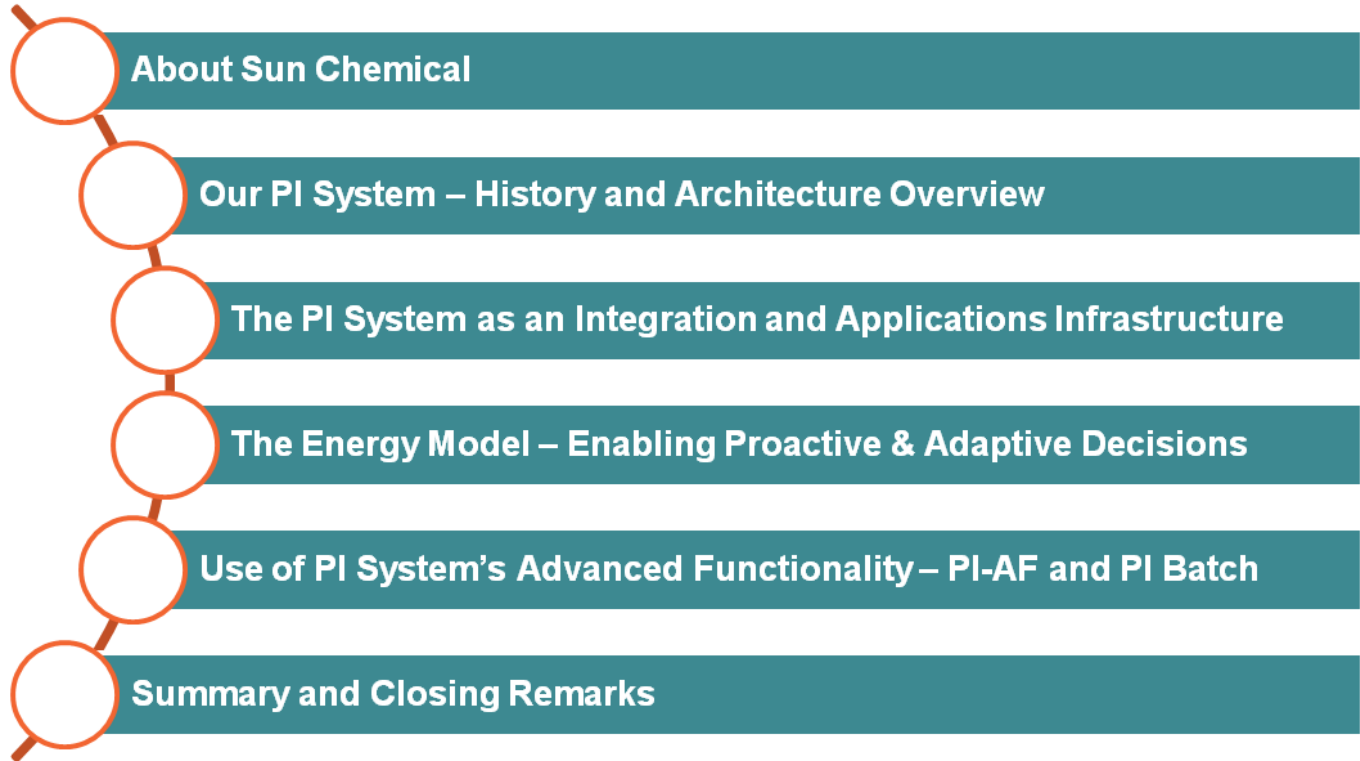


The Continuing Evolution of the PI System as Strategic Element of Energy and Process Optimization at Sun Chemical

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

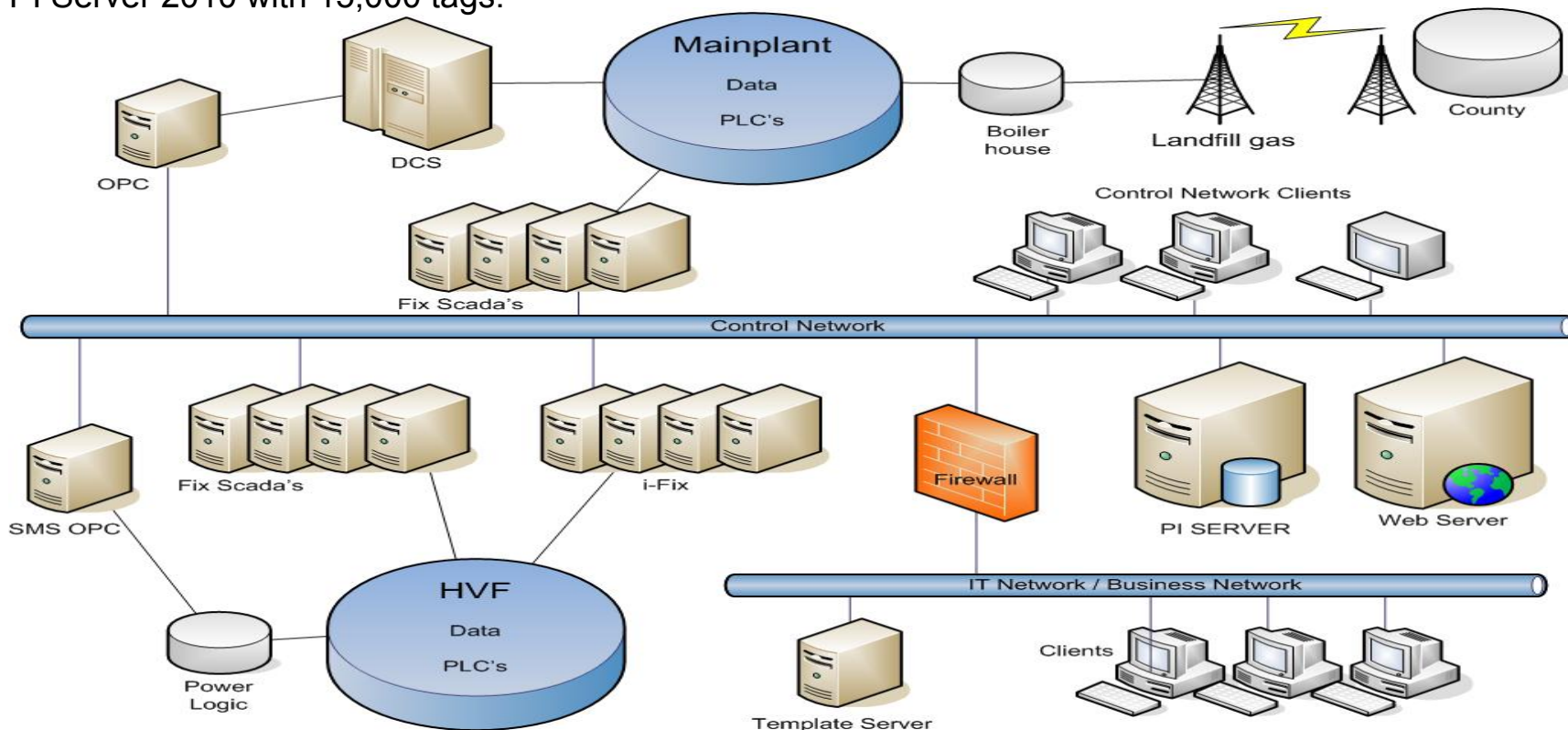
- Sustainability – “the ability to endure” by innovating and adapting with information
- Improved Energy & Process Optimization & Reliability
- Continuous Improvement Culture

