Regional Seminar Series

New Orleans, LA

How Customers are Maximizing the Value of their PI System

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Marketing Manager
OSIsoft

October 27, 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
Alyeska Pipeline	$ 1 million/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

Smarter water for a smarter planet

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

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

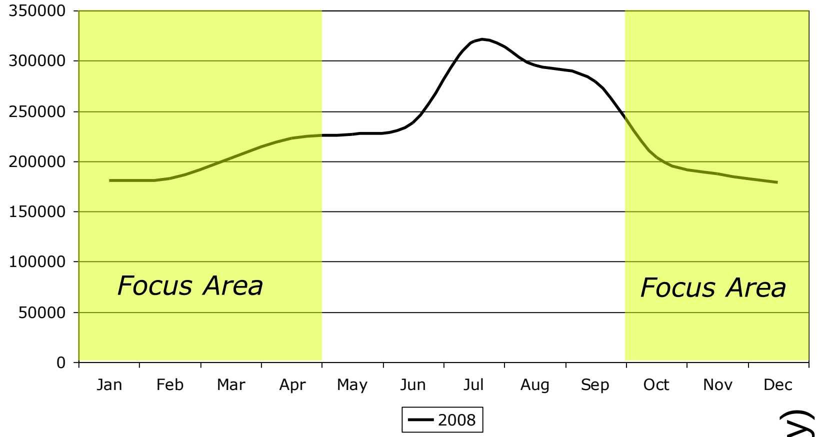
Manufacturing Capability

Up 30% since 2000
(excluding 2009)

Note: Energy cost savings are higher than other cost savings

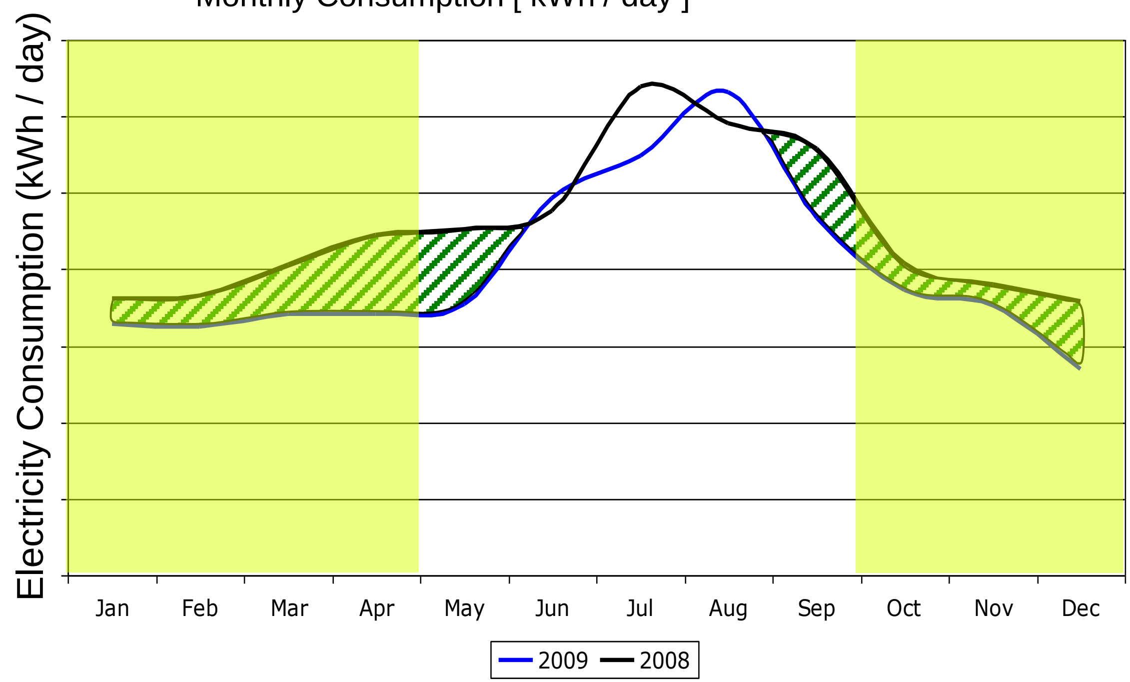
IBM Vermont – Smart Energy Usage

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]



