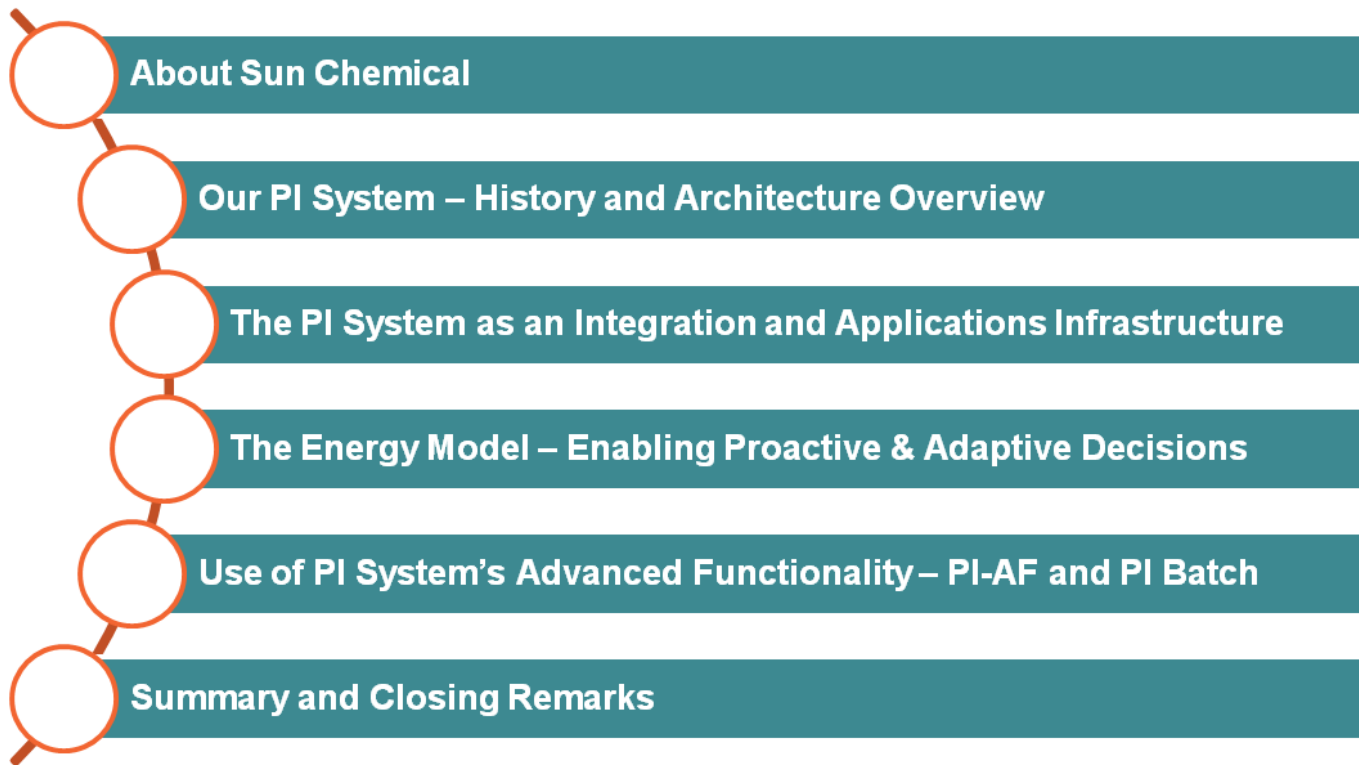


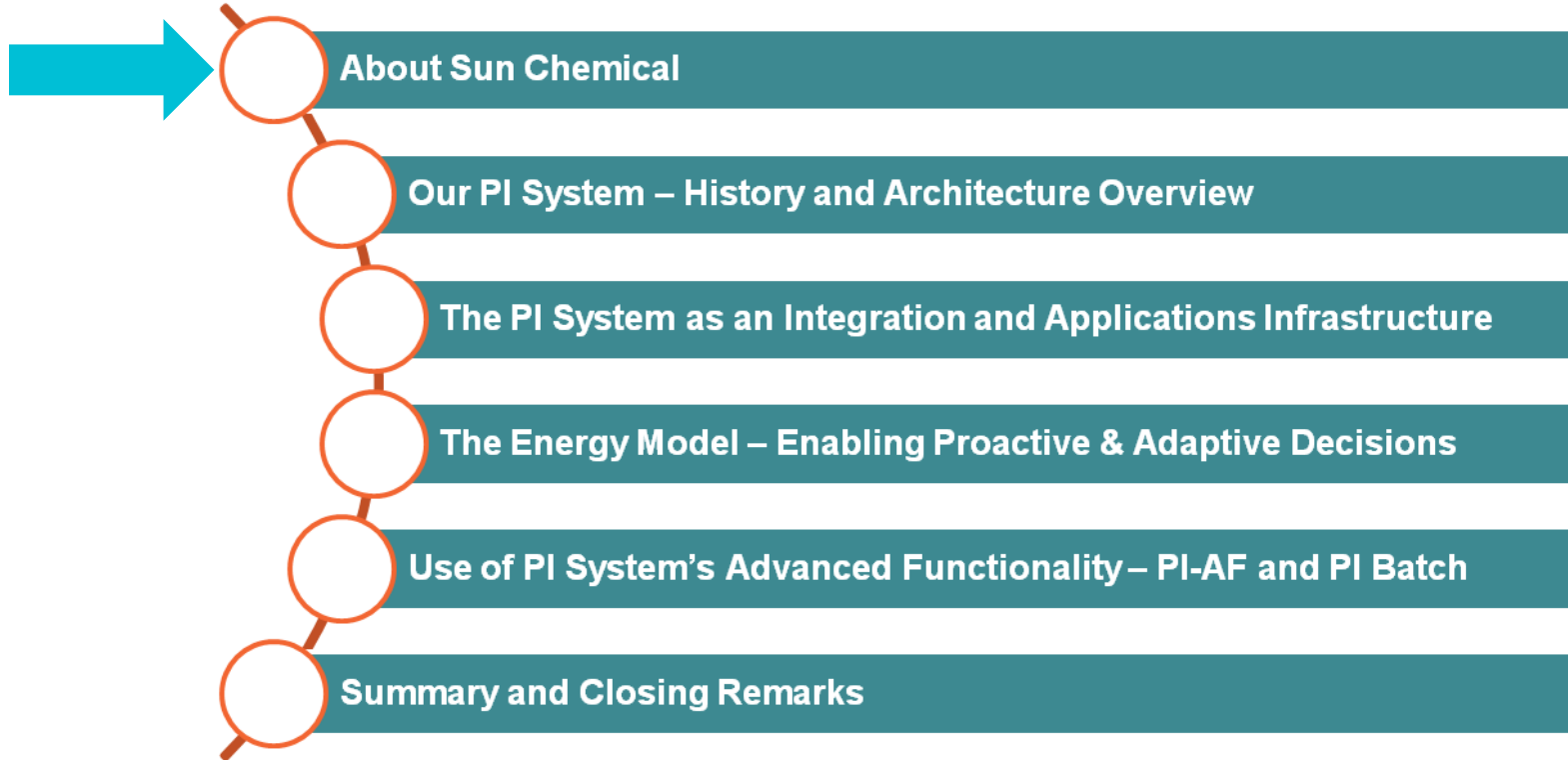
# The Continuing Evolution of the PI System as Strategic Element of Energy and Process Optimization at Sun Chemical

Presented by **Francis Lauryssens**  
**PI Systems Specialist**

# Agenda



# Agenda



# About “Sun Chemical”

- World's largest producer of printing inks and pigments.  
Leading provider of materials to packaging, publication, coatings, plastic, cosmetics etc...
- Annual sales over \$3.5 billion
- More than 8,000 employees
- 250+ locations in 56 countries
- Our Customer needs:
  - Improve performance and reliability
  - Increase On time delivery
  - Provide consistent product quality



# “The Power of Data - Thriving in a World of Change”

*“ The PI System has evolved into a critical element of decision support processes by providing timely, quality, and actionable information in context. Without the PI System, our plant would not be running as well today.”*

Plant Manager, Scott Hendryx



## Business Challenge

- Challenging and Dynamic Business Environment
- Open capacity
- Energy and Power largest variable costs
- Asset reliability issues

## Solution

- Evolved the PI System's use as a "historian" to a strategic provider of data and information
- Focus on energy and process reliability and optimization

## Results and Benefits

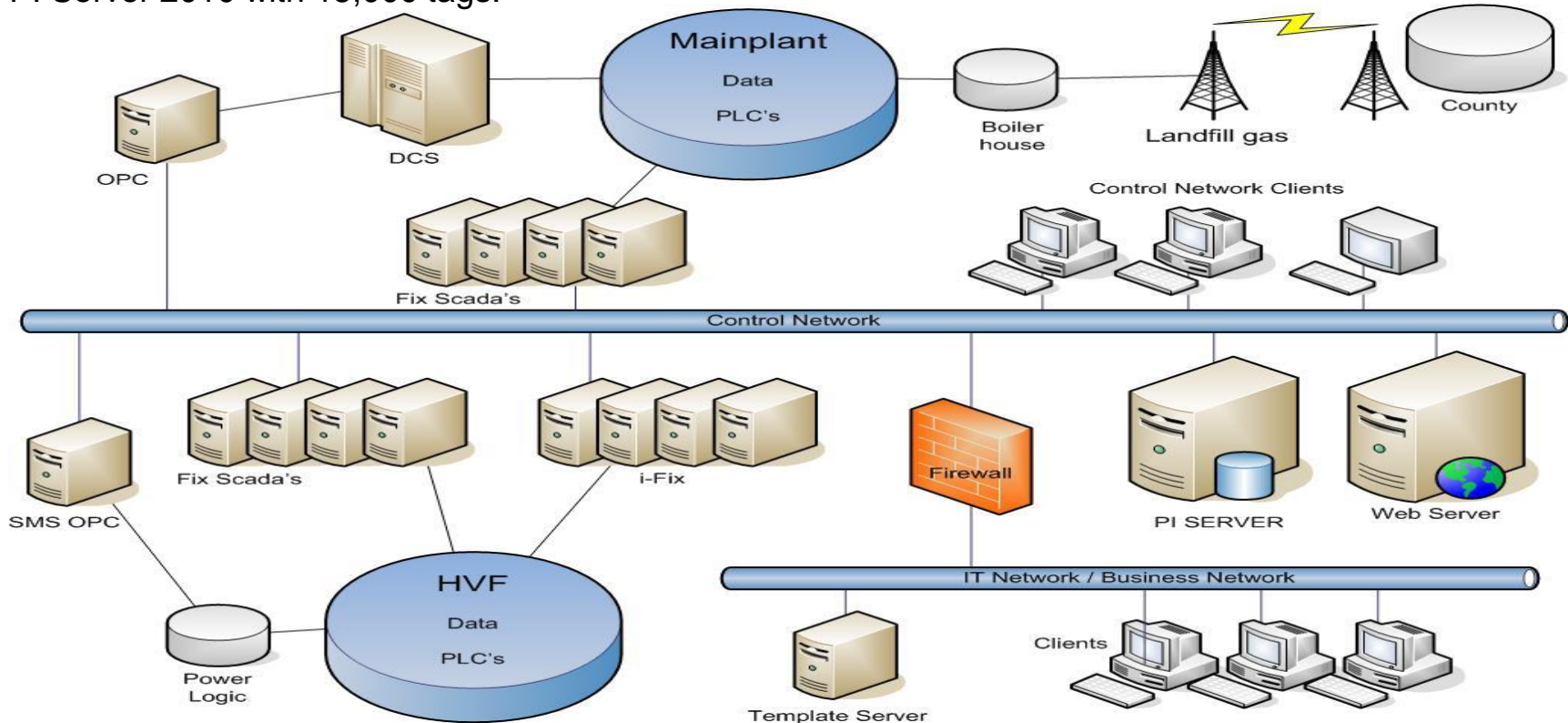
- Sustainability – “the ability to endure” by innovating and adapting with information
- Improved Energy & Process Optimization & Reliability
- Continuous Improvement Culture

