Regional Seminar Series

Anchorage, AK

# How Customers are Maximizing the Value of their PI Systems

Kumar Bangalore
Marketing Manager
OSIsoft

September 16, 2010

Real Time Information – Currency of the New Decade

# Objective

- Identify customers getting a relatively high value from their PI Systems
- Understand how they are using the PI System
- Note trends in the industry

# Summary – Benefits

| COMPANY | BENEFITS |
| --- | --- |
| IBM Vermont | $10 million/year |
| Cascades (paper) | $385 K+/year |
| Oji Paper | $470,000/year |
| Pertamina | $25-30 million/year |
| CENACE | $2 million/year |

# IBM Vermont – Monitoring

- Semiconductor manufacturing
- 200 mm wafer size, test 300 mm
- >3.2 million sq. ft. of facilities
- Started in 1957
- ~18,000 tags PI Server
- Some tags scan at millisecond rates
- 1,000 SPC charts monitor the tags
- Advanced Analytics / Data Mining

**$10 million/year**

# IBM Vermont – Reduction in Water Usage

- Direct effect
  - Lowers water bill
- Project to reduce water usage may not be justifiable based solely on lower water bill.
- Secondary, but significant, effects
  - Lowers energy costs (moving water around)
  - Lowers equipment costs (less water to process)
  - Lowers maintenance costs (less equipment)
  - Lowers water treatment costs (chemicals)

# California's Water-Energy Relationship

Every year water-related energy use consumes

- 19 % of state's electricity
- 30 % of its natural gas
- 88 billion gallons of diesel fuel

Demand is growing


Source: "California's Water-Energy Relationship", California Energy Commission, Nov. 2005, CEC-700-2005-011-SF

# IBM Vermont – Energy Recovery from Water

**Go a step further**

Recover energy from the water

- Heat energy (temperature) (heat recovery)
- Electricity (kinetic & potential energy)


# IBM Center of Excellence for Enterprise Operations
## Advanced Water Management: SMART and Sustainable

Close Supplier Relations

Kinetic Energy Recovery

Ultra Pure Water Treatment Efficiency

Instrumented – Obtain and collect real time data

Interconnected – Data analysis and visualization

Intelligent – Analysis becomes action, transform how we operate

Heat Energy Recovery

Manufacturing Use Efficiency

Stewards of the Resource

Waste Water Treatment

Smarter water for a smarter planet

# IBM Vermont – Results

- $3.6 million annual savings

**Water Usage**

Rates: + 66% since 2000
Usage: - 29% since 2000
Purchases: -$742K/yr

**Water Treatment Costs**

Annual Costs: - $598K/yr

**Water Related Energy Costs**

Annual Costs: -$2,278K/yr

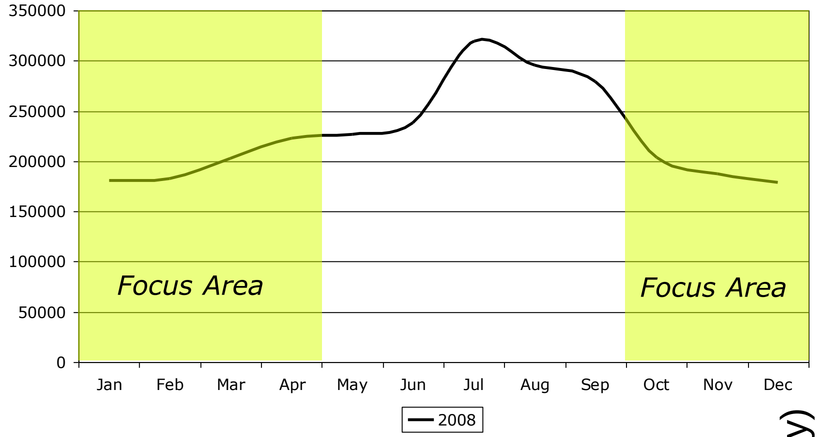
**Manufacturing Capability**

Up 30% since 2000
(excluding 2009)

<u>Note</u>: Energy cost savings are higher than other cost savings

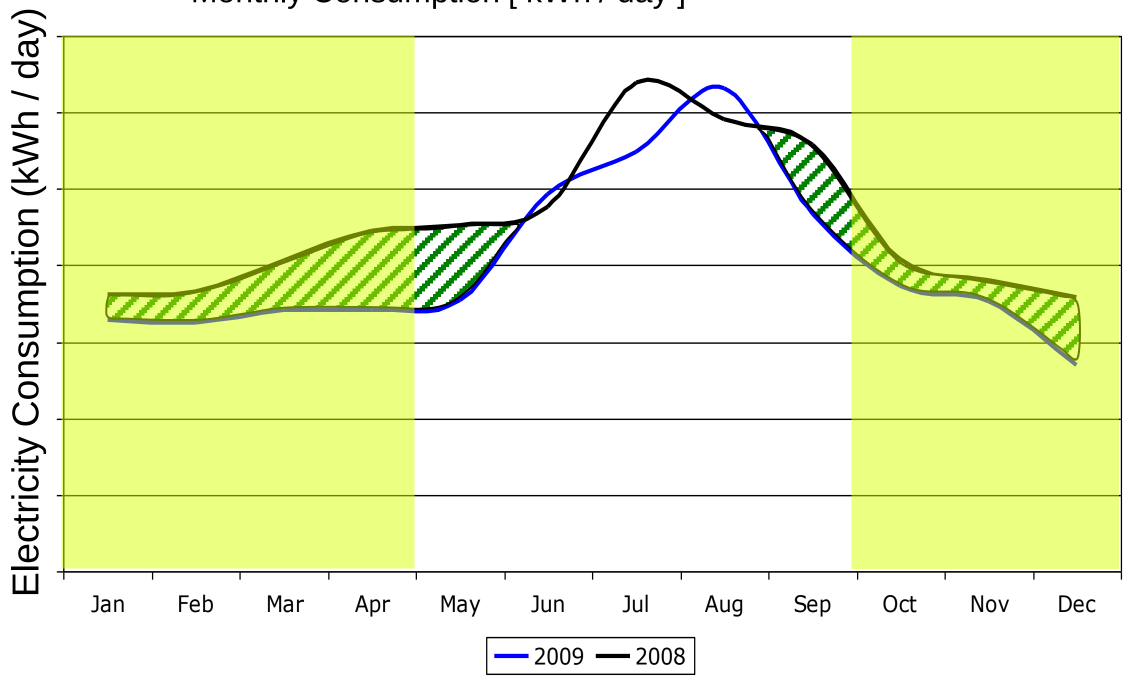
# IBM Vermont – Smart Energy Usage

2008 Central Utility Plant Electricity Curve
Monthly Consumption [ kWh / day ]




## Free winter cooling

2008 vs. 2009 Central Utility Plant Electricity Curve
Monthly Consumption [ kWh / day ]