Agenda

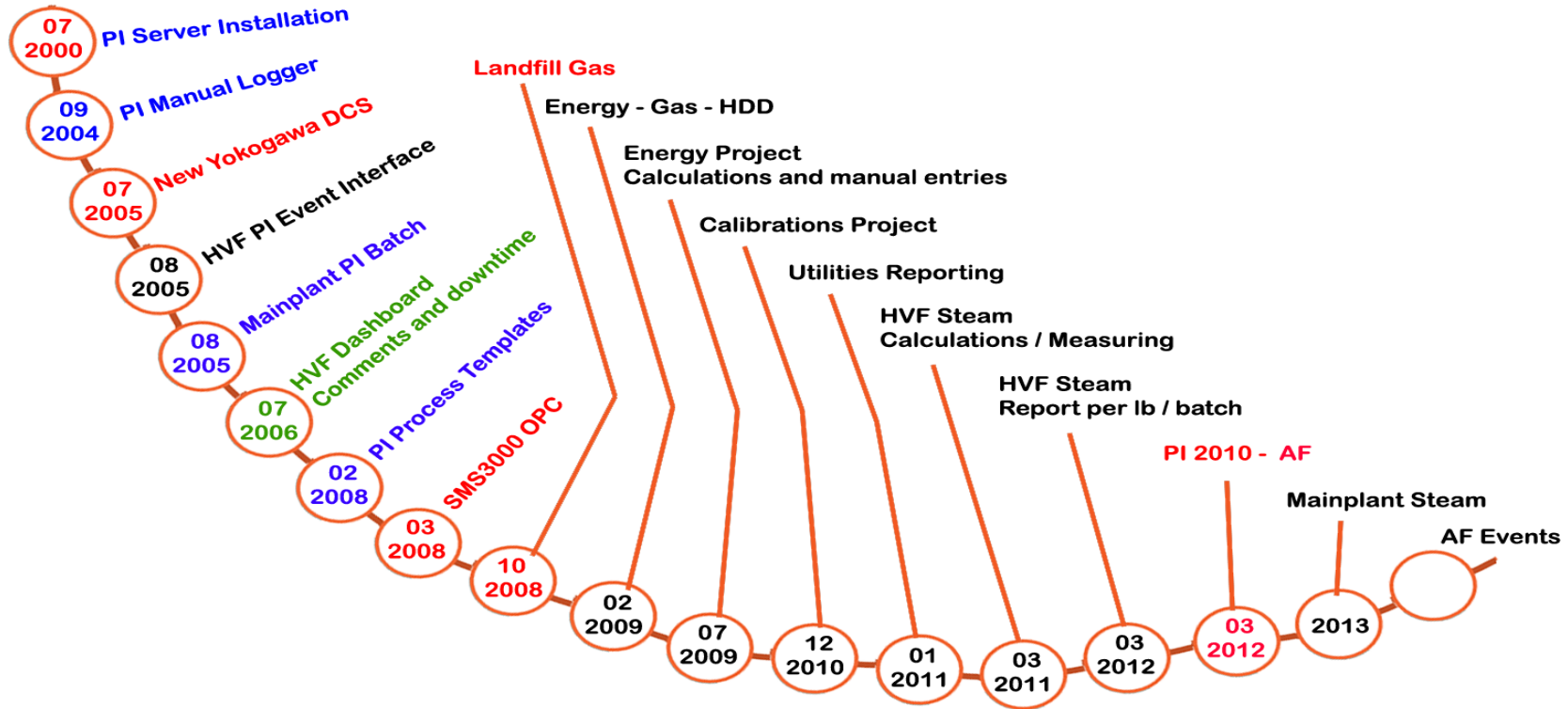


Our PI System History and Architecture

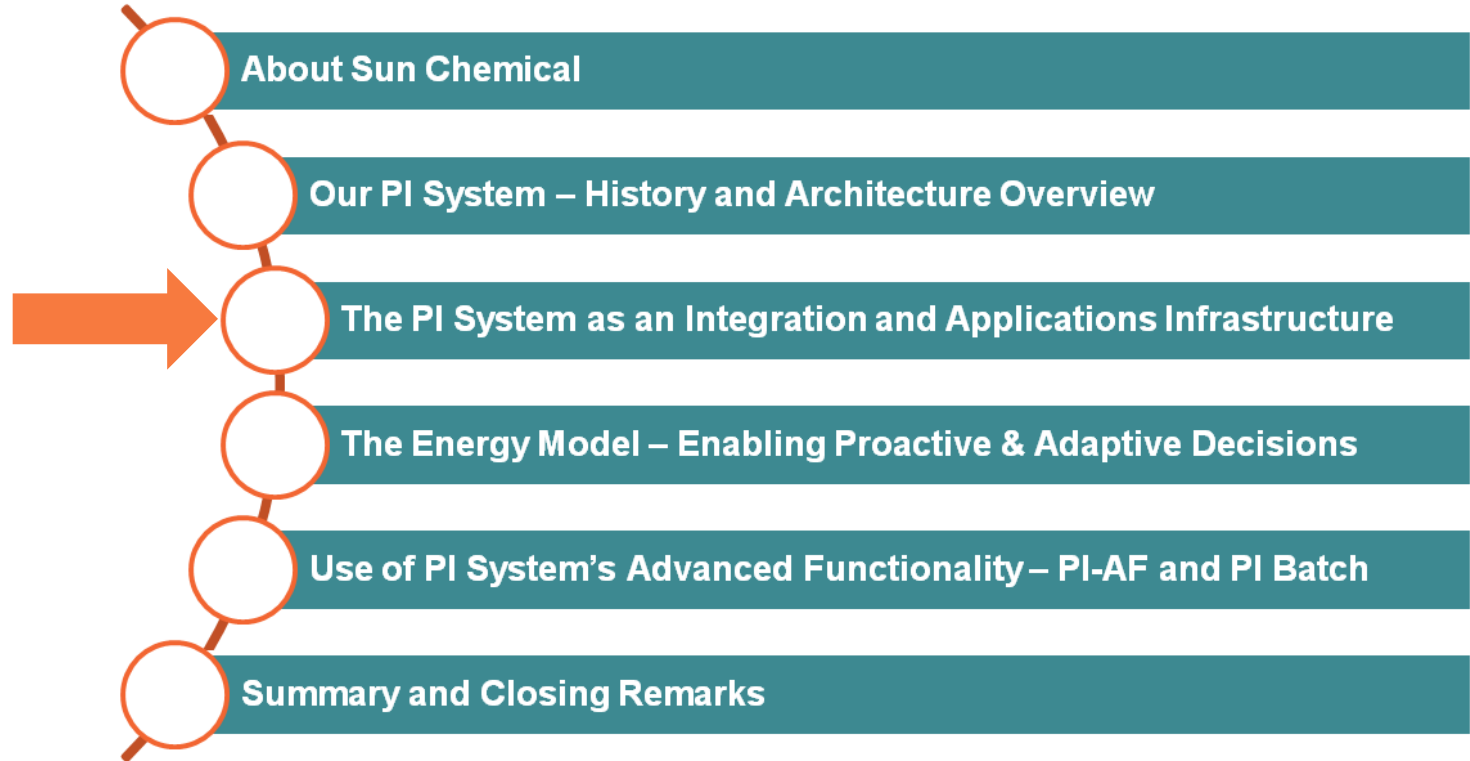
PI Server 2010 with 15,000 tags.



The Evolution Continues.....



Agenda



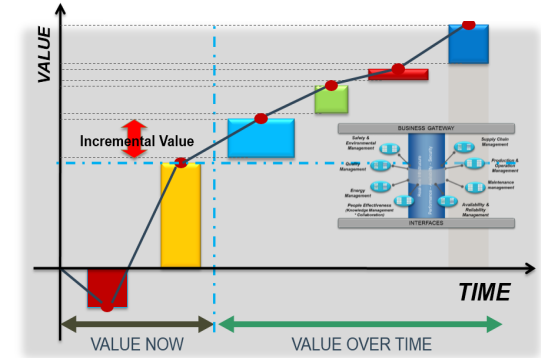
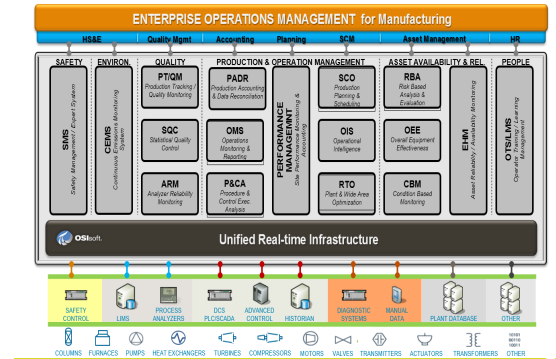
Integration and Applications Infrastructure

- Integration of Different Data Sources

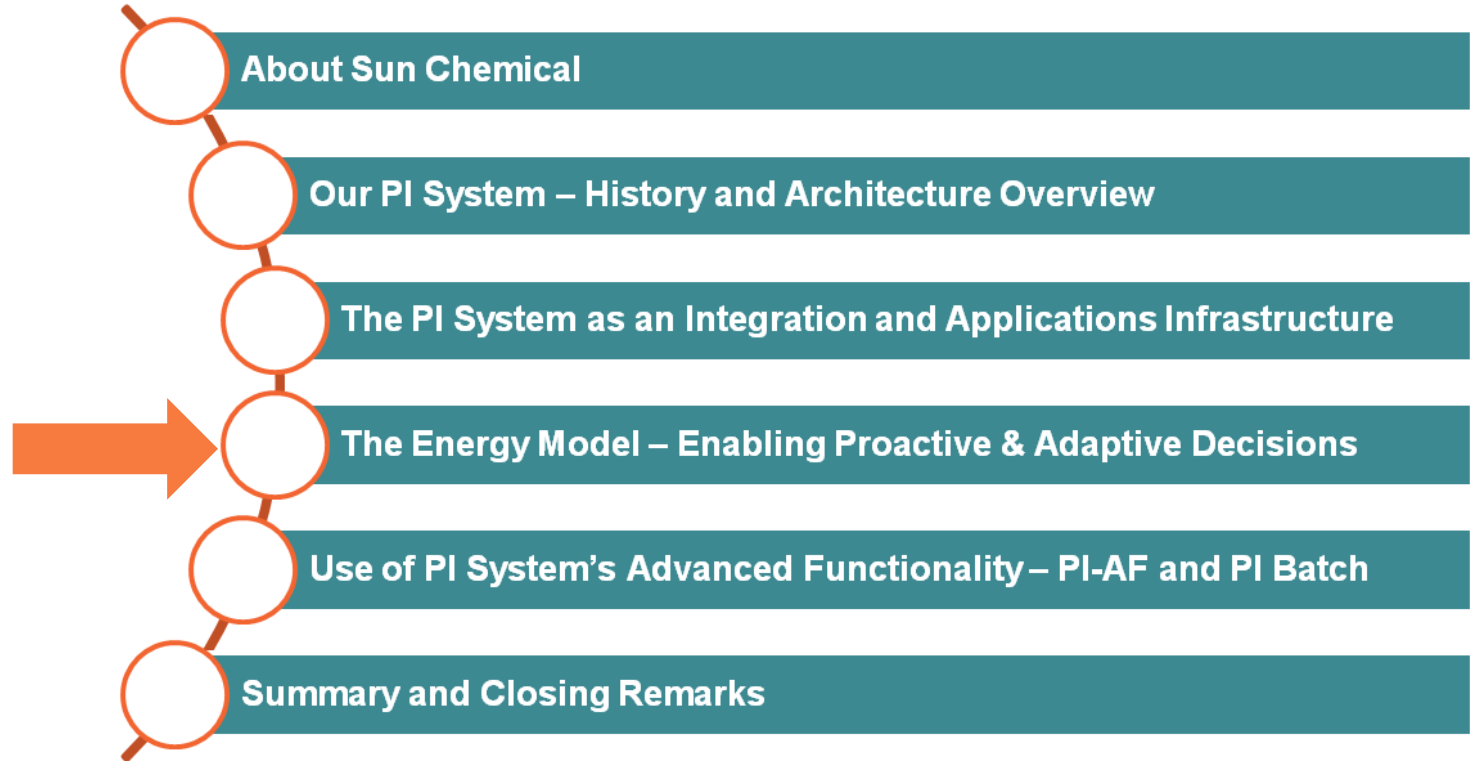
- DCS, SCADA, PLCs, LIMS
- Power Logic System
- Manual Data
- And many more....

- 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

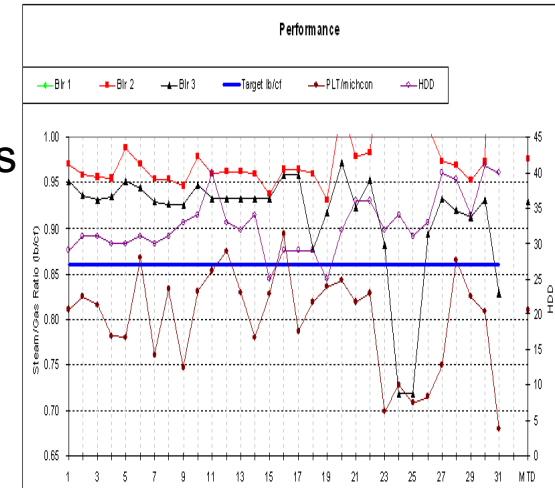
Business Challenge: Create an energy model for the plant that can be used for budgets and set baselines.