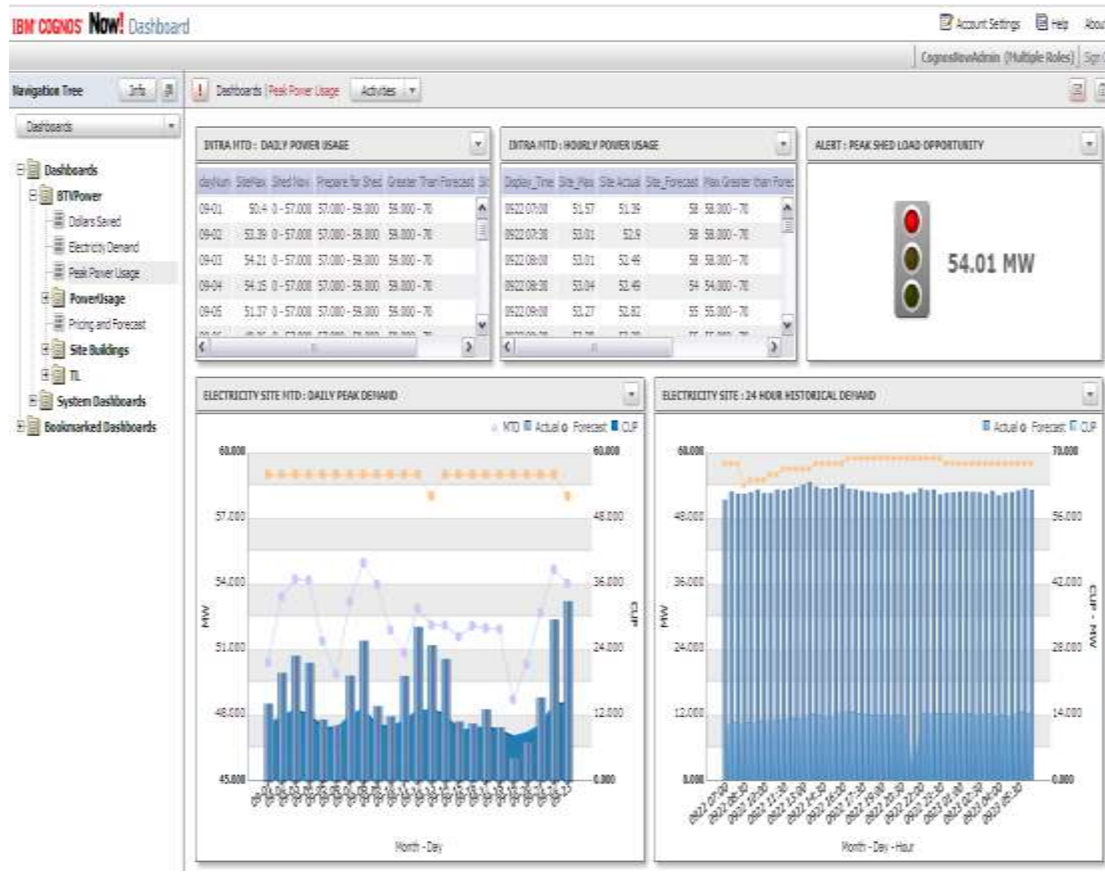
IBM Vermont - Peak Power Management

Manage maximum power consumption to:

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

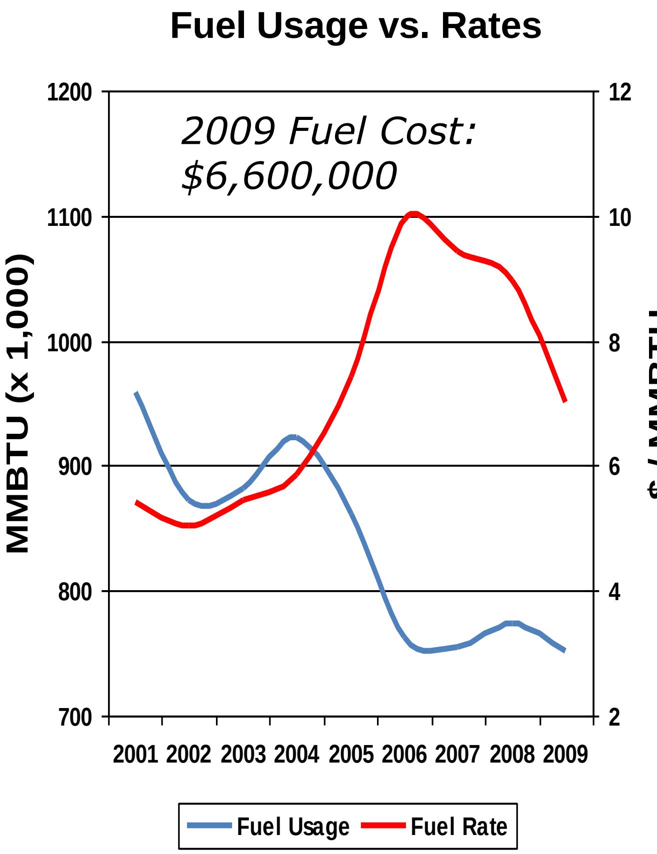
Requires complex data gathering and analysis

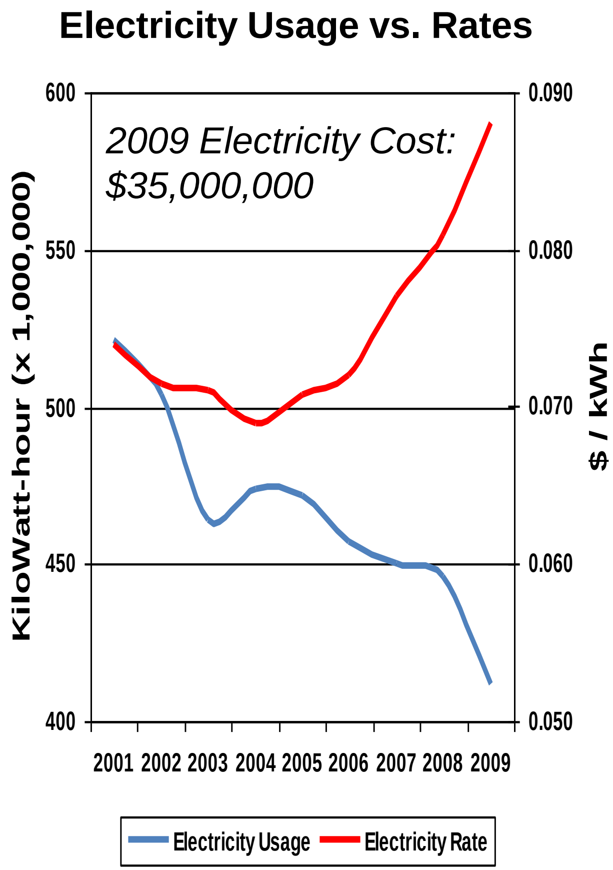
- Multiple data sources
  - Deep Thunder
  - ISO-NE Market Pricing
  - Power Meters
  - Site Data
- Predictive capability to forecast load shedding opportunities
  - ISO-NE 24 Hr Ahead Program



