Active Energy Management

Case Study:

The University of Arizona Central Plants

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UA Campus Overview

- ~42,000 Students
- ~15,000 Staff and Faculty
- ~11 Million Square Feet
- ~267 Buildings
- 3 Interconnected Central Plants

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UA Central Plant Overview

Arizona Health Sciences Central Plant

- 10,300 Ton Cooling Tower
- 10,000 Tons Electric H_2O Chillers
- 145,000 Lbs/Hr Steam
- 6 MW GTG w/HRSG

Central Heating and Refrigeration Plant

- 12,000 Ton Cooling Tower
- 13,500 Tons Electric H_2O Chillers
- 950 Ton Electric Glycol Chiller
- 7,350 Ton-Hours TES (ice) Storage
- 180,000 Lbs/Hr Steam
- 7 MW GTG w/HRSG

Central Refrigeration Building

- 12,000 Ton Cooling Tower
- 11,000 Electric H_2O Chillers
- 2,850 Ton Electric Glycol Chillers
- 23,400 Ton-Hours TES (ice) Storage

The Question:

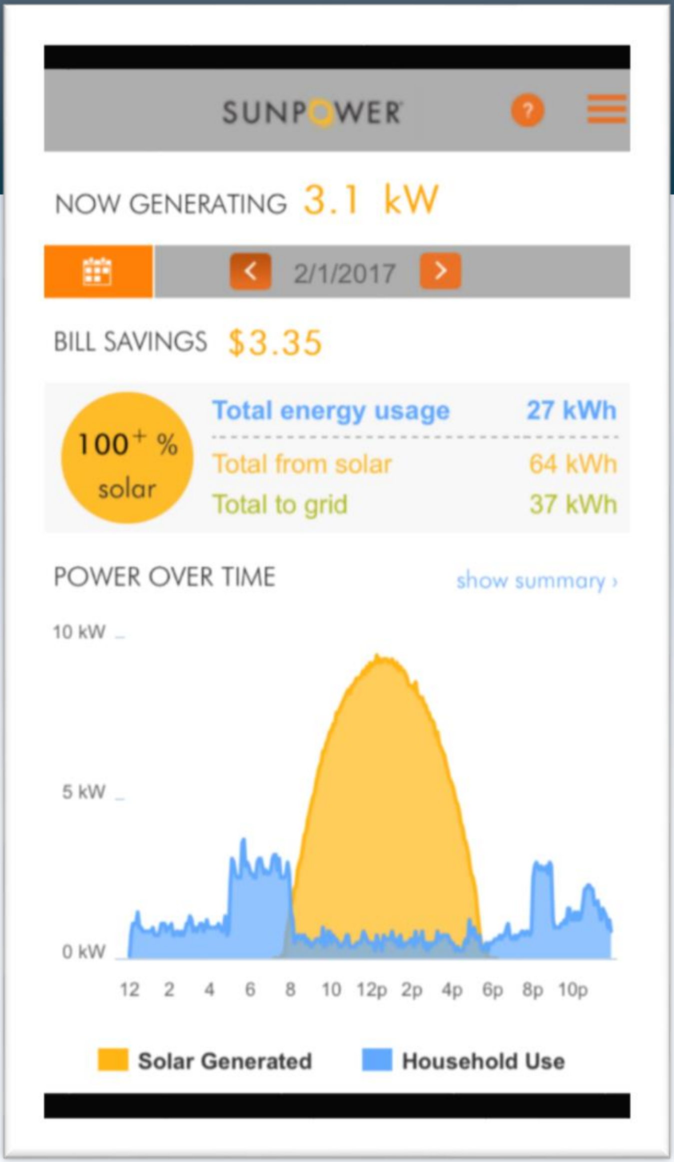
"How many of your Plant operators understand how to run the Plants as efficiently as possible ?"

- Chris Kopach, U of A Facilities Management AVP, 2012

The Challenge:

- Complex systems
- Operators making operational decisions based on experience, intuition, and legend
- Passing operational knowledge to new Plant operators
- Better stewards of our resources