1. Integration of energy data

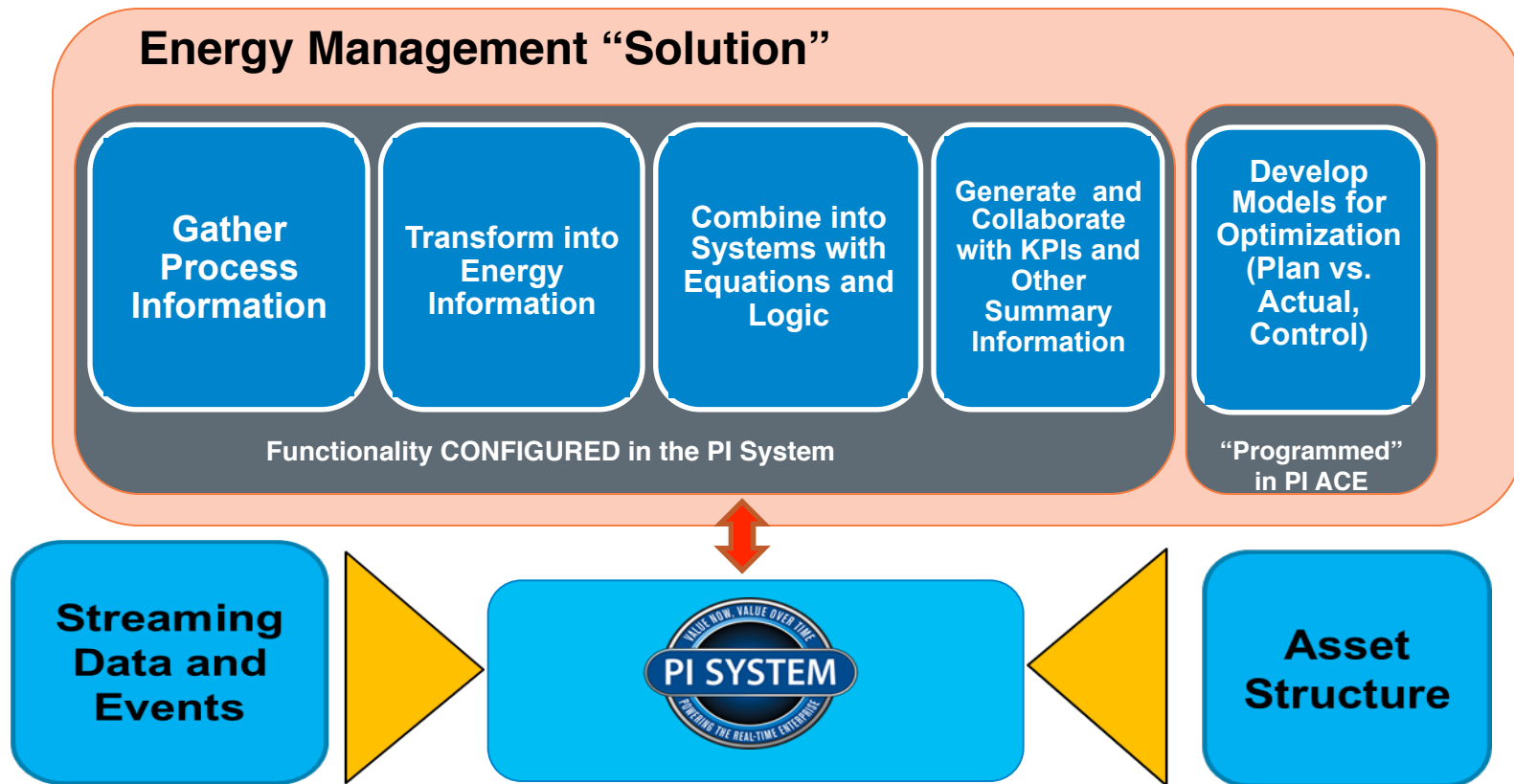
- Electricity data from Power Logic System
- Gas data from flow meters in PI and manual readings
- Boiler house steam production and flow meters
- Water data from meters and manual entry

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....

Database
Query Date
Back
Check In
New Element
New Attribute

Elements

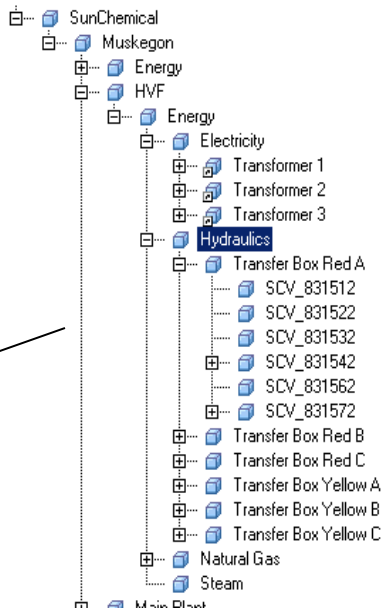
- [-] SunChemical
 - [-] Muskegon
 - [-] Energy
 - [-] Electricity
 - [-] Transformer 1
 - [-] Transformer 2
 - [-] Transformer 3
 - [-] Gas
 - [-] Land Fill Gas
 - [-] Natural Gas
 - [-] Admin Lab
 - [-] AZO Space Heat
 - [-] Belt Dryer
 - [-] Boiler House
 - [-] Boiler 1
 - [-] Boiler 2
 - [-] Boiler 3
 - [-] Flush Space Heat
 - [-] HVF Space Heat
 - [-] IB
 - [-] Maintenance Space Heat
 - [-] RCM Space Heat
 - [-] Spin Flash Dryers
 - [-] Spray Dryer
 - [-] Toner Space Heat
 - [-] HVF
 - [-] Energy
 - [-] Electricity
 - [-] Transformer 1
 - [-] Transformer 2
 - [-] Transformer 3
 - [-] Hydraulics
 - [-] Transfer Box Red A
 - [-] Transfer Box Red B
 - [-] Transfer Box Red C
 - [-] Transfer Box Yellow A
 - [-] Transfer Box Yellow B
 - [-] Transfer Box Yellow C
 - [-] Natural Gas
 - [-] Steam
 - [-] Main Plant
 - [-] Energy
 - [-] Electricity
 - [-] Steam
 - [-] Natural Gas








Electricity

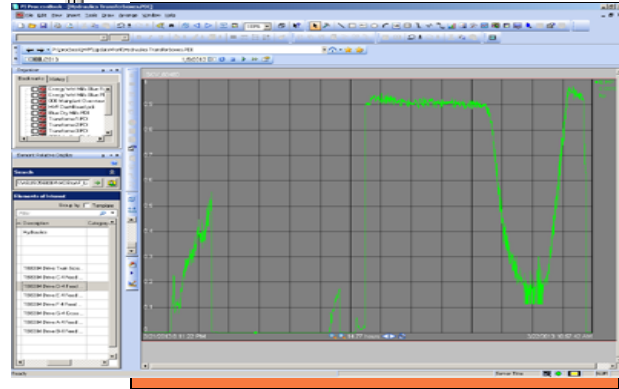
General | Child Elements | Attributes | Ports | Version

Filter

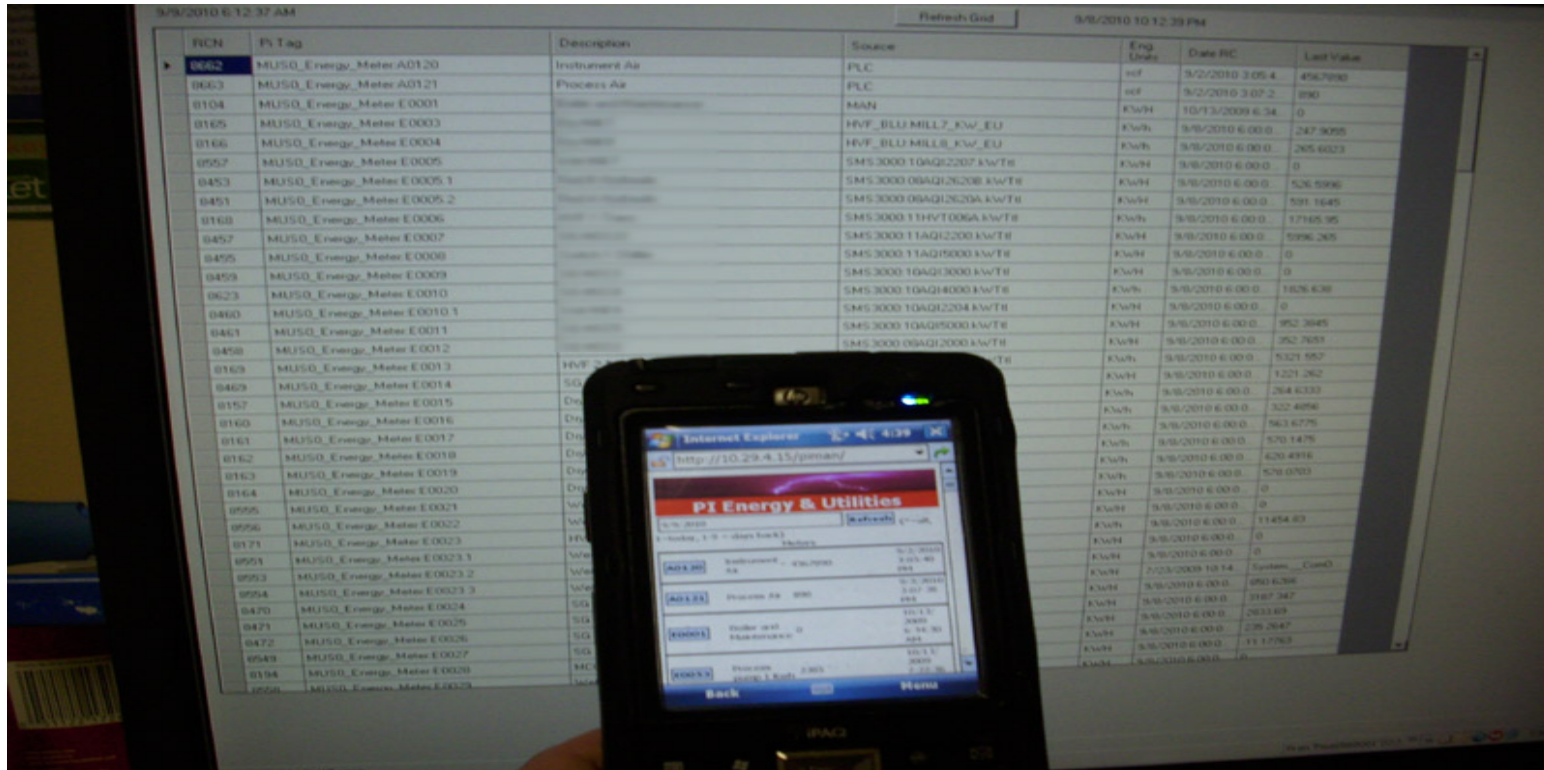
| Name | Value |
|-----------------------|----------------------|
| Usage Today | 43494.18 kWh |
| Usage Yesterday | 78355.564146713 kWh |
| Usage Yesterday - Now | 121849.636446163 kWh |