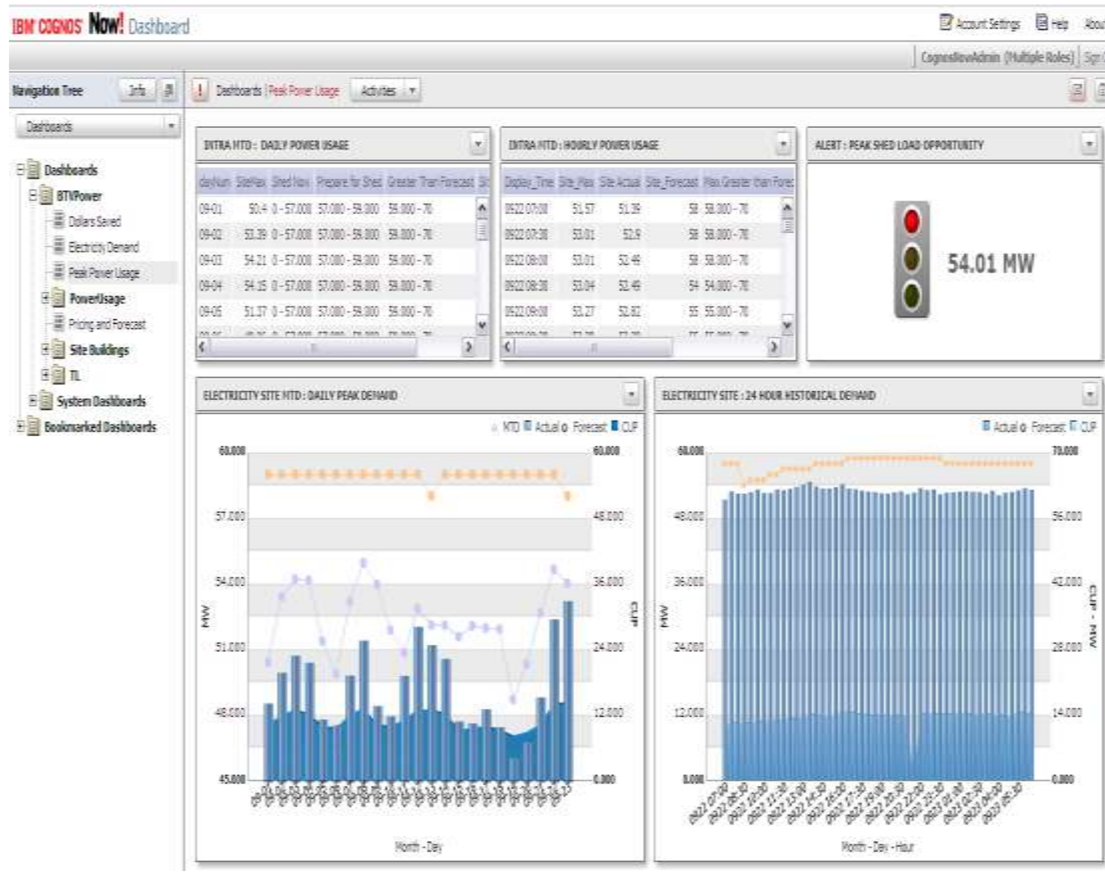
# IBM Vermont - Peak Power Management

Manage maximum power consumption to:

- Lower Electrical Cost
- Avoid infrastructure investments
- Reduce Green House Gas emissions

Requires complex data gathering and analysis

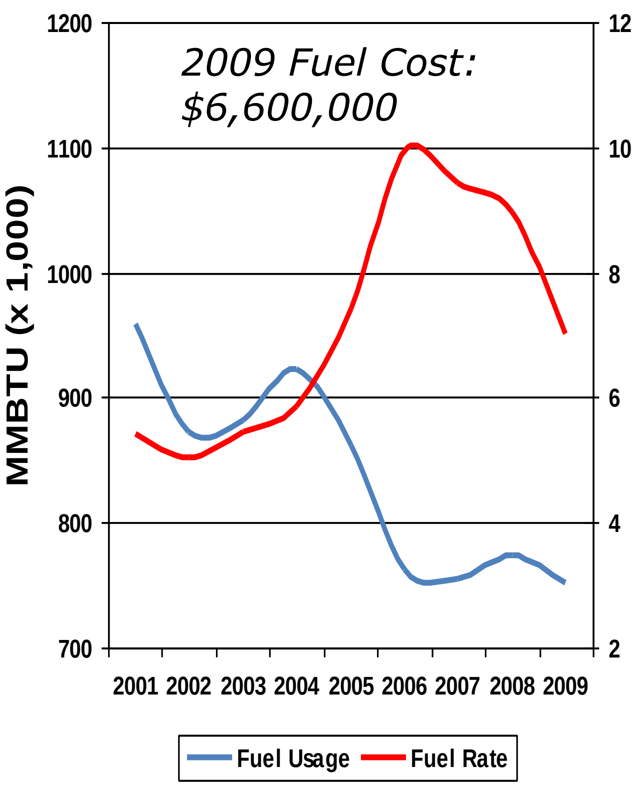
- Multiple data sources
  - Deep Thunder
  - ISO-NE Market Pricing
  - Power Meters
  - Site Data
- Predictive capability to forecast load shedding opportunities
  - ISO-NE 24 Hr Ahead Program



