

Managing the Operational Needs of the Campus and The Journey to a Campus Living Laboratory

Presented by:

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PI World Conference April 8, 2019

San Francisco, CA



UNIVERSITY OF
MARYLAND



University of Maryland, College Park (UMCP)

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



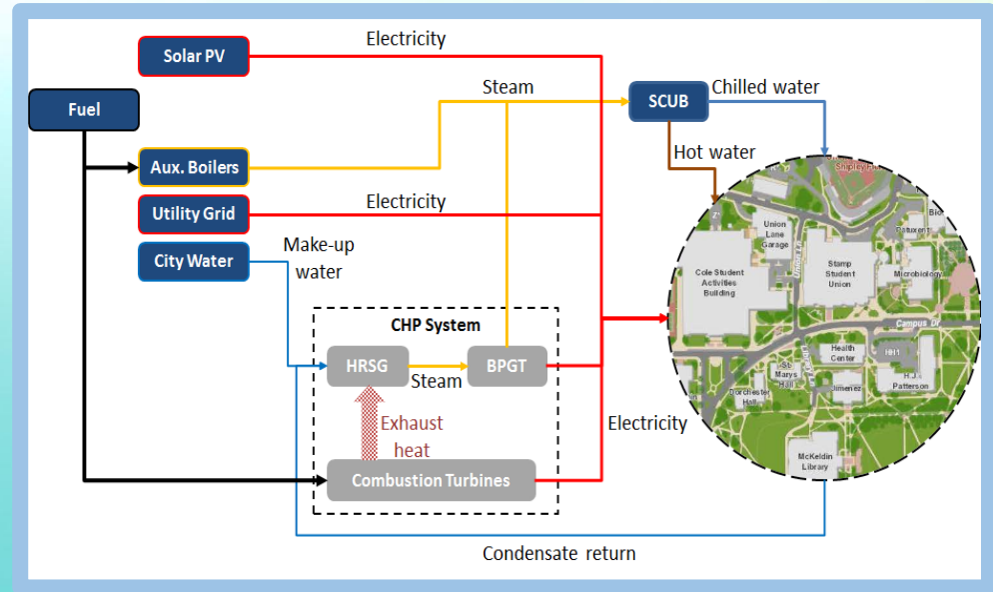
Campus Energy Production

- 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



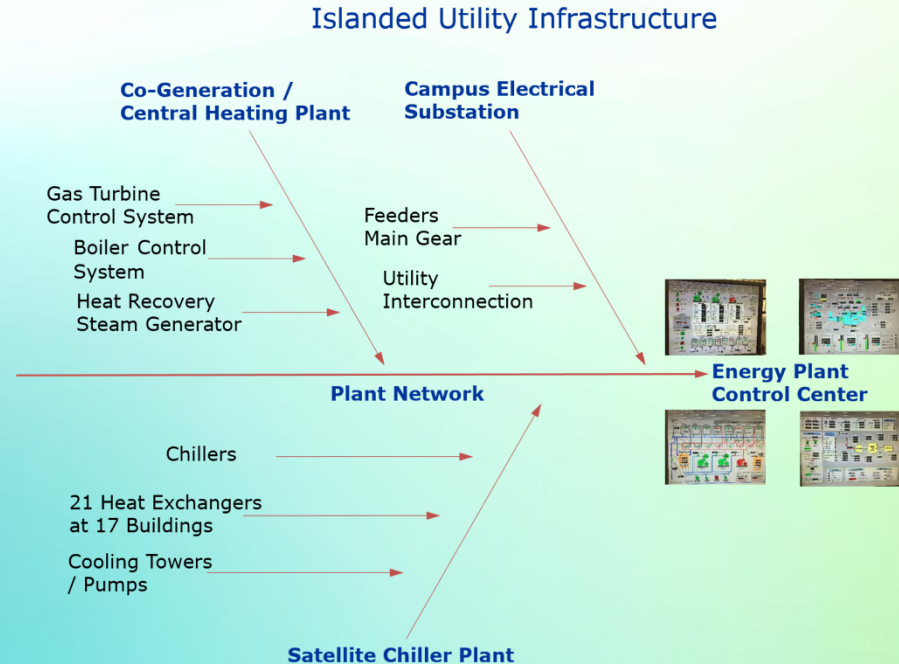
District Energy System

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



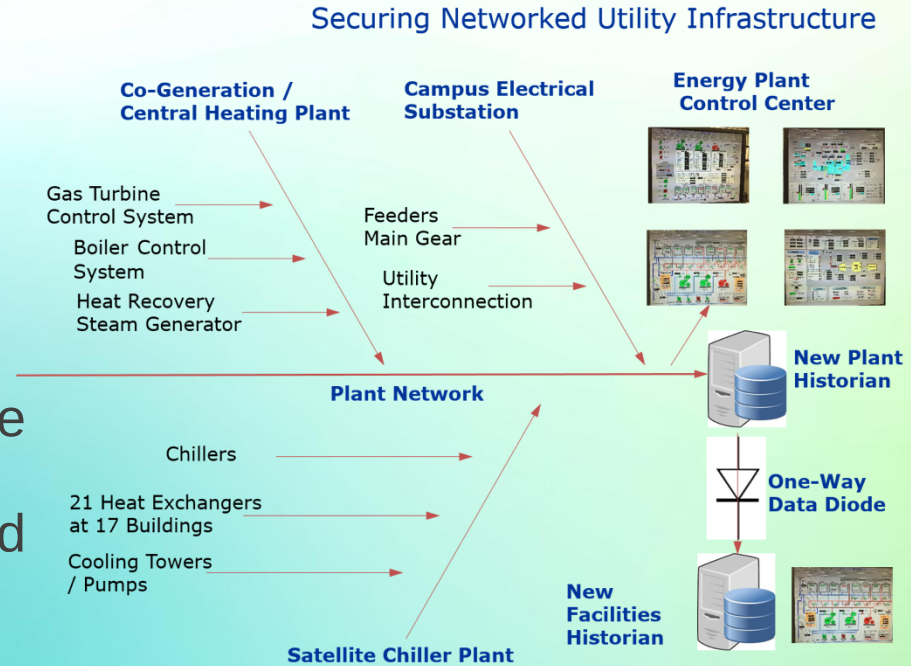
Challenge: Restore Utility Monitoring

- Integrated Utility system completed in 2002
- Utility System islanded to protect static platforms from increasing vulnerability to outside threats
- Live & Historical Central Plant Data was only available for viewing in the Plant Control Center