| 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

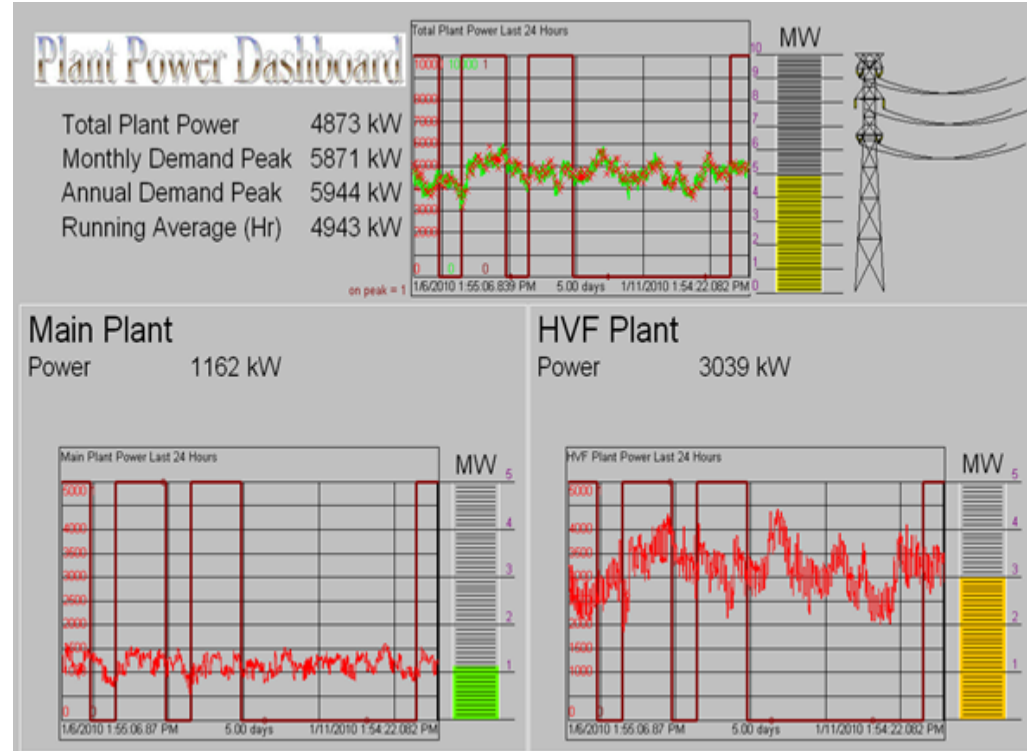


The image shows a computer screen displaying a data table from the PI Energy & Utilities application. The table lists various energy meters and their associated data. In the foreground, a handheld PDA device displays the same application interface, showing a list of meters and their data.

| FCN | PI Tag | Description | Source | Eng Units | Date PIC | Last Value |
|------|---------------------------|----------------|-------------------------|-----------|-----------------|-------------|
| 0662 | MUSO_Energy_Meter A0120 | Instrument Air | PLC | ref | 3/2/2010 3:05:4 | 450.7980 |
| 0663 | MUSO_Energy_Meter A0121 | Process Air | PLC | ref | 3/2/2010 3:07:2 | 890 |
| 0104 | MUSO_Energy_Meter E0001 | | MAN | Kw/h | 10/13/2009 6:34 | 0 |
| 0165 | MUSO_Energy_Meter E0003 | | HVF_BLU MILL7_KW_EU | Kwh | 3/9/2010 6:00:0 | 247.9095 |
| 0166 | MUSO_Energy_Meter E0004 | | HVF_BLU MILL8_KW_EU | Kwh | 3/9/2010 6:00:0 | 265.6023 |
| 0557 | MUSO_Energy_Meter E0005 | | SMS3000 10AQ1200 kWTh | Kwh | 3/9/2010 6:00:0 | 0 |
| 0453 | MUSO_Energy_Meter E0005.1 | | SMS3000 09AQ126208 kWTh | Kwh | 3/9/2010 6:00:0 | 526.5996 |
| 0451 | MUSO_Energy_Meter E0005.2 | | SMS3000 09AQ12620A kWTh | Kwh | 3/9/2010 6:00:0 | 591.1645 |
| 0168 | MUSO_Energy_Meter E0006 | | SMS3000 11HVT006A kWTh | Kwh | 3/9/2010 6:00:0 | 17145.95 |
| 0457 | MUSO_Energy_Meter E0007 | | SMS3000 11AQ12200 kWTh | Kwh | 3/9/2010 6:00:0 | 5996.265 |
| 0455 | MUSO_Energy_Meter E0008 | | SMS3000 11AQ15000 kWTh | Kwh | 3/9/2010 6:00:0 | 0 |
| 0459 | MUSO_Energy_Meter E0009 | | SMS3000 10AQ13000 kWTh | Kwh | 3/9/2010 6:00:0 | 0 |
| 0623 | MUSO_Energy_Meter E0010 | | SMS3000 10AQ14000 kWTh | Kwh | 3/9/2010 6:00:0 | 1626.636 |
| 0460 | MUSO_Energy_Meter E0010.1 | | SMS3000 10AQ12204 kWTh | Kwh | 3/9/2010 6:00:0 | 0 |
| 0461 | MUSO_Energy_Meter E0011 | | SMS3000 10AQ15000 kWTh | Kwh | 3/9/2010 6:00:0 | 352.3645 |
| 0458 | MUSO_Energy_Meter E0012 | | SMS3000 09AQ12000 kWTh | Kwh | 3/9/2010 6:00:0 | 352.7651 |
| 0169 | MUSO_Energy_Meter E0013 | HVF 2 | | Kwh | 3/9/2010 6:00:0 | 5321.557 |
| 0463 | MUSO_Energy_Meter E0014 | SG | | Kwh | 3/9/2010 6:00:0 | 1221.262 |
| 0157 | MUSO_Energy_Meter E0015 | Dg | | Kwh | 3/9/2010 6:00:0 | 264.6333 |
| 0160 | MUSO_Energy_Meter E0016 | Dg | | Kwh | 3/9/2010 6:00:0 | 322.4096 |
| 0161 | MUSO_Energy_Meter E0017 | Dg | | Kwh | 3/9/2010 6:00:0 | 563.6775 |
| 0162 | MUSO_Energy_Meter E0018 | Dg | | Kwh | 3/9/2010 6:00:0 | 570.1475 |
| 0163 | MUSO_Energy_Meter E0019 | Dg | | Kwh | 3/9/2010 6:00:0 | 620.4916 |
| 0164 | MUSO_Energy_Meter E0020 | Dg | | Kwh | 3/9/2010 6:00:0 | 578.0703 |
| 0555 | MUSO_Energy_Meter E0021 | Wf | | Kwh | 3/9/2010 6:00:0 | 0 |
| 0556 | MUSO_Energy_Meter E0022 | Wf | | Kwh | 3/9/2010 6:00:0 | 11454.63 |
| 0171 | MUSO_Energy_Meter E0023 | HVF | | Kwh | 3/9/2010 6:00:0 | 0 |
| 0551 | MUSO_Energy_Meter E0023.1 | Wf | | Kwh | 3/9/2010 6:00:0 | 0 |
| 0553 | MUSO_Energy_Meter E0023.2 | Wf | | Kwh | 2/23/2009 10:14 | System_Cond |
| 0554 | MUSO_Energy_Meter E0023.3 | Wf | | Kwh | 3/9/2010 6:00:0 | 680.6768 |
| 0470 | MUSO_Energy_Meter E0024 | SG | | Kwh | 3/9/2010 6:00:0 | 3187.247 |
| 0471 | MUSO_Energy_Meter E0025 | SG | | Kwh | 3/9/2010 6:00:0 | 2833.63 |
| 0472 | MUSO_Energy_Meter E0026 | SG | | Kwh | 3/9/2010 6:00:0 | 235.2647 |
| 0549 | MUSO_Energy_Meter E0027 | SG | | Kwh | 3/9/2010 6:00:0 | 11.1793 |
| 0194 | MUSO_Energy_Meter E0028 | NAC | | Kwh | 3/9/2010 6:00:0 | 0 |
| 0550 | MUSO_Energy_Meter E0029 | NAC | | Kwh | 3/9/2010 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

