Turning **insight** into **action**.

OSIsoft. USERS CONFERENCE 2011

Leveraging Real-time Data at University of Alaska Fairbanks

Presented by **Chilkoot Ward, University of Alaska Fairbanks.**

About UAF

- We are “America’s Arctic University”
- Established in 1917
- Approximately 10,000 students.
- 3,000,000 square feet of academic, research, administrative and housing space
- UAF ranks fifth among small research universities in the nation and among the top 10 universities in atmospheric science and environmental sciences.
- Research dollars coming to UAF have increased substantially, from $56.4 million in FY97 to $113 million in FY07.

UAF Central Utilities at a Glance

- Steam Heat
  - Two 50,000 lb/hr coal boilers (1964)
  - One 100,000 lb/hr oil boiler (1972)
  - One 100,000 lb/hr oil or gas boiler (1986)
- Electricity
  - 10 MW steam turbine (1980)
  - 9.6 MW diesel engine generator (DEG) (1999)
  - 4,160 volt distribution system (1964-present)
  - **12,470 volt switchgear (2010-2011)**
- Drinking and Fire Protection Water
  - 1 MGD Water Treatment Plant (1979)
- Walk Through Utilidor System
- 1,800 ton district Chilled Water system(Lower Campus Only) (2005)

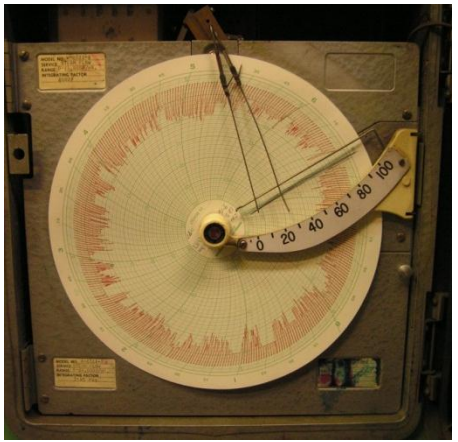
History of Plant Automation

Years of constant migration:

- Originally all pneumatic controls, conceived as a teaching lab
- Converted to Analog electric controls
- Converted to DCS
- Evolving to more distributed control and monitoring including field bus

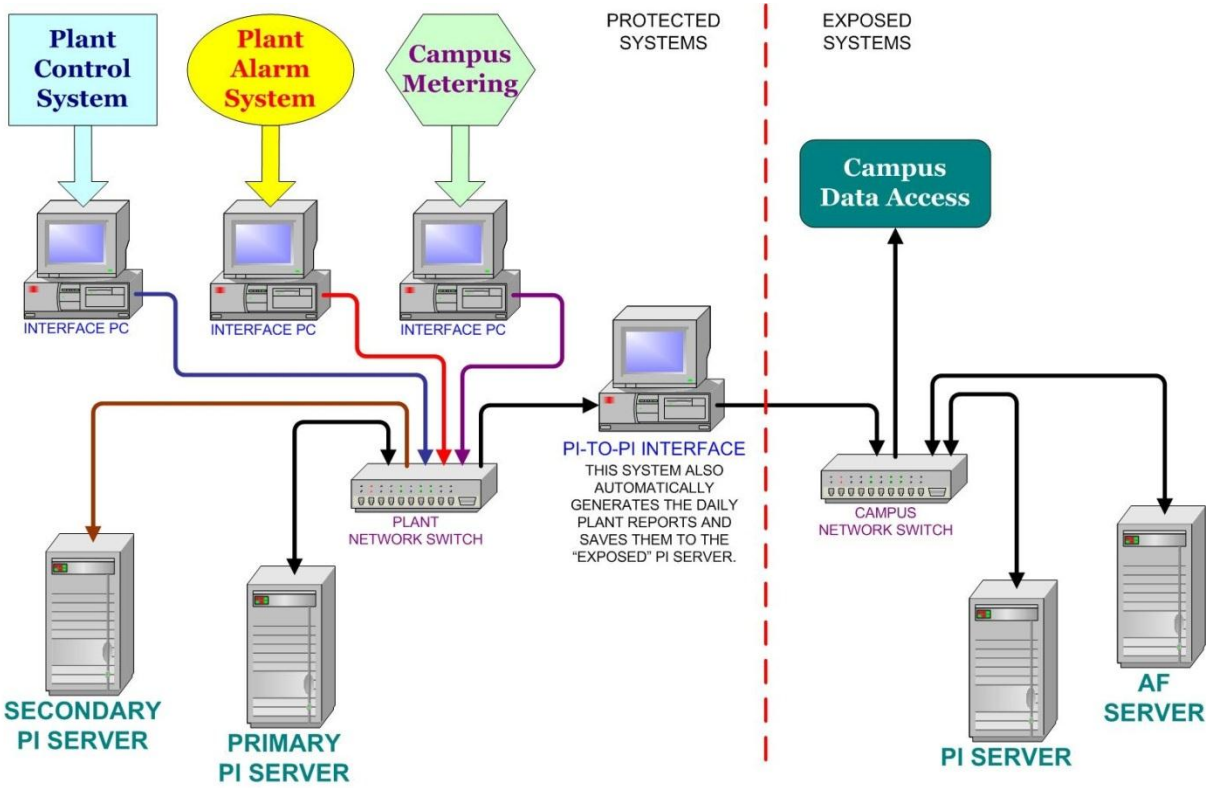
Data collection history:

- Clipboards
- Strip chart recorders (pneumatic and electric)
- Electronic collection with printing on paper
- Electronic collection with electronic storage
- Electronic collection with one database