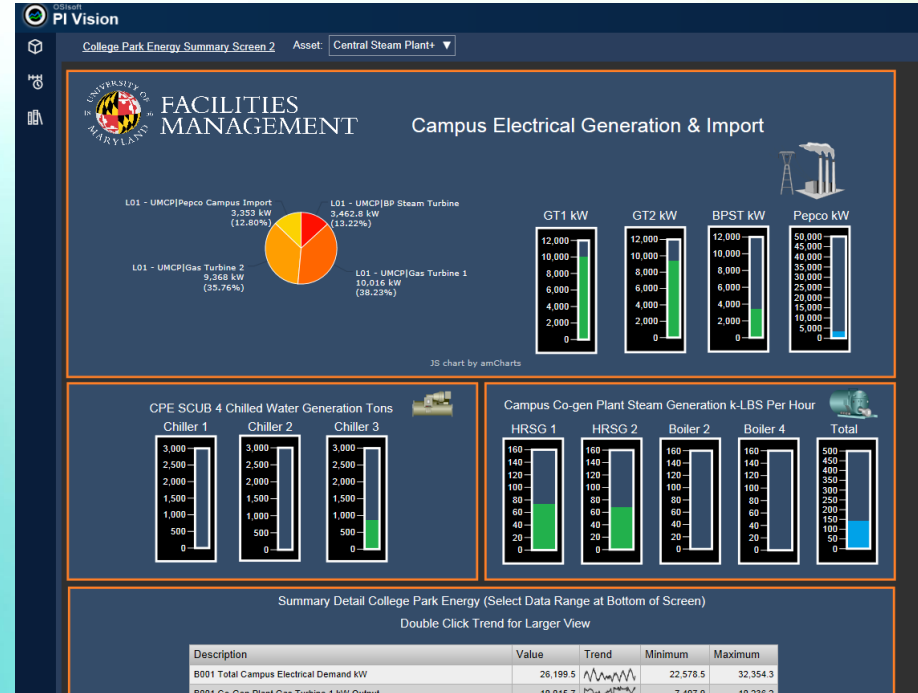
Solution: OSIsoft PI

- UMD partnered with the NIST National Cybersecurity Center of Excellence and DSA on the Situational Awareness Project
- UMD served as the live data source for this NIST Build
- Evaluation of products from the build led directly to the procurement by UMD of 2 build technologies
 - (2) PI Servers
 - (1) One-Way Data Diode



Results: Secure, Centralized Data

- Real-time monitoring restored
- Remote Access to Operational and Historical Data Feeds
- Event Notifications
- Common Data Source for the Utility Billing System and Campus Energy Dashboard “TerpFootprints”



