Lab **2017 EUI:** 420 kBtu/ft²	**Name:** Police Training Facility **Area:** 10,000 ft² **Bldg Type:** Office **2017 EUI:** 97 kBtu/ft²	**Name:** Marie Mount Hall **Area:** 113,268 ft² **Bldg Type:** Lab **2017 EUI:** 132 kBtu/ft²	**Name:** Technology Ventures **Area:** 54,000 ft² **Bldg Type:** Office **2017 EUI:** 92 kBtu/ft²	**Name:** McKeldin Library **Area:** 366,000 ft² **Bldg Type:** Other (Library) **2017 EUI:** 111 kBtu/ft²	**Name:** Eppley Recreation **Area:** 233,000 ft² **Bldg Type:** Other (Gym) **2017 EUI:** 456 kBtu/ft²
						
Retrofits: • Lighting Upgrade	**Retrofits**: • Lighting Upgrade • Chiller Plant Optimization • Demand Controlled Ventilation	**Retrofits**: • Lighting Upgrade • HVAC Scheduling/Tuning • Weatherization	**Retrofits** • HVAC Scheduling • Outdoor Air Economizers • Automation of VAV units	**Retrofits**: • HVAC Scheduling using Voltron	**Retrofits** • Lighting Upgrade • Improving Lighting Controls with Sensors	**Retrofits** • Lighting Upgrade • Pool Heat Recovery
Timeline: • Oct'13 – Feb'14	**Timeline**: • Oct'13 – Dec'14	**Timeline**: • Jul'13 – Dec'15	**Timeline**: • Nov'15 – Jun'16	**Timeline**: • Proposed	**Timeline**: • Proposed	**Timeline**: • Dec'15 – Sep'16
Cost: • $142,000	**Cost**: • $840,000	**Cost**: • $50,000	**Cost**: • $1,100,000	**Cost**: • $38,400	**Cost**: • $795,000	**Cost**: • $622,000

Human-Machine Collaboration (H-MAC) Systems in Buildings

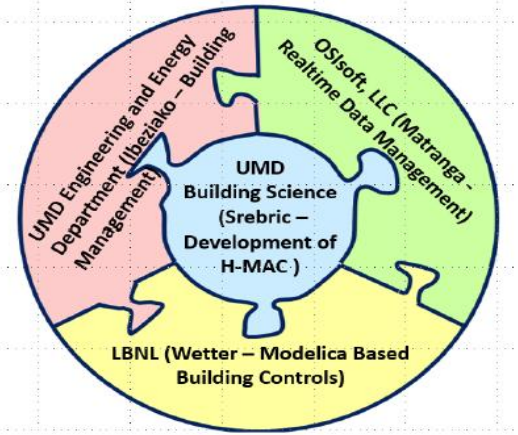
DE-FOA-0001825

TOPIC 4: Novel Approaches for Cyber-Physical Systems in Buildings

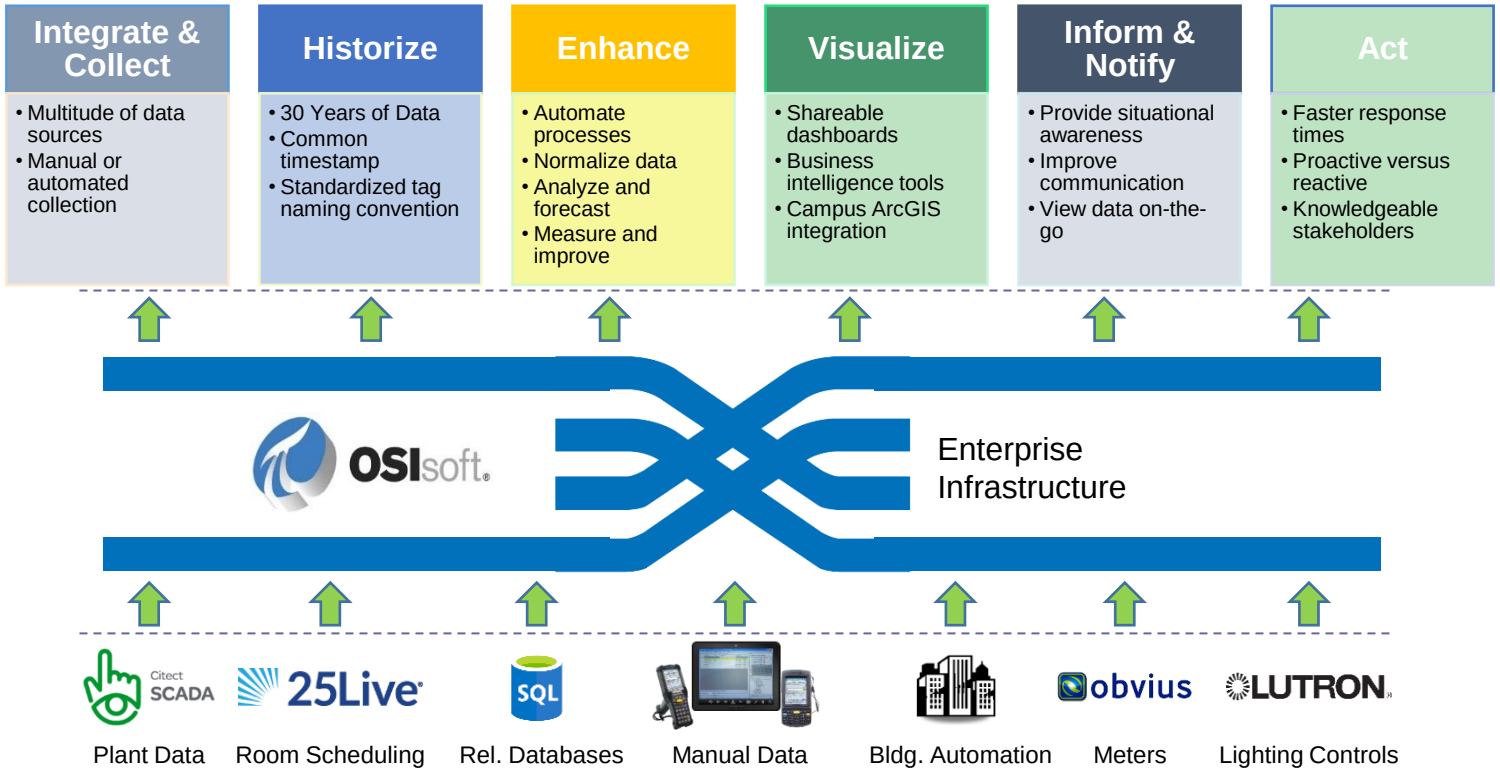
Assigned Control No. 1825-1621

Lead Organization: **University of Maryland** (College Park, MD)

PI: **Jelena Srebric**, Co-PIs:
Mary-Ann Ibeziako (UMD),
Michael Wetter (LBNL),
David Blum (LBNL) and
John Matranga (OSIsoft, LLC)



Real-Time Infrastructure Connects the Campus



Bringing Campuses to the Next Generation Sustainable Environment

University of Maryland

- Mary-Ann Ibeziako PEM, MBA
- Director-Engineering & Energy
- 2300 A Service Bldg, College Park MD 20742
- 301-314-0474 / mibeziak@umd.edu

Questions?

Please wait for the **microphone**

State your **name & company**

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