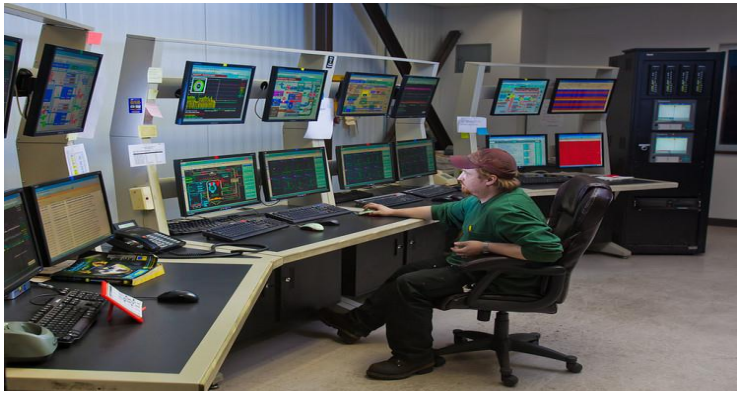
The Data Mess at UAF

Data Collection Systems Architecture



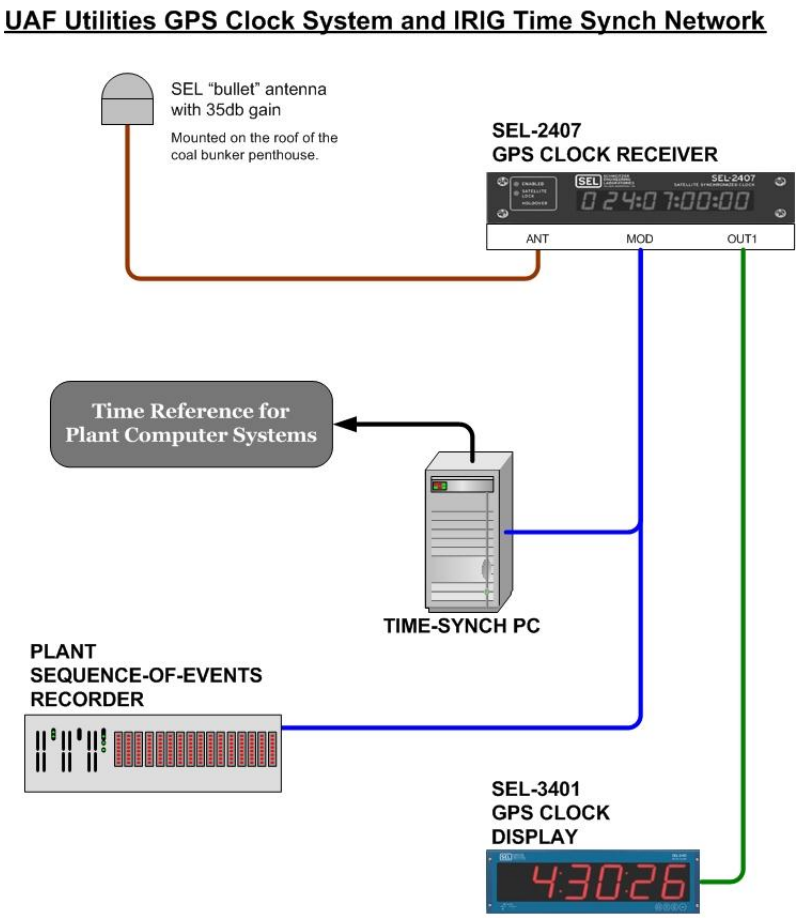
OSIsoft software used

- UAF currently uses
  - PI Server
  - PI ProcessBook
  - PI DataLink
  - PI System Management Tools (PI SMT)
  - PI ActiveView
  - PI to PI Interface
  - PI Manual Logger
  - PI AlarmView
  - Several PI System interfaces
  - PI AF
- Future implementation
  - PI OLEDB
  - PI DataLink for Excel Services
  - PI WebParts
  - PI Advanced Computing Engine (PI ACE)

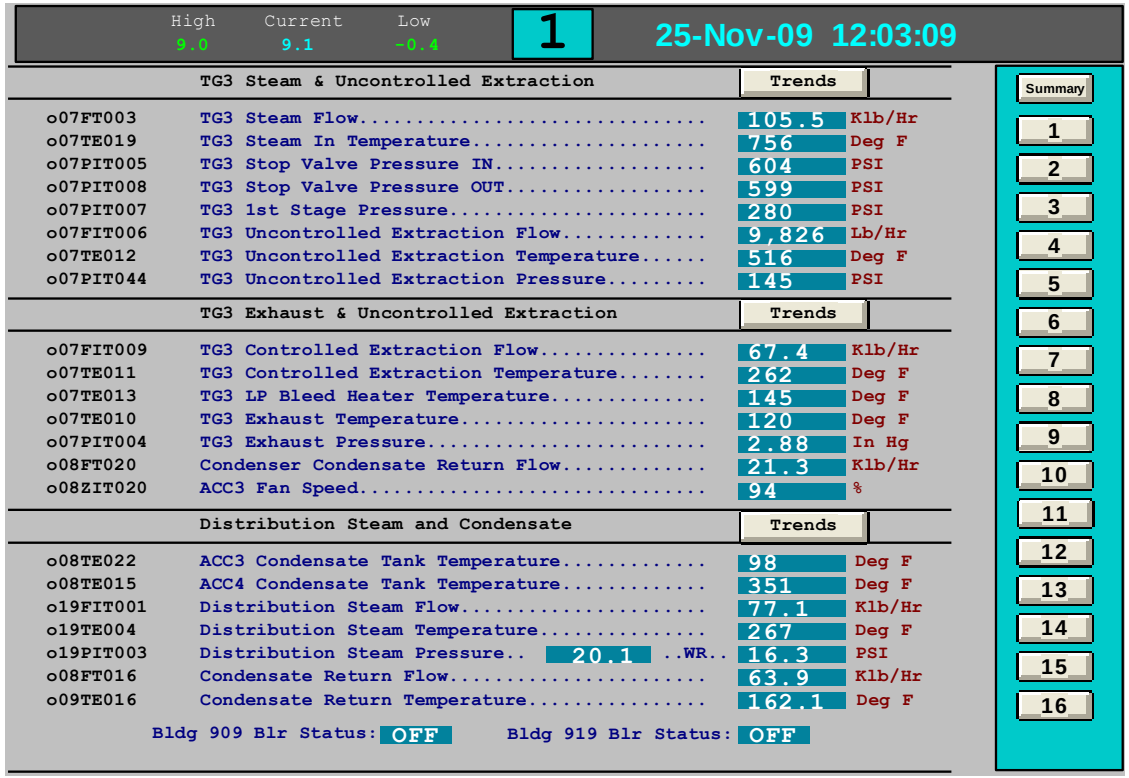


Time

- How to keep all the computer clocks synchronized



Old Style Displays



High	Current	Low		
9.0	9.1	-0.4	1	25-Nov-09 12:03:09

TG3 Steam & Uncontrolled Extraction — Trends

o07FT003	TG3 Steam Flow	105.5	Klb/Hr
o07TE019	TG3 Steam In Temperature	756	Deg F
o07PIT005	TG3 Stop Valve Pressure IN	604	PSI
o07PIT008	TG3 Stop Valve Pressure OUT	599	PSI
o07PIT007	TG3 1st Stage Pressure	280	PSI
o07FIT006	TG3 Uncontrolled Extraction Flow	9,826	Lb/Hr
o07TE012	TG3 Uncontrolled Extraction Temperature	516	Deg F
o07PIT044	TG3 Uncontrolled Extraction Pressure	145	PSI

TG3 Exhaust & Uncontrolled Extraction — Trends

o07FIT009	TG3 Controlled Extraction Flow	67.4	Klb/Hr
o07TE011	TG3 Controlled Extraction Temperature	262	Deg F
o07TE013	TG3 LP Bleed Heater Temperature	145	Deg F
o07TE010	TG3 Exhaust Temperature	120	Deg F
o07PIT004	TG3 Exhaust Pressure	2.88	In Hg
o08FT020	Condenser Condensate Return Flow	21.3	Klb/Hr
o08ZIT020	ACC3 Fan Speed	94	%