Academic Integrations

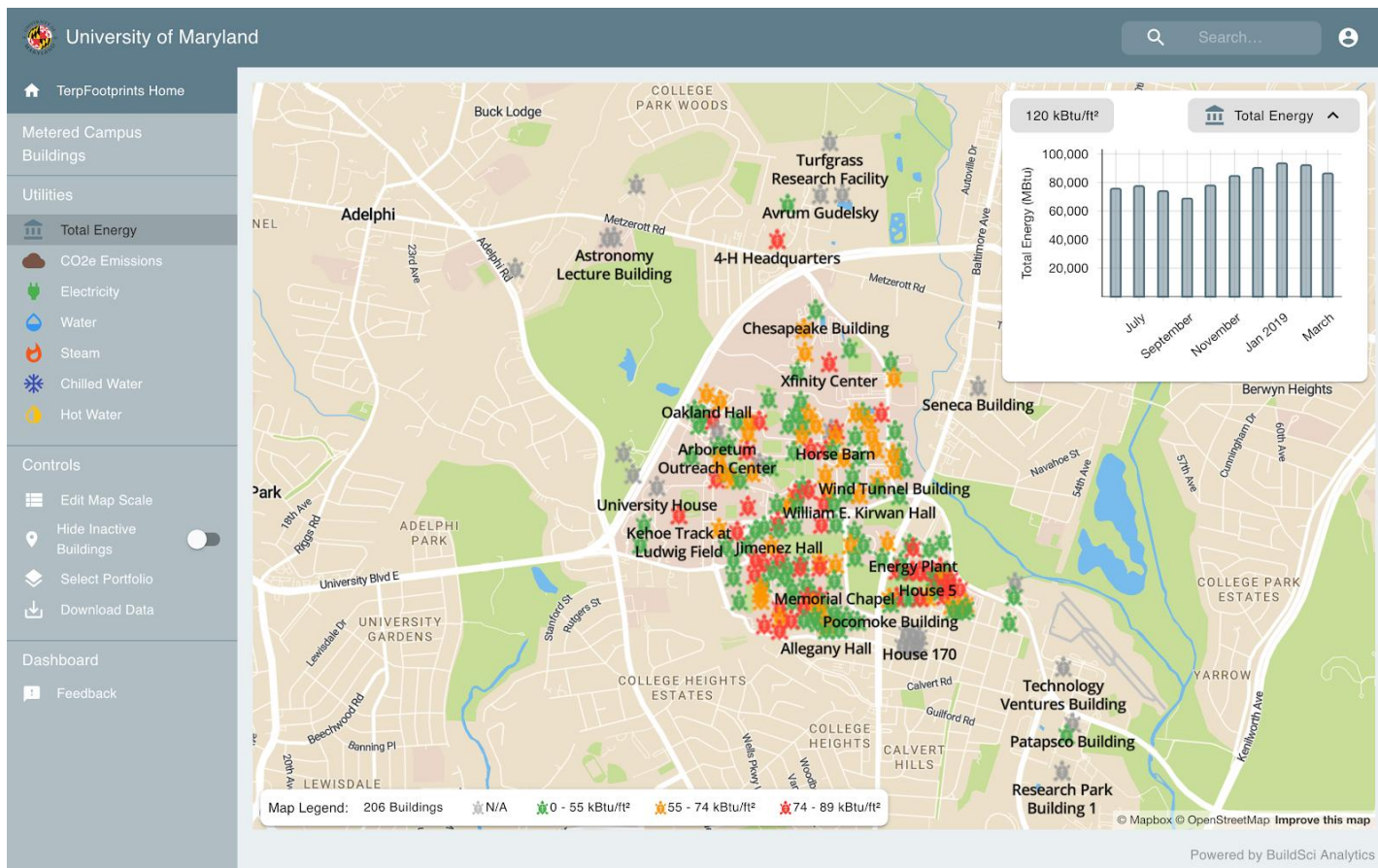


The Cluster for SustainabilTY in the Built Environment
at the University of Maryland



- Energy Dashboard
- Carbon Emissions
- Building Energy Modeling
- Retrofit Analysis Case Studies
- Model Predictive Controllers (MPCs)

Energy Dashboard



Classroom Exercises: Carbon Emissions

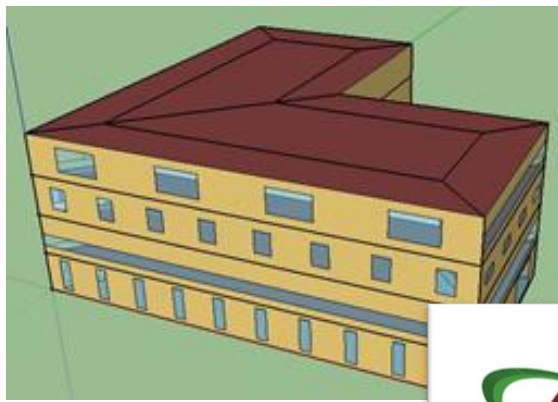
UMD's PI Server provides real-time high resolution interval data of:

1. CHP Plant
2. On Campus Renewables