# Agenda

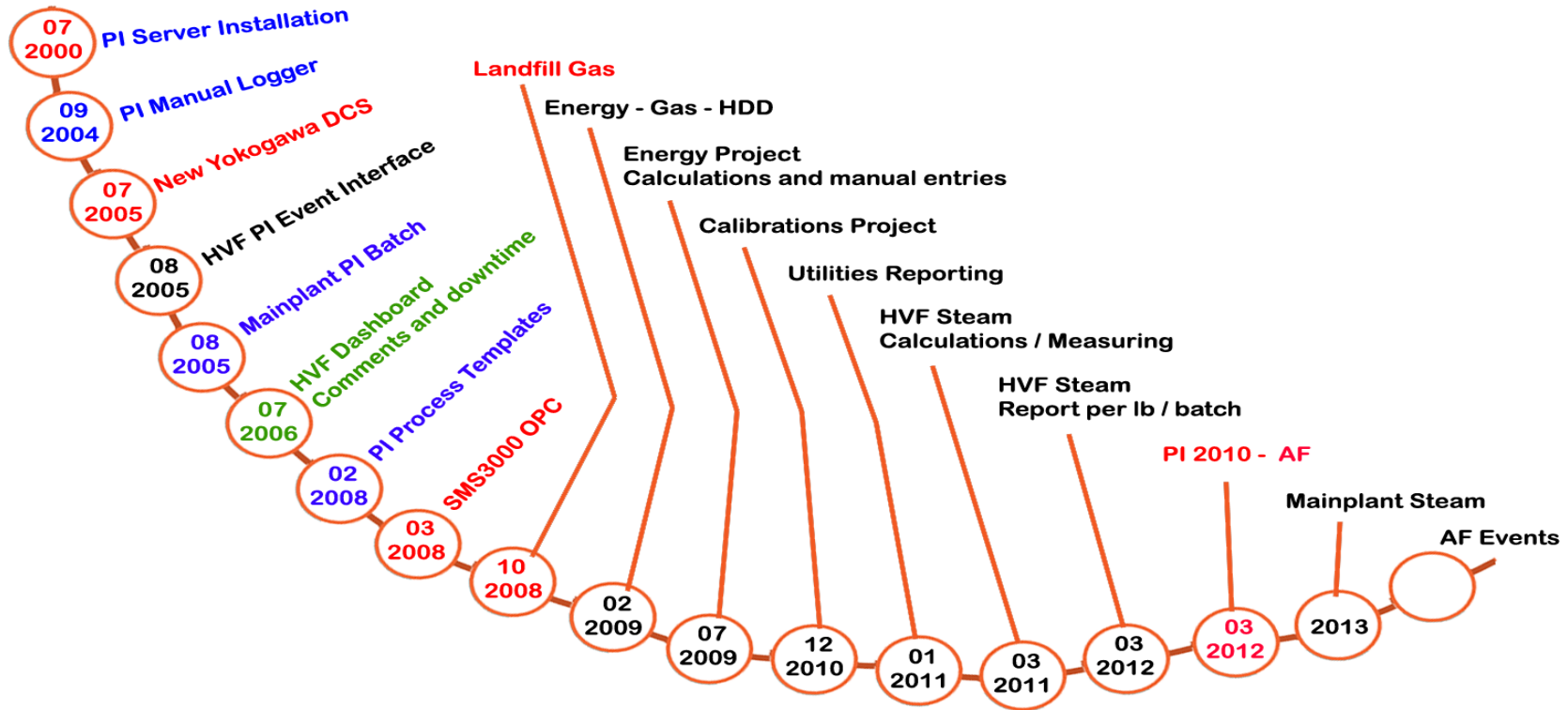


# Our PI System History and Architecture

PI Server 2010 with 15,000 tags.