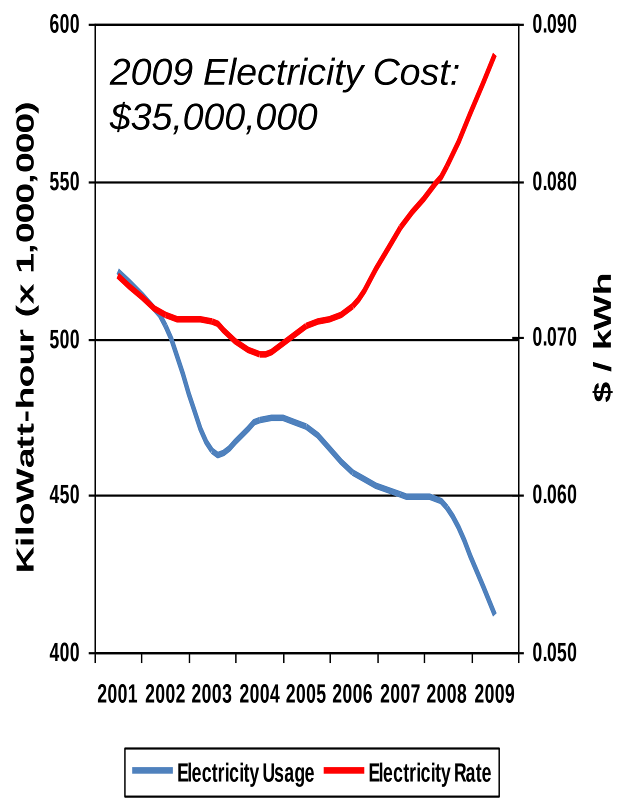
# IBM Vermont – Smart Energy Usage

- $6.5 million annual savings

**Fuel Usage vs. Rates**




**Electricity Usage vs. Rates**




SINCE 2001

**Fuel Usage**

Rates: + 30%
Usage: - 21%

**Electricity Usage**

Rates: + 19%
Usage: - 21%
Cost: -$6.5M/yr

**Plant Capability**

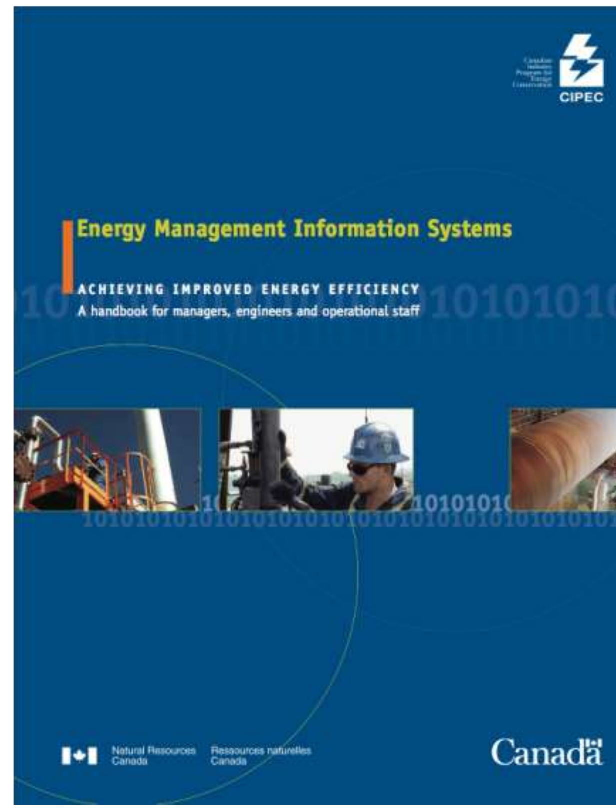
Up > 30%

# Cascades - Challenges

- $4 billion in revenues
- Overall energy bill ~$350 million
- Mills focus mostly on production
- Energy KPIs hard to evaluate (weather, production …)
- Need simple KPI delivered in real time
- Previous KPI was GJ/Unit
  – Did not consider all the influencing factors

# Cascades

- Implemented Energy Management Information System (EMIS)
- Use PI to collect production and energy consumption data
- New KPI in $$$
  - cost of energy consumption
  - available in real-time
- *Energy is a variable operating cost, not a fixed overhead charge.*

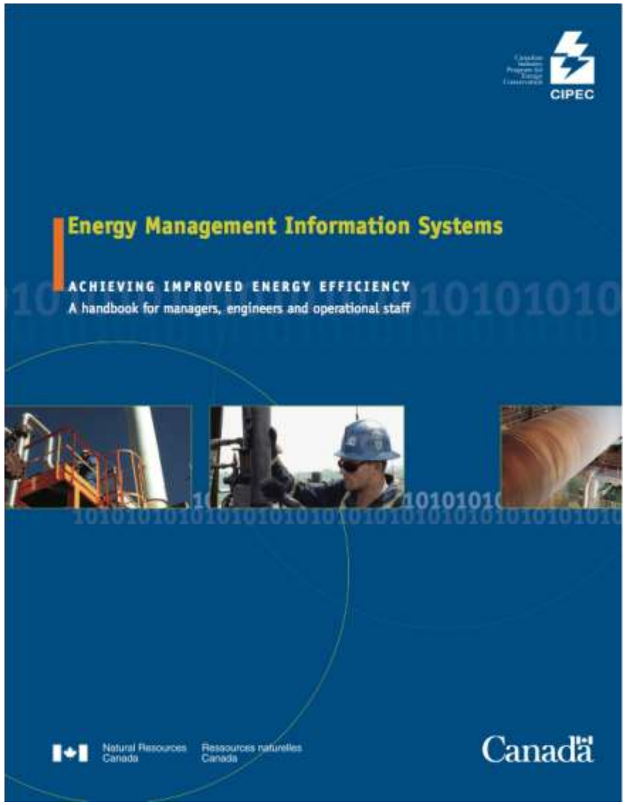



Cascades

# EMIS - Sections

EMIS deliverables

- Early detection of poor performance
- Support for decision making
- Effective performance reporting
- Auditing of historical operations
- Identification and justification of energy projects
- Evidence of success
- Support for energy budgeting and
  management accounting
- Energy data to other systems



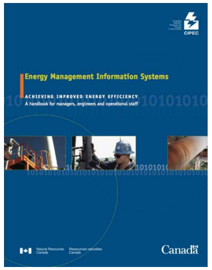
# EMIS – Early Detection of Poor Performance

OSIsoft

**Table 1. Examples of typical problems that cause higher energy costs**

| Typical Problems | Monitoring Frequency* |
|---|---|
| *Process Operations* | |
| • incorrect set-points | hourly |
| • fouled heat exchangers | daily |
| • advanced controls switched off | hourly |
| • poor control timing | hourly |
| *Boilers* | |
| • poor air-fuel ratio | hourly |
| • fouled exchangers | daily |
| • excessive blow-down | hourly |
| • incorrect boiler selection | hourly |
| *Refrigeration* | |
| • fouled condenser | daily |
| • air in condenser | daily |
| • incorrect superheat settings | daily |
| • high head pressure settings | daily |
| • incorrect compressor selection | hourly |
| *Compressed Air* | |
| • leaks | daily |
| • poor compressor control | daily/hourly |
| • incorrect pressure | hourly |
| *Steam* | |
| • leaks | hourly |
| • failed traps | hourly |
| • poor isolation | hourly |
| • incorrect set-points | hourly |
| • low condensate return | hourly |
| *Space Heating/Cooling* | |
| • excessive space temperature | hourly |
| • excessive fan power use | hourly |
| • overcooling | hourly |
| • heating and cooling | hourly |
| • high chilled water temperature | hourly |
| *Power Generation* | |
| • poor engine performance | hourly |
| • incorrect control settings | hourly |
| • poor cooling tower operation | hourly |
| • fouled heat exchangers | hourly |

* Appropriate monitoring frequency depends on the application.



