Maximize the Value of Each Existing Utility Meter

Presented by **David Phillips and David Trombly, UC Davis Utilities**

UC Davis (Main Campus)

- 34k students, 23k Faculty & Staff
- 1,000+ buildings, 180 over 10,000SF
- 11.3M SF total, 5,300 acres land
- Founded 1905, avg building age: 41 years old
- Steam production: 700M lbs/yr (NG boilers)
- Chilled water production: 30M ton-h/yr (elect chillers)
- Purchased utilities cost (elect & gas): $30M/year

Better utilizing data from a single electricity meter

"Developing a clear data picture from existing meters might be more valuable than installing a thousand new ones. The proliferation of new sensors should not outpace our efforts to take action using existing data streams."

UC DAVIS

Business Challenges

A. Inform occupants of building device status in real time

B. Generate alarms for assets

C. Assess device utilization to inform building standards development

D. Optimize runtime of building devices

Solution

A. Increase frequency of data collection

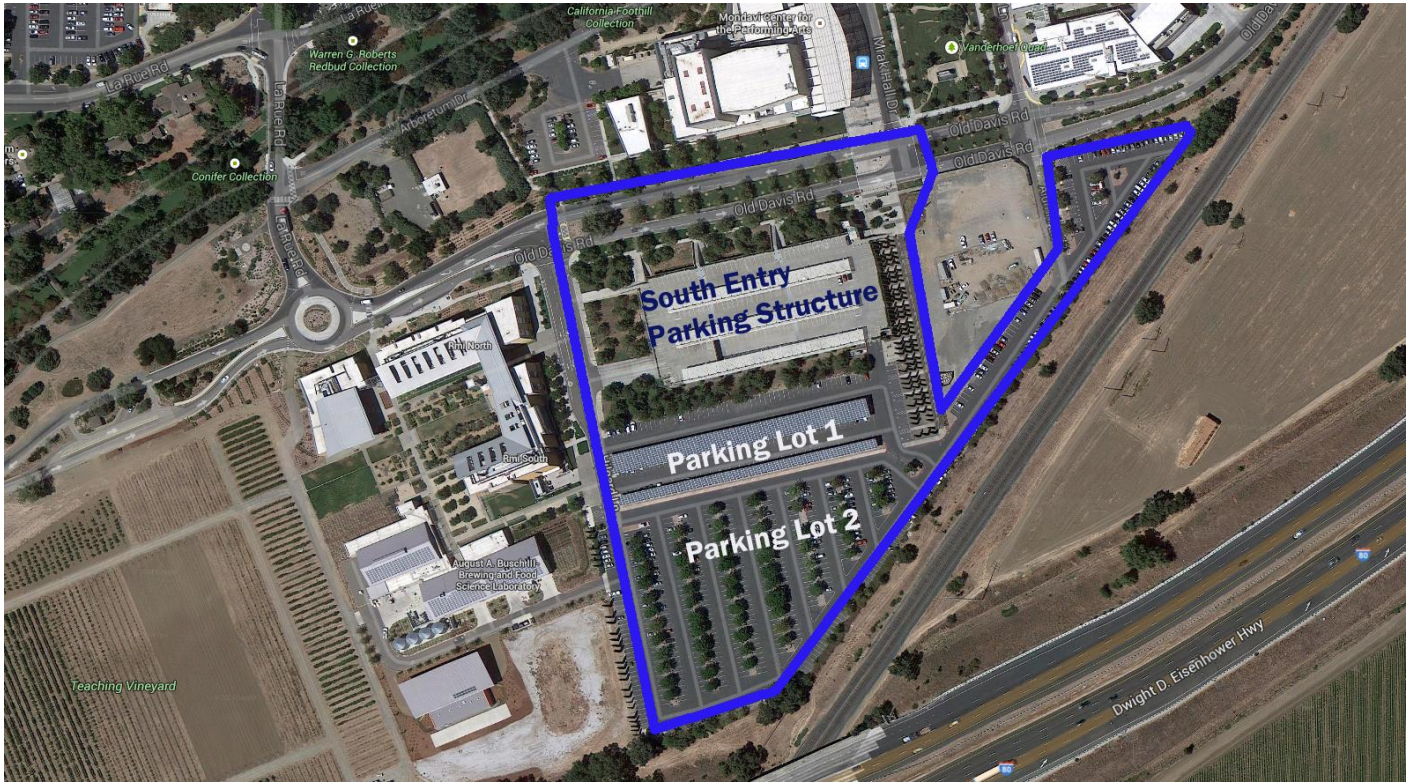
B. Develop detailed equipment inventory

C. Train and build real time analytics using machine learning

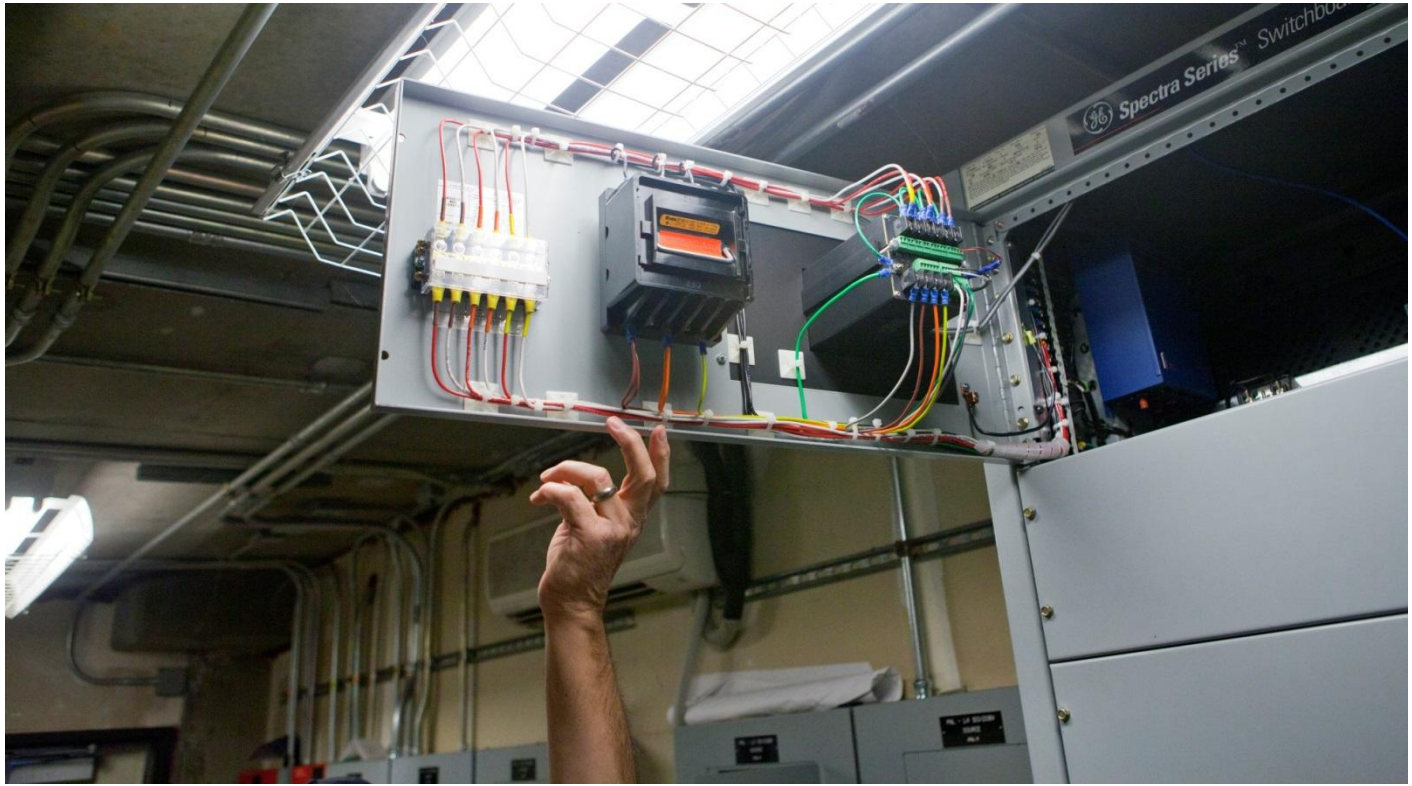
Results and Benefits

- "Easy" fixes by inspection
- Proof of concept app that integrates siloed car charger data

The study area includes a 3-level parking structure and adjacent parking lots

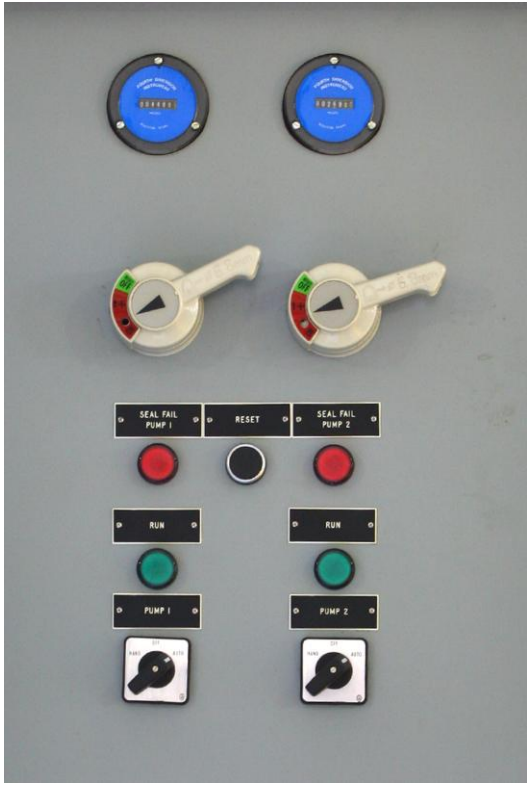


Like many sites, a single electrical meter monitors the whole district



Many electrical loads on the same meter: lights

Many electrical loads on the same meter: pumps & an elevator



Many electrical loads on the same meter: ticket machines & chargers

Business Challenges

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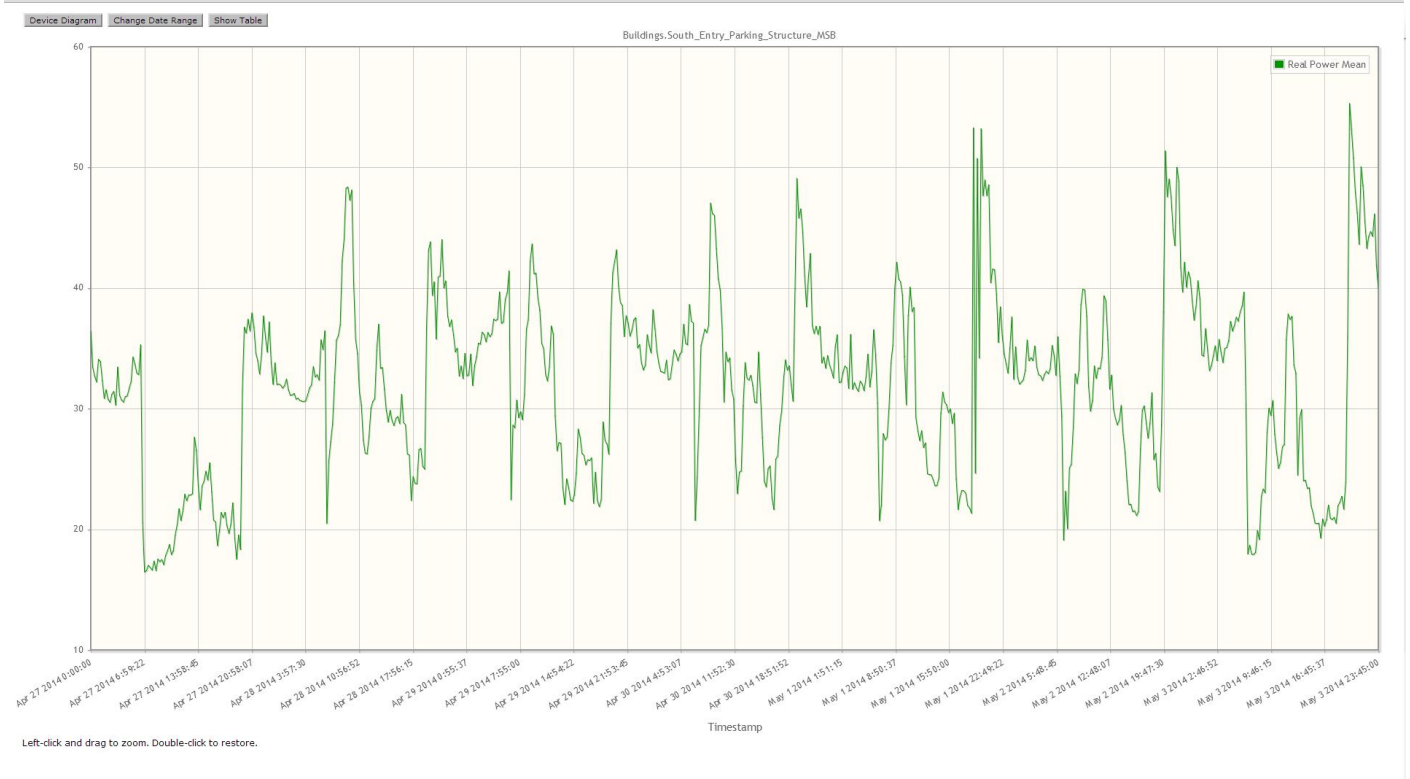
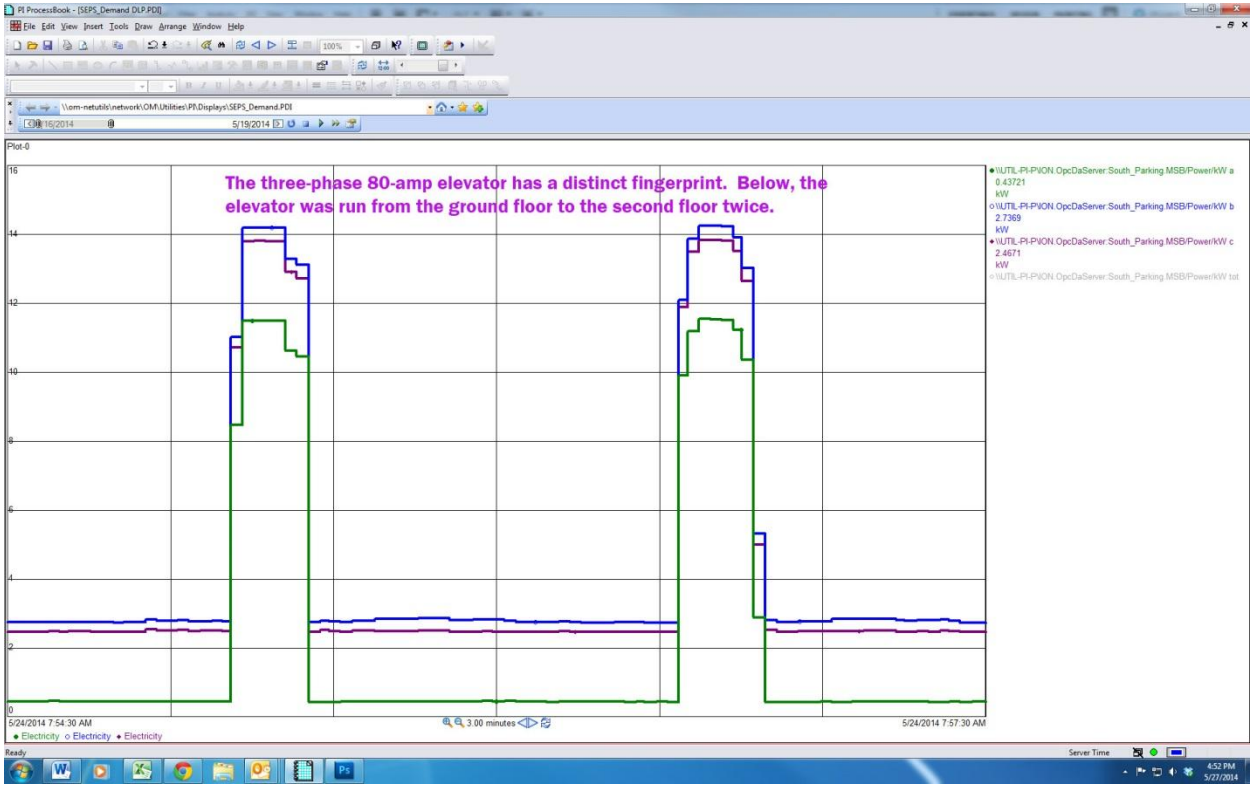
- Generate alarms for assets
- Assess device utilization to inform building standards development
- Optimize runtime of building devices