Sun Power Monitoring



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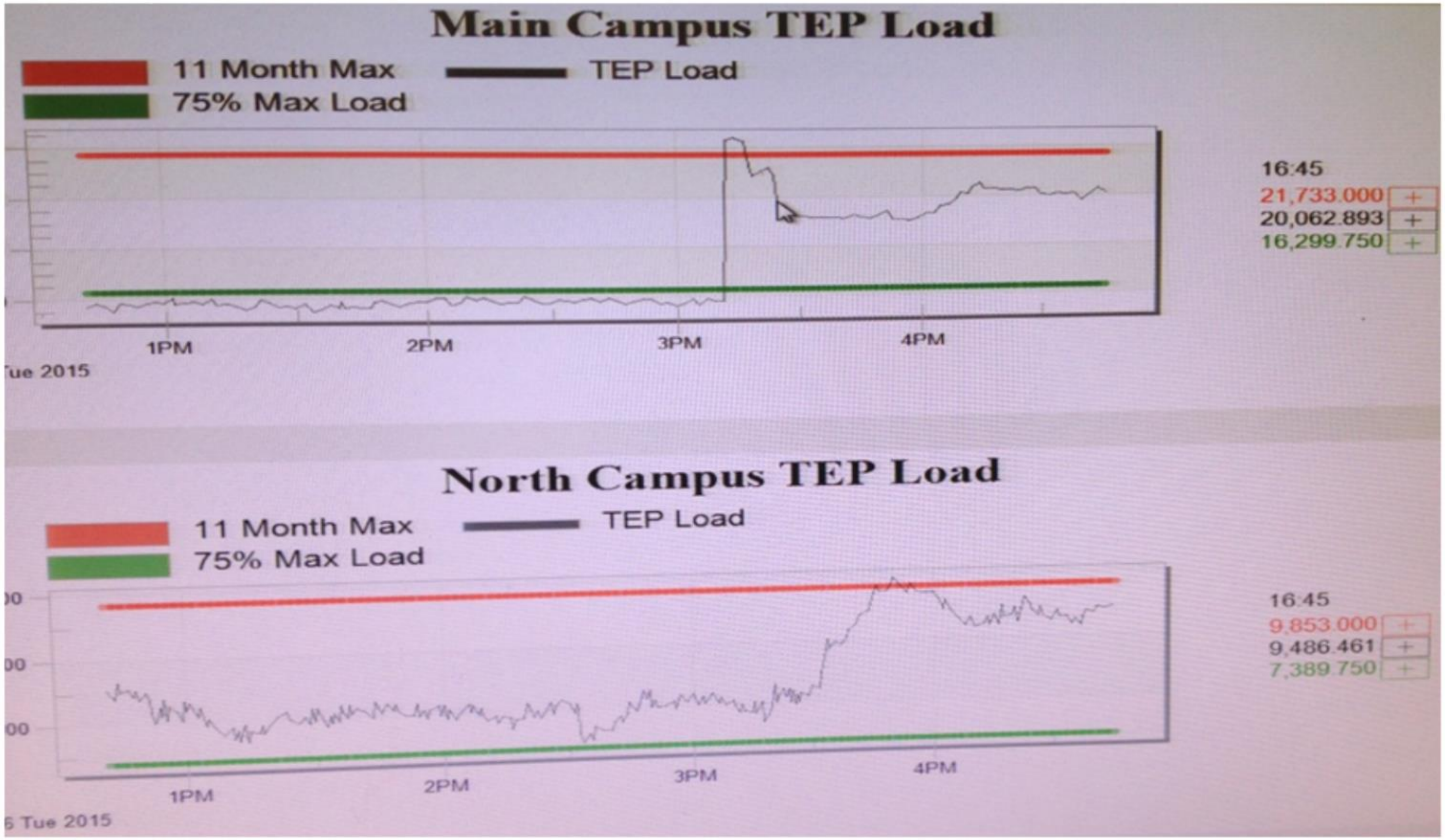
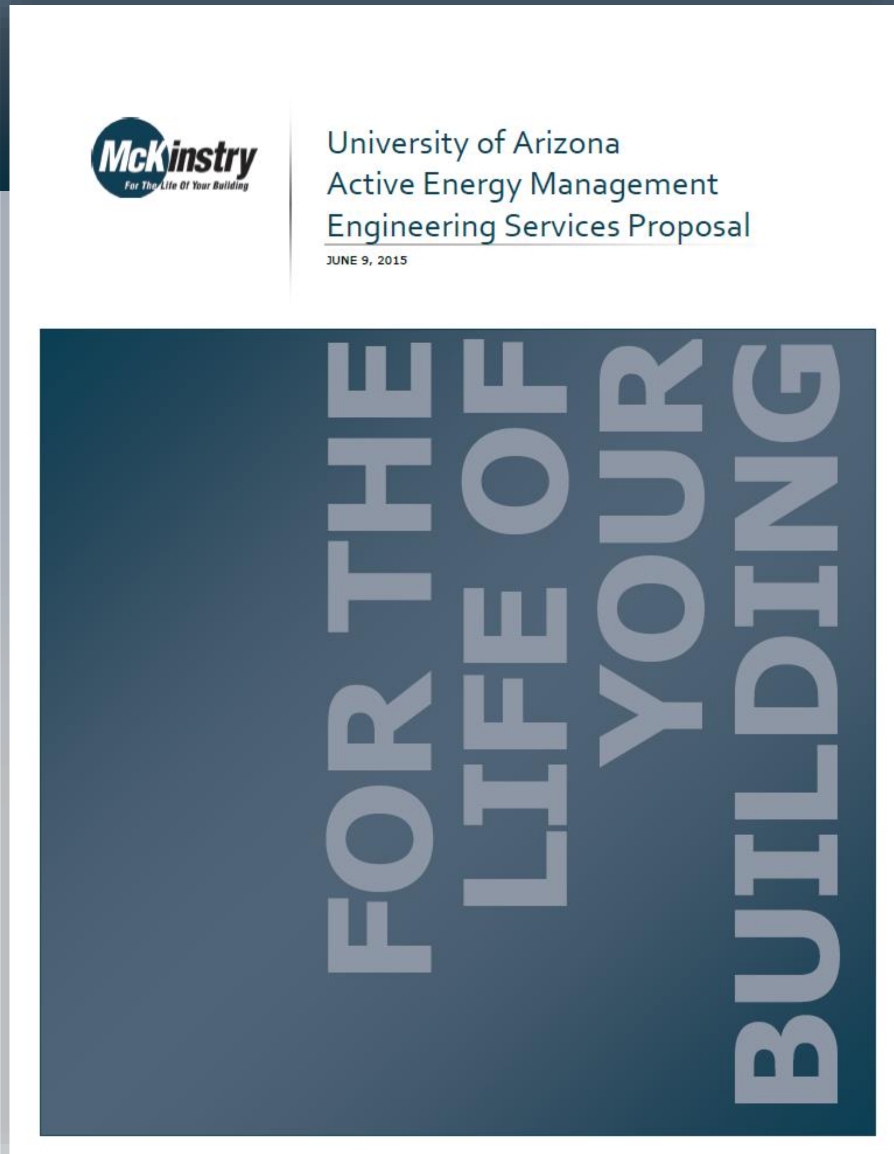
Primary Electric Meters – Real Time Monitoring