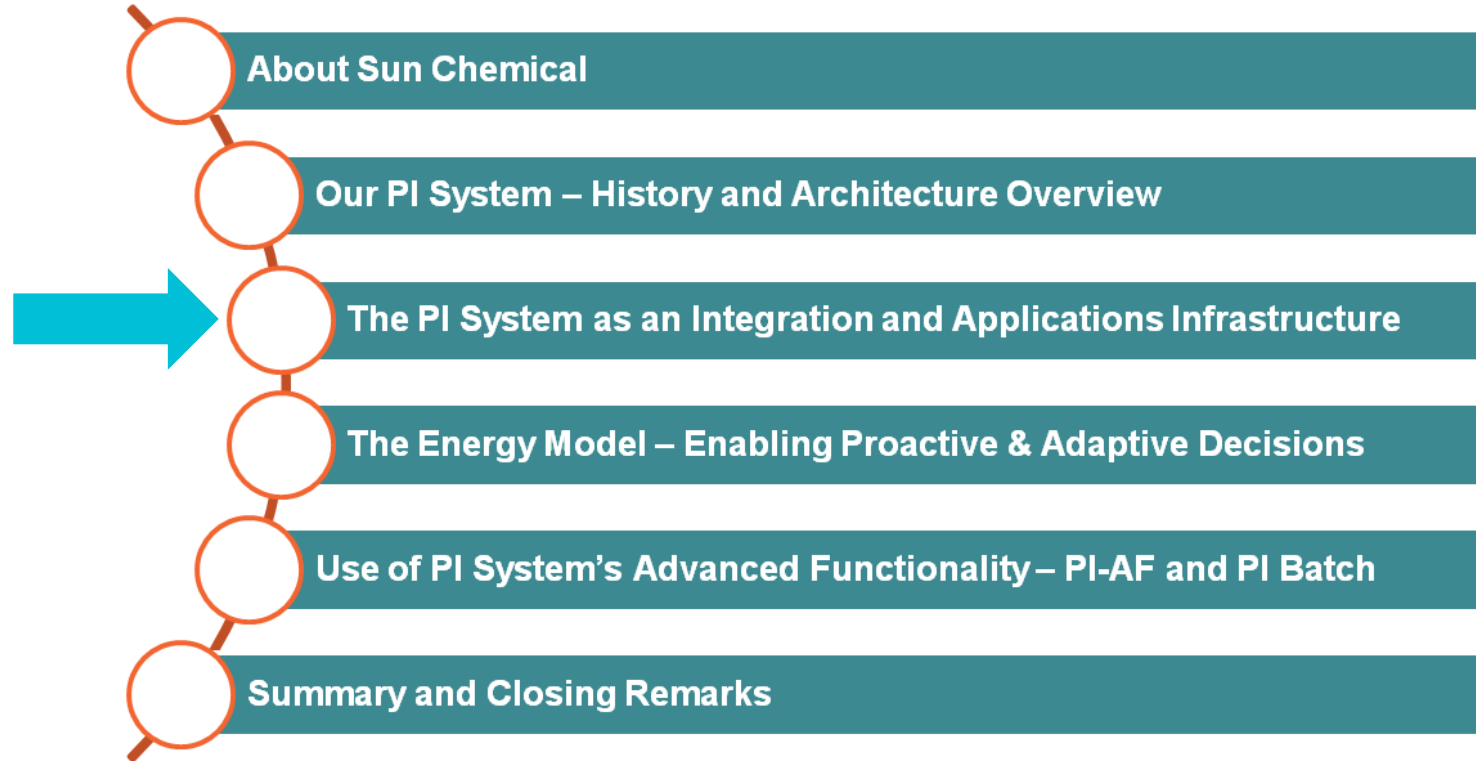


# The Evolution Continues.....



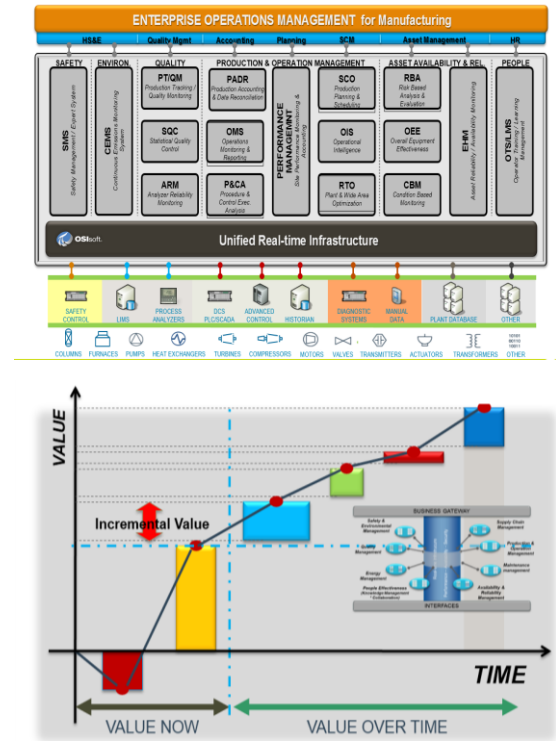


# Agenda

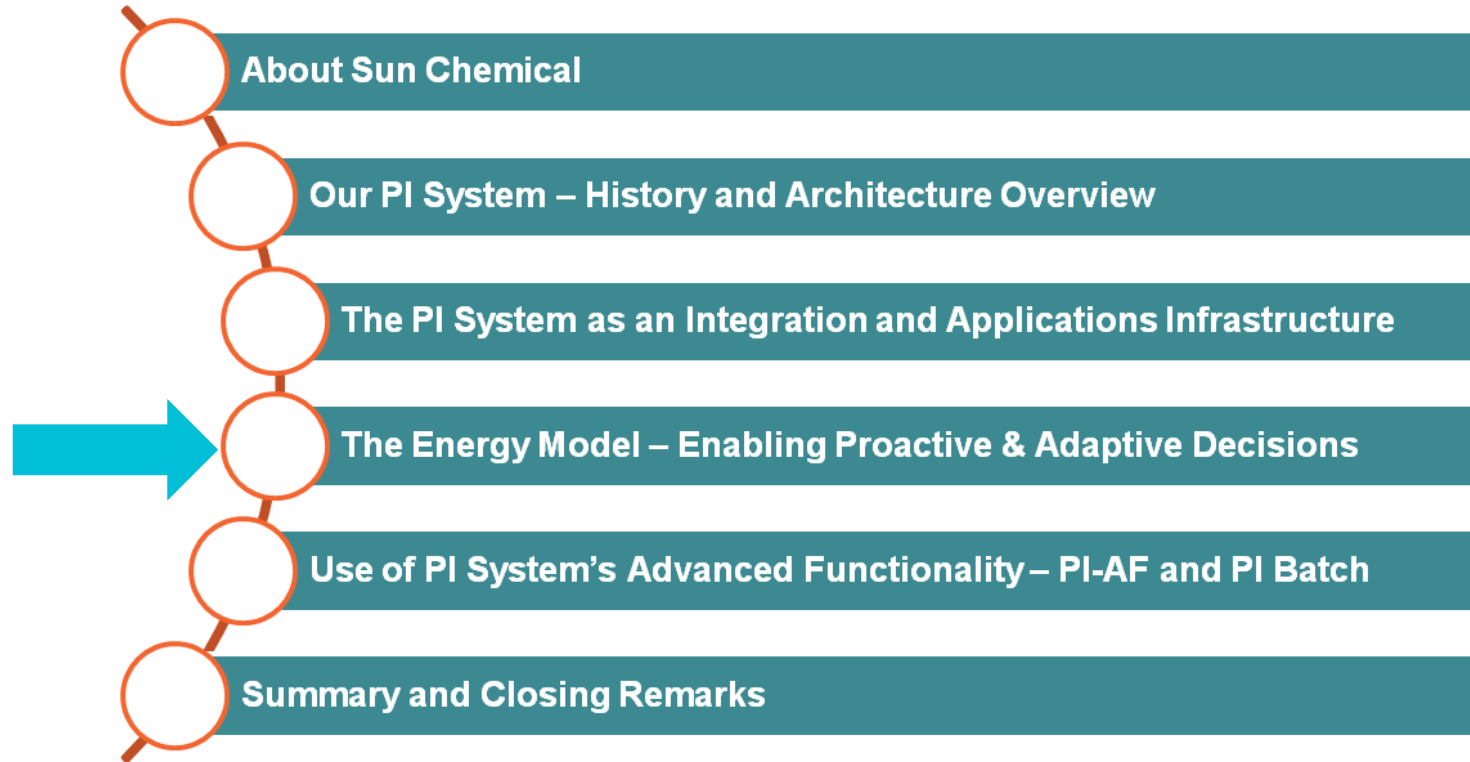


# Integration and Applications Infrastructure

- **Integration of Different Data Sources**
  - DCS, SCADA, PLCs, LIMS
  - Power Logic System
  - Manual Data
  - And many more....
- **Infrastructure for Applications:**
  - Electrical Usage and Purchase Optimizations
  - Land Fill Gas
  - Batch First Pass Yield
  - Utilities Usage and Optimization (Electricity, steam, etc)
  - Process Optimization
  - Asset Reliability and Performance Management
  - And many more....



# Agenda



# Recap of Prior UC2010 Presentation

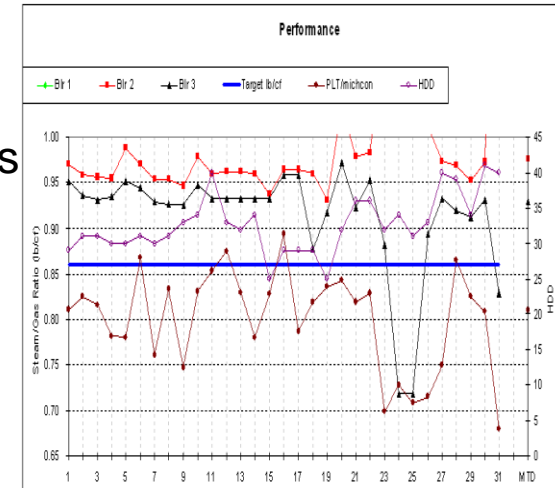
**Business Challenge:** Create an energy model for the plant that can be used for budgets and set baselines.

## 1. Integration of energy data

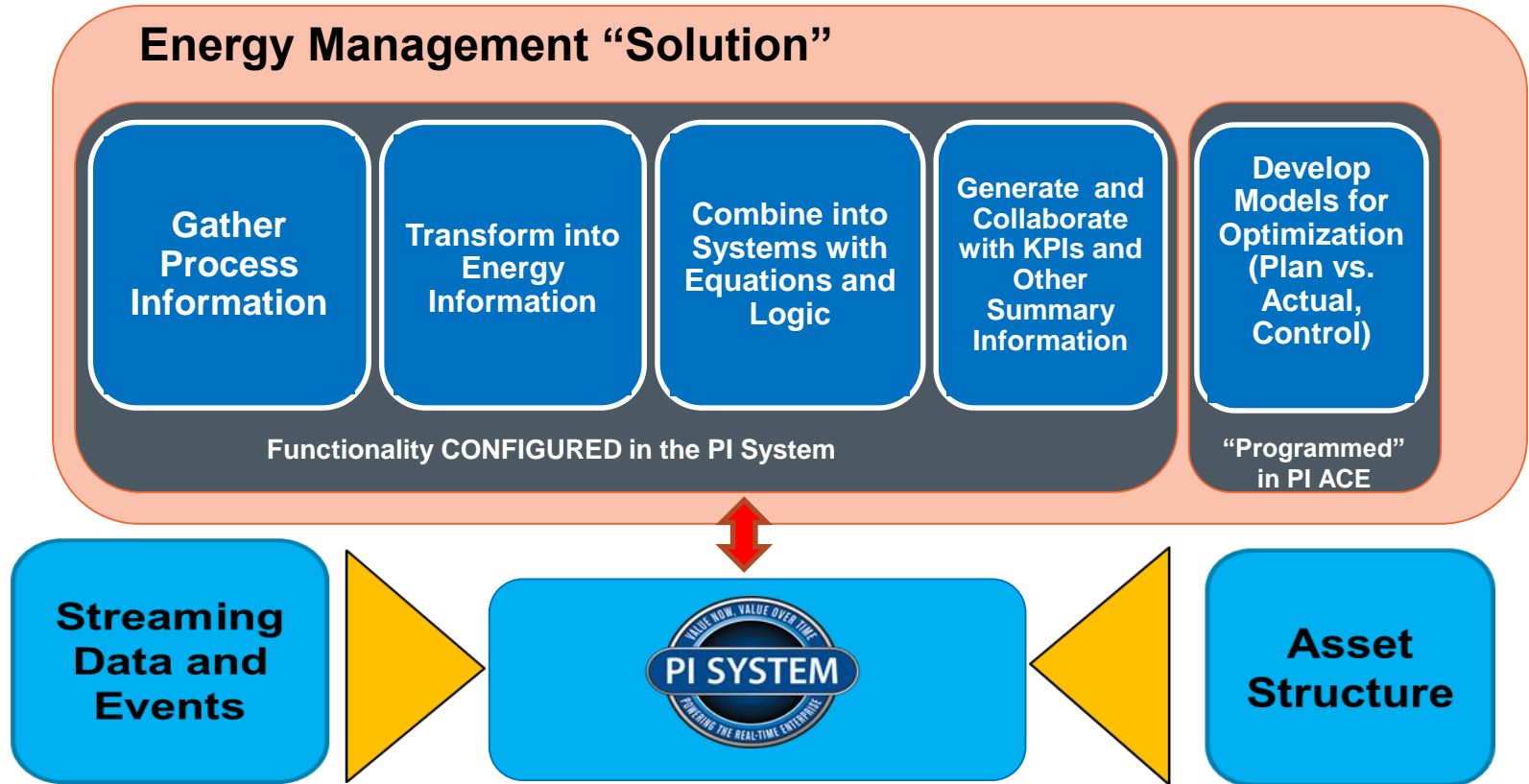
- Electricity data from Power Logic System
- Gas data from flow meters in PI and manual readings
- Boiler house steam production and flow meters
- Water data from meters and manual entry

## 2. Leverage of PI Systems Advanced Functionality

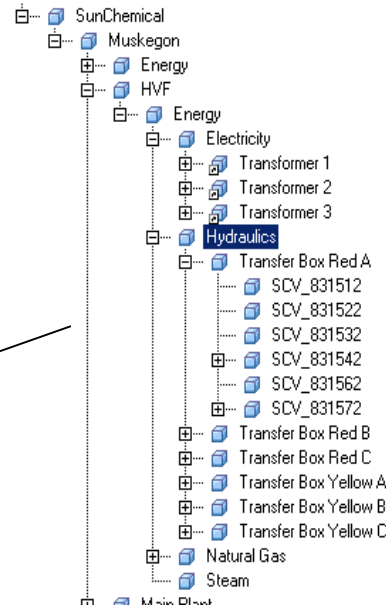
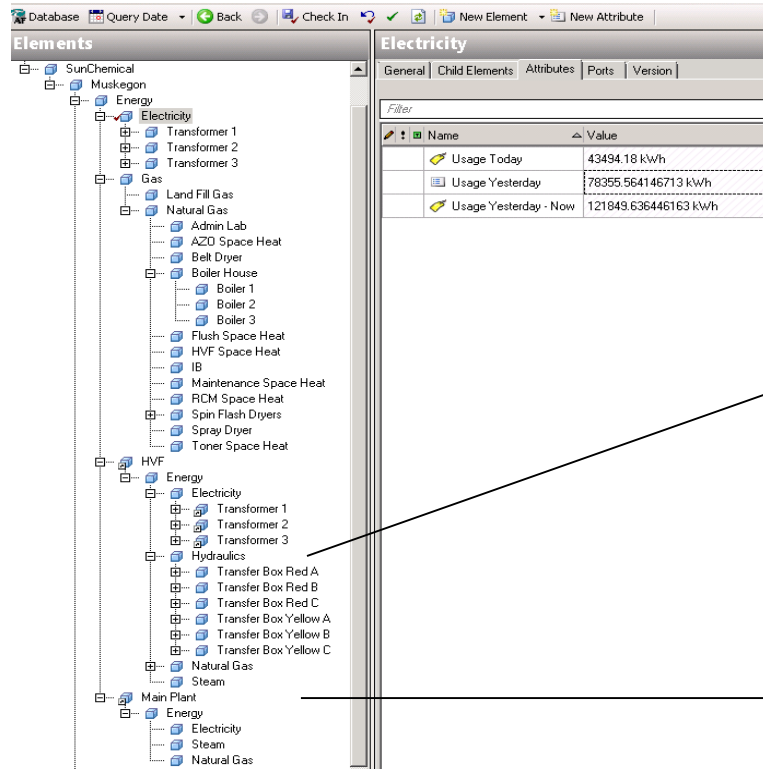
- PI-Performance Equations and Totalizers
- PI-AF
- PI-ACE
- PI-Batch



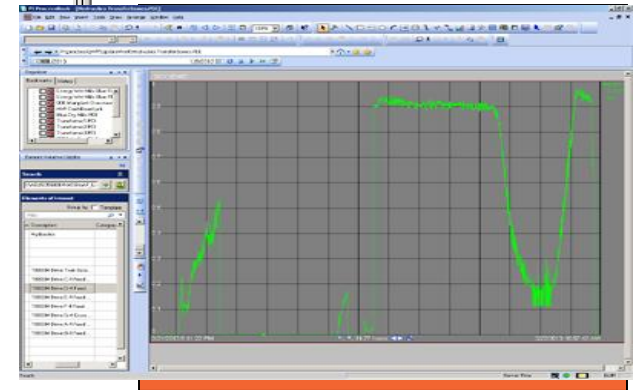
# Decomposing the Energy Management “Solution”