Historically, power use has been stored as typical 15-minute interval data



Increased frequency of data collection brings out unique device signatures



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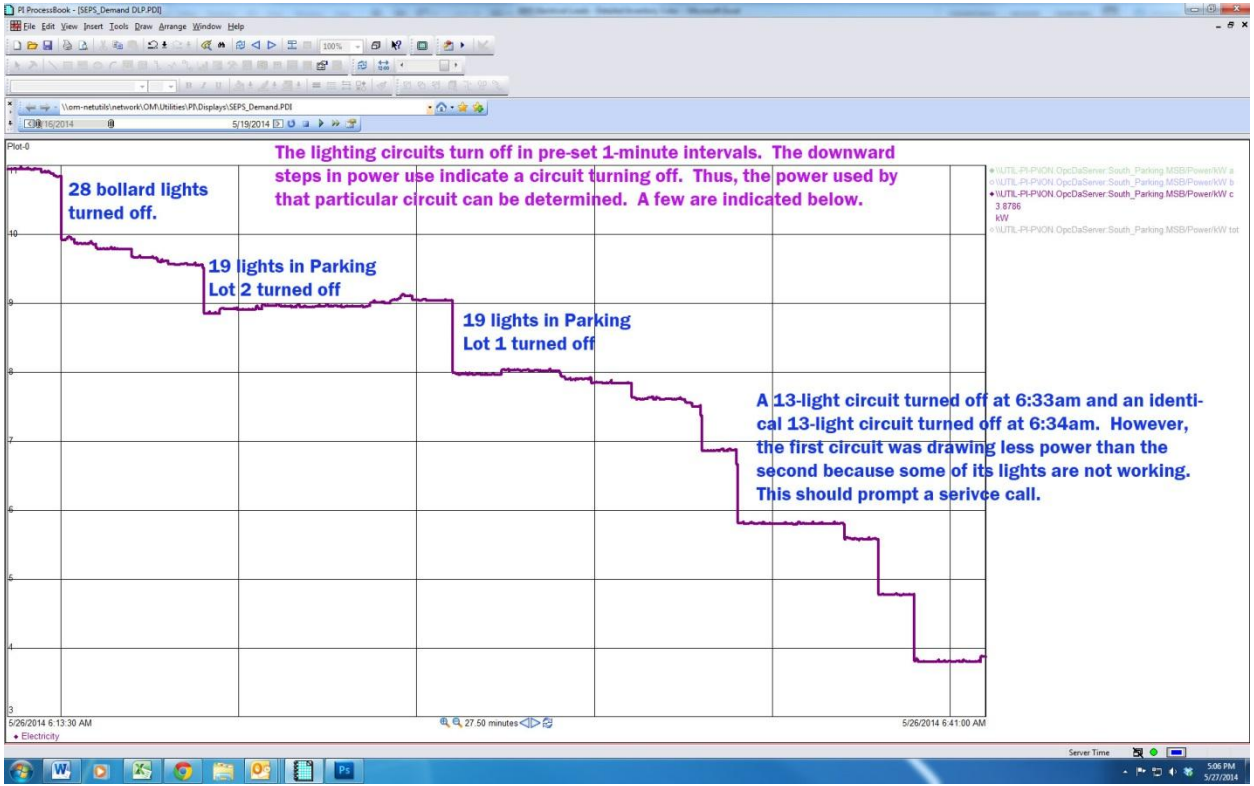
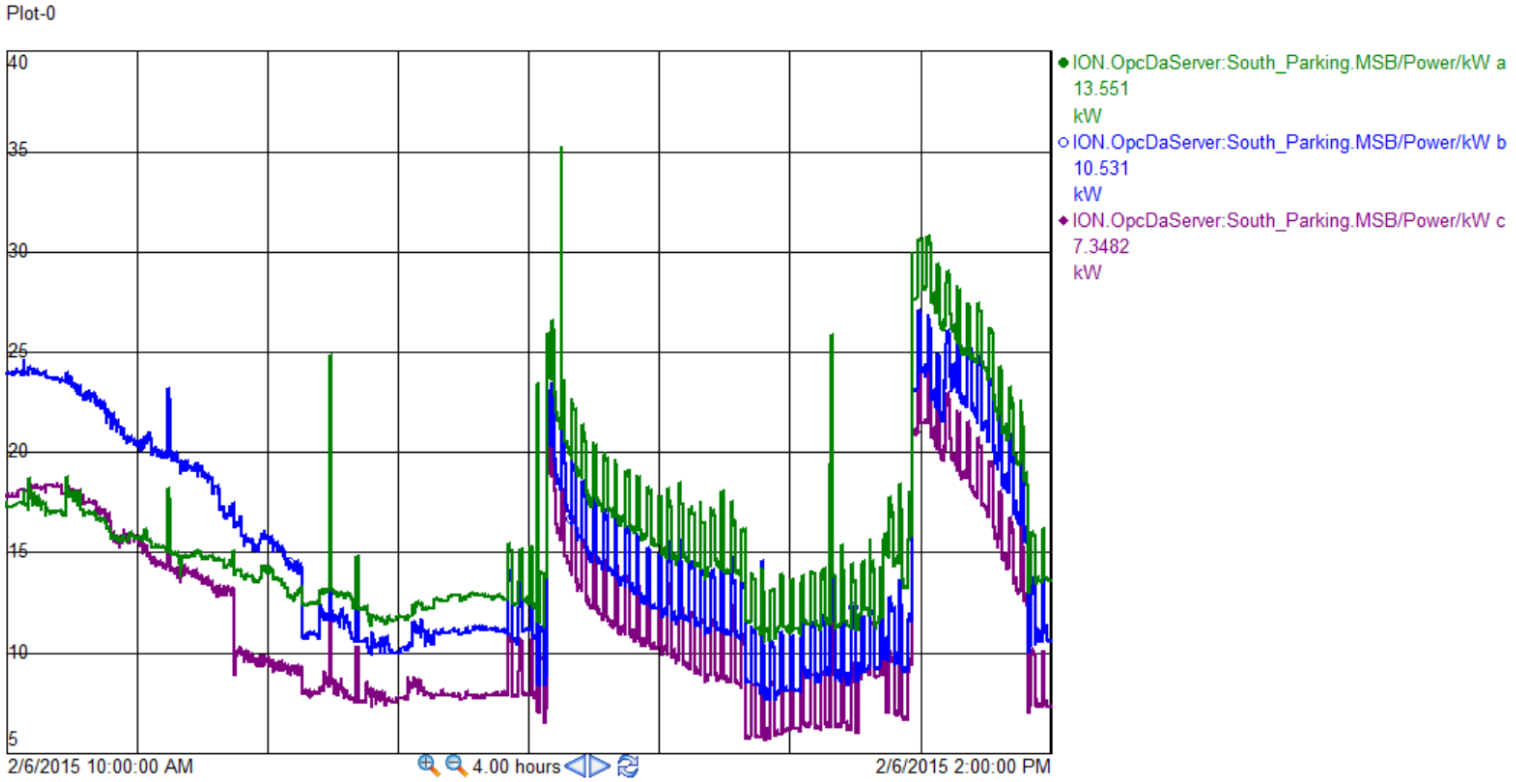
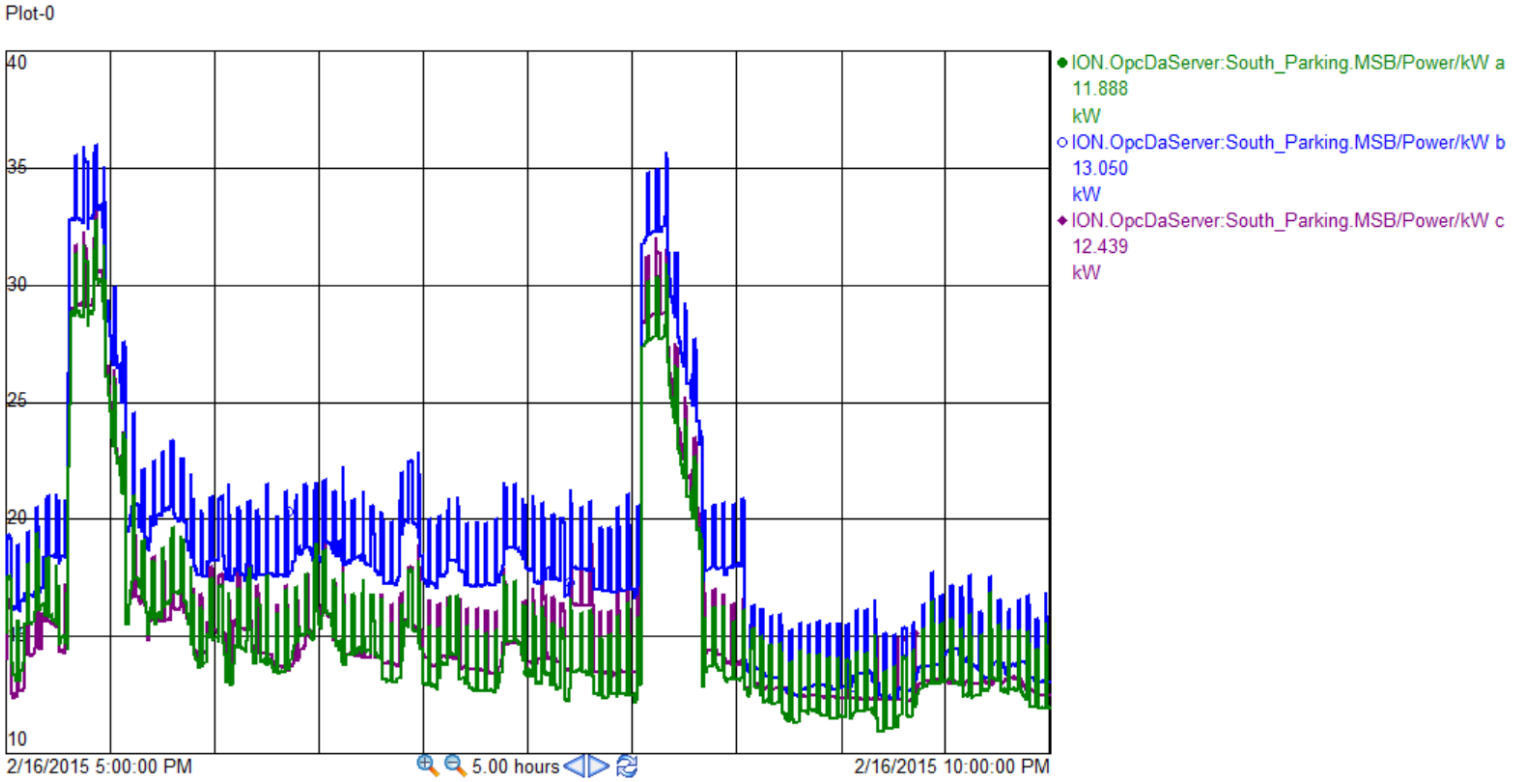