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University of Arizona
Active Energy Management
Engineering Services Proposal

JUNE 9, 2015

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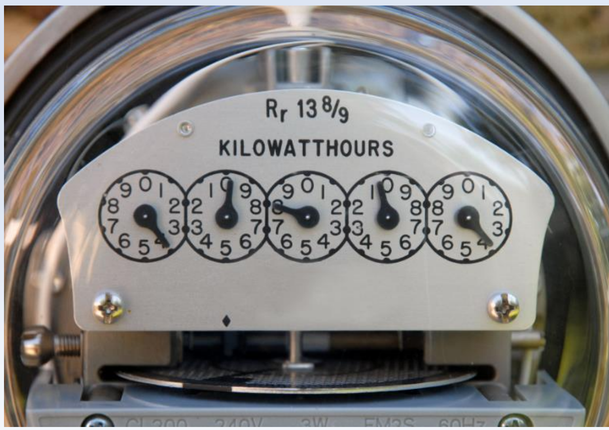
The Right information at the Right time



"We had to move past 'data drowning' and get to a point where we collect and sort the critical information in real time. This program allows us to make informed decisions and then see, understand and monetize the results of those actions."
Chris Kopach, AVP University of Arizona

Active Energy Management Overview

Active Energy Management is..

- "The concerted deployment of (1) monitoring-based technologies and (2) on-site building-system experts to drive continuous improvements."

What AEM is not…

- A controls system
- A software
- A product
- Not vendor-specific

Active Energy Management Outcomes

- Persistence of energy savings
- Increased systems visibility
- Institutionalizing technical data
- Saves staff time
- Real time building performance monitoring
    - Remote-response to faults
    - Root cause determination
    - Continuous facility optimization

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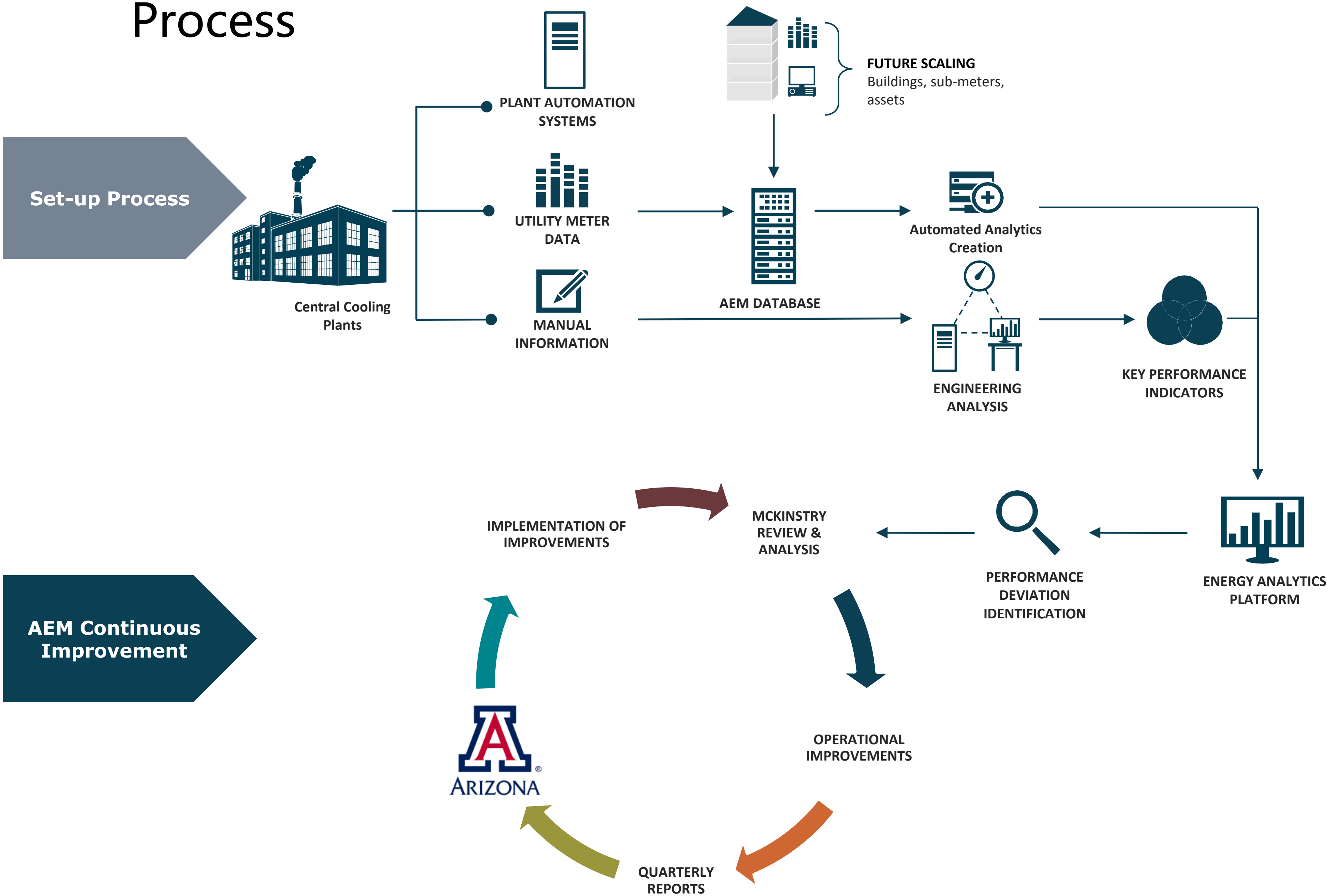
Conventional vs. Data-Driven

- ✓ Component-based
- ✓ Moment-in-time
- ✓ Individual investigation
- ✓ Reactive
- ✓ Institutional