IBM Vermont – Smart Energy Usage

- $6.5 million annual savings





SINCE 2001

Fuel Usage

Rates: + 30%

Usage: - 21%

Electricity Usage

Rates: + 19%

Usage: - 21%

Cost: -$6.5M/yr

Plant Capability

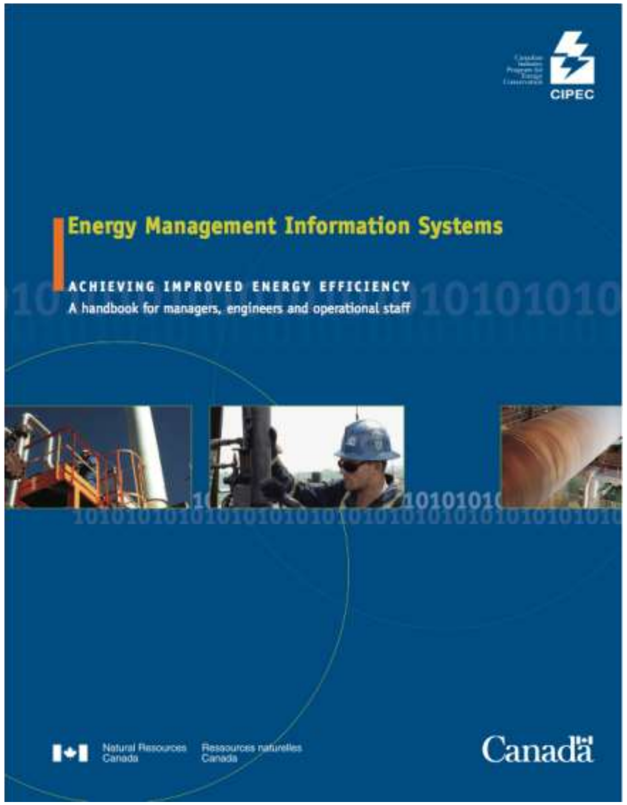
Up > 30%

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 the PI System 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.***

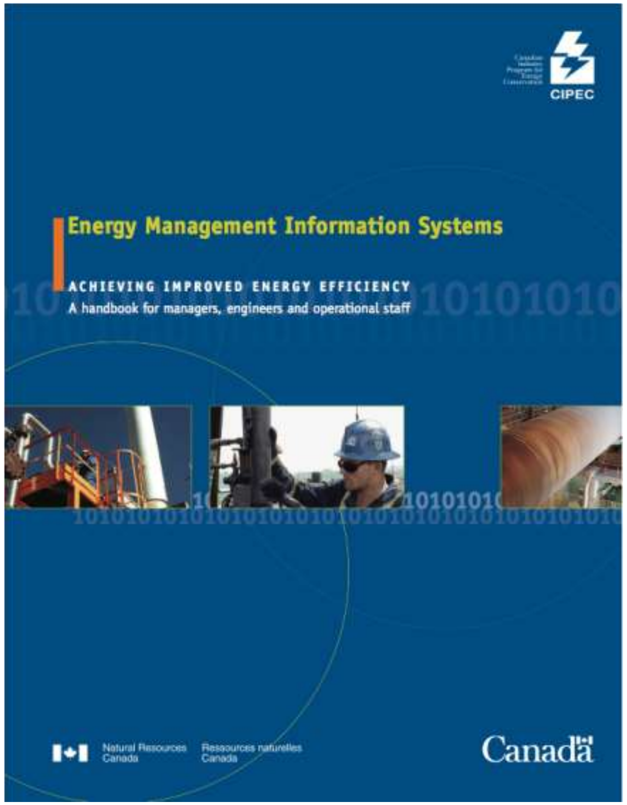


Cascades

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

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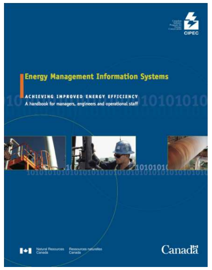
Table 1. Examples of typical problems that cause higher energy costs

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

6th 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

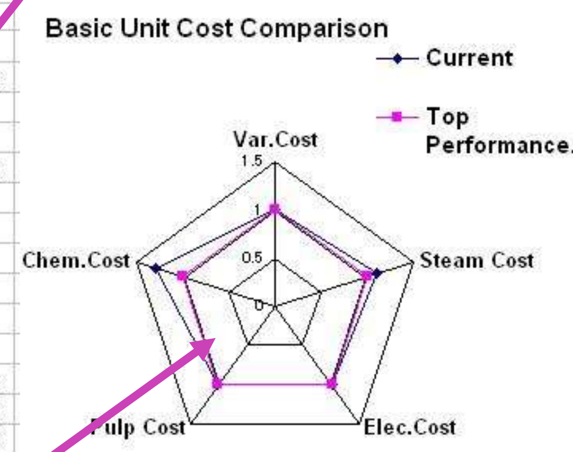
OJI PAPER GROUP

Real-Time Operation Progress Display - Oji Paper

★View by Brand ★Show Cost (**Cost Awareness**)