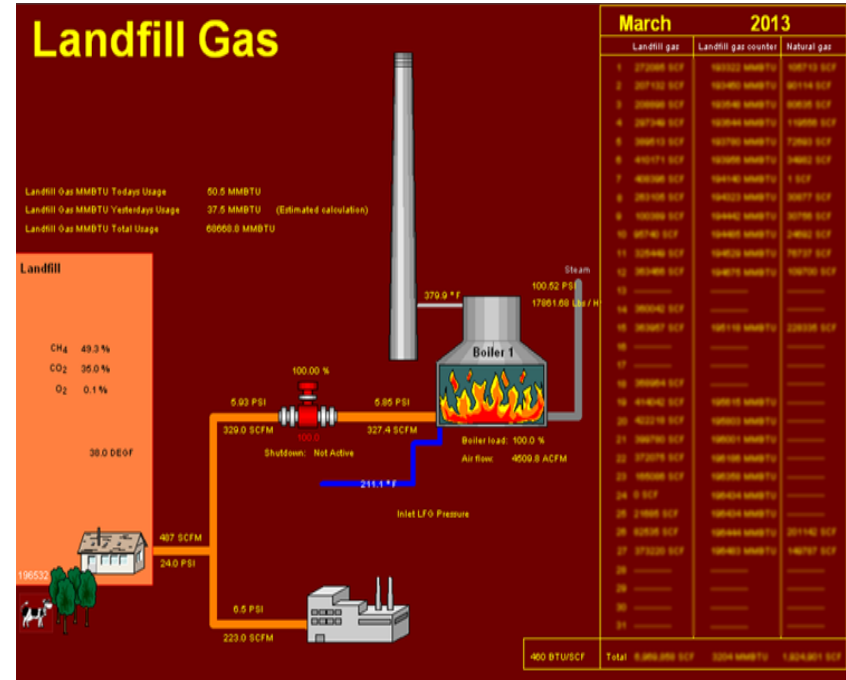


Continuous Improvement in Action

| 5/23/12 | | Operators monitor site demand vs. the maximum demand target | | | | | | | | | | | | Monthly Demand | Site kW | Weight | Weight | Weight v |
|---------------|----|-------------------------------------------------------------|----|----|----|----|----|----|----|----|----|----|----|----------------|---------|--------|--------|----------|
| | | kW | kW | kW | kW | kW | kW | kW | kW | kW | kW | kW | kW | | | | | |
| 5/23/12 6:00 | 57 | 1 | 58 | 61 | 59 | 60 | 63 | 64 | 46 | 57 | 68 | 60 | 60 | 5244 | 4467 | 4968 | 4990 | 4623 |
| 5/23/12 6:30 | 56 | 42 | 57 | 61 | 59 | 60 | 43 | 66 | 47 | 58 | 69 | 61 | 61 | 5244 | 4873 | 5149 | 4989 | 4624 |
| 5/23/12 7:00 | 55 | 61 | 58 | 62 | 60 | 60 | 58 | 66 | 33 | 58 | 59 | 62 | 62 | 5244 | 4873 | 5669 | 4989 | 4624 |
| 5/23/12 7:30 | 54 | 60 | 37 | 62 | 50 | 60 | 59 | 39 | 40 | 46 | 51 | 62 | 62 | 5244 | 5279 | 6063 | 5462 | 4623 |
| 5/23/12 8:00 | 44 | 60 | 35 | 49 | 20 | 54 | 60 | 61 | 43 | 38 | 65 | 20 | 62 | 5244 | 4873 | 6691 | 6097 | 4624 |
| 5/23/12 8:30 | 59 | 61 | 58 | 17 | 50 | 18 | 61 | 63 | 44 | 59 | 66 | 60 | 60 | 5244 | 5076 | 6986 | 6692 | 4624 |
| 5/23/12 9:00 | 58 | 61 | 57 | 59 | 61 | 63 | 62 | 64 | 44 | 58 | 66 | 60 | 60 | 5244 | 5076 | 6872 | 6752 | 4624 |
| 5/23/12 9:30 | 56 | 36 | 56 | 63 | 61 | 61 | 39 | 65 | 45 | 58 | 67 | 60 | 60 | 5244 | 5279 | 4340 | 7208 | 4624 |
| 5/23/12 10:00 | 56 | 59 | 57 | 62 | 61 | 60 | 42 | 65 | 34 | 59 | 62 | 61 | 61 | 5244 | 5076 | 2537 | 6834 | 4623 |
| 5/23/12 10:30 | 56 | 60 | 57 | 63 | 62 | 61 | 61 | 6 | 0 | 57 | 18 | 62 | 62 | 5244 | 4873 | 2972 | 4258 | 4624 |
| 5/23/12 11:00 | 15 | 60 | 42 | 63 | 55 | 62 | 62 | 16 | 0 | 13 | 0 | 31 | 31 | 5244 | 5279 | 3366 | 3135 | 4624 |
| 5/23/12 11:30 | 0 | 61 | 25 | 63 | 1 | 20 | 63 | 7 | 0 | 0 | 0 | 38 | 38 | 5244 | 4467 | 3872 | 4038 | 4624 |
| 5/23/12 12:00 | 0 | 61 | 0 | 10 | 0 | 0 | 64 | 64 | 0 | 0 | 0 | 61 | 61 | 5244 | 4264 | 3919 | 4472 | 4624 |
| 5/23/12 12:30 | 0 | 18 | 0 | 0 | 0 | 0 | 63 | 5 | 0 | 0 | 0 | 5 | 5 | 5244 | 4264 | 3971 | 4806 | 4624 |
| 5/23/12 13:00 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 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 | 0 | 5244 | 3858 | 4251 | 4829 | 4624 |
| 5/23/12 14:00 | 0 | 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 | 0 | 5244 | 4061 | 4250 | 4825 | 4624 |
| 5/23/12 15:00 | 0 | 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 | 0 | 5244 | 3249 | 4246 | 4825 | 4623 |
| 5/23/12 16:00 | 0 | 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 | 0 | 5244 | 3046 | 4246 | 4821 | 4622 |
| 5/23/12 17:00 | 0 | 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 | 0 | 5244 | 3046 | 4247 | 4821 | 4622 |
| 5/23/12 18:00 | 0 | 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 | 0 | 5244 | 3046 | 4247 | 4821 | 4624 |
| 5/23/12 19:00 | 37 | 2 | 17 | 0 | 15 | 0 | 42 | 18 | 16 | 0 | 15 | 16 | 16 | 5244 | 3655 | 4248 | 4823 | 4625 |
| 5/23/12 19:30 | 61 | 29 | 62 | 3 | 49 | 6 | 64 | 67 | 45 | 27 | 57 | 64 | 64 | 5244 | 3858 | 4245 | 4825 | 4625 |
| 5/23/12 20:00 | 60 | 63 | 58 | 47 | 63 | 62 | 64 | 67 | 46 | 62 | 69 | 63 | 63 | 5244 | 4264 | 4245 | 4825 | 4625 |
| 5/23/12 20:30 | 59 | 62 | 58 | 65 | 63 | 62 | 64 | 67 | 47 | 59 | 69 | 64 | 64 | 5244 | 4467 | 4243 | 4821 | 4625 |
| 5/23/12 21:00 | 59 | 62 | 58 | 63 | 63 | 61 | 65 | 67 | 46 | 59 | 69 | 62 | 62 | 5244 | 4264 | 4245 | 4869 | 4625 |
| 5/23/12 21:30 | 54 | 63 | 59 | 64 | 63 | 61 | 65 | 45 | 47 | 59 | 70 | 45 | 45 | 5244 | 4467 | 4269 | 5430 | 4625 |
| 5/23/12 22:00 | 41 | 63 | 48 | 64 | 40 | 62 | 43 | 63 | 19 | 60 | 46 | 63 | 63 | 5244 | 4467 | 4757 | 5492 | 4624 |
| 5/23/12 22:30 | 51 | 33 | 0 | 64 | 25 | 32 | 62 | 64 | 18 | 38 | 9 | 62 | 62 | 5244 | 4670 | 5348 | 5961 | 4625 |
| 5/23/12 23:00 | 59 | 57 | 0 | 44 | 42 | 9 | 62 | 65 | 25 | 60 | 37 | 62 | 62 | 5244 | 4873 | 5565 | 6731 | 4625 |
| 5/23/12 23:30 | 58 | 60 | 0 | 67 | 60 | 59 | 62 | 66 | 43 | 59 | 68 | 63 | 63 | 5244 | 4873 | 2765 | 6822 | 4625 |
| 5/24/12 0:00 | 57 | 60 | 40 | 62 | 60 | 61 | 63 | 66 | 44 | 58 | 67 | 50 | 50 | 5244 | 5279 | 1940 | 5510 | 4626 |
| 5/24/12 0:30 | 57 | 61 | 58 | 63 | 60 | 60 | 62 | 8 | 44 | 59 | 67 | 0 | 0 | 5244 | 5482 | 2041 | 2802 | 4628 |
| 5/24/12 1:00 | 56 | 61 | 57 | 63 | 61 | 60 | 42 | 17 | 45 | 60 | 68 | 26 | 26 | 5244 | 5482 | 2400 | 2082 | 4627 |
| 5/24/12 1:30 | 42 | 51 | 57 | 63 | 61 | 61 | 59 | 52 | 46 | 41 | 69 | 61 | 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.



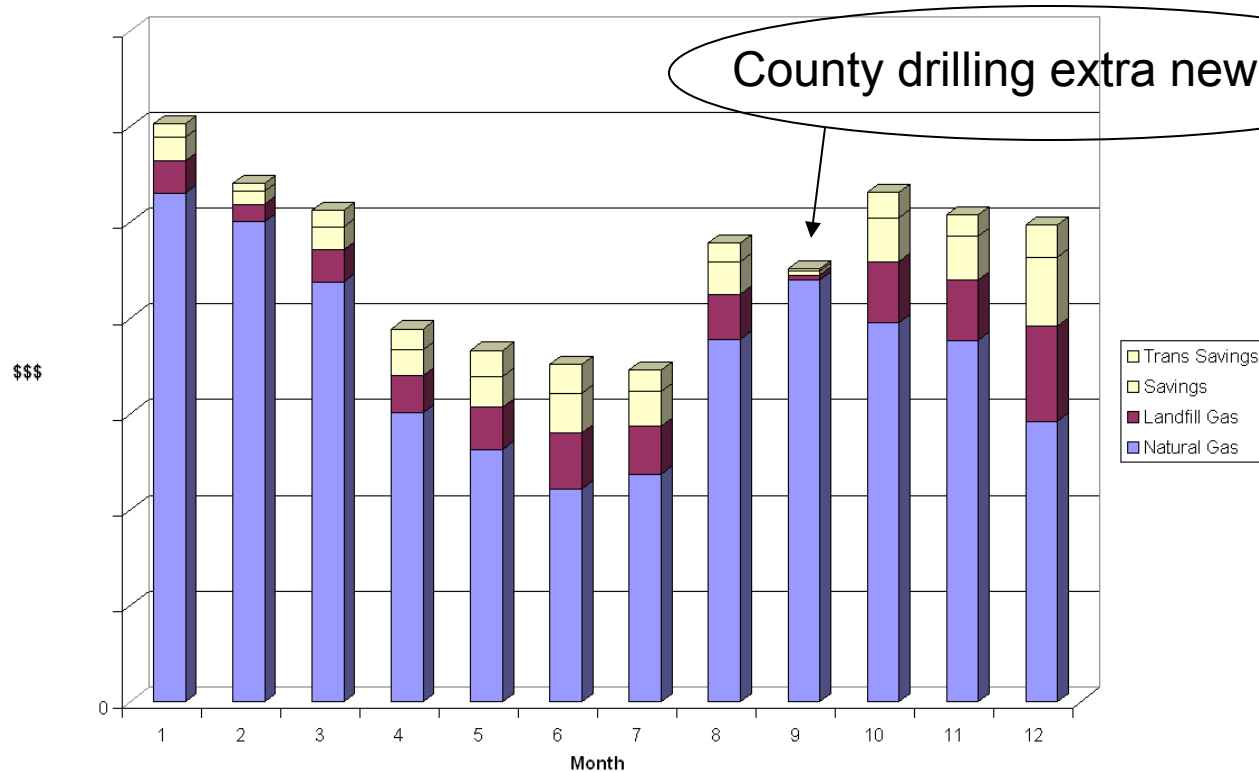
Optimizing Boiler House Operations

- 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.