- ✓ System-based
- ✓ Continuous monitoring
- ✓ Collective intelligence
- ✓ Predictive
- ✓ Documented

UA Active Energy Management – The Process



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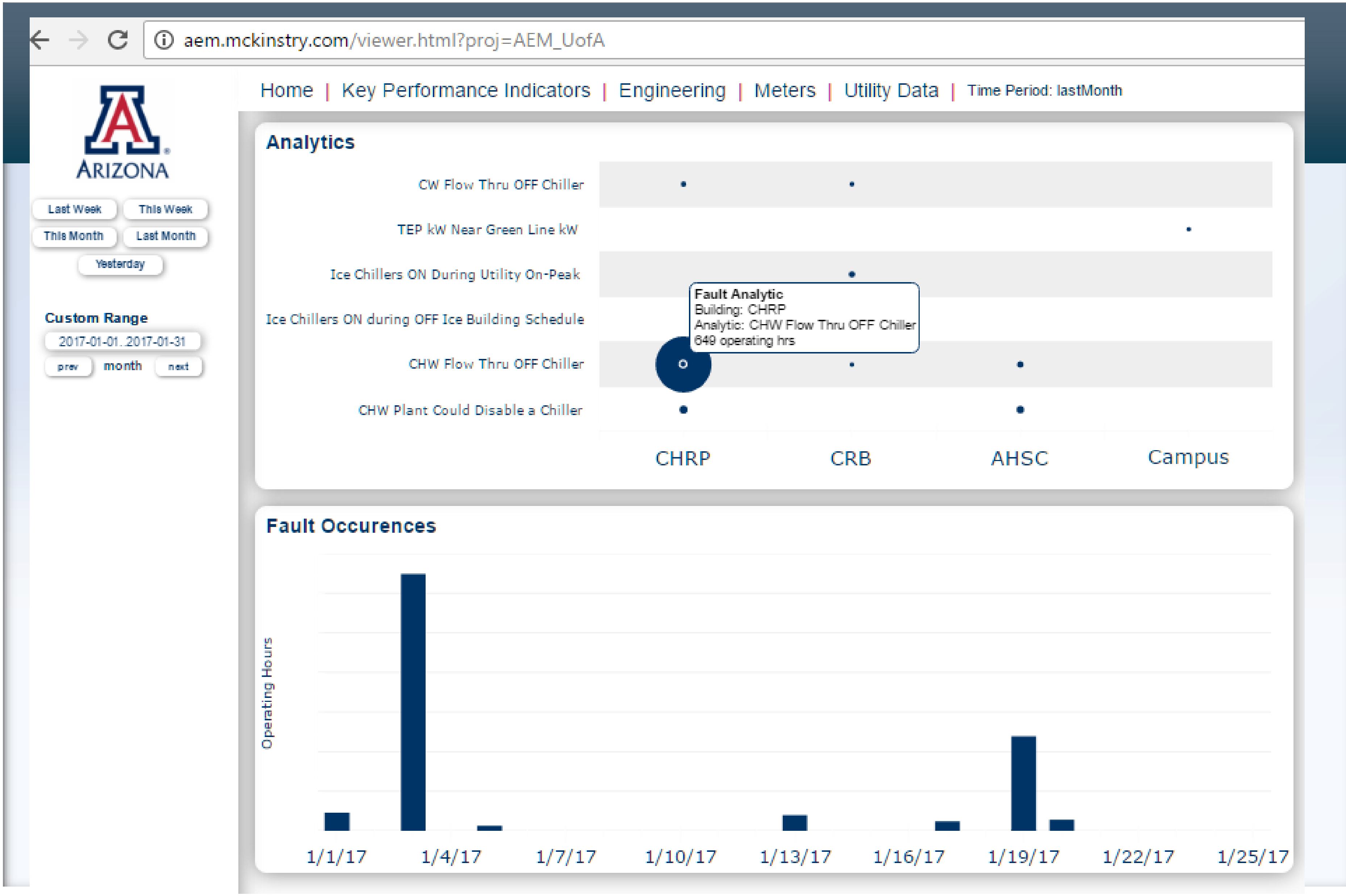
aem.mckinstry.com/viewer.html?proj=AEM_UofA
Home | Key Performance Indicators | Engineering | Meters | Utility Data | Time Period: lastMonth
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Last Week
This Week
This Month
Last Month
Yesterday
Custom Range
2017-01-01..2017-01-31
prev
month
next
Analytics
CW Flow Thru OFF Chiller
TEP kW Near Green Line kW
Ice Chillers ON During Utility On-Peak
Ice Chillers ON during OFF Ice Building Schedule
CHW Flow Thru OFF Chiller
CHW Plant Could Disable a Chiller
Fault Analytic
Building: CHRP
Analytic: CHW Flow Thru OFF Chiller
649 operating hrs
CHRP
CRB
AHSC
Campus
Fault Occurences
Operating Hours
1/1/17
1/4/17
1/7/17
1/10/17
1/13/17
1/16/17
1/19/17
1/22/17
1/25/17