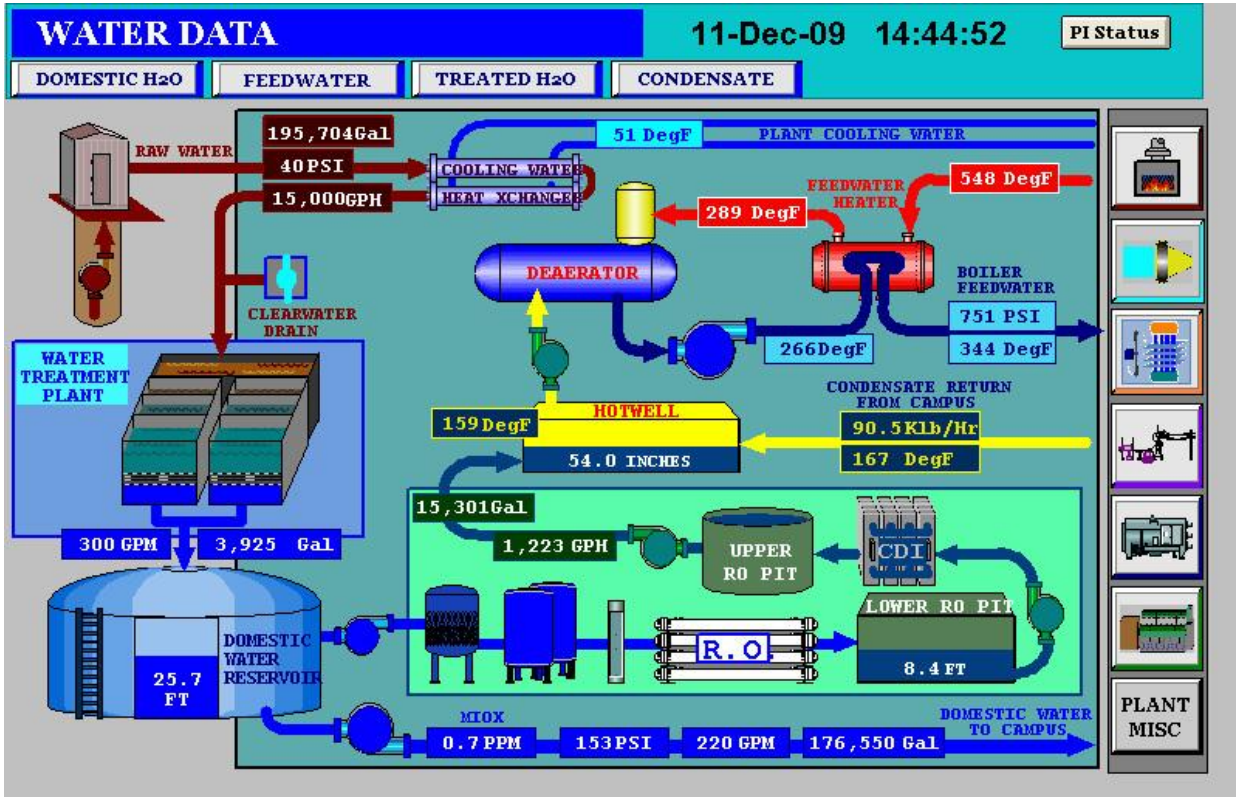
Distribution Steam and Condensate — Trends

o08TE022	ACC3 Condensate Tank Temperature			98	Deg F
o08TE015	ACC4 Condensate Tank Temperature			351	Deg F
o19FIT001	Distribution Steam Flow			77.1	Klb/Hr
o19TE004	Distribution Steam Temperature			267	Deg F
o19PIT003	Distribution Steam Pressure..	20.1	..WR..	16.3	PSI
o08FT016	Condensate Return Flow			63.9	Klb/Hr
o09TE016	Condensate Return Temperature			162.1	Deg F