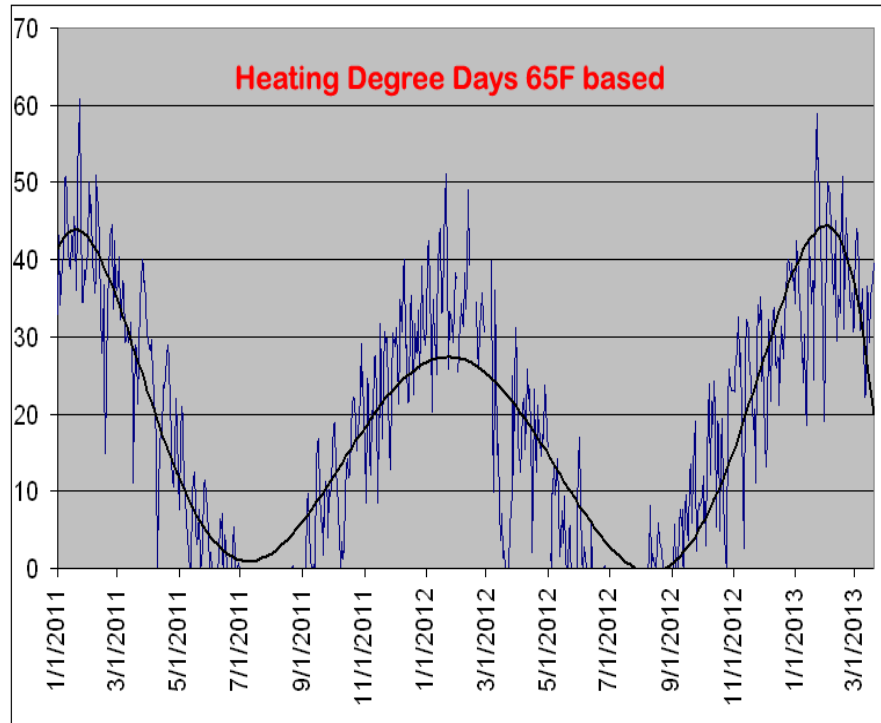
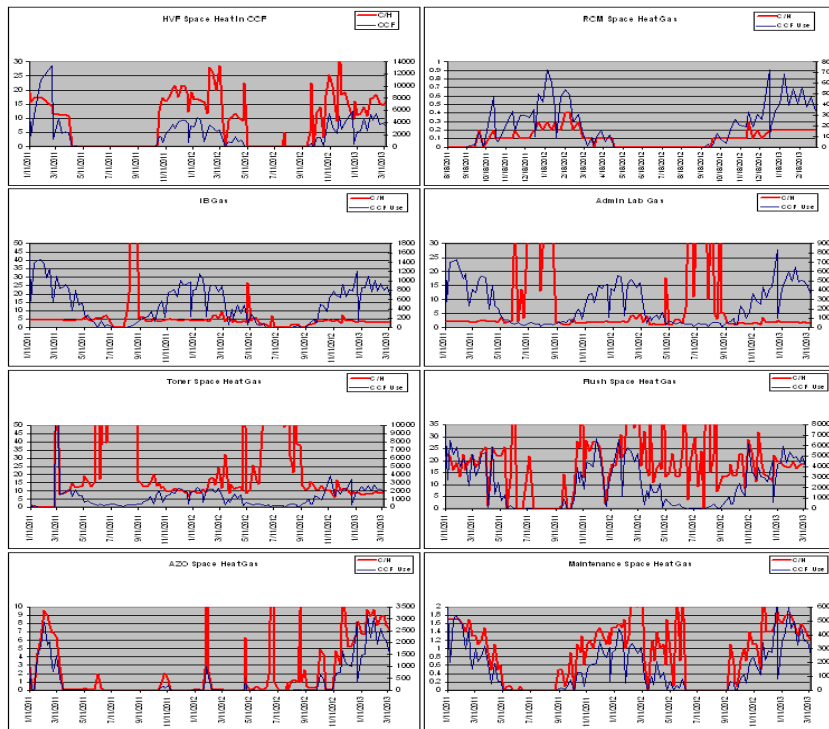


Real time Monitoring

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

The screenshot displays the 'Performance Equations - PI System Management Tools' application. The 'Equation' tab is selected, showing the following details:

- Event tag:** HVF_YEL:TC_82111_OUTPUT
- Equation:**
$$\text{if trunc('HVF_YEL:TC_82111_OUTPUT';10)} = 0 \text{ then } 0 + (\text{'HVF_YEL:TC_82111_OUTPUT'} - \text{trunc('HVF_YEL:TC_82111_OUTPUT';10)}) * 0.205 \text{ else if trunc('HVF_YEL:TC_82111_OUTPUT';10)} = 10 \text{ then } 2.05 + (\text{'HVF_YEL:TC_82111_OUTPUT'} - \text{trunc('HVF_YEL:TC_82111_OUTPUT';10)}) * 0.302 \text{ else if trunc('HVF_YEL:TC_82111_OUTPUT';10)} = 20 \text{ then } 5.07 + (\text{'HVF_YEL:TC_82111_OUTPUT'} - \text{trunc('HVF_YEL:TC_82111_OUTPUT';10)}) * 0.493 \text{ else if trunc('HVF_YEL:TC_82111_OUTPUT';10)} = 30 \text{ then } 10 + (\text{'HVF_YEL:TC_82111_OUTPUT'} - \text{trunc('HVF_YEL:TC_82111_OUTPUT';10)}) * 0.72 \text{ else if}$$
- Evaluate:** [Empty field]
- Timestamp:** [Empty field] **Value:** [Empty field]
- Snapshot:** 4/3/2013 9:35:18 AM **Value:** 0

An orange arrow points to the 'Evaluate' button. Below the main window, a smaller version of the same interface is visible, showing the same equation and a value of 0.

PI Totalizers Are Used Extensively

The screenshot displays the 'Totalizers - PI System Management Tools' window. The interface includes a sidebar with navigation options like 'Collectives and Servers', 'System Management Tools', and 'Security'. The main area shows a table of totalizers with columns for 'Server', 'Totalizer', 'Descriptor', and 'Point Type'. A detailed view at the bottom shows the configuration for a specific totalizer, including its name, description, source tag, units, and point type. The 'Totalizer Type' section shows 'Summary Calculation' selected, with 'Block', 'Time Weighted', and 'Total' options. A session record at the bottom indicates a successful deletion of a point.

| Server | Totalizer | Descriptor | Point Type |
|----------|----------------------------------------|---------------------------|------------|
| MUSO_003 | HIS0124.01540163_totalized | H2O Flow To Strike | Float32 |
| MUSO_003 | 2126_003_YEL_DRYR.00F1700301_totalized | Water To Boilers | Float32 |
| MUSO_005 | 2126_003_YEL_DRYR.00F1701301_totalized | Gas Flow to Boiler 1 | Float32 |
| MUSO_005 | 2126_003_YEL_DRYR.00F1701302_totalized | Steam From Boiler 1 | Float32 |
| MUSO_005 | 2126_003_YEL_DRYR.00F1702301_totalized | Gas Flow to Boiler 2 | Float32 |
| MUSO_005 | 2126_003_YEL_DRYR.00F1703301_totalized | Gas Flow to Boiler 3 | Float32 |
| MUSO_005 | 2126_003_YEL_DRYR.00F1703302_totalized | Steam From Boiler 3 | Float32 |
| MUSO_005 | 2126_003_YEL_DRYR.00F1710101_totalized | Instrument Air | Float32 |
| MUSO_005 | 2126_003_YEL_DRYR.00F17136_totalized | Flow to CAMUS | Float32 |
| MUSO_005 | 2126_003_YEL_DRYR.00F1720101_totalized | Process Air | Float32 |
| MUSO_005 | 2126_003_YEL_DRYR.00F1724201_totalized | RO Reject Recycle | Float32 |
| MUSO_005 | 2126_003_YEL_DRYR.00F1724202_totalized | RO Reject To Drain | Float32 |
| MUSO_005 | 2126_003_YEL_DRYR.00F17217_totalized | Flow to MCVWMS | Float32 |
| MUSO_005 | 2126_003_YEL_DRYR.1501_totalized | Main Plant Scrubber | Float32 |
| MUSO_068 | 2800_083_HVF_YEL-FE_83346_totalized | Yel C Leems F-8303 Dischg | Float32 |
| MUSO_068 | 2800_083_HVF_YEL-FE_83347_totalized | Yel C Leems F-8313 Dischg | Float32 |
| MUSO_068 | 2800_083_HVF_YEL-FE_83350_totalized | Yel C Leems F-8303 III | Float32 |
| MUSO_068 | 2800_083_HVF_YEL-FE_83359_totalized | Yel C Leems F-8313 III | Float32 |
| MUSO_068 | 2800_084_HVF_RED-FE_83446_totalized | Red C Leems F-8304 | Float32 |
| MUSO_068 | 2800_084_HVF_RED-FE_83447_totalized | Red C Leems F-8311 | Float32 |
| MUSO_068 | 2800_084_HVF_RED-FE_83450_totalized | Red C Leems F-8304 III | Float32 |
| MUSO_068 | 2800_084_HVF_RED-FE_83459_totalized | Red C Leems F-8314 III | Float32 |
| MUSO_068 | 2800_084_HVF_RED-FE_83546_totalized | Red A Leems F-8305 | Float32 |
| MUSO_068 | 2800_084_HVF_RED-FE_83547_totalized | Red A Leems F-8315 | Float32 |
| MUSO_068 | 2800_084_HVF_RED-FE_83646_totalized | Red B Leems F-8306 | Float32 |
| MUSO_068 | 2800_084_HVF_RED-FE_83647_totalized | Red B Leems F-8316 | Float32 |