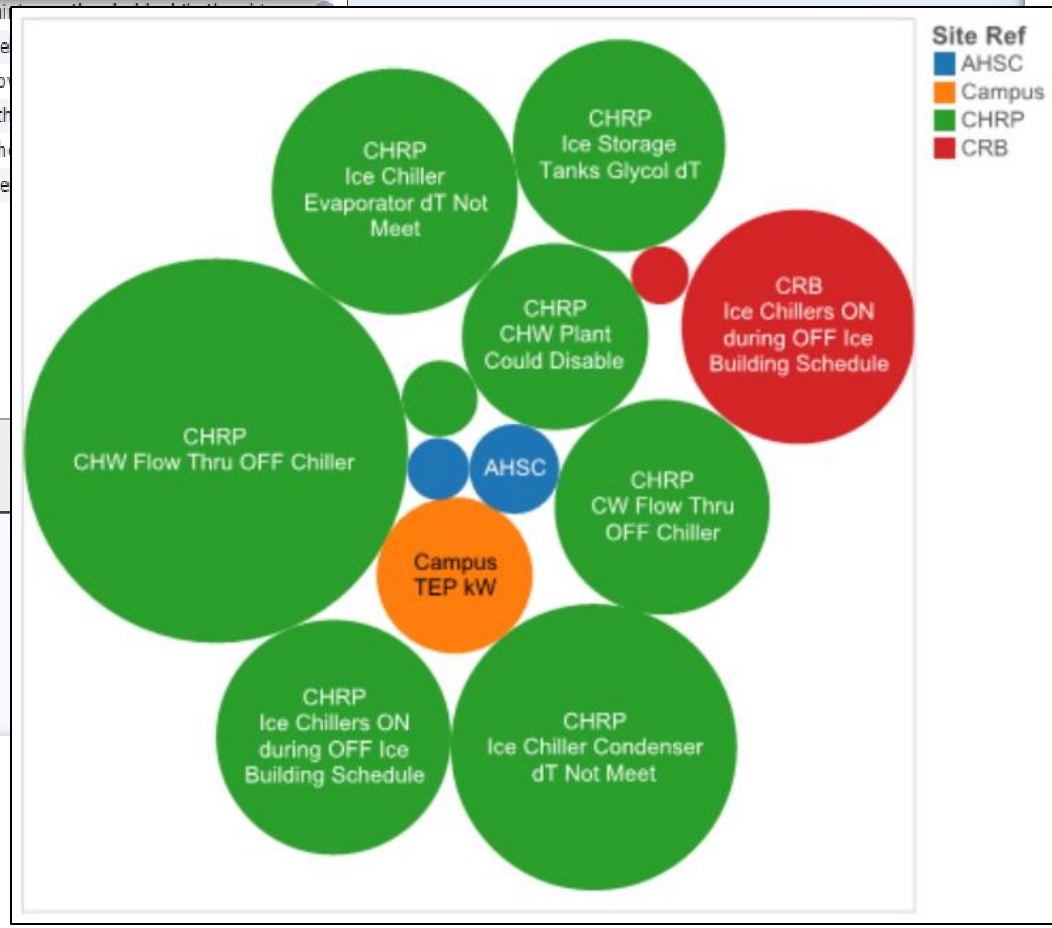
AEM Strategies – "CHW Flow Thru"