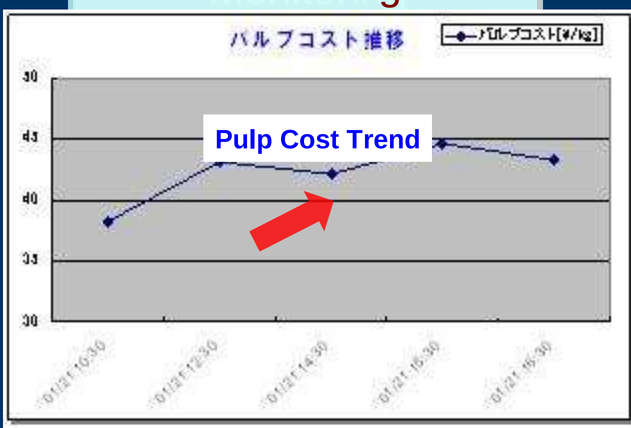
Fujinomiya B-2M/C Operation

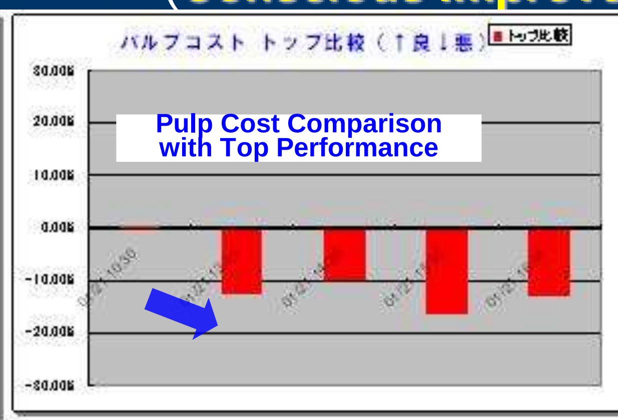
					Date	2009/1/21 5:00	
Brand Data							
Brand Name	**Wood Shaving Paper(A)R**	Basis Weight	701	g/m3	Var.Cost	77.7	Yen/kg
Brand No.	030						
** Brand	**Wood Shaving Paper A**	Basis Weight		g/m2	**Var.Cost	73.26	Yen/kg
		Machine Speed	46	m/min	**Trim Width	2,660	mm
		Reel Basis Wt	590.8	g/m2			
		Reel 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)

OSIsoft

- 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.

Alyeska Pipeline

Alyeska pipeline SERVICE COMPANY

- 800 miles long
- 48" diameter pipe
- 5 Pump Stations
- Marine Terminal
- 1.4 Million bpd operating capacity
- Logistics & Operations centers in Valdez, Anchorage, and Fairbanks