Name & Type | Sampling | Results | Archive | Security | System | Options | Summary |

Name: MUSO_005_2126_003_YEL_DRYR.00F1700301_totalized Rename PI Server:

Description: Water To Boilers

Source Tag: MUSO_YEL_DRYR.00F1700301

Eng Units: Gal / Day Point Class: Totalizer PS: T

Point Type: Float32 Digital Set:

Totalizer Type

☒ Summary Calculation ☐ Count Events

Block Time Weighted Total

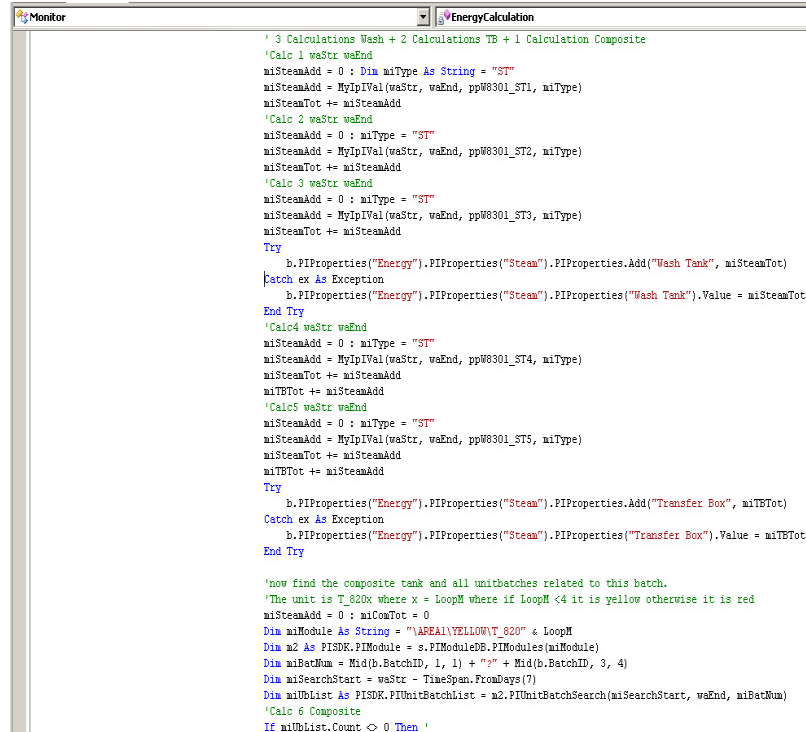
Session Record

4/3/2013 9:45:38 AM (PROD\francis.lauryssens) PI-ToEd: Deleting point \\\nasus0568004\MUSO_005_2126_003_YEL_DRYR.00F1724203_totalized [pointid:4743][recno:4086] [SDKDeletePoint]
4/3/2013 9:45:38 AM (PROD\francis.lauryssens) PI-ToEd: Point \\\nasus0568004\MUSO_005_2126_003_YEL_DRYR.00F1724203_totalized successfully deleted.

PI-AF is the Foundation

The screenshot displays the PI System Explorer application. The main window is titled 'Transfer Box Yellow C' and shows a tree view of elements on the left. The 'Elements' pane lists a hierarchy: SunChemical > Muskegon > Energy > HVF > Electricity > Hydraulics > Transfer Box Yellow C. The 'Transfer Box Yellow C' window is open, showing a 'Formula Configuration' dialog. The 'Parameters' section lists variables: A=\SCV_83379\HP, B=\SCV_83380\HP, C=\SCV_83381\HP, D=\SCV_83382\HP, E=\SCV_83383\HP, F=\SCV_83384\HP, G=\SCV_83385\HP, H=\SCV_83378\VA\HP, and I=\SCV_83378\B\HP. The 'Equations' section contains the formula: $A+B+C+D+E+F+G+H+I$. The 'Result' section shows the UOM as '<Default> (hp)' and the value as '0.02066132 hp'. The 'Settings' section shows the formula: $A=\backslash\text{SCV_83379}\backslash\text{HP}; B=\backslash\text{SCV_83380}\backslash\text{HP}; C=\backslash\text{SCV_83381}\backslash\text{HP}; D=\backslash\text{SCV_83382}\backslash\text{HP}; E=\backslash\text{SCV_83383}\backslash\text{HP}; F=\backslash\text{SCV_83384}\backslash\text{HP}; G=\backslash\text{SCV_83385}\backslash\text{HP}; H=\backslash\text{SCV_83378}\backslash\text{VA}\backslash\text{HP}; I=\backslash\text{SCV_83378}\backslash\text{B}\backslash\text{HP}; [A+B+C+D+E+F+G+H+I].min=0$. The 'Connections' and 'Analyses' tabs are visible on the right side of the window.

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



The screenshot shows the PI Monitor application window with a dropdown menu set to 'EnergyCalculation'. The main area displays a VBA script for calculating energy. The script is color-coded: comments are green, variable declarations and assignments are blue, and logic statements are black. It includes several 'Calc' sections (Calc 1 to Calc 6) that calculate steam totals and transfer box values. The script uses the PIProperties object to add and retrieve values for 'Wash Tank' and 'Transfer Box'. It also includes a loop to find the composite tank and all unit batches related to a batch, and a final 'Calc 6 Composite' section that counts the number of units.