Bldg 909 Blr Status: OFF Bldg 919 Blr Status: OFF

Summary 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

New Displays

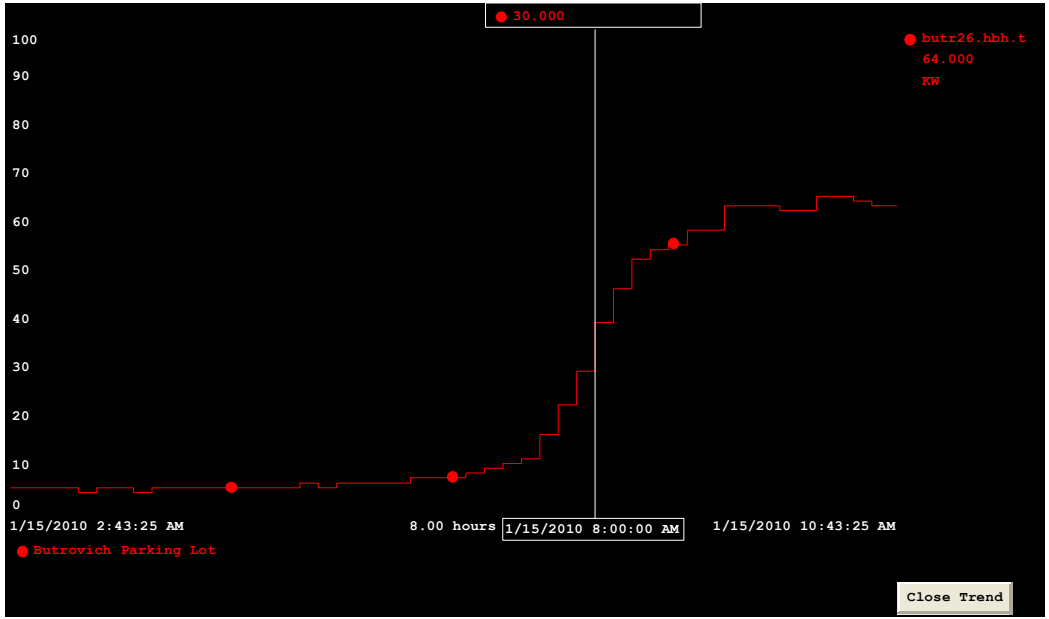


Data Sources

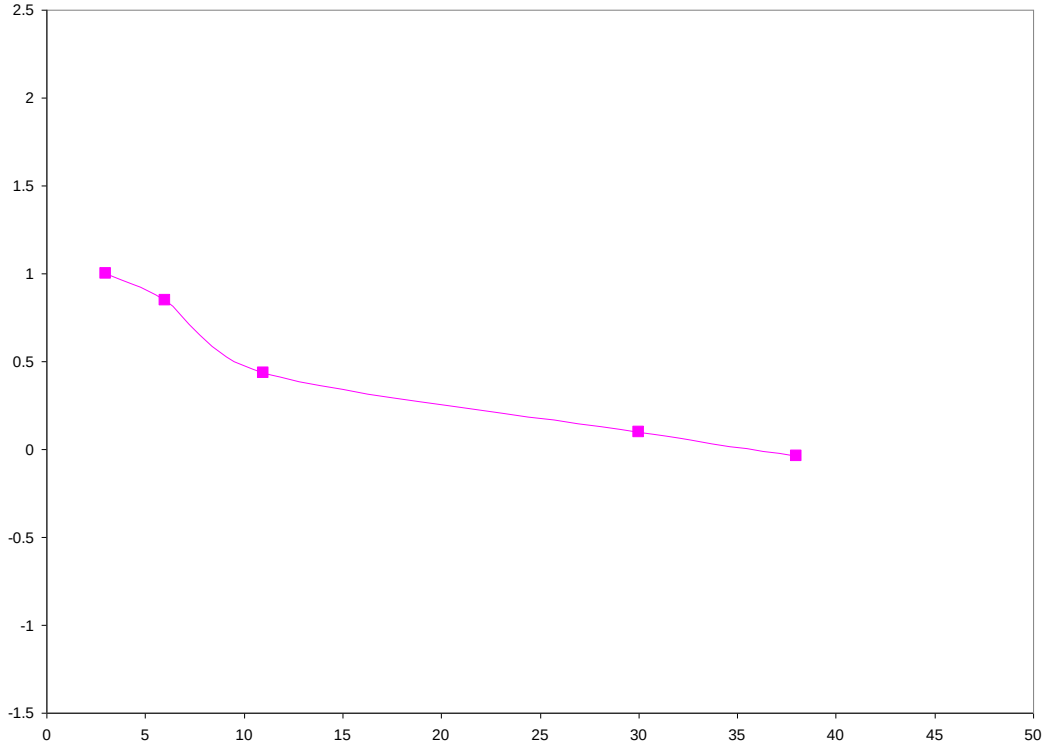
- CHP equipment
- Water treatment plant
- Chilled water plant
- Building automation system
- Campus energy monitoring system
- Or a small portion of UAF's 360+ million acre campus

What to Measure

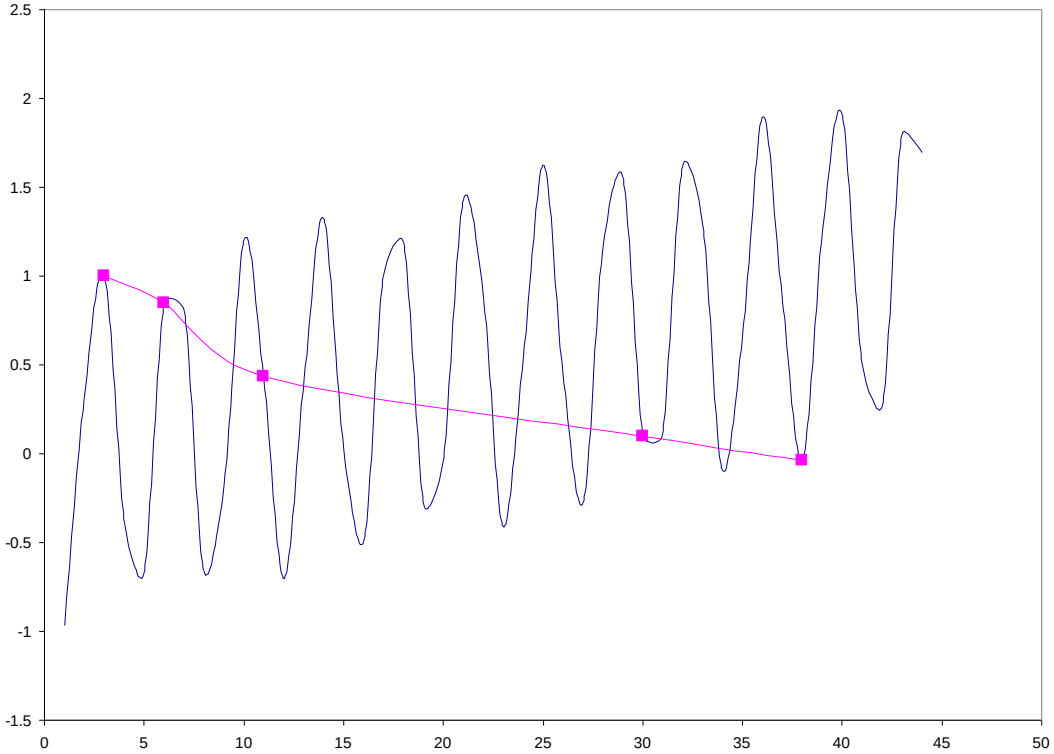
- **Measure everything**
  - Including Set points and control outputs
  - **Measure rate data whenever possible**
  - Connect to as many data points as possible
  - One Storage database with a single reporting tool
- **Trend everything**