Alyeska Pipeline

Brooks Range

Alyeska Pipeline

Tanana River Bridge Crossing

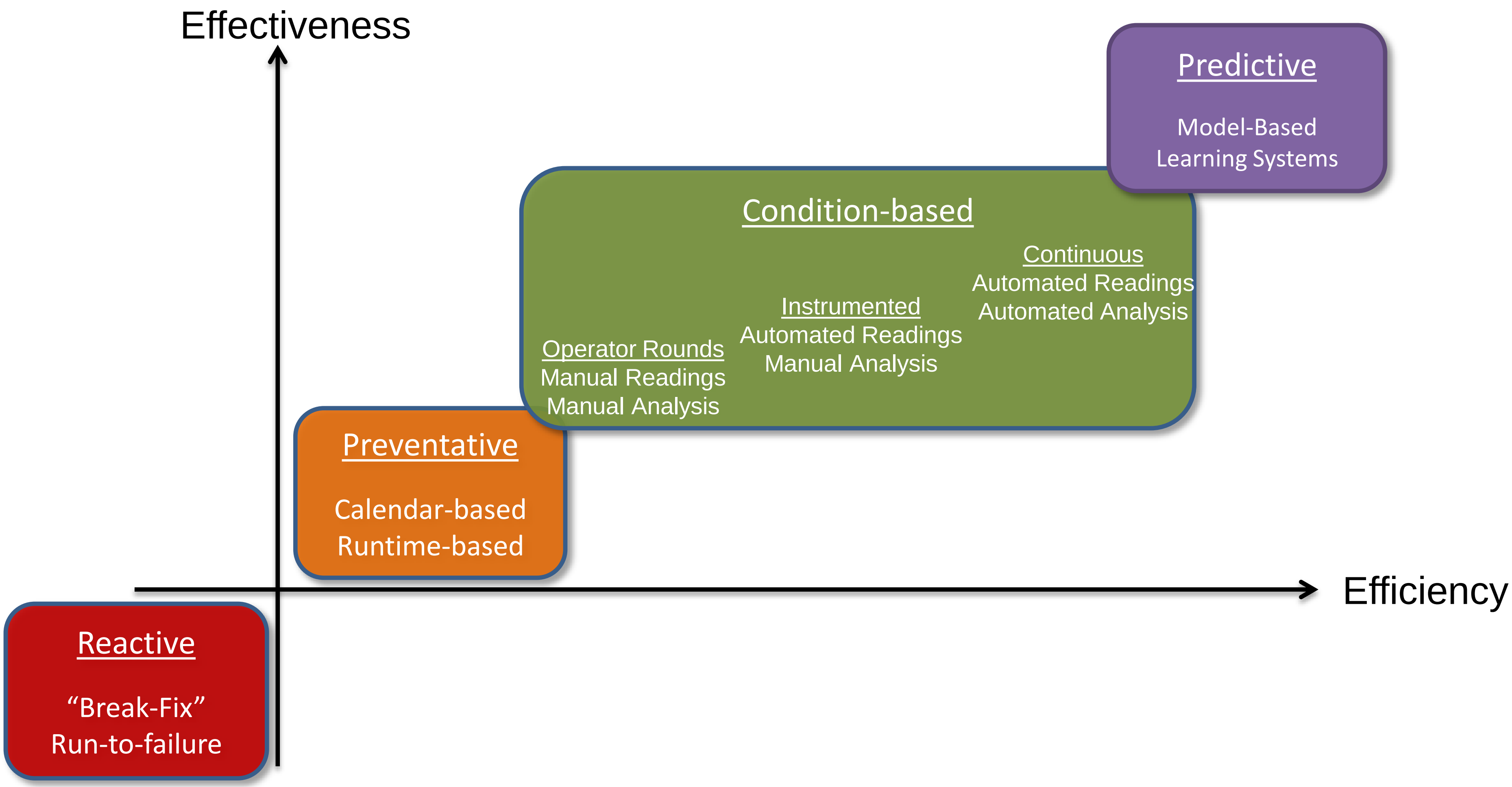
Alyeska Pipeline – Challenges & Solution

- Extreme environmental conditions
- No infrastructure – roads
- If Maintenance team does not have the right parts, job does not get done.
- Leverage the PI System to know ahead of time
  - what the problem is
  - what parts are needed to fix the problem
  - what tools are needed for the job

Alyeska Pipeline – Challenges & Solution

- 30-years in operation
- Large number of SMEs about to retire
- Capture knowledge of SMEs in models

Alyeska Pipeline – Evolution of Maintenance Strategies



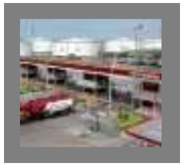
Alyeska Pipeline - Benefits

EDRC BENEFIT	ANNUAL SAVINGS
Regulatory Calendar-based PM Automation	
DOT Valve Strokes – Reduced Field Man-Hours	$400,000
Function Testing of Valves – Reduced Field Man-Hours	$100,000
DOT Relief Valve Testing	$50,000
Tank Level PM's	$35,000
Continuous CBM and PBM Algorithms	
Unplanned Downtime Avoidance	$350,000
Device Deviation Monitoring – Reduced Field Man Hrs	$150,000
FIRST YEAR ANNUAL SAVINGS	**$1,085,000**