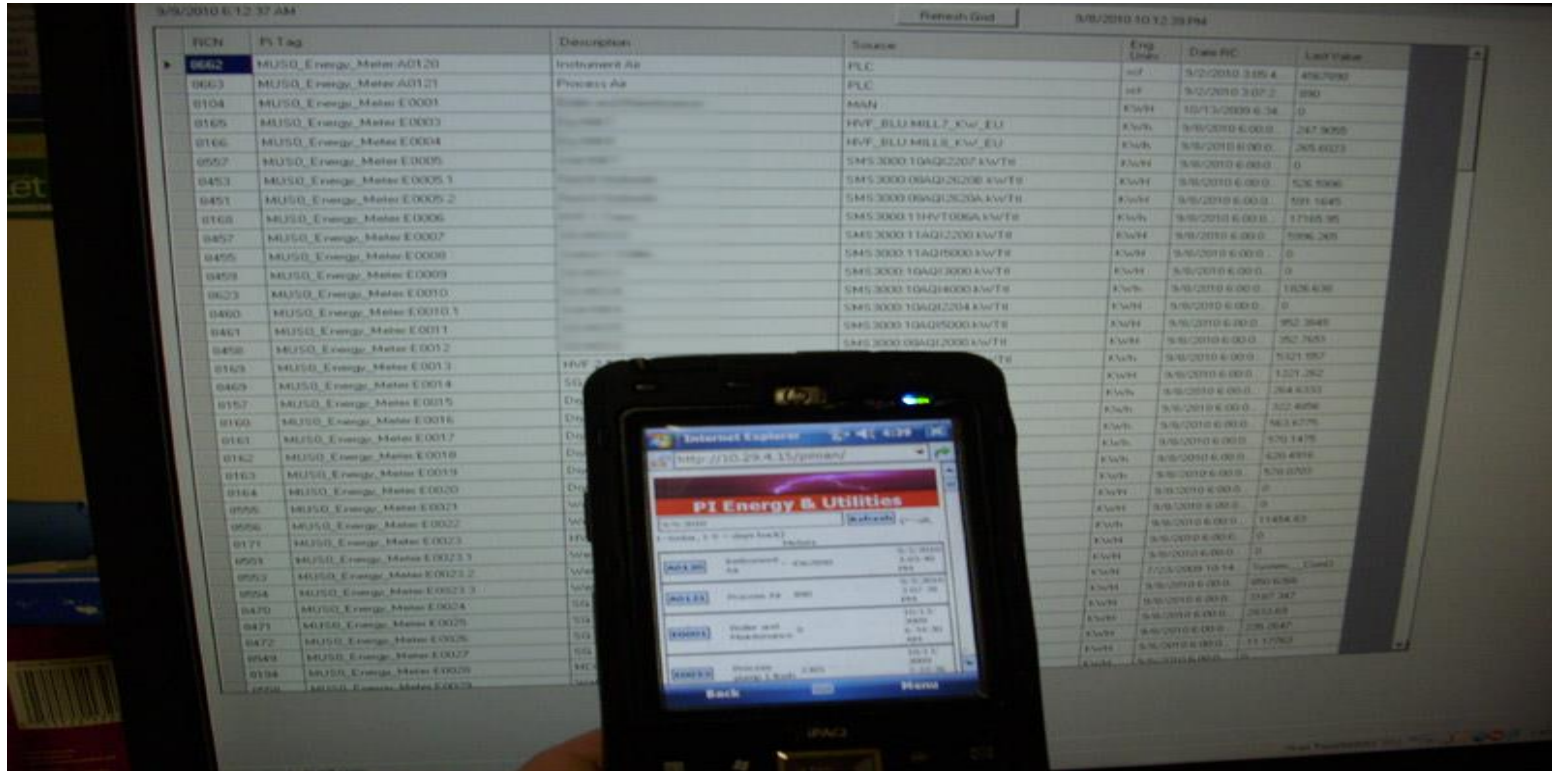
# It all Starts with PI-AF....



Filter	
Name	Value
Constant 1714	1714
HP	0.2771244 hp
KW calculated	0.3464055 kW
MCC22	114 kW



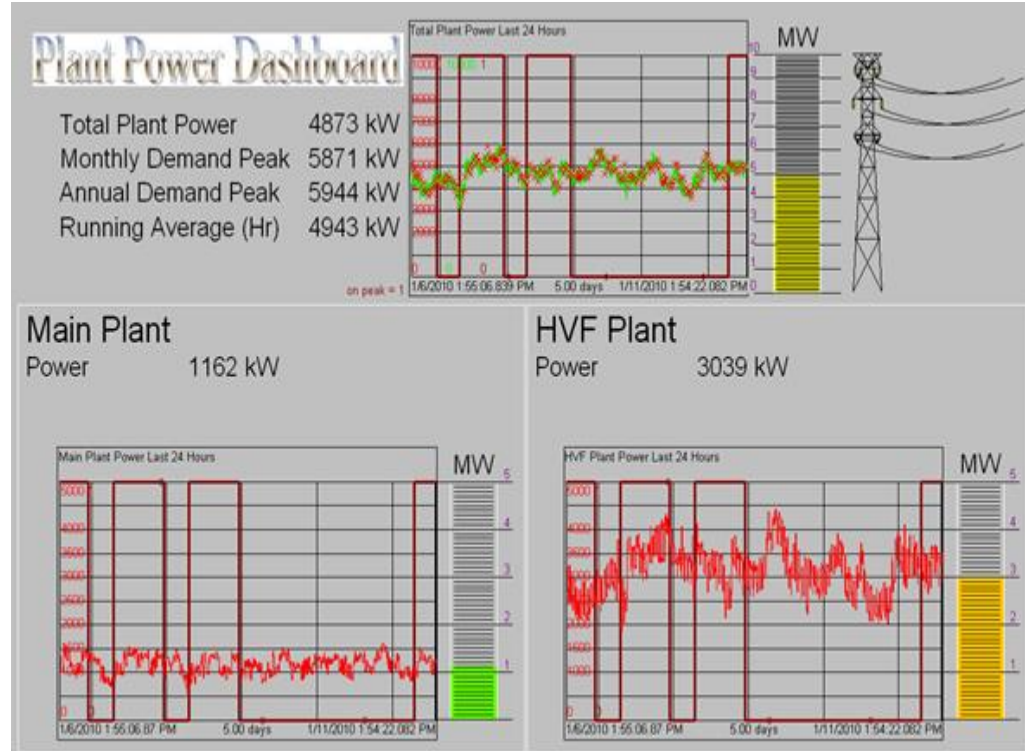
# Obtaining Missing Data With PI Manual Logger



Tag	PI Tag	Description	Source	Eng Units	Date RC	Last Value
0662	MUSO_Energy_Meter A0120	Instrument Air	PLC	in3	5/2/2010 3:05:4	476.7790
0663	MUSO_Energy_Meter A0121	Process Air	PLC	in3	5/2/2010 3:07:2	890
0104	MUSO_Energy_Meter E0001	...	MAN	KWH	10/13/2009 6:34	0
0165	MUSO_Energy_Meter E0003	...	HVF_BLI MILL2_KW_EU	Kwh	5/6/2010 6:00:0	247.9055
0166	MUSO_Energy_Meter E0004	...	HVF_BLI MILL2_KW_EU	Kwh	5/6/2010 6:00:0	245.6023
0557	MUSO_Energy_Meter E0005	...	SMS 3000 10AQ2207 kWTR	Kwh	5/6/2010 6:00:0	0
0453	MUSO_Energy_Meter E0005.1	...	SMS 3000 09AQ26206 kWTR	Kwh	5/6/2010 6:00:0	526.1066
0451	MUSO_Energy_Meter E0005.2	...	SMS 3000 09AQ26206 kWTR	Kwh	5/6/2010 6:00:0	591.1645
0168	MUSO_Energy_Meter E0006	...	SMS 3000 11HVT006A kWTR	Kwh	5/6/2010 6:00:0	17165.35
0457	MUSO_Energy_Meter E0007	...	SMS 3000 11AQ21200 kWTR	Kwh	5/6/2010 6:00:0	7096.267
0455	MUSO_Energy_Meter E0008	...	SMS 3000 11AQ25000 kWTR	Kwh	5/6/2010 6:00:0	0
0459	MUSO_Energy_Meter E0009	...	SMS 3000 10AQ23000 kWTR	Kwh	5/6/2010 6:00:0	0
0623	MUSO_Energy_Meter E0010	...	SMS 3000 10AQ24000 kWTR	Kwh	5/6/2010 6:00:0	1626.636
0460	MUSO_Energy_Meter E0010.1	...	SMS 3000 10AQ21204 kWTR	Kwh	5/6/2010 6:00:0	0
0461	MUSO_Energy_Meter E0011	...	SMS 3000 10AQ25000 kWTR	Kwh	5/6/2010 6:00:0	952.3645
0458	MUSO_Energy_Meter E0012	...	SMS 3000 09AQ21000 kWTR	Kwh	5/6/2010 6:00:0	262.7653
0149	MUSO_Energy_Meter E0013	...	...	Kwh	5/6/2010 6:00:0	5121.057
0463	MUSO_Energy_Meter E0014	...	...	Kwh	5/6/2010 6:00:0	1201.262
0157	MUSO_Energy_Meter E0015	...	...	Kwh	5/6/2010 6:00:0	264.6331
0160	MUSO_Energy_Meter E0016	...	...	Kwh	5/6/2010 6:00:0	322.4056
0161	MUSO_Energy_Meter E0017	...	...	Kwh	5/6/2010 6:00:0	663.6776
0162	MUSO_Energy_Meter E0018	...	...	Kwh	5/6/2010 6:00:0	570.1478
0163	MUSO_Energy_Meter E0019	...	...	Kwh	5/6/2010 6:00:0	420.4056
0164	MUSO_Energy_Meter E0020	...	...	Kwh	5/6/2010 6:00:0	570.0703
0556	MUSO_Energy_Meter E0021	...	...	Kwh	5/6/2010 6:00:0	0
0556	MUSO_Energy_Meter E0022	...	...	Kwh	5/6/2010 6:00:0	11454.63
0171	MUSO_Energy_Meter E0023	...	...	Kwh	5/6/2010 6:00:0	0
0501	MUSO_Energy_Meter E0023.1	...	...	Kwh	5/6/2010 6:00:0	0
0553	MUSO_Energy_Meter E0023.2	...	...	Kwh	5/6/2010 6:00:0	11454.63
0554	MUSO_Energy_Meter E0023.3	...	...	Kwh	5/6/2010 6:00:0	0
0470	MUSO_Energy_Meter E0024	...	...	Kwh	5/6/2010 6:00:0	0
0471	MUSO_Energy_Meter E0025	...	...	Kwh	5/6/2010 6:00:0	0
0472	MUSO_Energy_Meter E0026	...	...	Kwh	5/6/2010 6:00:0	0
0449	MUSO_Energy_Meter E0027	...	...	Kwh	5/6/2010 6:00:0	0
0194	MUSO_Energy_Meter E0028	...	...	Kwh	5/6/2010 6:00:0	11776.02
0750	MUSO_Energy_Meter E0029	...	...	Kwh	5/6/2010 6:00:0	0