Manual Readings

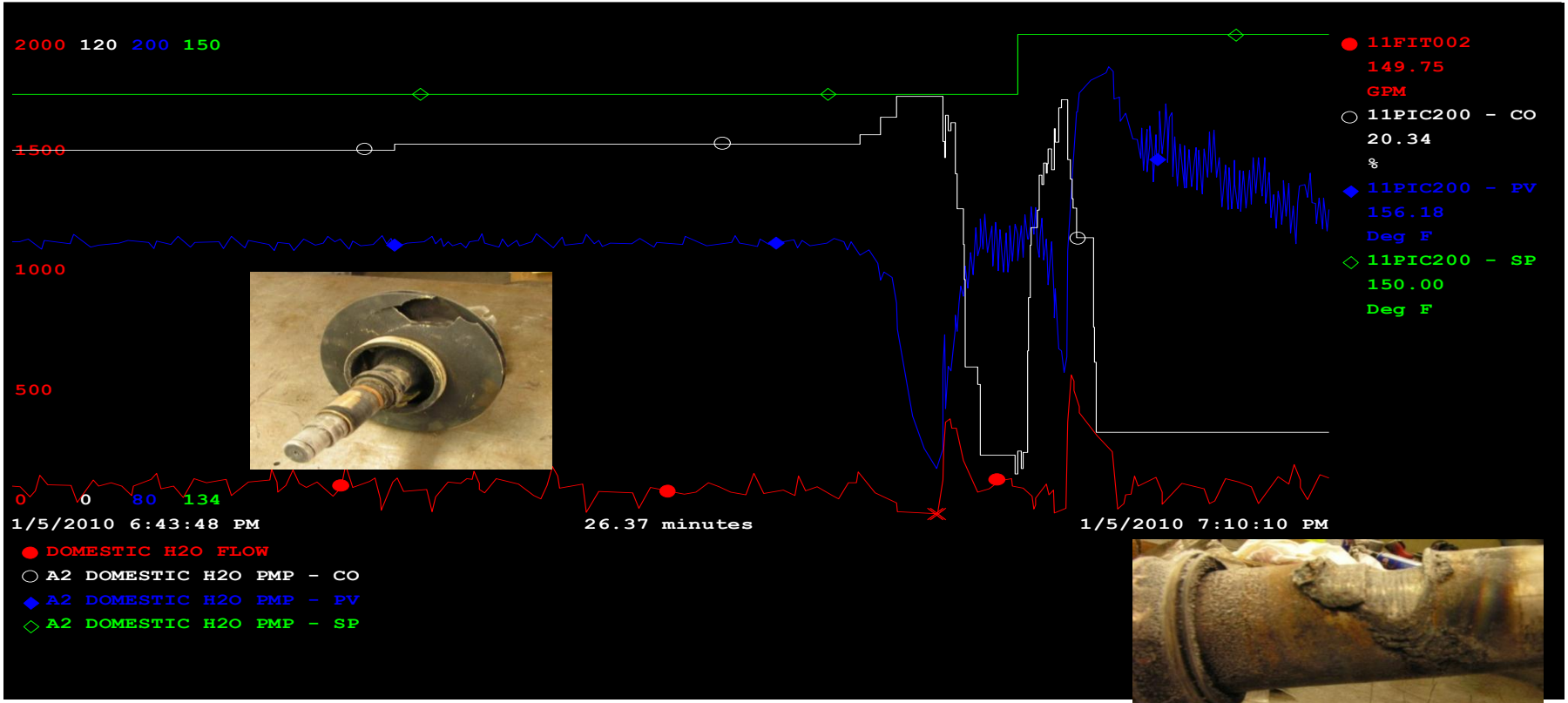


The real data can be hidden!



Electronic Clipboard

Destruction of A2 Domestic Water Pump



The Plan to Save

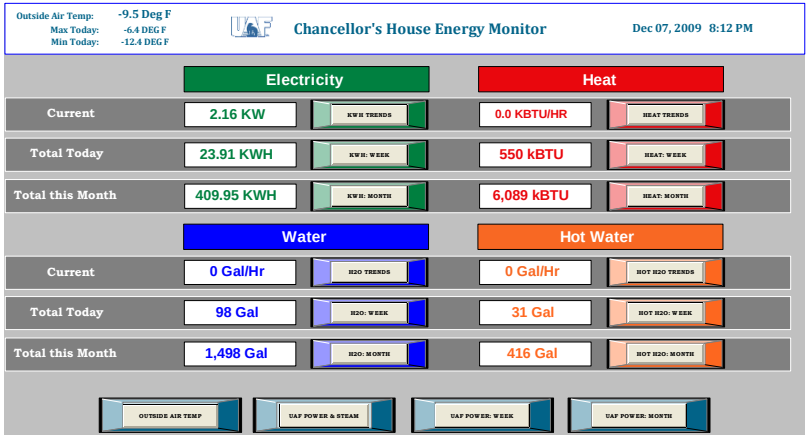
- Currently the campus users have know idea the amount of energy they consume, or what it costs.
- We are switching from a “utilities are free” model to utilities billed on actual usage.
- We will accomplish this using the same data collection system we already have in place.

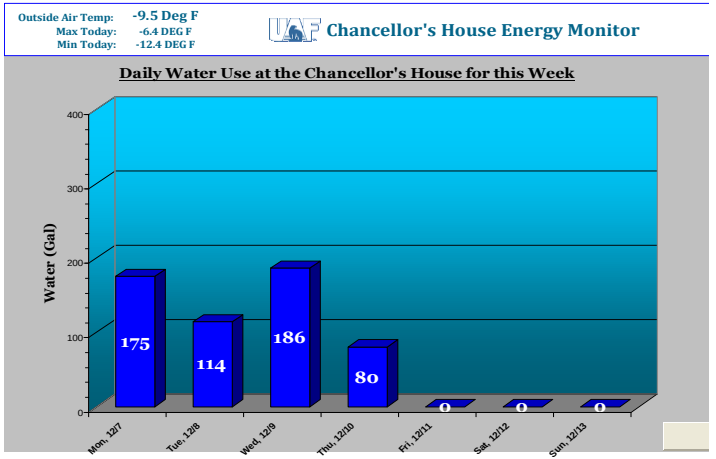
The key to conservation success is visibility into cost and performance data that spans the entire chain of energy production and use across the university