# Cascades - Results

Energy Savings from EMIS

- Prevent waste
- React now, not when receiving the bill
- Identify best practices
- Optimize process set points
- Stabilize the process

# Cascades Energy Management System

## Example: Steam over usage after a shutdown


Cost of steam over usage = $8,000 in 2 days

# Cascades - Benefits

- A paper machine cut by 15% natural gas consumption by evaluating cross effects and optimizing dampers and an extra 115K$/year in shutting down a 300HP fan.
- A paper machine's natural gas valve locked down (150K$ saving/year)
- A small converting mill identified a problem costing them 10K$ per month
- Paper mill saved 90K$ in 3 months by optimizing energy source selection based on real-time pricing
- And the list expands every single day…
- ROI < 1 year at Corporate Level based on the deployment speed.
- **Overall benefits = $385 K+/year**

# Cascades - Recommendations

- Send information back to operations
- Talk with $$$
- CUSUM charts provide crucial information

# Oji Paper

Largest paper company in Japan

$6^{th}$ largest in the world

~$11 billion in revenues

# Oji Paper – Challenge & Solution

- Crew had little concerns for the cost of operations they were involved in
  - Displaying cost instead of quantity would raise their cost awareness.
  - Timeliness of real-time updates would allow for immediate improvement in the following shift.
  - Graphing the comparison of the top performance and the current operation results would stimulate crew's consciousness for improvement.
  - Changed units from yen/kg to yen/day so that crew can see how much their work makes per day.

**$470,000 improvement in one year as a result**

OJI PAPER GROUP

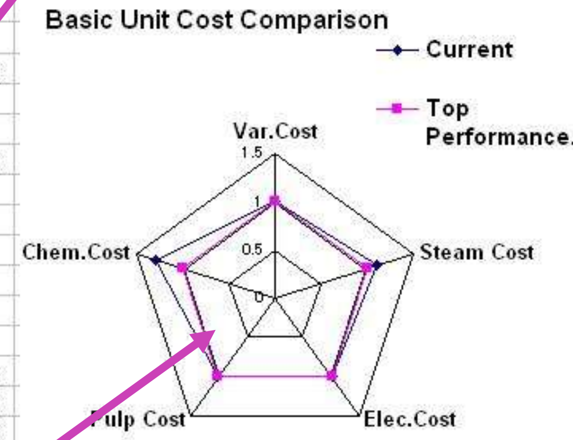
# Real-Time Operation Progress Display - Oji Paper

★View by Brand

★Show Cost (**Cost Awareness**)

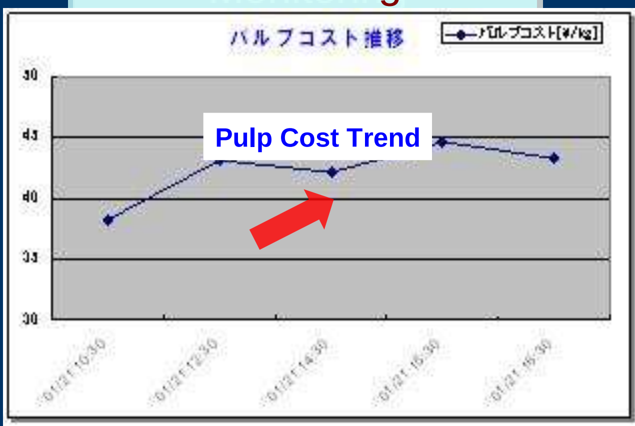
**Fujinomiya B-2M/C Operation** — Date 2009/1/21 5:00

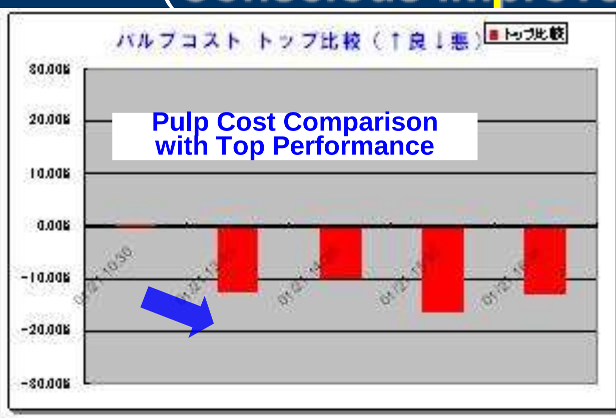
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Brand Data** | | | | | | | |
| Brand Name | Wood Shaving Paper(A)R | Basis Weight | 701 | g/m3 | Var.Cost | 77.7 | Yen/kg |
| Brand No. | 030 | | | | | | |
| ** Brand | Wood Shaving Paper A | Basis Weight | | g/m2 | **Var.Cost | 73.26 | Yen/kg |
| | | Machine Speed | 46 | m/min | **Trim Width | 2,660 | mm |
| | | Reel Basis Wt | 590.8 | g/m2 | | | |
| | | Reel Moisture | 8.1 | % | | | |
| | | BM Speed | 56.4 | m/min | BM Trim Width | 2,559 | mm |
| | | Steam Usage | 8.25 | t/h | Steam Cost | 0.1 | Yen/kg |
| | | Elec. Usage | 798.6 | kWh/t | Elec.Cost | 2.1 | Yen/kg |
| | | | | | Pulp Cost | 69.0 | Yen/kg |
| | | | | | Chem.Cost | 5.6 | Yen/kg |




Real-Time Cost Trend Monitoring

★Comparison with Top Performance (**Conscious Improvement**)




★Monitor Rejection %, Stock Blending %, Density & Flow Variation → **Action for Improvement**

# Caveats – KPIs (Boise)

- Need to be able to identify when changes in cost are due to changes in

Raw Material Costs

vs.