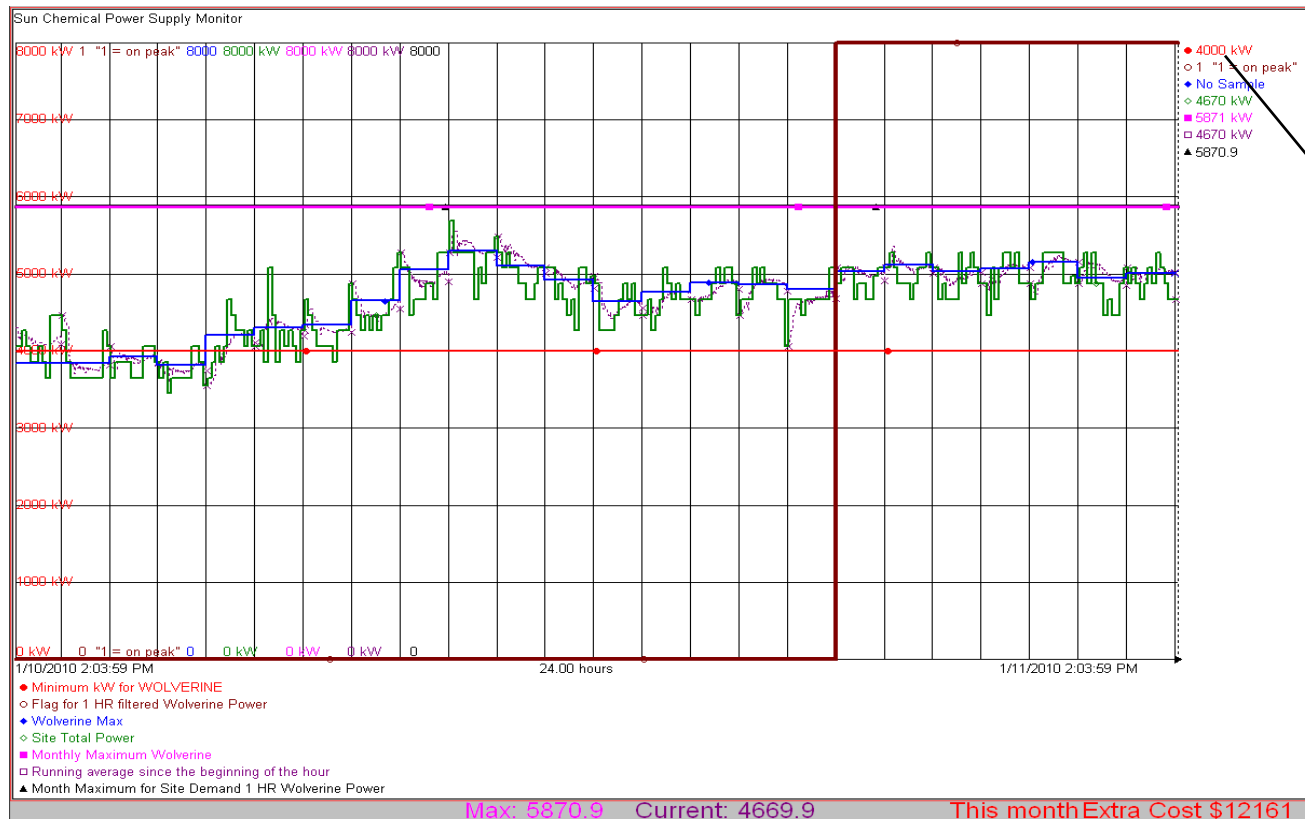
# Real-Time Power Dashboard

- A dashboard that reflects how electricity is billed.
- A contracted usage for the site: 4 Mega Watts peak demand.
- Peak hours from 7 am to 11 pm on weekdays.
- A monthly and annual demand peak based upon 15 minutes and hourly averages and calculations.





# Real- Time Monitoring of Power Supply

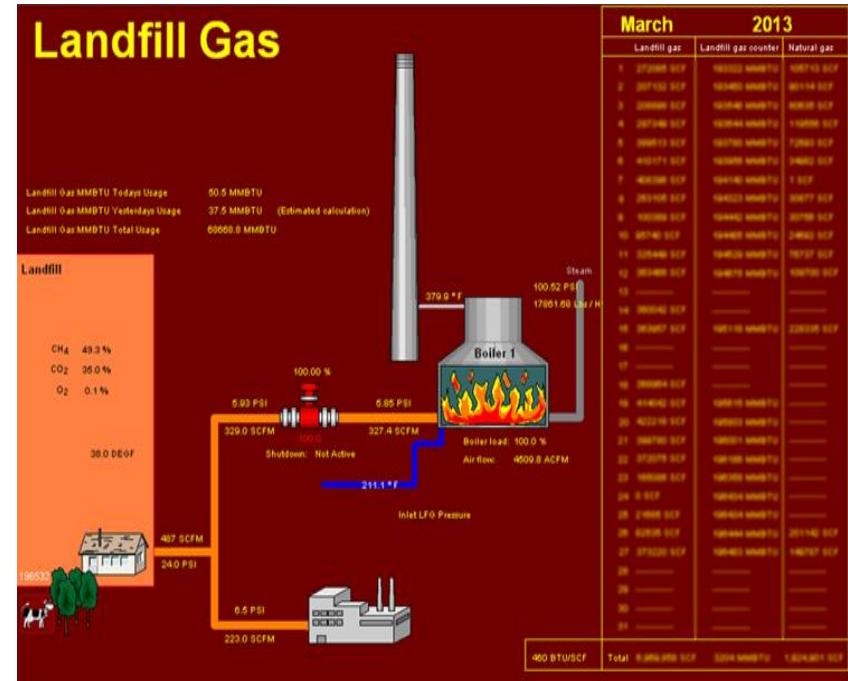


# Continuous Improvement in Action

	Operators monitor site demand vs. the maximum demand target																
5/23/12																	
	kW	kW	kW	kW	kW	kW	kW	kW	kW	kW	kW	kW	Monthly Demand	Site kW	Weight	Weight	Weight V
5/23/12 6:00	57	1	58	61	59	60	63	64	46	57	68	60	5244	4467	4958	4990	4623
5/23/12 6:30	56	42	57	61	59	60	43	66	47	58	69	61	5244	4873	5149	4989	4624
5/23/12 7:00	55	61	58	62	60	60	58	66	33	58	59	62	5244	4873	5669	4989	4624
5/23/12 7:30	54	60	37	62	50	60	59	39	40	46	51	62	5244	5279	6063	5462	4623
5/23/12 8:00	44	60	35	49	20	54	60	61	43	38	65	20	5244	4873	6691	6097	4624
5/23/12 8:30	59	61	58	17	50	18	61	63	44	59	66	60	5244	5076	6986	6692	4624
5/23/12 9:00	58	61	57	59	61	63	62	64	44	58	66	60	5244	5076	6872	6752	4624
5/23/12 9:30	56	36	56	63	61	61	39	65	45	58	67	60	5244	5279	4340	7208	4624
5/23/12 10:00	56	59	57	62	61	60	42	65	34	59	62	61	5244	5076	2537	6834	4623
5/23/12 10:30	56	60	57	63	62	61	61	6	0	57	18	62	5244	4873	2972	4258	4624
5/23/12 11:00	15	60	42	63	55	62	62	16	0	13	0	31	5244	5279	3366	3135	4624
5/23/12 11:30	0	61	25	63	1	20	63	7	0	0	0	38	5244	4467	3872	4038	4624
5/23/12 12:00	0	61	0	10	0	0	64	64	0	0	0	61	5244	4264	3919	4472	4624
5/23/12 12:30	0	18	0	0	0	0	63	5	0	0	0	5	5244	4264	3971	4806	4624
5/23/12 13:00	0	0	0	0	0	0	4	0	0	0	0	0	5244	4264	4253	4831	4624
5/23/12 13:30	0	0	0	0	0	0	0	0	0	0	0	0	5244	3858	4251	4829	4624
5/23/12 14:00	0	0	0	0	0	0	0	0	0	0	0	0	5244	4061	4251	4828	4625
5/23/12 14:30	0	0	0	0	0	0	0	0	0	0	0	0	5244	4061	4250	4825	4624
5/23/12 15:00	0	0	0	0	0	0	0	0	0	0	0	0	5244	3858	4246	4826	4623
5/23/12 15:30	0	0	0	0	0	0	0	0	0	0	0	0	5244	3249	4246	4825	4623
5/23/12 16:00	0	0	0	0	0	0	0	0	0	0	0	0	5244	3452	4246	4823	4623
5/23/12 16:30	0	0	0	0	0	0	0	0	0	0	0	0	5244	3046	4246	4821	4622
5/23/12 17:00	0	0	0	0	0	0	0	0	0	0	0	0	5244	3452	4247	4820	4622
5/23/12 17:30	0	0	0	0	0	0	0	0	0	0	0	0	5244	3046	4247	4821	4622
5/23/12 18:00	0	0	0	0	0	0	0	0	0	0	0	0	5244	3452	4246	4821	4623
5/23/12 18:30	0	0	0	0	0	0	0	0	0	0	0	0	5244	3046	4247	4821	4624
5/23/12 19:00	37	2	17	0	15	0	42	18	16	0	15	16	5244	3655	4248	4823	4625
5/23/12 19:30	61	29	62	3	49	6	64	67	45	27	57	64	5244	3858	4245	4825	4625
5/23/12 20:00	60	63	58	47	63	62	64	67	46	62	69	63	5244	4264	4245	4825	4625
5/23/12 20:30	59	62	58	65	63	62	64	67	47	59	69	64	5244	4467	4243	4821	4625
5/23/12 21:00	59	62	58	63	63	61	65	67	46	59	69	62	5244	4264	4245	4869	4625
5/23/12 21:30	54	63	59	64	63	61	65	45	47	59	70	45	5244	4467	4269	5430	4625
5/23/12 22:00	41	63	48	64	40	62	43	63	19	60	46	63	5244	4467	4757	5492	4624
5/23/12 22:30	51	33	0	64	25	32	62	64	18	38	9	62	5244	4670	5348	5961	4625
5/23/12 23:00	59	57	0	44	42	9	62	65	25	60	37	62	5244	4873	5565	6731	4625
5/23/12 23:30	58	60	0	67	60	59	62	66	43	59	68	63	5244	4873	2765	6822	4625
5/24/12 0:00	57	60	40	62	60	61	63	66	44	58	67	50	5244	5279	1940	5510	4626
5/24/12 0:30	57	61	58	63	60	60	62	8	44	59	67	0	5244	5482	2041	2802	4628
5/24/12 1:00	56	61	57	63	61	60	42	17	45	60	68	26	5244	5482	2400	2082	4627
5/24/12 1:30	42	51	57	63	61	61	59	52	46	41	69	61	5244	5482	2702	2800	4625

# Natural Gas and Landfill Gas - Example of the Power of Data

- The PI System was used to calculate how much gas we used and how much we could replace with landfill gas.
  - Landfill gas that was not used by others would be available to Sun Chemical.
  - Savings in cheaper gas and no transportation costs.
  - 1 boiler was converted to consume landfill gas.