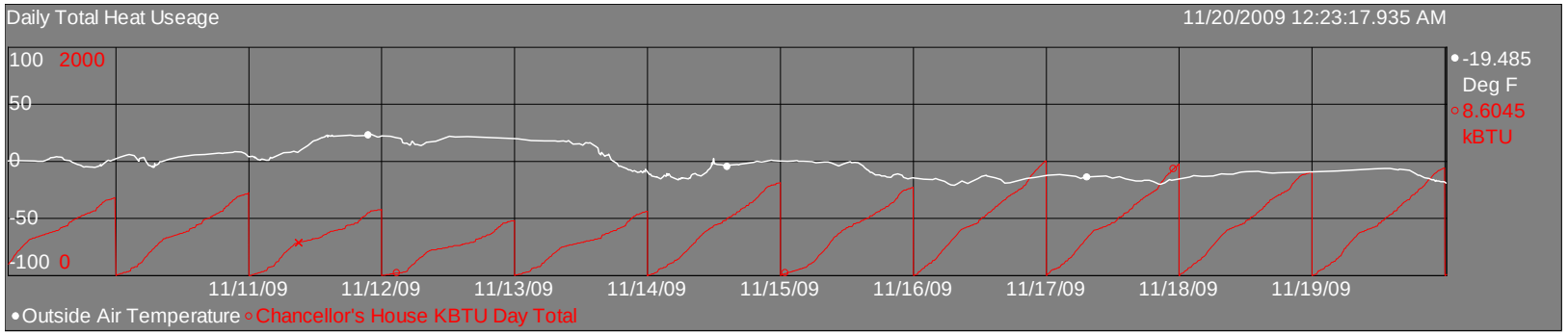
Energy Kiosk

CURRENT ENERGY USE

Chancellor's House Display

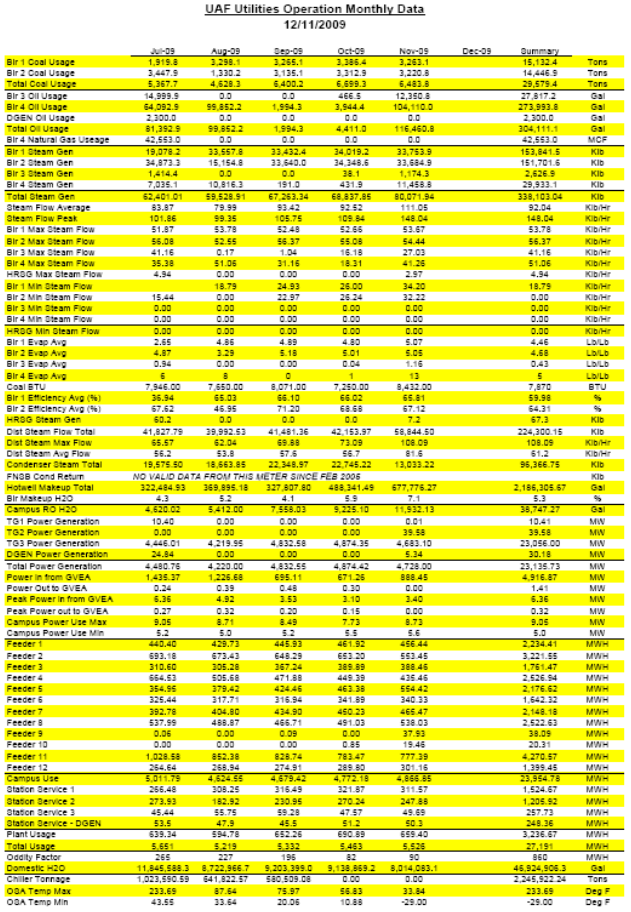






Reporting

- Reports Generated
  - Hourly
  - Daily
  - Weekly
  - Monthly
  - Environmental
  - EIA
  - Ad hoc reports



UAF Utilities Operation Monthly Data
12/11/2009

	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Summary	
Blr 1 Coal Usage	1,919.8	3,298.1	3,285.1	3,386.4	3,263.1		15,132.4	Tons
Blr 2 Coal Usage	3,447.9	1,330.2	3,135.1	3,312.9	3,220.8		14,446.9	Tons
Total Coal Usage	5,367.7	4,628.3	6,400.2	6,699.3	6,483.8		29,579.4	Tons
Blr 3 Oil Usage	14,999.9	0.0	0.0	466.5	12,360.8		27,817.2	Gal
Blr 4 Oil Usage	64,092.9	99,862.2	1,994.3	3,944.4	104,110.0		273,993.8	Gal
DGEN Oil Usage	2,300.0	0.0	0.0	0.0	0.0		2,300.0	Gal
Total Oil Usage	81,392.9	99,862.2	1,994.3	4,411.0	116,460.8		304,111.1	Gal
Blr 4 Natural Gas Useage	42,563.0	0.0	0.0	0.0	0.0		42,563.0	MCF
Blr 1 Steam Gen	19,078.2	33,557.8	33,432.4	34,019.2	33,753.9		153,841.5	Klb
Blr 2 Steam Gen	34,873.3	15,164.8	33,640.0	34,348.6	33,684.9		151,701.6	Klb
Blr 3 Steam Gen	1,414.4	0.0	0.0	38.1	1,174.3		2,626.9	Klb
Blr 4 Steam Gen	7,035.1	10,816.3	191.0	431.9	11,458.8		29,933.1	Klb
Total Steam Gen	62,401.01	59,528.91	67,263.34	68,837.85	80,071.94		338,103.04	Klb
Steam Flow Average	83.87	79.99	93.42	92.52	111.05		92.04	Klb/Hr
Steam Flow Peak	101.86	99.36	105.75	109.84	148.04		148.04	Klb/Hr
Blr 1 Max Steam Flow	51.87	53.78	52.49	52.66	53.67		53.78	Klb/Hr
Blr 2 Max Steam Flow	56.08	52.56	56.37	55.08	54.44		56.37	Klb/Hr
Blr 3 Max Steam Flow	41.16	0.17	1.04	16.18	27.03		41.16	Klb/Hr
Blr 4 Max Steam Flow	35.38	51.06	31.16	18.31	41.26		51.06	Klb/Hr
HRDG Max Steam Flow	4.94	0.00	0.00	0.00	2.97		4.94	Klb/Hr
Blr 1 Min Steam Flow		18.79	24.93	26.00	34.20		18.79	Klb/Hr
Blr 2 Min Steam Flow	15.44	0.00	22.97	26.24	32.22		0.00	Klb/Hr
Blr 3 Min Steam Flow	0.00	0.00	0.00	0.00	0.00		0.00	Klb/Hr
Blr 4 Min Steam Flow	0.00	0.00	0.00	0.00	0.00		0.00	Klb/Hr
HRDG Min Steam Flow	0.00	0.00	0.00	0.00	0.00		0.00	Klb/Hr
Blr 1 Evap Avg	2.65	4.86	4.89	4.80	5.07		4.46	Lb/Lb
Blr 2 Evap Avg	4.87	3.29	5.18	5.01	5.05		4.68	Lb/Lb
Blr 3 Evap Avg	0.94	0.00	0.00	0.04	1.16		0.43	Lb/Lb
Blr 4 Evap Avg	6	6	0	1	13		6	Lb/Lb
Coal BTU	7,946.00	7,650.00	8,071.00	7,250.00	8,432.00		7,870	BTU
Blr 1 Efficiency Avg (%)	36.94	65.33	66.10	66.02	65.81		59.86	%
Blr 2 Efficiency Avg (%)	67.62	46.96	71.20	68.68	67.12		64.31	%
HRDG Steam Gen	60.2	0.0	0.0	0.0	7.2		67.3	Klb
Dist Steam Flow Total	41,827.79	39,992.53	41,491.36	42,153.97	58,844.50		224,300.15	Klb
Dist Steam Max Flow	65.57	62.04	69.88	73.09	108.09		108.09	Klb/Hr
Dist Steam Avg Flow	56.2	53.8	57.6	56.7	81.6		61.2	Klb/Hr
Condenser Steam Total	19,575.60	18,663.85	22,348.97	22,745.22	13,033.22		96,366.75	Klb
FNDB Cond Return	*NO VALID DATA FROM THIS METER SINCE FEB 2006*							Klb
Hotwell Makeup Total	322,484.93	369,895.18	327,807.80	488,341.49	677,776.27		2,186,305.67	Gal
Blr Makeup H2O	4.3	5.2	4.1	6.9	7.1		5.3	%
Campus RO H2O	4,620.02	5,412.00	7,558.03	9,225.10	11,932.13		38,747.27	Gal
TG1 Power Generation	10.40	0.00	0.00	0.00	0.01		10.41	MW
TG2 Power Generation	0.00	0.00	0.00	0.00	39.58		39.58	MW
TG3 Power Generation	4,446.01	4,219.95	4,832.58	4,874.35	4,683.10		23,056.00	MW
DGEN Power Generation	24.84	0.00	0.00	0.00	5.34		30.18	MW
Total Power Generation	4,480.76	4,220.00	4,832.58	4,874.42	4,728.00		23,136.73	MW
Power in from GVEA	1,435.37	1,226.68	695.11	671.26	888.45		4,916.87	MW
Power Out to GVEA	0.24	0.39	0.48	0.30	0.00		1.41	MW
Peak Power in from GVEA	6.36	4.92	3.53	3.10	3.40		6.36	MW
Peak Power out to GVEA	0.27	0.32	0.20	0.15	0.00		0.32	MW
Campus Power Use Max	9.05	8.71	8.49	7.73	8.73		9.05	MW
Campus Power Use Min	5.2	5.0	5.2	5.5	5.6		5.0	MW
Feeder 1	440.40	429.73	445.93	461.92	456.44		2,234.41	MWH
Feeder 2	693.16	673.43	648.29	663.20	663.45		3,221.55	MWH
Feeder 3	310.60	306.28	367.24	389.89	388.46		1,761.47	MWH
Feeder 4	664.63	505.68	471.88	449.39	435.46		2,526.94	MWH
Feeder 5	354.95	379.42	424.46	463.38	554.42		2,176.62	MWH
Feeder 6	325.44	317.71	316.94	341.89	340.33		1,642.32	MWH
Feeder 7	392.78	404.80	434.90	460.23	466.47		2,148.18	MWH
Feeder 8	537.99	488.87	466.71	491.03	538.03		2,522.63	MWH
Feeder 9	0.06	0.00	0.09	0.00	37.93		38.09	MWH
Feeder 10	0.00	0.00	0.00	0.85	19.46		20.31	MWH
Feeder 11	1,028.58	852.38	828.74	783.47	777.39		4,270.57	MWH
Feeder 12	264.64	268.94	274.91	289.80	301.16		1,399.45	MWH
Campus Use	5,011.79	4,624.55	4,679.42	4,772.18	4,866.85		23,954.78	MWH
Station Service 1	266.48	306.25	316.49	321.87	311.57		1,524.67	MWH
Station Service 2	273.93	182.92	230.95	270.24	247.88		1,205.92	MWH
Station Service 3	45.44	55.75	59.28	47.57	49.69		257.73	MWH
Station Service - DGEN	53.5	47.9	45.5	51.2	50.3		248.36	MWH
Plant Usage	639.34	594.78	652.26	690.89	659.40		3,236.67	MWH
Total Usage	5,651	5,219	5,332	5,463	5,526		27,191	MWH
Oddity Factor	265	227	196	82	90		860	MWH
Domestic H2O	11,846,588.3	8,722,966.7	9,203,399.0	9,138,869.2	8,014,083.1		46,924,906.3	Gal
Chiller Tonnage	1,023,690.59	641,922.57	580,609.08	0.00	0.00		2,246,922.24	Tons
OGA Temp Max	233.69	87.64	75.97	56.83	33.84		233.69	Deg F
OGA Temp Min	43.55	33.64	20.06	10.88	-29.00		-29.00	Deg F