Recycled Material

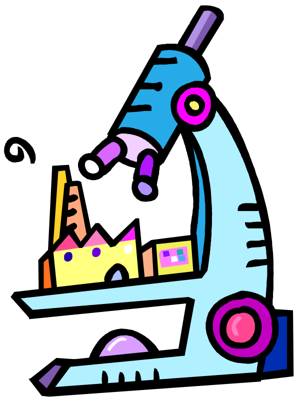
(indicates quality issue)

vs.

Process Changes

- Constantly updating raw material costs to reflect reality is counterproductive.
- Optimizing costs in one shift can cause the next shift to have to make up for it.

# Levels of Monitoring



- Basic Monitoring
  - Monitor variables directly or simple combination
    - temperature
    - pressure
- Advanced Monitoring – Start with an objective
  - Consider all influencing factors / multiple data sources (Cascades – Energy KPI; IBM Vermont – Peak Power management)
  - Hold all but one of the factors constant (Boise – Cost KPI)
  - Compensate for factors that change, but cannot be controlled (IBM)
- Examples
  - Energy usage as a function of outdoor temperature
  - Monitor steam balance to detect boiler tube leaks

# Pertamina

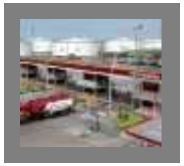
PERTAMINA

Indonesia's National Integrated Oil & Gas Company

**Benefits $25-30 million/year**





# Pertamina Downstream

## Assets

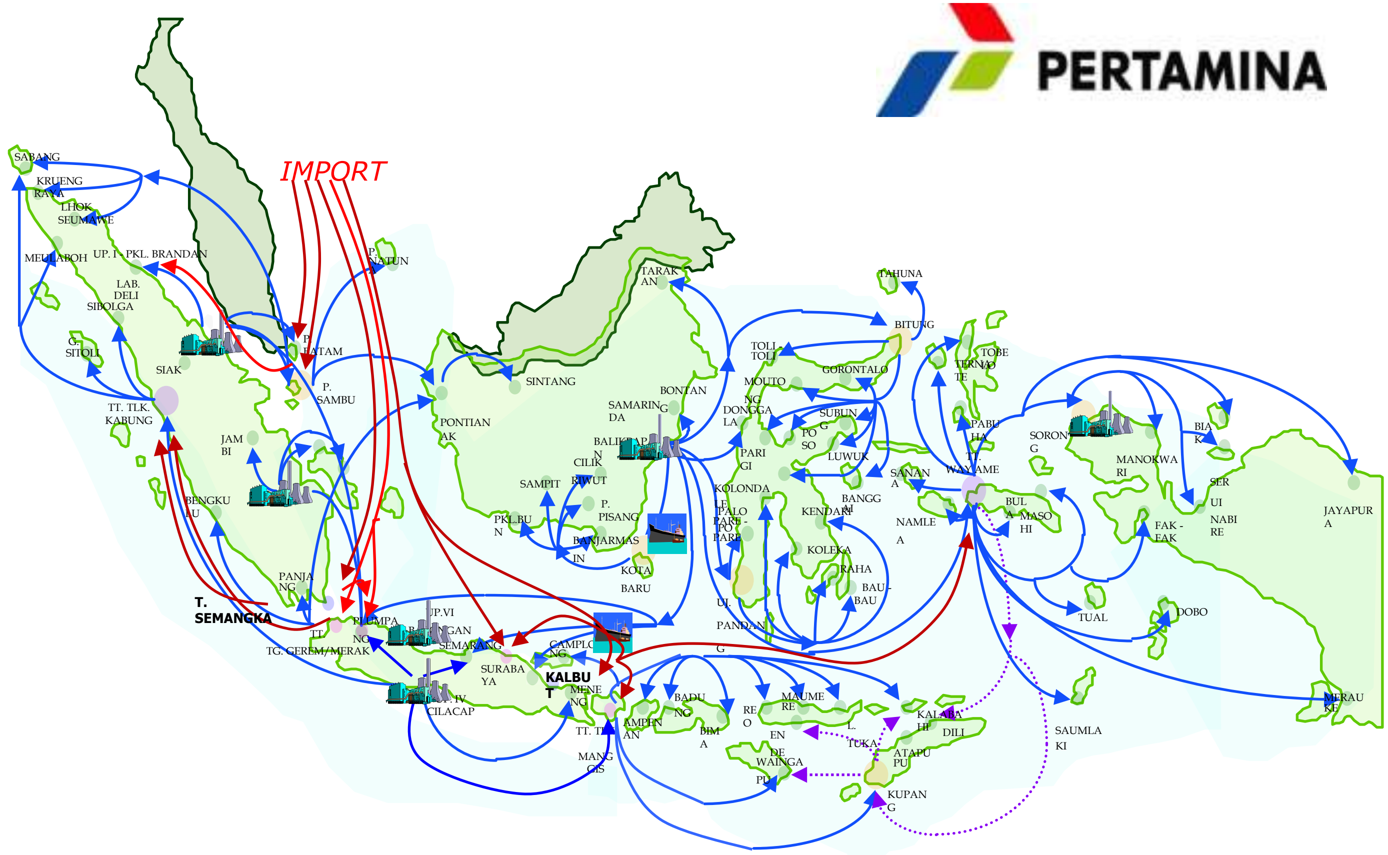
6 Refineries :
1,034 Million bbl/day

120 + Depots

98 Vessels

3,400 Fuel Stations

Sales Volume :
1,200 Million bbl/day
(92 % Market Share)




One of the most complex Downstream Supply Chains in the world

# Pertamina – Challenges (early 2007)

**Process, People, Structure**

- Business process based on functional units, planning based on functional target, **no one is accountable for downstream margin**.
- “Legacy” structure, rigid interfaces between Refining & Marketing, creating silos within the organization.
- No single point of coordination for Supply operations.