Status obvious at a glance:
Storm pumps running when it's raining



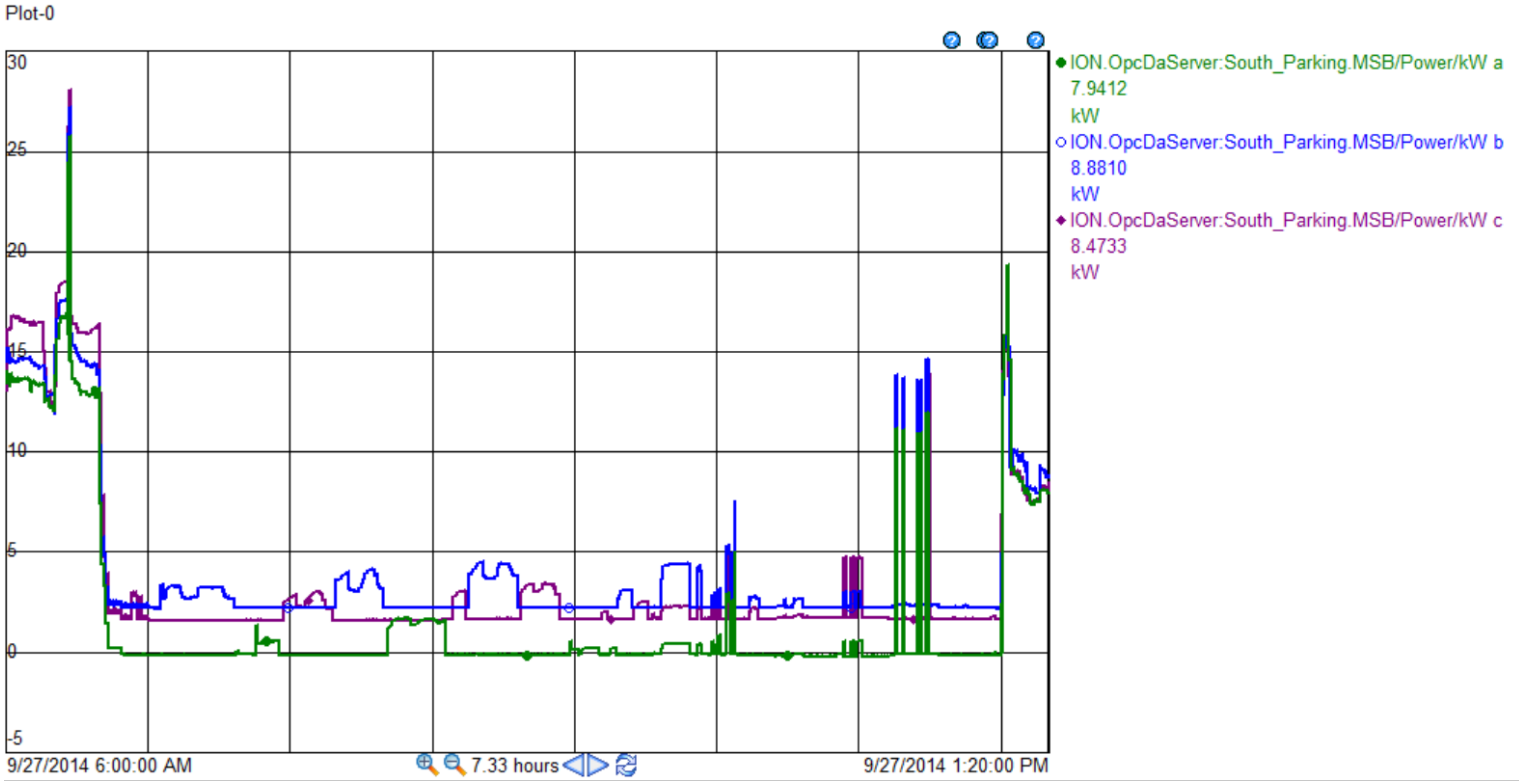
Problems also obvious:
Pumps still running a week later



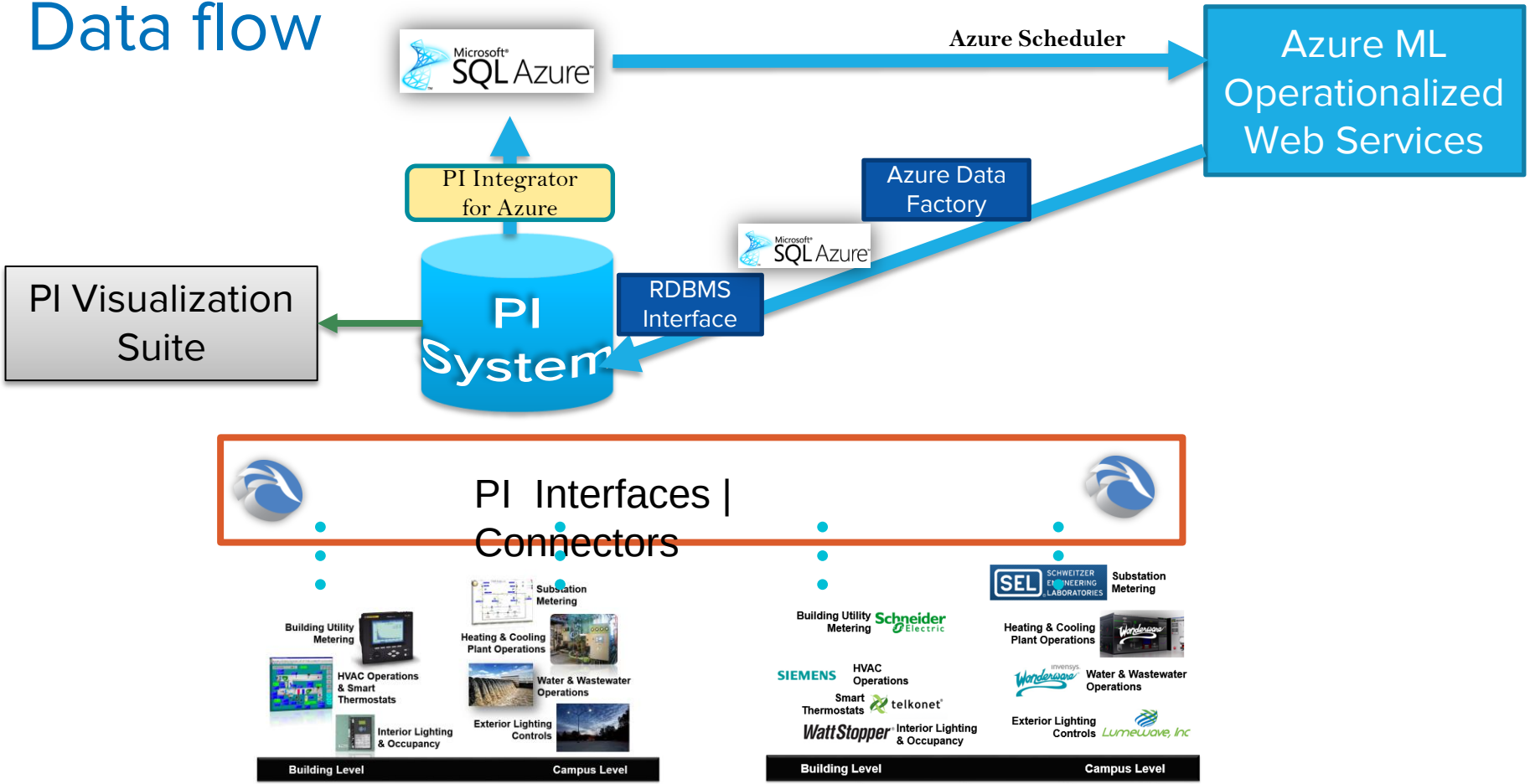
All loads entered into a database to support disaggregation