Info on the Data Collection System

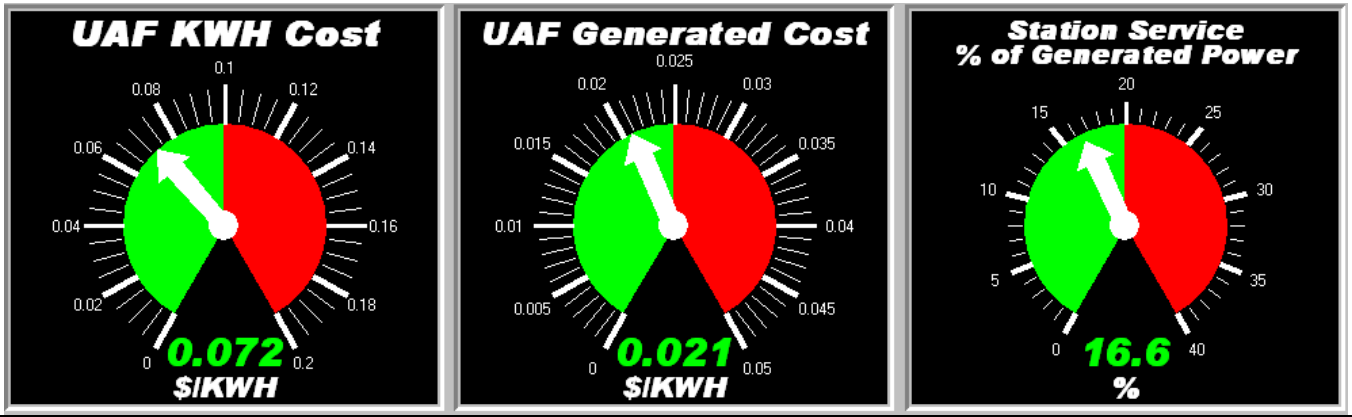
- Over 5,000 data points connected
- Data from 330 building energy meters
- 10 years of historical data online (9 more stored)
- This is accomplished with 15 computers
- Data interfaces using either OPC, Modbus TCP/IP or API
- Uses OSIsoft high availability PI System (PI HA)

Academic Uses of Plant Data

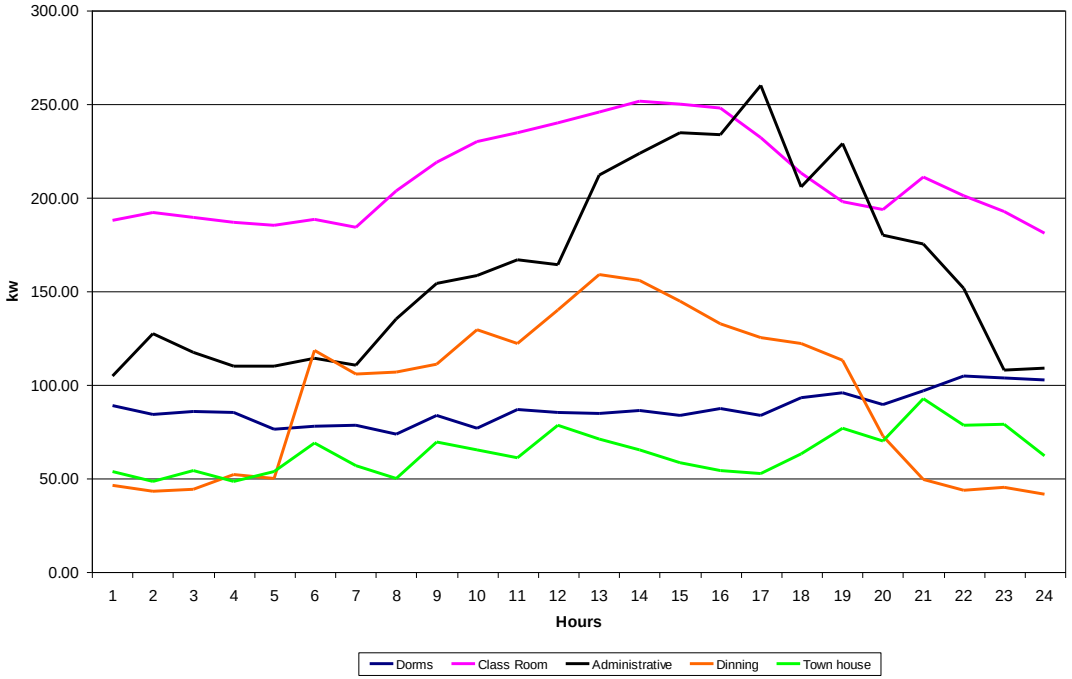
- Live plant data is used in the introduction to engineering class
- Live data is used in the process technology classes
- Historical data is being used in engineering design projects