3. PEPCO Grid Connection

This allows for a student exercise in a multidimensional timeseries analysis of UMD's carbon emissions (lbs CO₂e)



Building Energy Models



Classroom Cafeteria Corridor Gym Kitchen Library Lobby Mech

Percent of Total Floor Area 50.3 % Space Type Floor 23,123.5 ft²

Densities

Lighting per Area 1.26 W/ft² Occupancy per Area 23.22

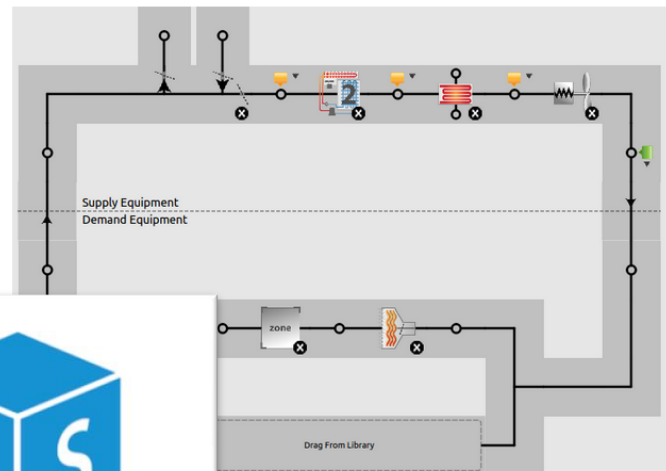
Electric Equipment per Area 1.02 W/ft² Infiltration per Exterior Area 0.0446 ft³/min-ft²