**Systems**

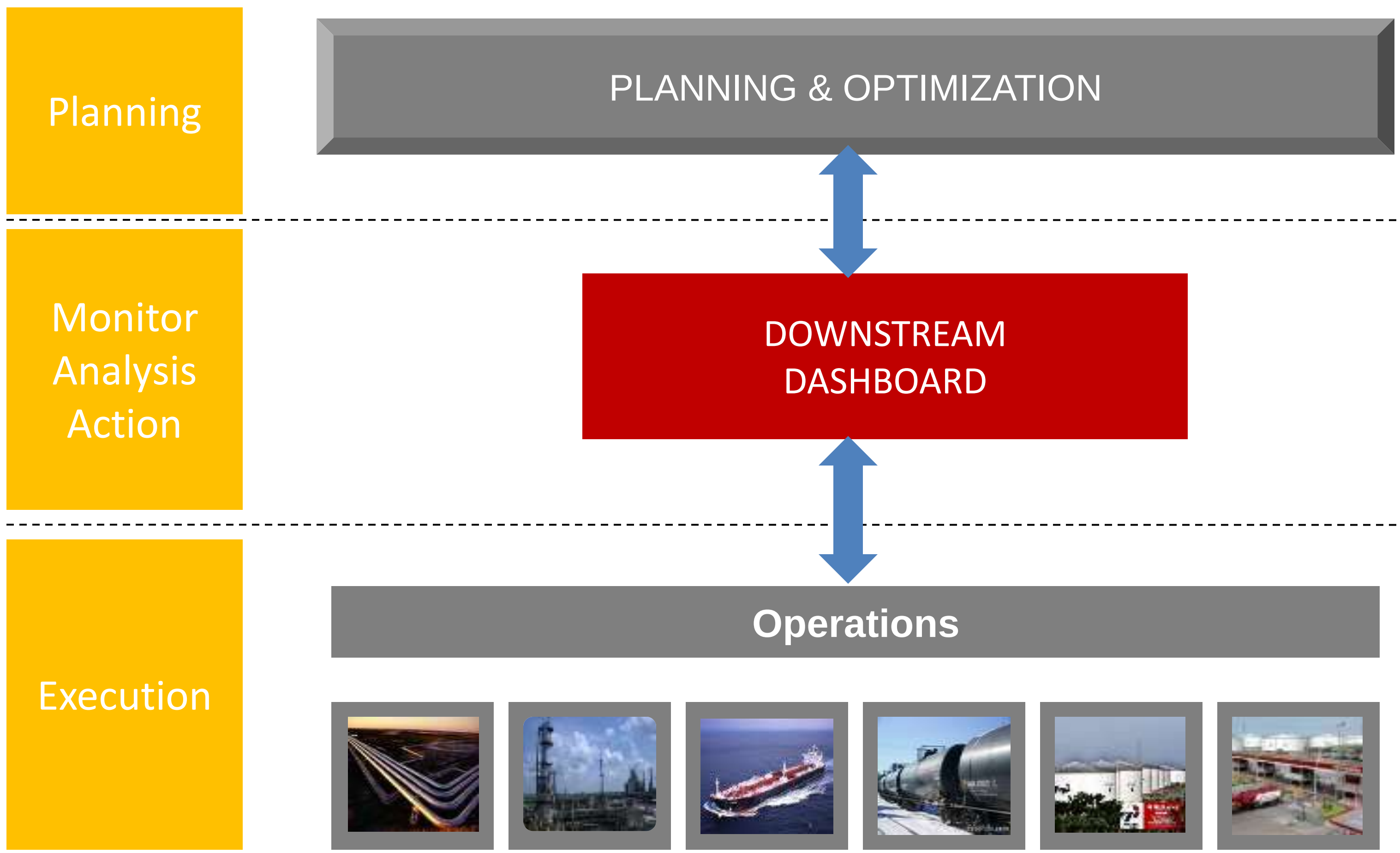
- Lack of integrated system for planning optimization and scheduling
- No coherent single view of downstream timely operational data
- Unable to track Plan vs. Actual

# Pertamina - Integrated Downstream Dashboard

## Objectives :

- Consistent single view of entire downstream supply chain.
- Integrated real time data from Crude Purchases to Secondary Distribution.
- Decision making support (normal operations, supply chain disruptions)

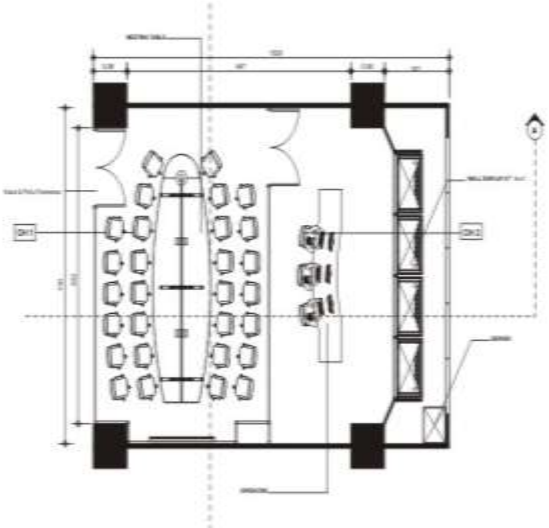
# Pertamina - Integrated Downstream Dashboard



# Pertamina - HQ Control Room Design

## Design Objectives

- **Single operations room for Refining, Supply, Shipping & Marketing.**
- Ergonomic working environment.
- **Direct communication to refineries, vessels and depots.**
- Single wall display



# Pertamina - Main Dashboard Display


## Objective

- Management View of Entire Supply Chain

## Features

- Easy to understand "traffic lights"
- Highlighted items
- Drill down capabilities

# SUMMARY – Integrated Downstream Dashboard

PERTAMINA

| | BEFORE - 2007 | AFTER - 2009 |
|---|---|---|
| **Working Environment** | 4 Operating Group, Separate floors | Single floor, in Control Room |
| **Planning process** | Functional Silos | Integrated planning and operations from end to end |
| **Data Timeliness** | Outdated, not synchronized data | Real time and near real time data |
| **Data Visibility** | Limited view of supply chain data | Single coherent view |
| **Monitoring tools** | Manual monitoring - Excel | Track plan vs. actual through ProcessBook, Web |

# Pertamina - Benefits

## Tangible Benefits

- National stocks maintained at optimal level
- Reduced Critical Depots (stock outs) by 65 %
- Reduced Demurrage by 40 %
- Better loss monitoring & control

US$ 25 – 30 Million/Year

## Intangible Benefits

- Better Team Work & Coordination
- Better Decision Making
- Faster response to supply chain problems
- Integrated end to end downstream visibility

"Downstream First" Mindset

# CENACE


## CENACE (Ecuadorian National Power Control Centre)

**ISO** responsible for **coordinating the real time operation of the national power grid** including ties with neighboring countries **of Colombia and Perú**; It is also in charge of **administration** of the **Wholesale Electricity** Market in Ecuador, South America.

# CENACE


Operation of the Electrical System is

- a highly specialized activity of extreme complexity
- designed to secure supply of energy to the country
- includes synchronous operation of the electrical systems of Ecuador and Colombia.

# CENACE

Currently **28 thermal power stations are in operation** in Ecuador, **belonging to 20 companies**, 7 are private and 13 state owned, of which 14 have a larger fuel storage capacity to 200,000 gallons.