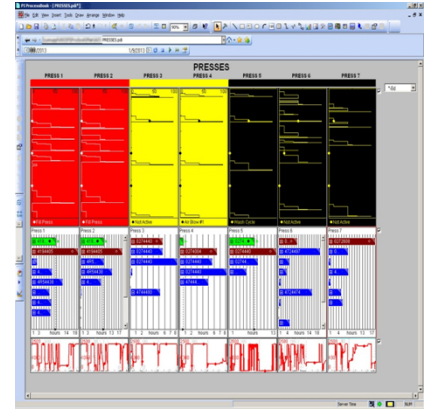
```
' 3 Calculations Wash + 2 Calculations TB + 1 Calculation Composite
'Calc 1 waScr waEnd
miSteamAdd = 0 : Dim miType As String = "ST"
miSteamAdd = MyIpIVal(waScr, waEnd, ppW8301_ST1, miType)
miSteamTot += miSteamAdd
'Calc 2 waScr waEnd
miSteamAdd = 0 : miType = "ST"
miSteamAdd = MyIpIVal(waScr, waEnd, 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) + "2" & 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...



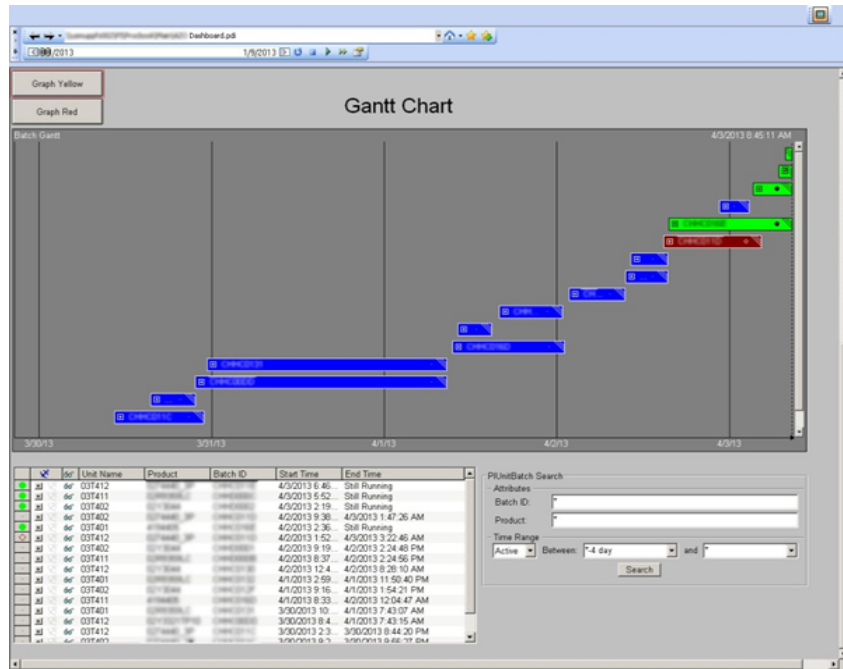
Benefits of PI Process Templates

- 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)

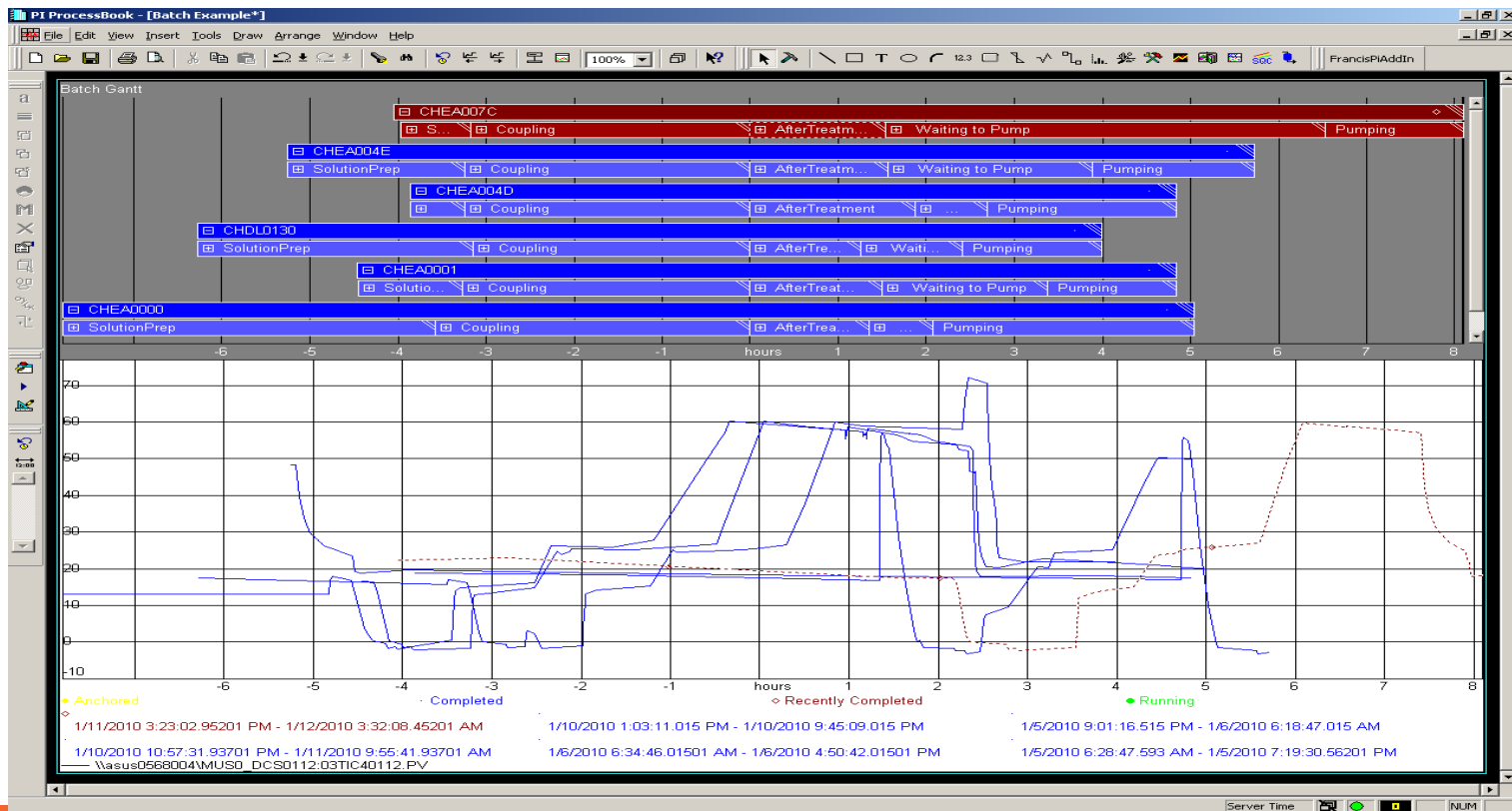
The screenshot displays the PI ProcessBook software interface, titled "PI ProcessBook - 1 PRESSES.pdb". The main workspace is divided into seven columns, each representing a different press: PRESS 1, PRESS 2, PRESS 3, PRESS 4, PRESS 5, PRESS 6, and PRESS 7. Each column contains three vertically stacked panels:

- Top Panel:** A large area showing the press status over time. The background color indicates the state: red for active, yellow for idle, and black for inactive. A timeline at the top of each panel shows the duration of the press cycle.
- Middle Panel:** A list of events or alarms associated with the press. Each event is represented by a colored bar (green for normal, red for alarm, blue for informational) and includes a timestamp and a description. For example, PRESS 1 shows events like "Press 1" and "Press 2" with timestamps like "01/14/05".
- Bottom Panel:** A line graph showing the pressure profile of the press over time. The y-axis is labeled "PSI" and the x-axis is labeled "hours". The graph shows a series of peaks and valleys, indicating the pressure fluctuations during the press cycle.

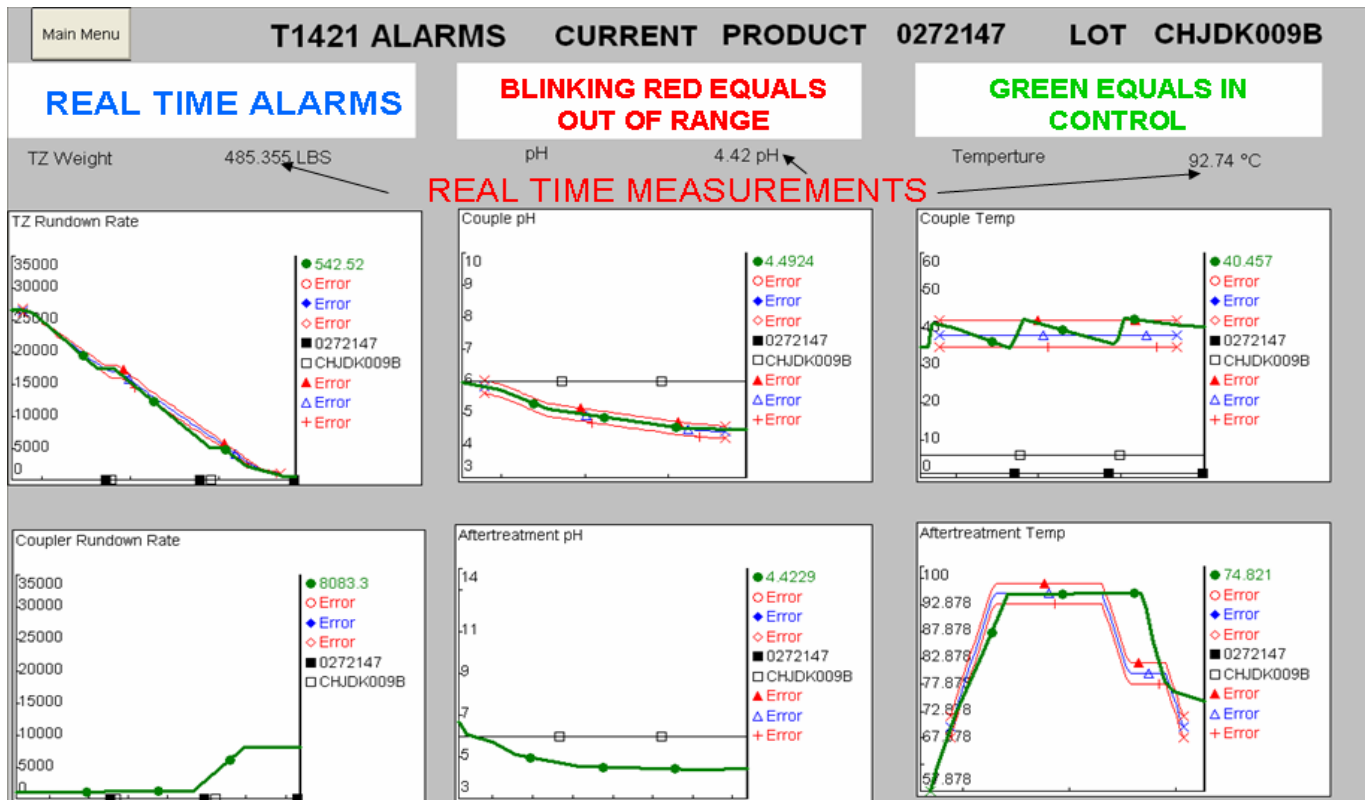
The interface also includes a standard Windows menu bar (File, Edit, View, Insert, Tools, Draw, Arrange, Window, Help) and a toolbar with various icons for navigation and data manipulation. The status bar at the bottom indicates the "Server time" and the current date and time.



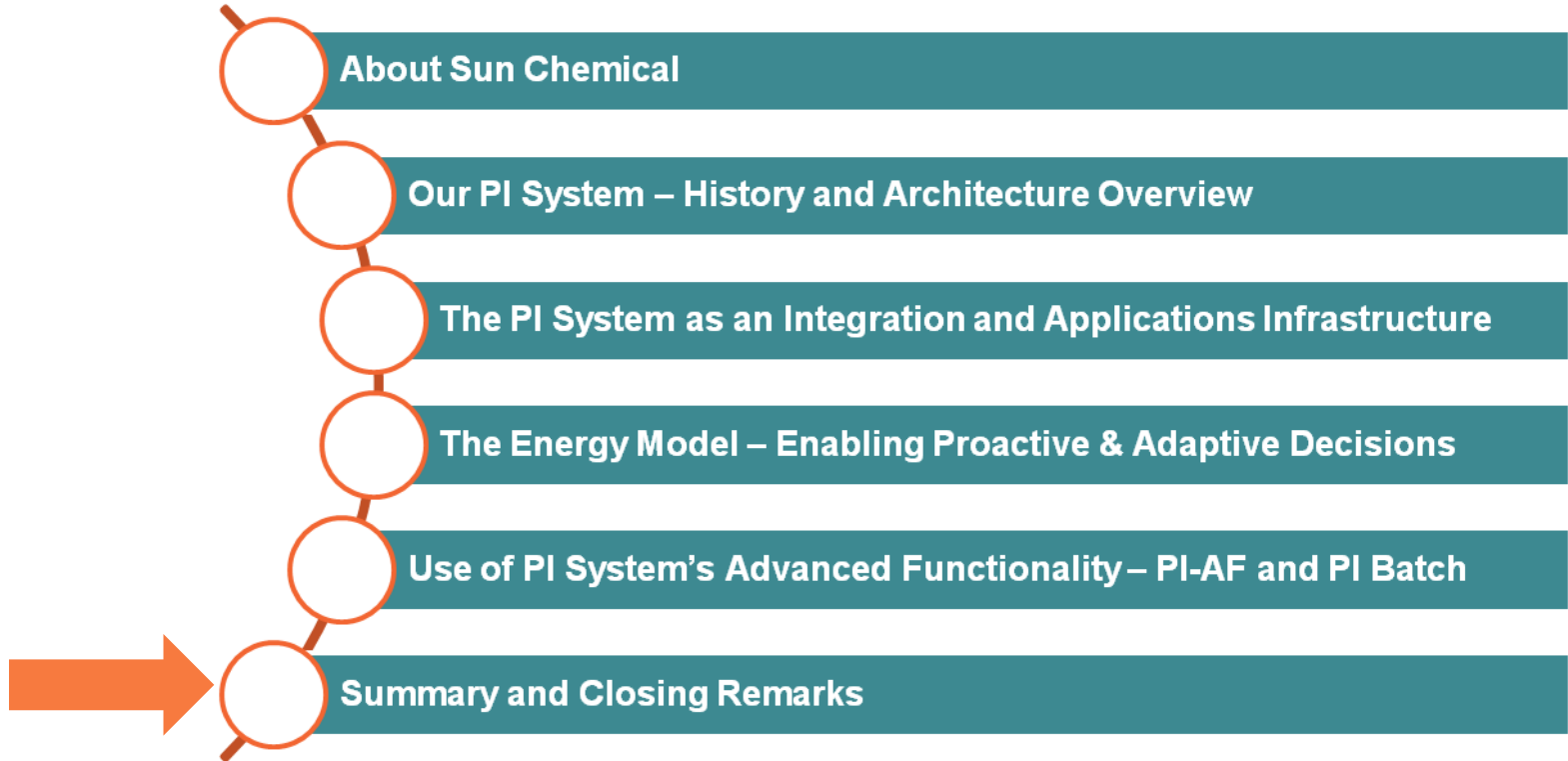
Example Screen Shots for PI Batch



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 |



- 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)

Francis Lauryssens

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PI Systems Specialist
SunChemical



THANK

YOU

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