Schedules

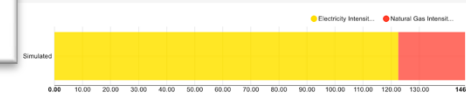
Occupancy Lighting Electric Equipment Gas Equipment [SHOW TABULAR DATA](#)

Setpoints

Heating Setpoint Cooling Setpoint [SHOW TABULAR DATA](#)



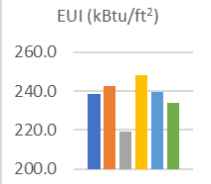
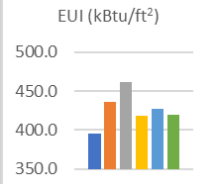
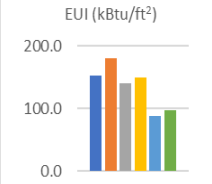
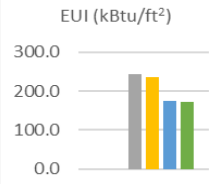
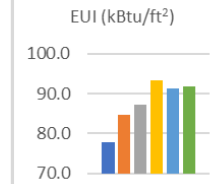
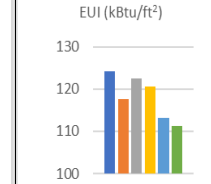
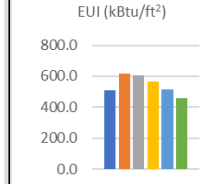
Energy Use Intensity: 146.4 ktu/ft²