Actually **no real time accurate integrated information is available** at CENACE regarding:

- Fuel inventory at local sites
- Fuel volume consumptions of thermal power stations

# CENACE

**Thermal power companies use the following fuel types:**

- Diesel 2
- Fuel Oil 4
- Fuel Oil 6
- Low Octane Naptha

Fuel Storage infrastructure capacity for thermal generation totals: **19** million gallons of fuel oil, **7.7** million gallons of diesel and **1.9** million gallons of naptha.

The supply of fuel is running via:

- Pipelines
- Ship-tanks
- Land transfers by car-tanks

# CENACE

- The effective power of thermal unit generation in the interconnected national power system (S.N.I.) in Ecuador is **2,083.70 MW**, accounting for **48% of the total effective power available**. **The guarantee of continuous electricity supply in the country depends highly on the availability of thermal generation and the reliable supply of fuel for its operation.**
- US$ 300 million are spent yearly by Ecuadorian power stations on fuel for electricity generation.

The OSIsoft tools used in the development of SICOMB project are among others as follows:


PI ProcessBook


PI Datalink


PI ACE


PI SDK


PI WebParts


RtReports


SharePoint

# CENACE - Benefits

- Availability of accurate fuel information for energy planning
- Optimization of real-time operations
- Control and auditing of fuel use in power sector
- Timely availability of fuel oil to avoid problems of unavailability of electricity generation by lack of fuel

- For a company carrying 200,000 gallons of fuel/day
  - **Benefits = $ 2 million/year**
  - **Payback period = 1 year**

# Takeaways

- Comprehensive use of data
  - Process-wise (including energy & utility usage)
  - Time-wise (archived data, current data, prediction)
  - Integrated systems; global optimization
- Consider secondary effects also (e.g. water usage)
- KPIs in monetary units ($$$)
- Model building
  - compare actual to expected
  - calculate value at each point in a process (water cycle)
  - Knowledge capture and dissemination

# Thank you



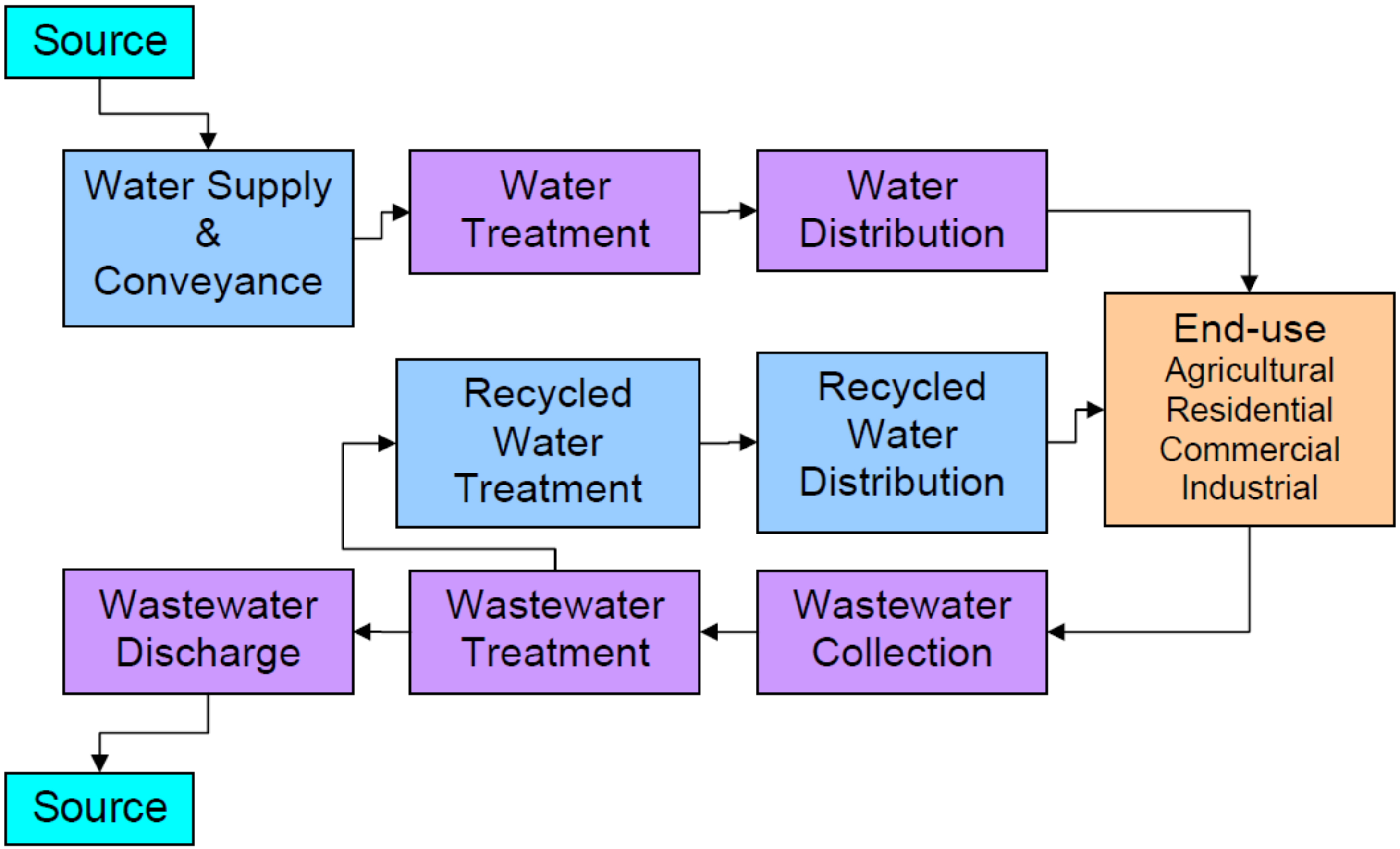
777 Davis St., Suite 250 San Leandro, CA 94577