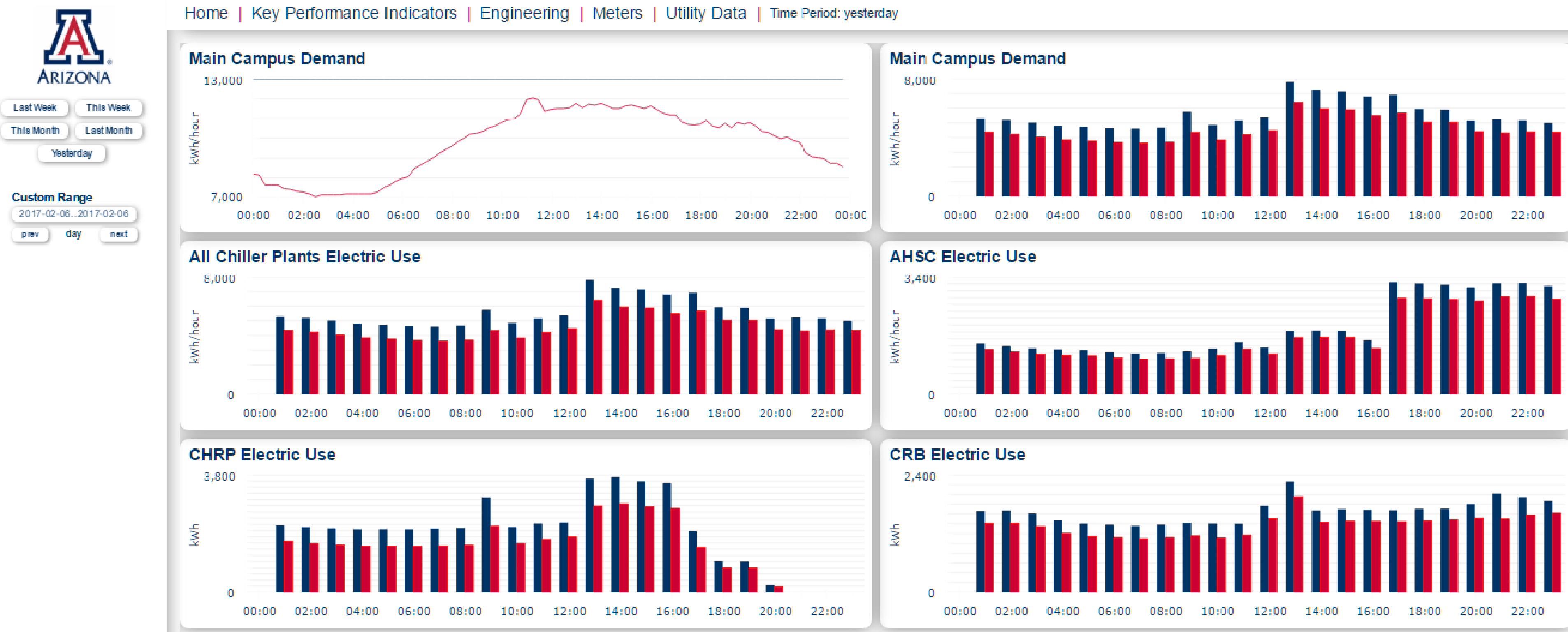
Rule Info

Rule	Sparks	Help
CHW Flow Thru OFF Chiller	158	Chilled water dP is above a minimum threshold while the chill...
CHW Plant % RLA Low	97	C...
CHW Plant Could Disable a Chiller	46	At l... online chiller at the plant can be disa...
CRB Not Running Both Ice Chillers	10	CRB is expected to operate 2 ice chillers at a time. Only 1 ...
CT Capacity Remaining & CDW Not Meet	28	The cooling tower leaving condenser water temperature is abov...
CW Flow Thru OFF Chiller	93	Condenser water dP is above a mi
Ice Chiller Condenser dT Not Meet	93	The Ice Chiller condenser dT is be
Ice Chiller Evaporator dT Not Meet	88	The Ice Chiller dT is below or abov
Ice Chillers ON during OFF Ice Building Schedule	237	Ice chillers are running during eith
Ice Storage Tanks Glycol dT Not Meet	62	The Ice Storage Tanks common h
TEP kW Near Green Line kW	94	The TEP kW is up to 90% of gree

Chilled water dP is above a minimum threshold while the chiller if OFF. This may be leading to unnecessary pump pressure losses.