Monthly Electricity Consumption by End Use



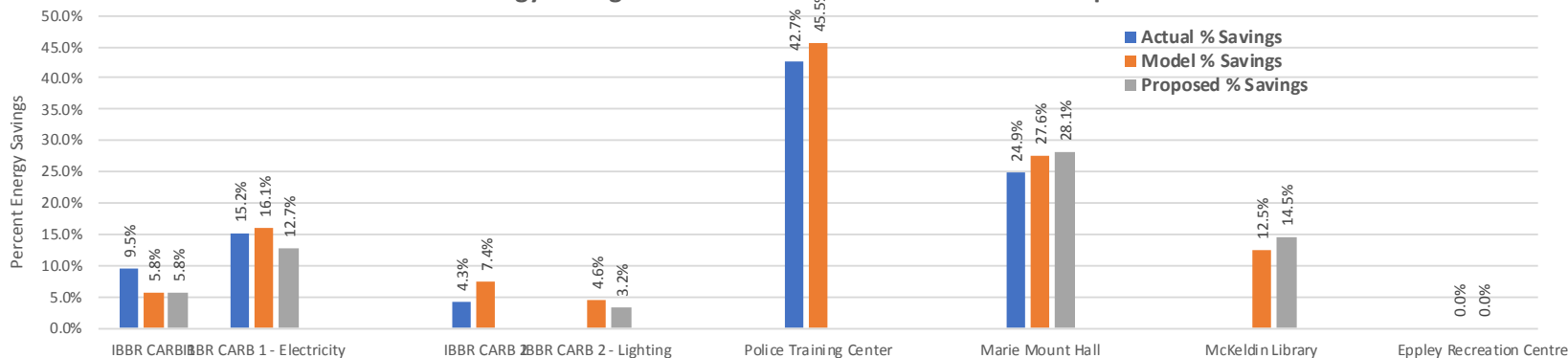
Retrofit Analysis Case Study Buildings

						
Name: IBBR Carb-1 (#976) Area: 77,000 ft ² Bldg Type: Lab 2017 EUI: 234 kBtu/ft ²	Name: IBBR Carb-2 (#977) Area: 126,000 ft ² Bldg Type: Lab 2017 EUI: 420 kBtu/ft ²	Name: Police Training Facility Area: 10,000 ft ² Bldg Type: Office 2017 EUI: 97 kBtu/ft ²	Name: Marie Mount Hall Area: 113,268 ft ² Bldg Type: Lab 2017 EUI: 132 kBtu/ft ²	Name: Technology Ventures Area: 54,000 ft ² Bldg Type: Office 2017 EUI: 92 kBtu/ft ²	Name: McKeldin Library Area: 366,000 ft ² Bldg Type: Other (Library) 2017 EUI: 111 kBtu/ft ²	Name: Eppley Recreation Area: 233,000 ft ² Bldg Type: Other (Gym) 2017 EUI: 456 kBtu/ft ²
						
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: Jun'17 – Jun'18	Timeline: Apr'18 – May'19	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

Retrofit Analysis Case Study Buildings

						
IBBR Carb-1 (#976)	IBBR Carb-2 (#977)	Police Training Facility	Marie Mount Hall	Technology Ventures	McKeldin Library	Eppley Recreation
Annual Electricity & Steam Savings						
380,000 kWh	510,000 kWh	186,000 kWh	840,000 kWh	124,000 kWh	1,867,000 kWh	1,189,000 kWh
-	4,390,000 lbs.	-	8,228,000 lbs.	-	-	-
Annual Cost Savings						
\$41,000	\$1,606,000	\$20,000	\$288,000	\$14,000	\$205,000	\$130,000
Payback Period (Years)						
3.4	5.2	2.4	3.8	2.8	3.9	4.8

Energy Savings Predictions - Actual vs. Modeled vs. Proposed

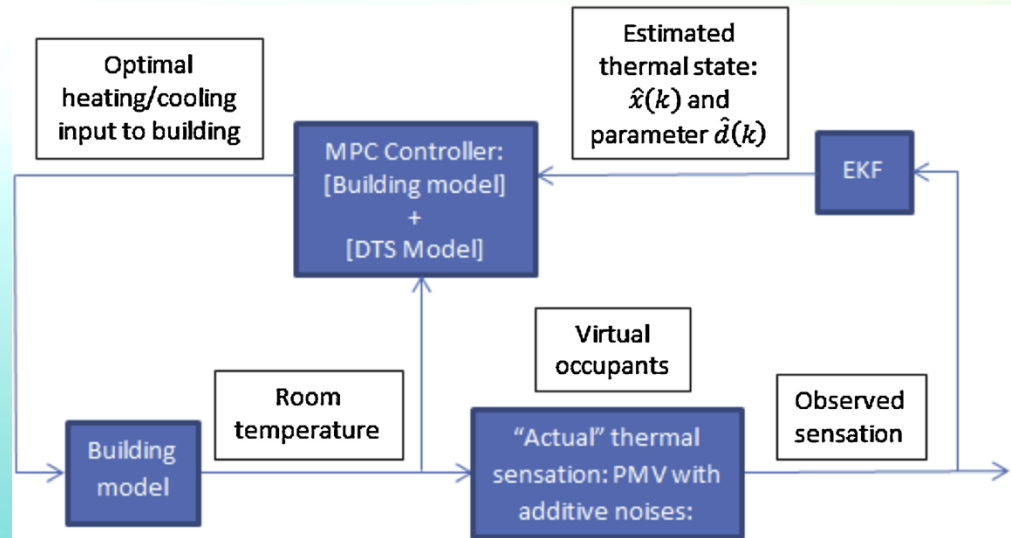


Model Predictive Controllers (MPCs)

Requirements: Real-time building, occupant, controls, and environmental data

Process: Uses continuous interval data stream to generate fine-grain controls strategies in real-time

Yields: Increases in occupant comfort and energy use optimization



Credit: X.Chen, Q.Wang, J.Srebric



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