Load Number	Load Type	Description	High W	Low W	Fed from Panel	Breaker No.	Leg	Load Pattern
1	Elevator	3-Phase Elevator	11 kVa		EH	32, 34, 36	ABC	Periodic based on occupancy
2	Pumps	3-Phase Storm Drainage Pump 2x10HP	7.7 kVa		EH	26, 28, 30	ABC	Periodic based on rainfall
3	Pumps	3-Phase Sewage Ejector 2x1.5HP	1.4 kVa		EH	25, 27, 29	ABC	Periodic based on water use
4	Charger	3-Phase Quick Charger Under Solar Canopy			EH	20, 22, 24	ABC	Periodic based on demand
5	Cooling	2-Pole Cooling Unit, CU-1 in Elev. Rm.			L2	14,16	ABC	Periodic based on temperature
6	Heating	2-Pole Water Heater 4,500W			L2	18,20	CA	Periodic based on water use
7	Heating/Cooling	2-Pole Heat Pump (Ext)			L2	22, 24	BC	Periodic based on temperature
8	Heating/Cooling	2-Pole Heat Pump (Int) in Office			L2	13, 15	ABC	Periodic based on temperature
15	Electronics	Irrigation Controller			L2	26	A	Always on
16	Fans	Fans in Bathroom, Jan., & Office, EF-1, EF-5, SF-1			L2	27	B	Periodic based on occupancy
17	Heating	Generator Heater			L2	28	B	Periodic based on temperature
18	Pumps	MH ABCD Sump Pump			L2	30	C	Periodic based on rainfall
23	Refrigerator	Refridgerator			L1	18	C	Periodic based on temperature
24	Lighting	Traffic Lights	0.2 KvA		L1	1	A	Always on
28	Lighting	South Entry Parking Structure Ground-level	115	55	EH	1	A	Always on - Hi/Lo
31	Lighting	South Entry Parking Structure 2nd-level	115	55	EH	17	C	Always on - Hi/Lo
35	Lighting	South Entry Parking Structure Stairs	70	70	EH	10	B	Dusk-30m to Dawn+30m - Constant
62	Lighting	Parking Lot 1	75	38	H2	1	A	Dusk-30m to Dawn+30m - Hi/Lo
63	Lighting	Parking Lot 1 Under PV Canopy	75	38	H2	1	A	Dusk-30m to Dawn+30m - Hi/Lo