Uses of Data

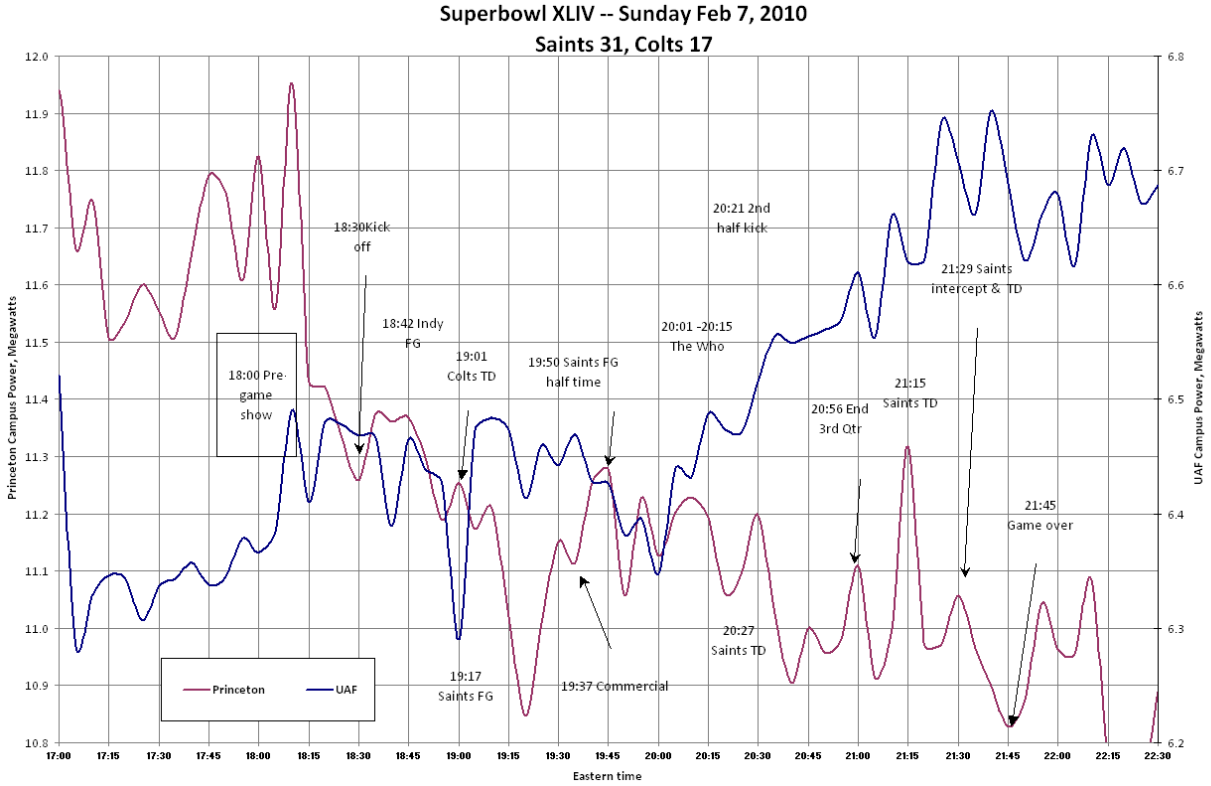
- Intelligent Ash system
- Soot blowing optimization
- Utilities master planning including building modeling
- Baghouse improvements
- Tuning process loops
- Key performance indicators (KPI)



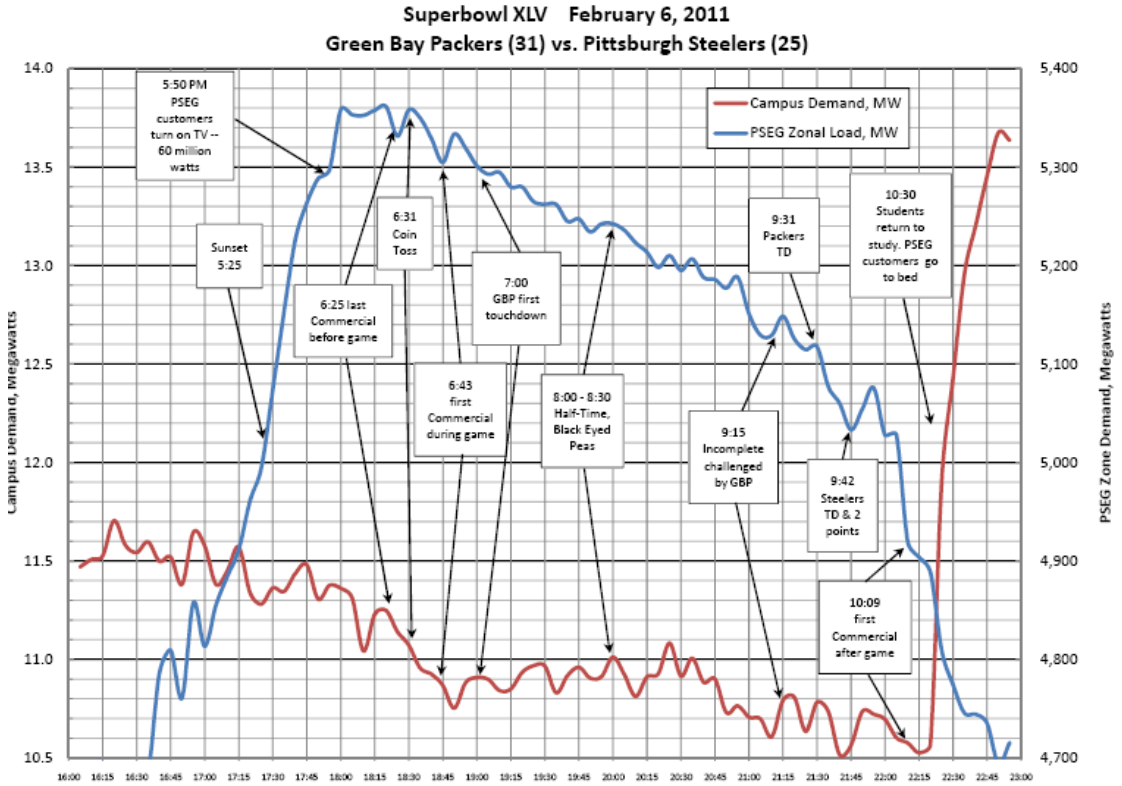
Building Load Profiles



Know Your Customers' Habits



Know Your Customers' Changing Habits



Turning **insight** into **action**.

Questions

Chilkoot Ward

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Thank you