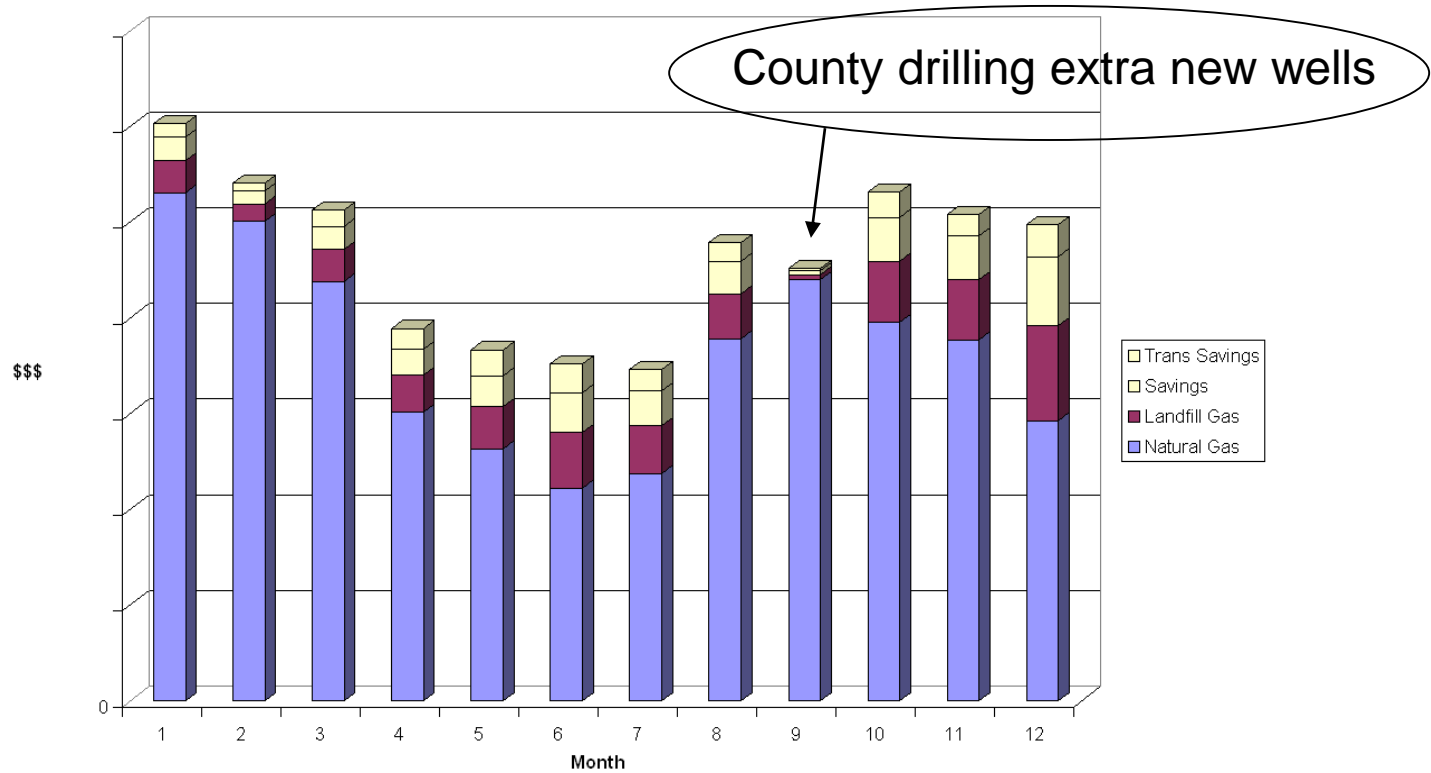
# Optimizing Boiler House Operations

- Major steam leaks were identified and repaired.
- Boiler 2 was shutdown.
- Reduced pressure on boiler 3 to minimize natural gas usage.
- Increased the allowable steam header pressure on boiler 1 to maximize landfill gas.
- Requested a 2 psi pressure increase from the county.
- Increased allowable load on the landfill gas boiler from 60% to 80% to maximize usage of landfill gas.
- Adjusted controls on boiler 1 to keep boiler running during low landfill gas conditions.

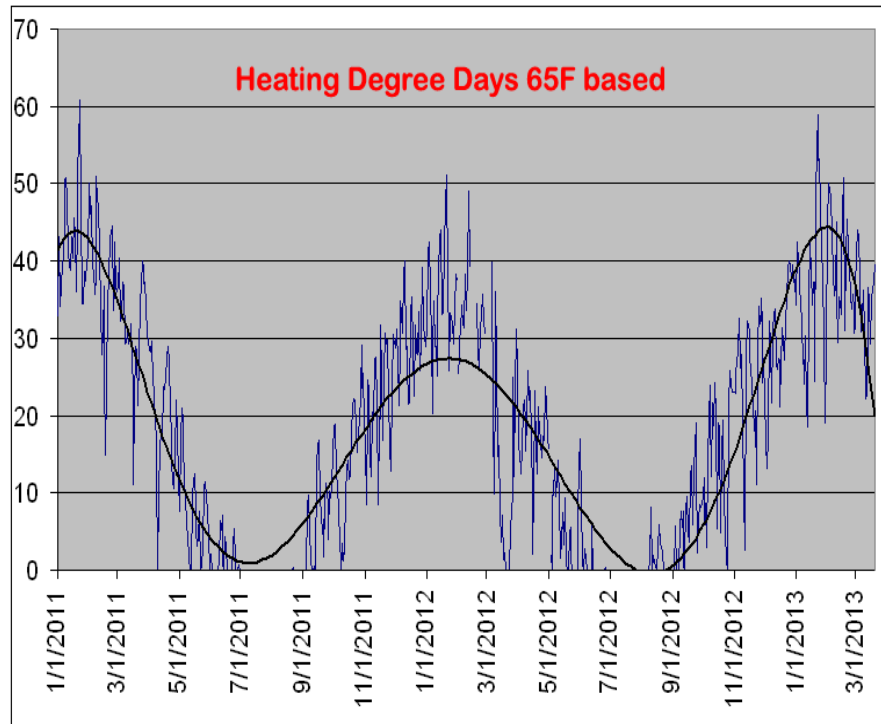
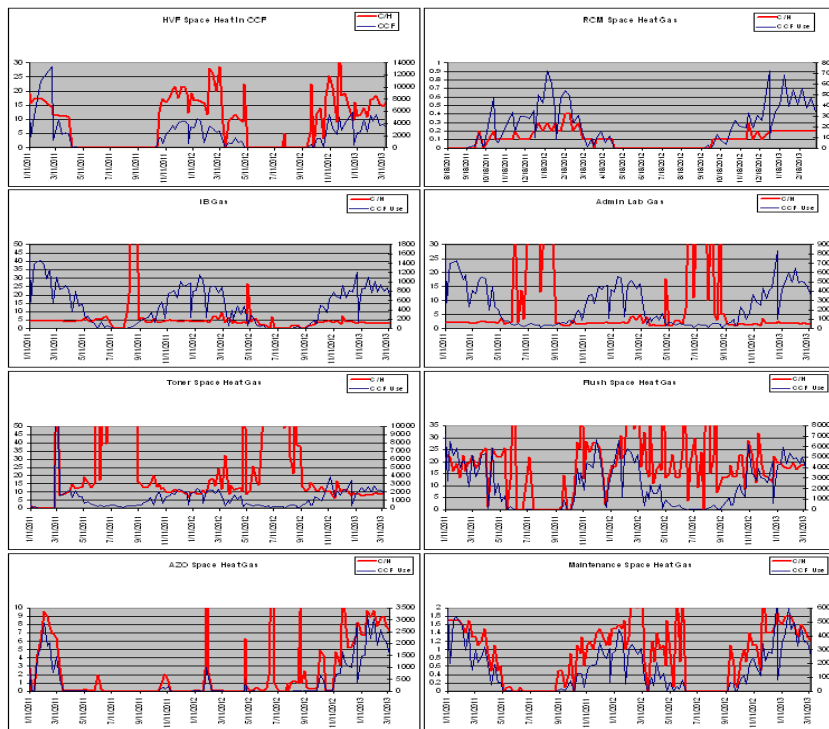


# Real time Monitoring

Gas Usage 2012



# Heating Natural Gas - CCF per HDD



# Warehouse Heating Improvement

- Sealed and repaired all doors for air leaks.
- Installed fans to distribute the heat better.
- Lowered the thermostat five degrees Celcius.
- Data from the PI System enabled and Operator buy in.
- Tracking gas usage per HDD (reviewing every other week)



# Agenda





# PI Performance Equation Example

Performance Equations - PI System Management Tools

File View Tools Help

Collectives and Servers

Search

Servers

Server PS Point

Extended Descriptor

432 points

General Equation Scheduling Security Archive Classic System

Event tag: HVF\_YEL:TC\_82111\_OUTPUT

Equation:

```
if trunc('HVF_YEL:TC_82111_OUTPUT';10) = 0 then 0 + ('HVF_YEL:TC_82111_OUTPUT' - (trunc('HVF_YEL:TC_82111_OUTPUT';10))) * 0.205 else if trunc('HVF_YEL:TC_82111_OUTPUT';10) = 10 then 2.05 + ('HVF_YEL:TC_82111_OUTPUT' - (trunc('HVF_YEL:TC_82111_OUTPUT';10))) * 0.302 else if trunc('HVF_YEL:TC_82111_OUTPUT';10) = 20 then 5.07 + ('HVF_YEL:TC_82111_OUTPUT' - (trunc('HVF_YEL:TC_82111_OUTPUT';10))) * 0.493 else if trunc('HVF_YEL:TC_82111_OUTPUT';10) = 30 then 10 + ('HVF_YEL:TC_82111_OUTPUT' - (trunc('HVF_YEL:TC_82111_OUTPUT';10))) * 0.72 else if
```

Evaluate

Timestamp: Value:

Snapshot: 4/3/2013 9:35:18 AM 0

General Equation Scheduling Security Archive Classic System

Event tag: HVF\_YEL:TC\_82111\_OUTPUT

Equation:

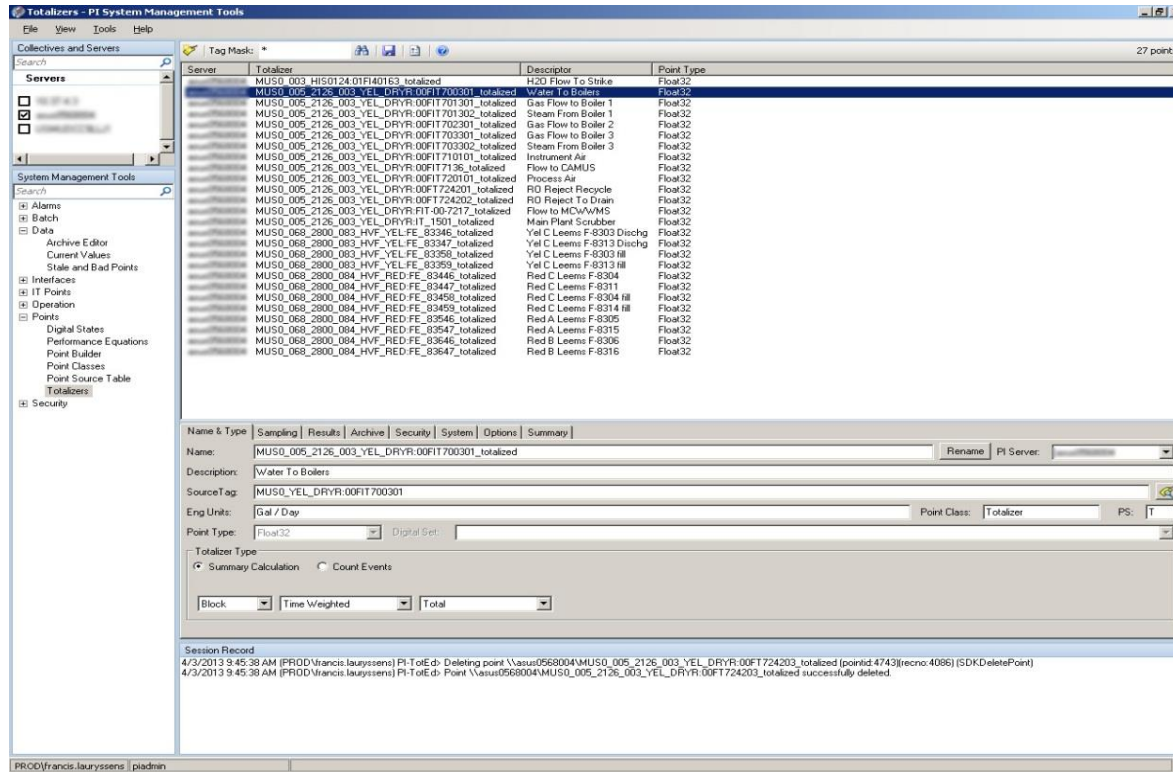
```
if trunc('HVF_YEL:TC_82111_OUTPUT';10) = 0 then 0 + ('HVF_YEL:TC_82111_OUTPUT' - (trunc('HVF_YEL:TC_82111_OUTPUT';10))) * 0.205 else if trunc('HVF_YEL:TC_82111_OUTPUT';10) = 10 then 2.05 + ('HVF_YEL:TC_82111_OUTPUT' - (trunc('HVF_YEL:TC_82111_OUTPUT';10))) * 0.302 else if trunc('HVF_YEL:TC_82111_OUTPUT';10) = 20 then 5.07 + ('HVF_YEL:TC_82111_OUTPUT' - (trunc('HVF_YEL:TC_82111_OUTPUT';10))) * 0.493 else if trunc('HVF_YEL:TC_82111_OUTPUT';10) = 30 then 10 + ('HVF_YEL:TC_82111_OUTPUT' - (trunc('HVF_YEL:TC_82111_OUTPUT';10))) * 0.72 else if
```

Evaluate

Timestamp: Value:

Snapshot: 4/3/2013 9:35:18 AM 0

# PI Totalizers Are Used Extensively



# PI-AF is the Foundation

The screenshot displays the PI-AF software interface, which is used for configuring and managing process information. The main window is titled "Transfer Box Yellow C" and shows a tree view of elements on the left. The "Elements" pane lists various components, including "Transfer Box Red A", "Transfer Box Red B", "Transfer Box Yellow A", "Transfer Box Yellow B", and "Transfer Box Yellow C". The "Transfer Box Yellow C" element is selected, and its configuration is shown in the main area.

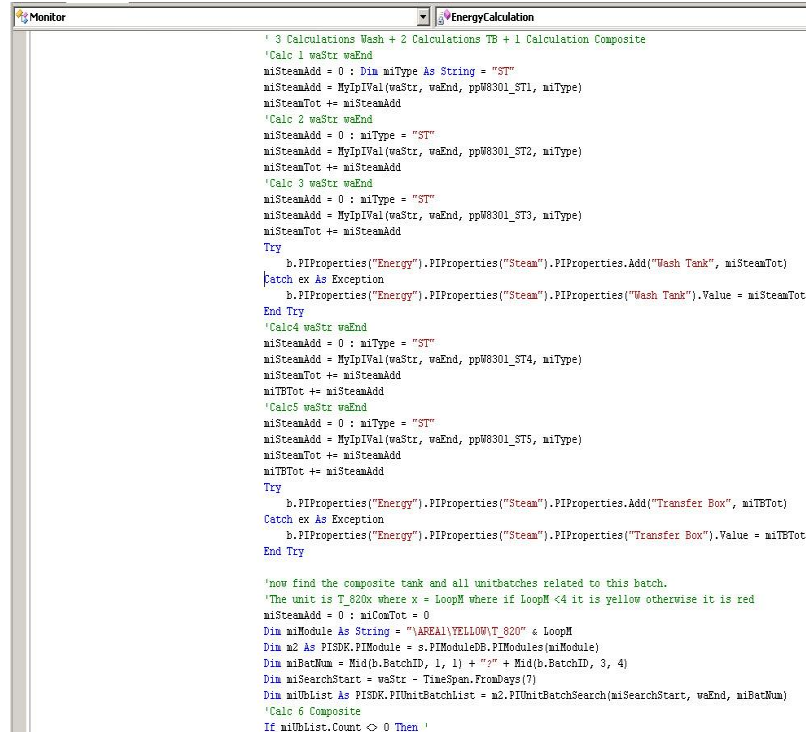
The configuration window for "Transfer Box Yellow C" includes a "Formula Configuration (HP)" dialog box. This dialog box has two tabs: "Parameters" and "Equations". The "Parameters" tab is active, showing a list of parameters with their values. The "Equations" tab shows the formula for calculating the value of the parameter.

The "Formula Configuration (HP)" dialog box also includes a "Result" section with a "UOM" (Unit of Measure) dropdown menu set to "<Default> (hp)". The "Minimum" and "Maximum" fields are set to 0 and 1, respectively. The "Stepped" checkbox is unchecked.

The "Settings" section at the bottom of the dialog box contains a "Data Reference" field with the formula:  $A = \text{SCV\_83379HP} + \text{SCV\_83380HP} + \text{SCV\_83381HP} + \text{SCV\_83382HP} + \text{SCV\_83383HP} + \text{SCV\_83384HP} + \text{SCV\_83385HP} + \text{SCV\_83378VAHP} + \text{SCV\_83378VBHP}$ .

The "Connections" and "Analyses" tabs are visible on the right side of the interface.

# PI-ACE Further Extends the PI System's Analytical Capabilities



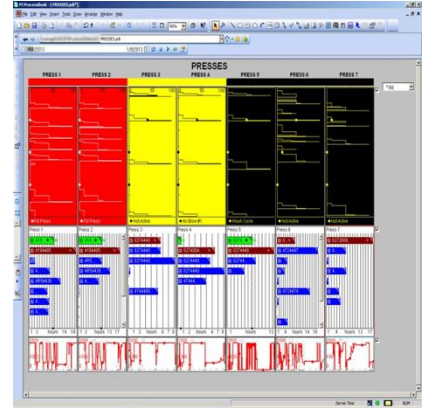
```
' 3 Calculations Wash + 2 Calculations TB + 1 Calculation Composite
'Calc 1 waScr waEnd
miSteamAdd = 0 : Dim miType As String = "ST"
miSteamAdd = MyIpIVal(waScr, waEnd, ppW8301_ST1, miType)
miSteamTot += miSteamAdd
'Calc 2 waScr waEnd
miSteamAdd = 0 : miType = "ST"
miSteamAdd = MyIpIVal(waScr, waEnd, ppW8301_ST2, miType)
miSteamTot += miSteamAdd
'Calc 3 waScr waEnd
miSteamAdd = 0 : miType = "ST"
miSteamAdd = MyIpIVal(waScr, waEnd, ppW8301_ST3, miType)
miSteamTot += miSteamAdd
Try
    b.PIProperties("Energy").PIProperties("Steam").PIProperties.Add("Wash Tank", miSteamTot)
Catch ex As Exception
    b.PIProperties("Energy").PIProperties("Steam").PIProperties("Wash Tank").Value = miSteamTot
End Try
'Calc4 waScr waEnd
miSteamAdd = 0 : miType = "ST"
miSteamAdd = MyIpIVal(waScr, waEnd, ppW8301_ST4, miType)
miSteamTot += miSteamAdd
miTBTot += miSteamAdd
'Calc5 waScr waEnd
miSteamAdd = 0 : miType = "ST"
miSteamAdd = MyIpIVal(waScr, waEnd, ppW8301_ST5, miType)
miSteamTot += miSteamAdd
miTBTot += miSteamAdd
Try
    b.PIProperties("Energy").PIProperties("Steam").PIProperties.Add("Transfer Box", miTBTot)
Catch ex As Exception
    b.PIProperties("Energy").PIProperties("Steam").PIProperties("Transfer Box").Value = miTBTot
End Try

'now find the composite tank and all unitbatches related to this batch.
'The unit is T_820x where x = LoopM where if LoopM <4 it is yellow otherwise it is red
miSteamAdd = 0 : miComTot = 0
Dim miModule As String = "\AREAL\YELLOW\T_820" & LoopM
Dim m2 As PISDK.PIModule = s.PIModuleDB.PIModules(miModule)
Dim miBatchNum = Mid(b.BatchID, 1, 1) + "g" & Mid(b.BatchID, 3, 4)
Dim miSearchStart = waScr - TimeSpan.FromDays(7)
Dim miUblList As PISDK.PIUnitBatchList = m2.PIUnitBatchSearch(miSearchStart, waEnd, miBatchNum)
'Calc 6 Composite
If miUblList.Count <> 0 Then '
```

# Use of PI-Batch and PI Process Templates

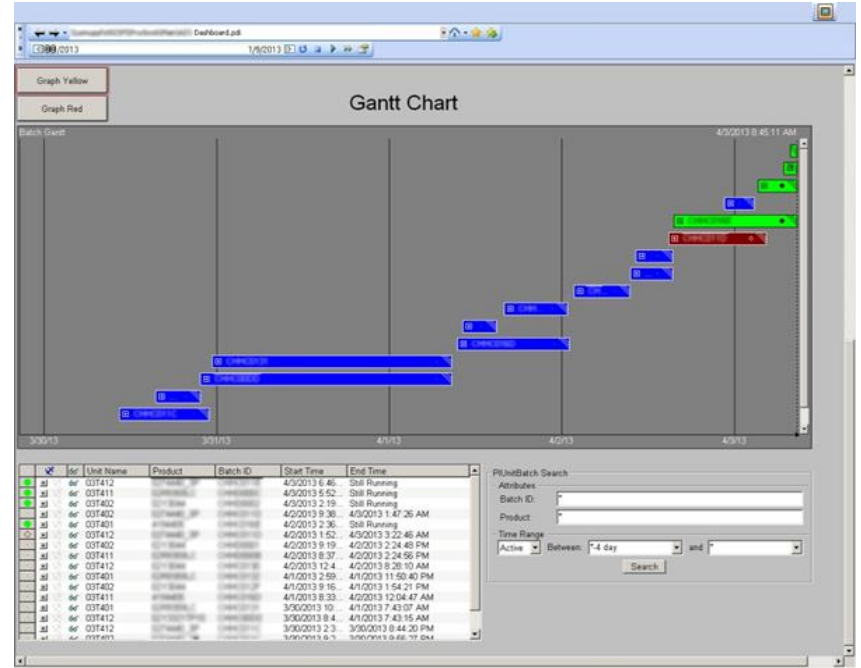
Business Driver-Improve the First Pass Yield.