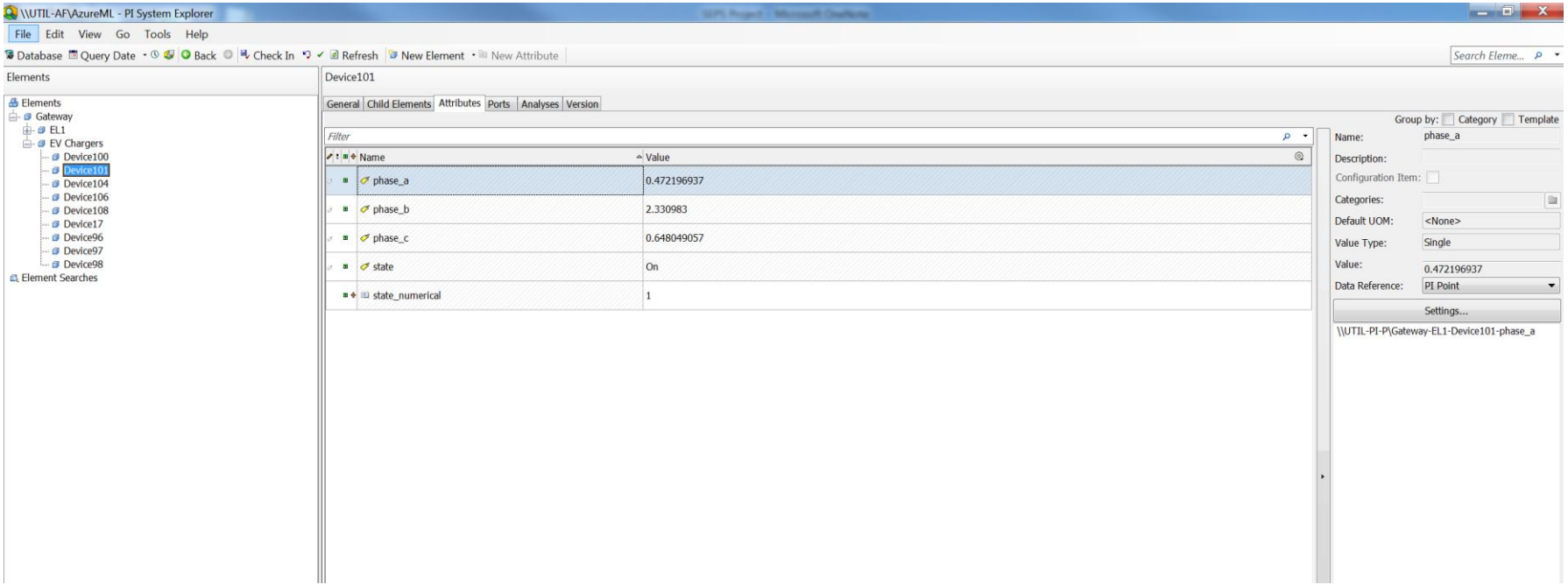
Machine learning: model training



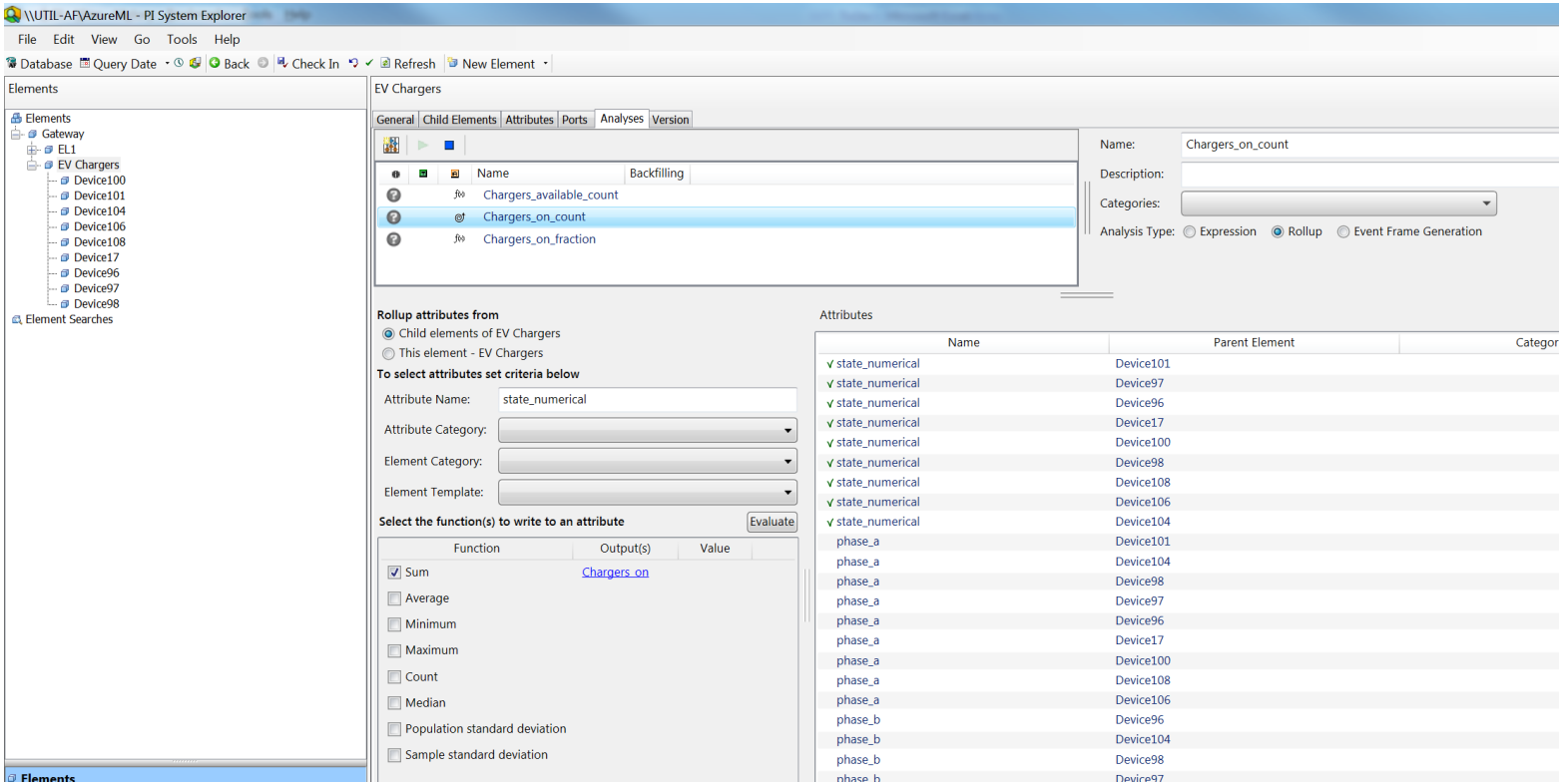
Data flow



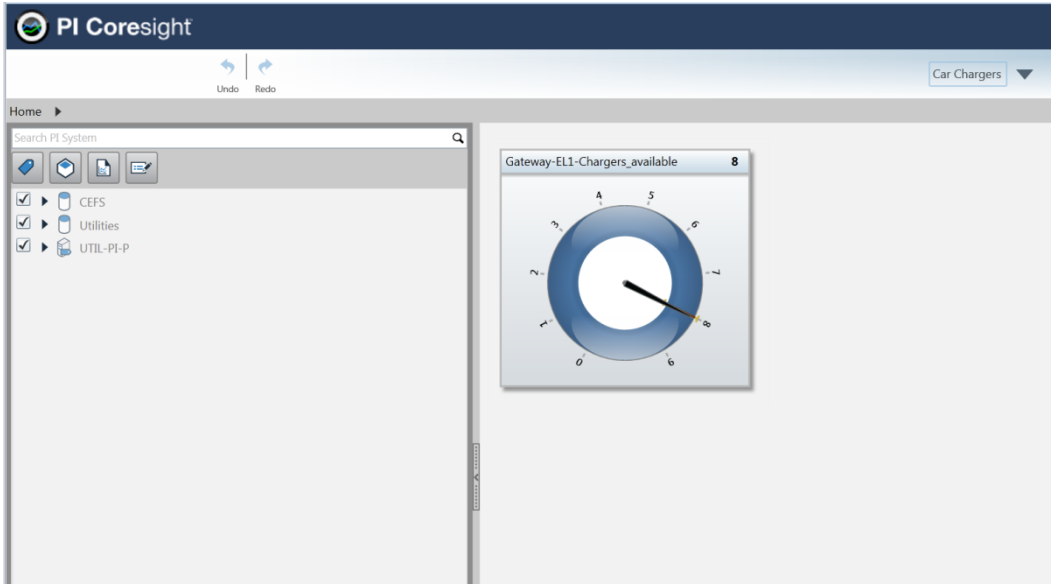
EV charger status in Asset Framework (AF)

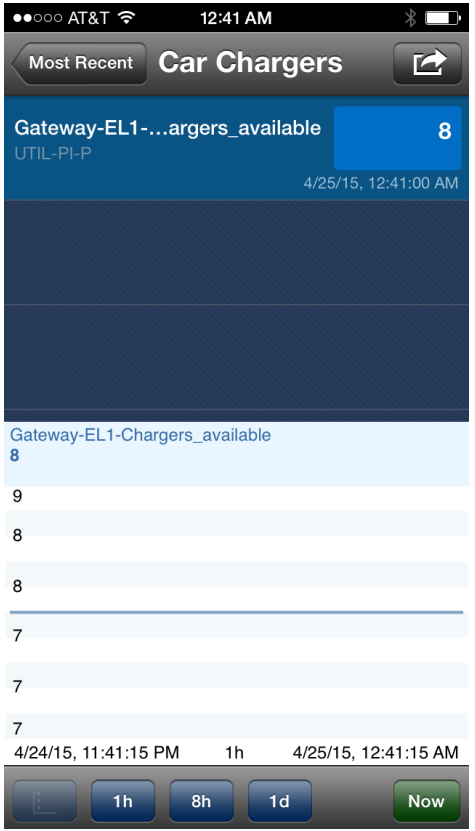


Asset Analytics on EV charger status



Coresight app: number of chargers available





Extensions

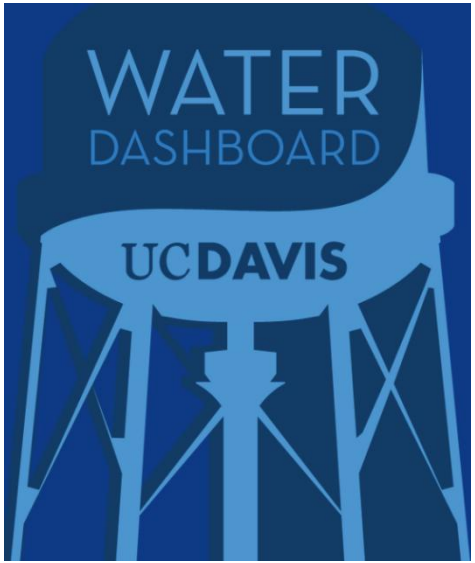
- Deploy car charger app across campus and publicize
- Automate alarms for lights, pumps, elevators
- Use light utilization data to turn the lights down
- Use historical data to inform campus planning

Gateway District

SYSTEMS AND STATUS								
CURRENT USE	43% Max	1/8 Spots						
USE OVER LAST DAY	66% Max	22 Cars	16 Rides	2 Cycles	0 Cycles			
COST OVER LAST WEEK	$251	$143	$18	$3	$0	$8	$28	$75

Better utilizing data from a group of water meters

"Developing a clear data picture from existing meters might be more valuable than installing a thousand new ones. The proliferation of new sensors should not outpace our efforts to take action using existing data streams."