dP ON Threshold = 1.0 psi





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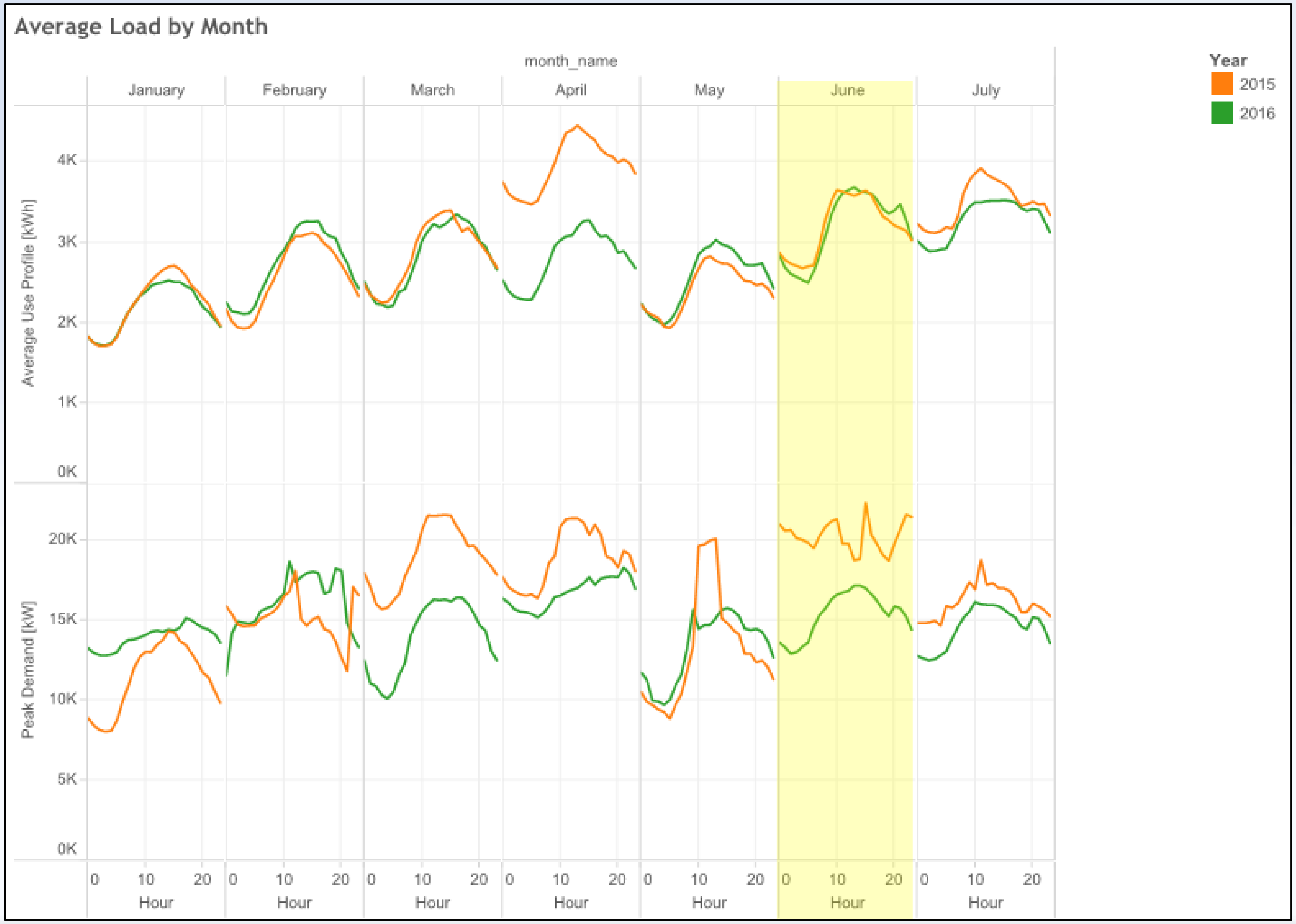
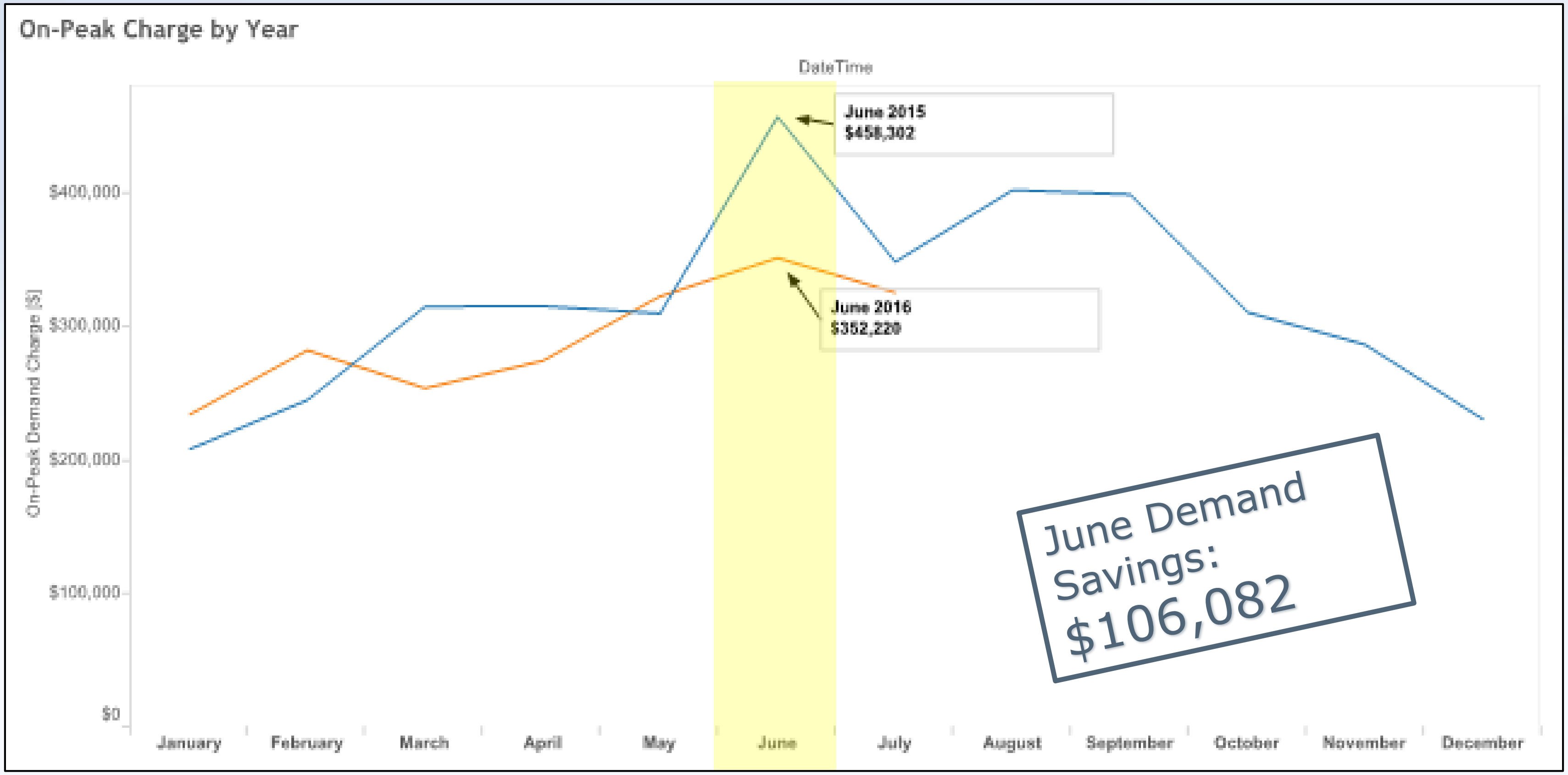
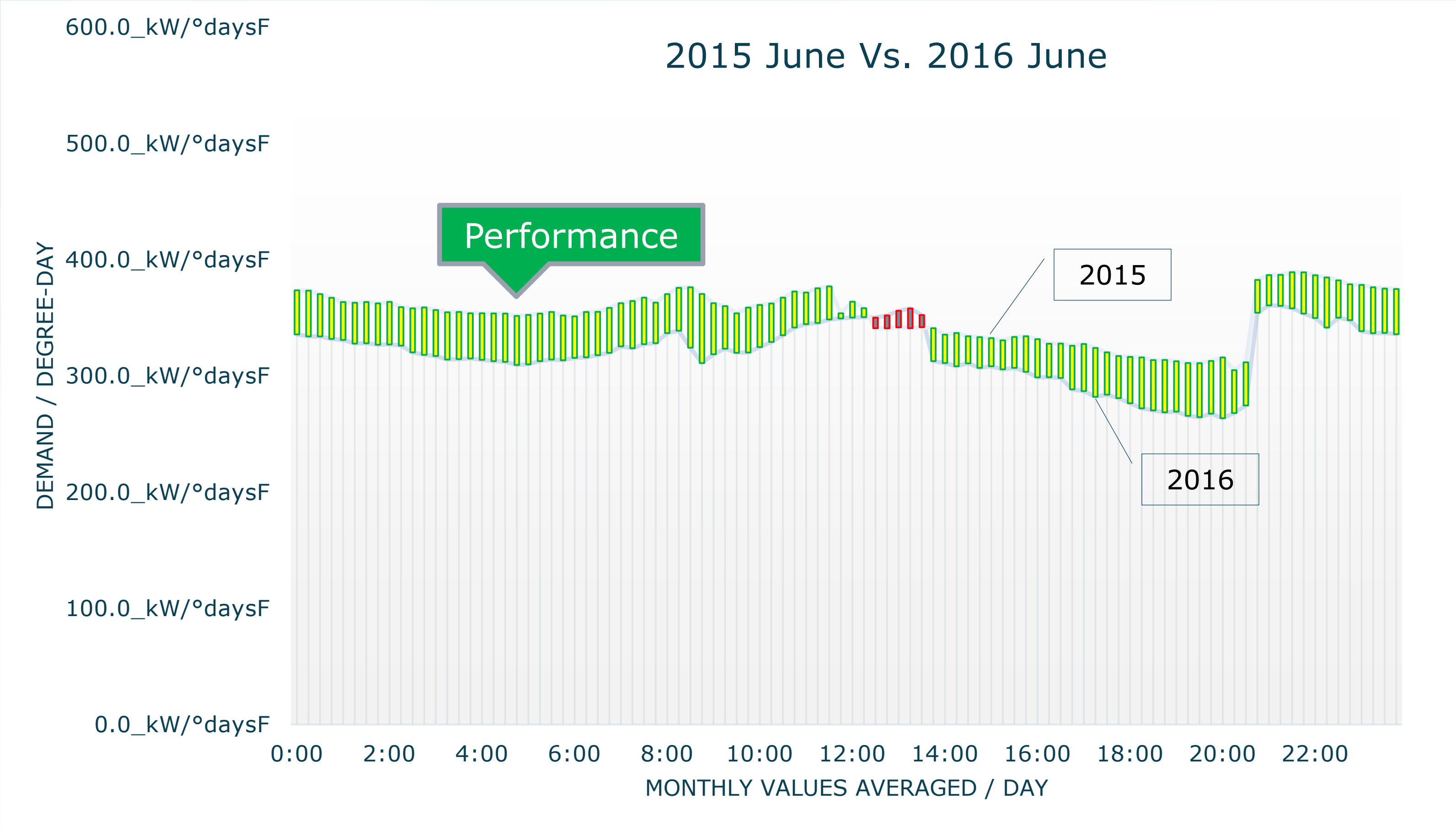
AEM Results – Demand Control