# Supporting Slides

Supporting slides follow

# California’s Water-Energy Relationship

**Figure 1-1: California’s Water Use Cycle**




Source: California Energy Commission

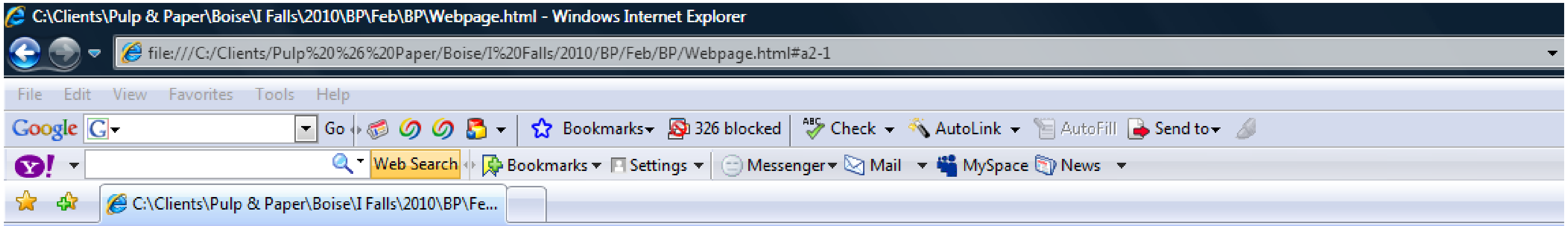
# California's Water-Energy Relationship

## Table 1-1: Water-Related Energy Use in California in 2001

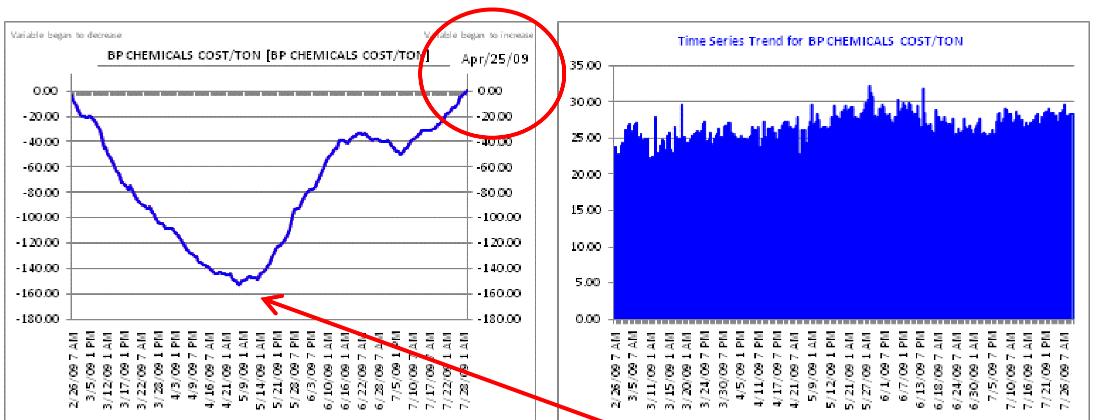
<table>
<tr><th></th><th>Electricity (GWh)</th><th>Natural Gas (Million Therms)</th><th>Diesel (Million Gallons)</th></tr>
<tr><td colspan="4">Water Supply and Treatment</td></tr>
<tr><td>Urban</td><td>7,554</td><td>19</td><td>?</td></tr>
<tr><td>Agricultural</td><td>3,188</td><td></td><td></td></tr>
<tr><td colspan="4">End Uses</td></tr>
<tr><td>Agricultural</td><td>7,372</td><td>18</td><td>88</td></tr>
<tr><td>Residential</td><td rowspan="3">27,887</td><td rowspan="3">4,220</td><td rowspan="3">?</td></tr>
<tr><td>Commercial</td></tr>
<tr><td>Industrial</td></tr>
<tr><td>Wastewater Treatment</td><td>2,012</td><td>27</td><td>?</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Total Water Related Energy Use</td><td>48,012</td><td>4,284</td><td>88</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Total California Energy Use</td><td>250,494</td><td>13,571</td><td>?</td></tr>
<tr><td>Percent</td><td>19%</td><td>32%</td><td>?</td></tr>
</table>

Source: California Energy Commission

# Boise Inc. - Cost CUSUM and TimeSeries




View CUSUM and TimeSeries Charts




View Max/Min Correlations

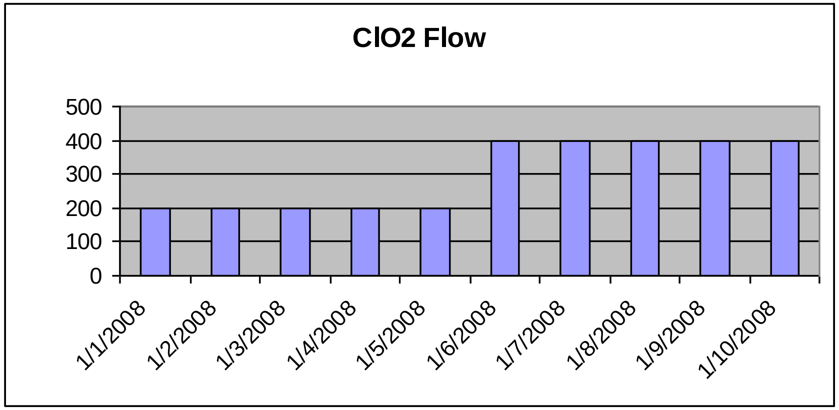
View Significant Changes Since Last Run and Dead Tags

View top 25 $R^2$ Correlations

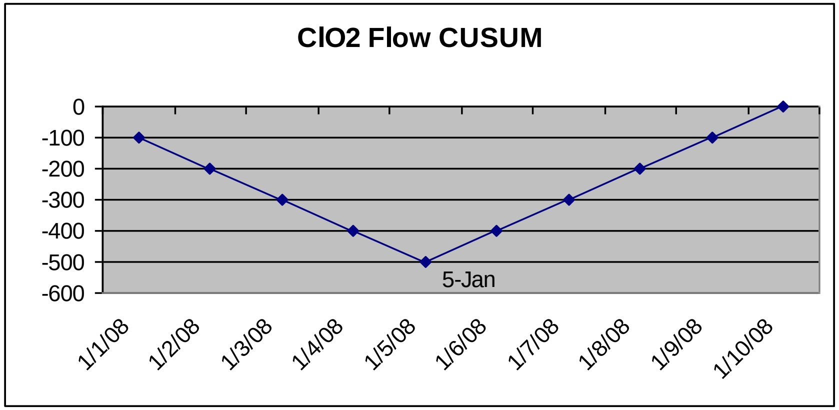
The chart on the left is like the first derivative of cost – if the line is going down, costs are below average. An inflection point shows when costs changed.

Costs increased on April 25, 2009

# Boise Inc. - CUSUM Chart




- Chart at left is the same normal time series chart




- The CUSUM chart shows us exactly when the change occurs, in this case, Jan 5