UCDAVIS

Business Challenges

A. Meet campus 20% water reduction goal

Solution

A. Publicly display usage data

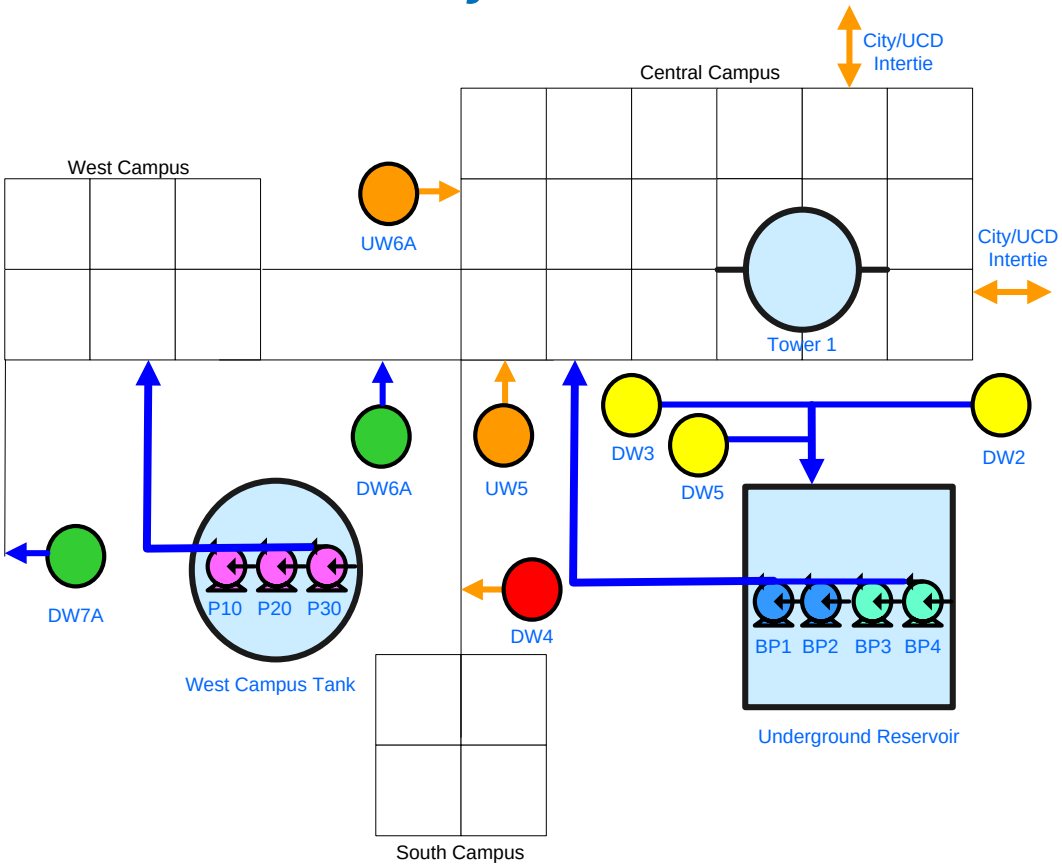
B. Integrate data systems with the PI Server (in progress)

C. Work with stakeholders to identify ways to save

Results and Benefits

- We know where we stand
- Better defined ownership
- Healthy peer pressure

Campus domestic water system



Publicly display usage: water.ucdavis.edu

Please report leaks and other water waste, and send your ideas about how to save water at UC Davis.

DOMESTIC WATER
Water used for campus buildings, central plant, and campus cooling systems

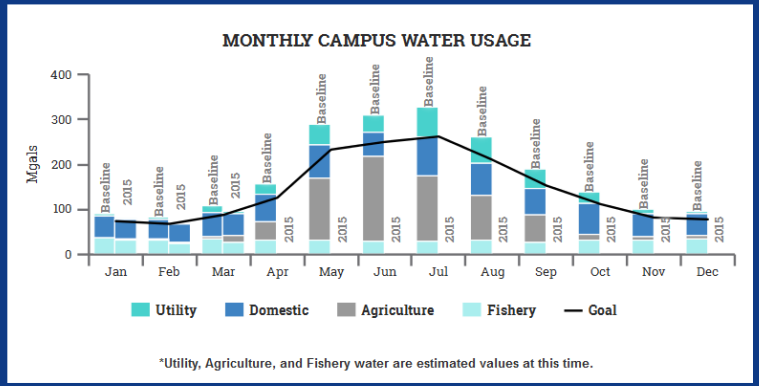
UTILITY WATER
Water used primarily for landscape irrigation

AGRICULTURE WATER
Water used primarily for agricultural research

FISHERIES WATER
Water used for fisheries research

MGAL
Unit designating 1 million gallons

LOOK AT CAMPUS **USAGE** | LOOK AT CAMPUS **DEMAND**



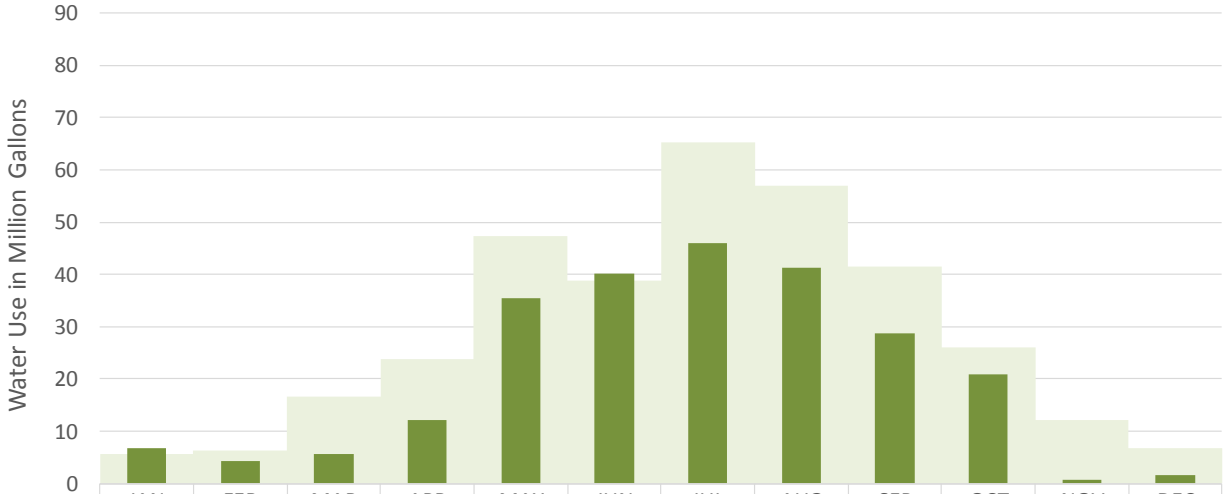
Integration with the PI System

- Real-time demand for domestic and landscape irrigation water: in the PI System from Wonderware, displayed through PI Web API/PI Web Services
- Monthly totals: currently through manually read meters; to be integrated with the PI System in real-time or through PI Manual Logger

Results

Utility Water Use for 2014 and 2013

Total Use in 2014 was 70% of 2013 Baseline



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2013	5.7	6.4	16.7	23.8	47.3	38.8	65.2	56.9	41.5	26.1	12.1	6.7
2014	6.9	4.4	5.6	12.2	35.6	40.1	45.9	41.4	28.7	21.0	0.8	1.7

Results

- We know where we stand
- Better defined ownership
- Healthy peer pressure

Questions

Please wait for the microphone before asking your questions

State your
name & company

THANK YOU

Especially to our project team at Microsoft and OSIsoft