AEM Results – Financial



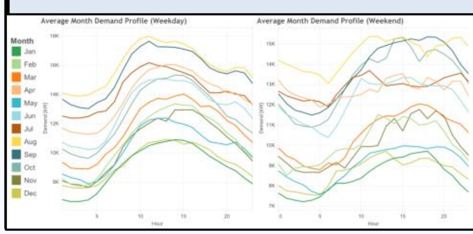
AEM Analysis – Performance Review

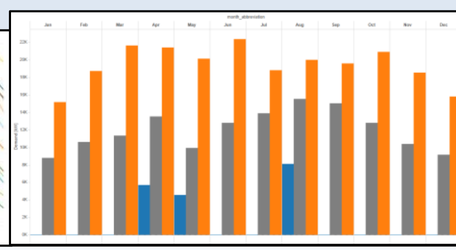


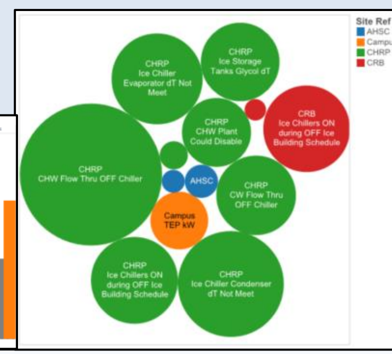
U of A Project Results To-Date

- ~$500,000 in operational opportunities
- Developed 69 Tracked KPIs
- Developed performance dashboards for key measures
- Documented and Written Operations

To move the needle --- you need the right needle







Equipment	Rule	Times (Sun - 2/21)	Sun - 2/21	Sat - 2/20	Fri - 2/19	Thu - 2/18	Wed - 2/17	Tue - 2/16	Mon - 2/15	Sun - 2/14
AHSC CH-03	CW dP Thru OFF Chiller	12:00a (1day)	100% | 24hr	100% | 24hr	100% | 24hr	100% | 24hr	100% | 24hr	100% | 24hr	100% | 24hr	90% | 15.75hr
CHRP CH-07	CHW dP Thru OFF Chiller	12:00a (1day)	100% | 24hr	100% | 24hr	100% | 24hr	100% | 24hr	100% | 24hr	100% | 24hr	100% | 24hr	100% | 24hr
CHRP CH-09	Chiller Design Evaporator dP Exceeded	12:00a (1day)	100% | 24hr	100% | 24hr	100% | 24hr	100% | 24hr	100% | 14.25hr	100% | 12.5hr	95% | 9hr	100% | 9hr
CHRP CH-09	Chiller Evaporator dT Not Meet	12:00a (1day)	100% | 24hr	100% | 24hr	99% | 23.75hr	33% | 8hr	16% | 2.25hr	6% | 45min	--	8% | 45min
CHRP CH-11	Chiller Design Evaporator dP Exceeded	12:00a (1day)	100% | 24hr	100% | 24hr	100% | 24hr	100% | 12.5hr	100% | 22hr	100% | 24hr	98% | 23.5hr	100% | 24hr
CHRP CH-11	Chiller Design Condenser dP Exceeded	12:00a (1day)	100% | 24hr	100% | 24hr	100% | 24hr	98% | 12.25hr	99% | 21.75hr	97% | 23.25hr	100% | 24hr	100% | 24hr
CHRP CH-11	Chiller Condenser dT Not Meet	12:00a (1day)	100% | 24hr	100% | 24hr	99% | 23.75hr	--	14% | 3hr	36% | 8.75hr	24% | 5.75hr	45% | 10.75hr

Lessons Learned

1. Data, Data, Data – Acquiring, Organizing, and Quality Control
    - Preventing the “junk in, junk out” problem

2. It is critical to spend time on-site to thoroughly understand and re-commission the plant controls
    - Spend time with each shift
    - The better the understanding of operations the better the automation, FDD, and monitoring

3. Acknowledge and approach the central plant for what it is:
    - “Everything should be made as simple as possible, but no simpler.” – Einstein

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Thank You

Questions?

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