- Exele PI Process Templates Project
- Building on our event history (PI Batch)
- Builds a “visual roadmap” of a process by displaying upper and lower control limits from historical data.
- Shows where the process is versus where the process is supposed to be.
- Critical to Quality parameters such as pH, temperature, transfer rates, etc...

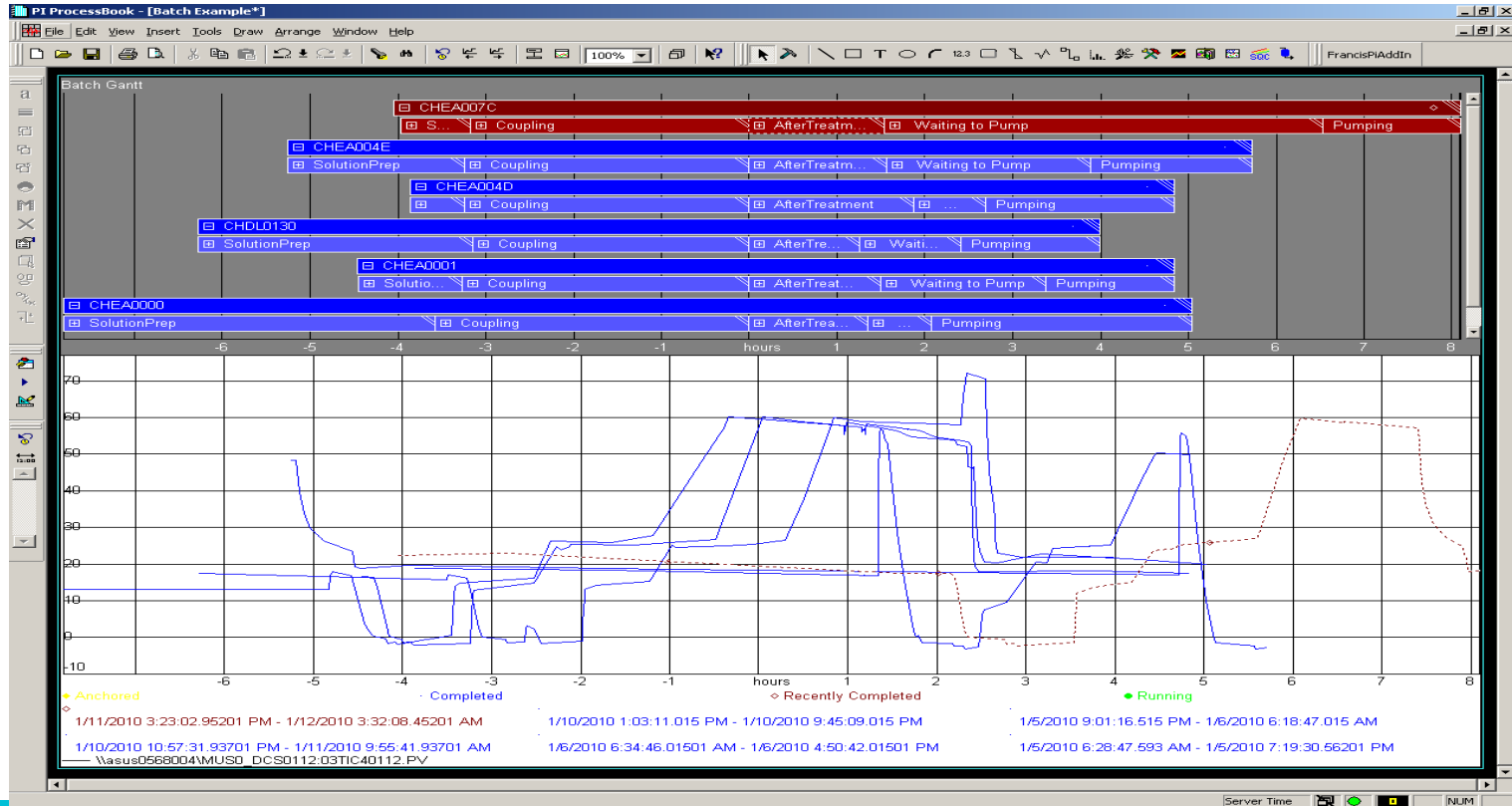


# Benefits of PI Process Templates

- 6 to 9 Critical-To-Quality parameters for each of over 75 codes made in the department were “templated”.
- A visual roadmap of the expected process makes analysis timely and easy.
- Batches are reviewed with operators upon completion. This interaction is critical to learning everyday what does and what doesn't make our processes work.
- Potential process upsets are alarmed in real time; therefore decisions can be made in real time. (Pro-Active)

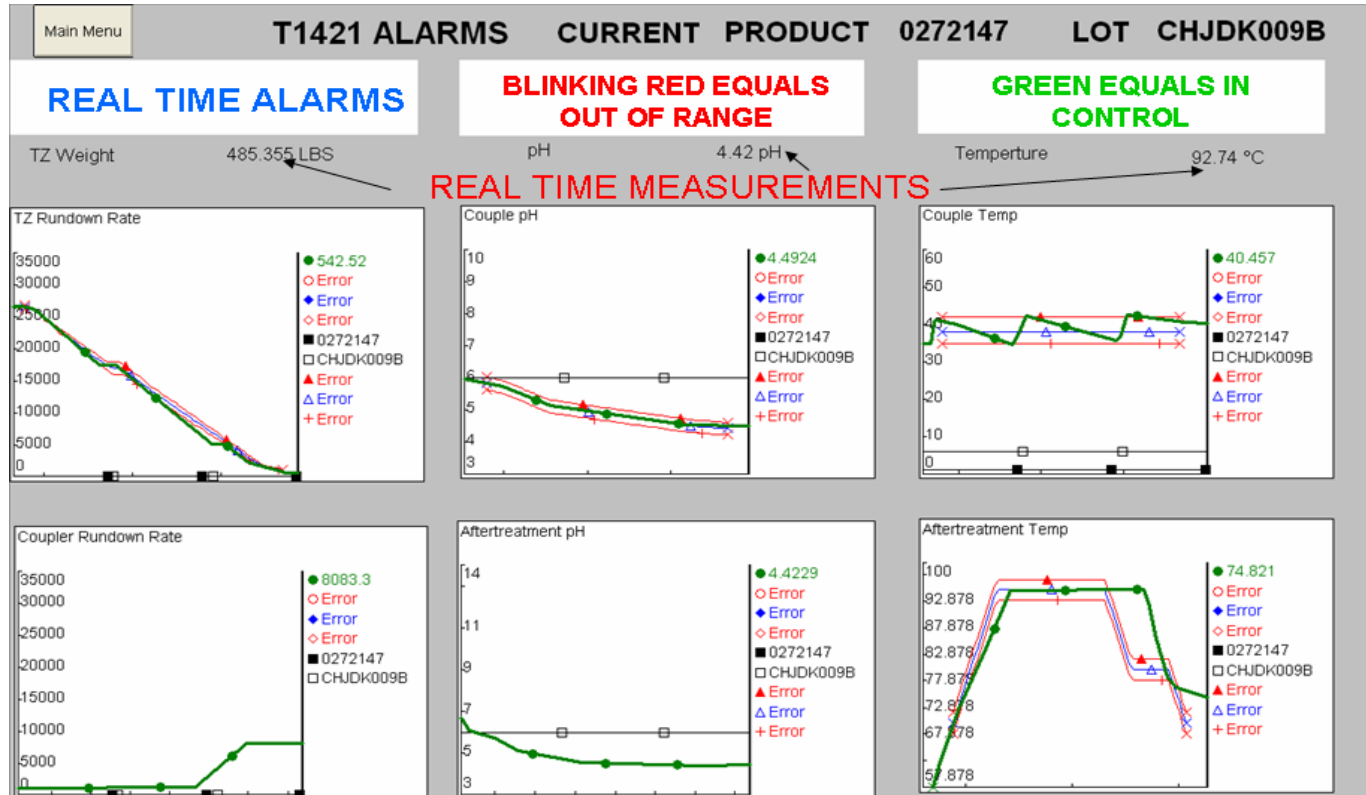
[illegible]

# Example Screen Shots for PI Batch





# Real-Time Templates in ProcessBook



# Agenda



# How the PI System was Leveraged

- Integration, analytics, visualization, and reporting
- The use of advanced functionality:
  - PI-AF
  - PI ACE
  - PI Batch and
  - PI Process Templates
- Migration of Applications
- Foundation for real-time collaboration and continuous improvement.



# Tangible/Intangible Benefits

- FPY      Year      Goal      %

	2008		96.27
	2009	97.02	97.25
	2010		98.28
	2011		97.76
	2012		97.09
	2013		97.76
- 2010 and later: new product lines adversely affected the FPY.
- “*Millions of Dollars saved*” – Still operating...still alive



# In the Spirit of Continuous Improvement - Future plans at Sun Chemical

- Expand PI templates usage to more processes.
- Generate process optimization projects by identifying process capability opportunities.
- Continue to Expand the PI AF asset model and expand use.
- Migrate PI-Batch Generator to PI Event Frames in AF.



# Summary

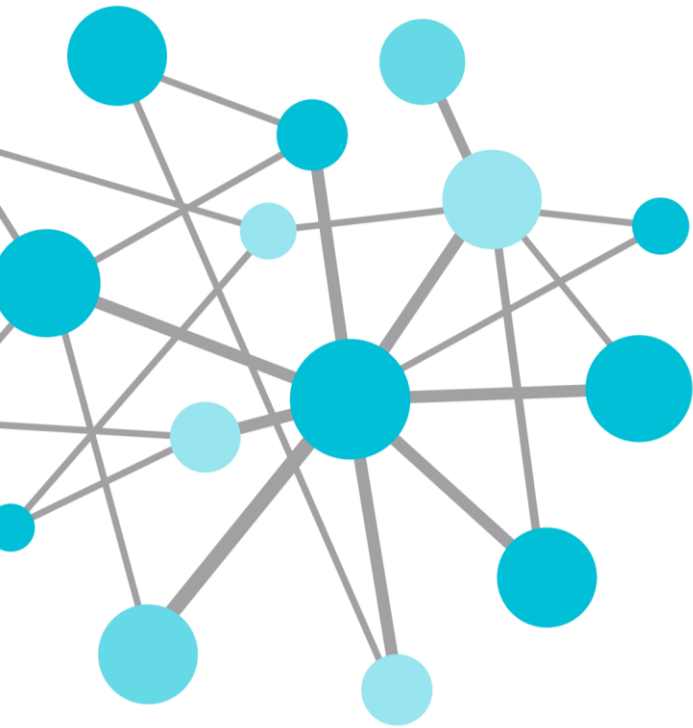


- The PI System has evolved significantly and now is capable of doing over 90% of traditional “solutions”...”From Historian to a *Infrastructure*”
- Continuous improvement is about a 1000 projects to drive cultural change from leveraging real time information and collaboration – “The Power of *Real-Time Data*”... and making data based decisions
- “Evolutionary” applications like energy management are more cost effective and lasting vs. the “Big Bang” propriety solutions
- The PI System has enabled Sun Chemical to realize and monetize their most important asset – real-time information- to survive (hopefully Thrive)

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**PI Systems Specialist**  
**SunChemical**



THANK  
YOU