Pertamina

Indonesia's National Integrated Oil & Gas Company

Benefits $25-30 million/year

Pertamina Downstream

Assets

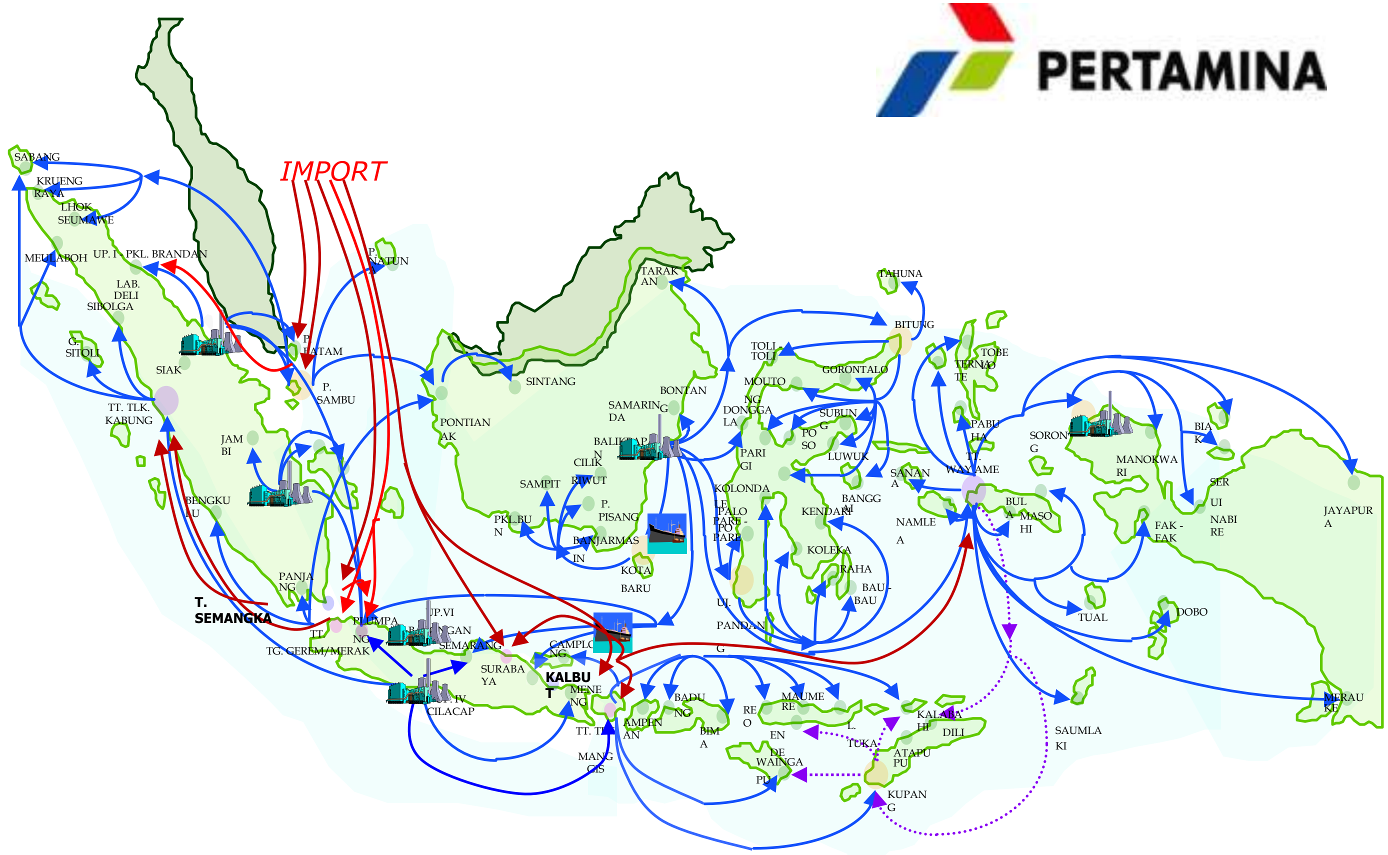
6 Refineries :
1,034 Million bbl/day

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)

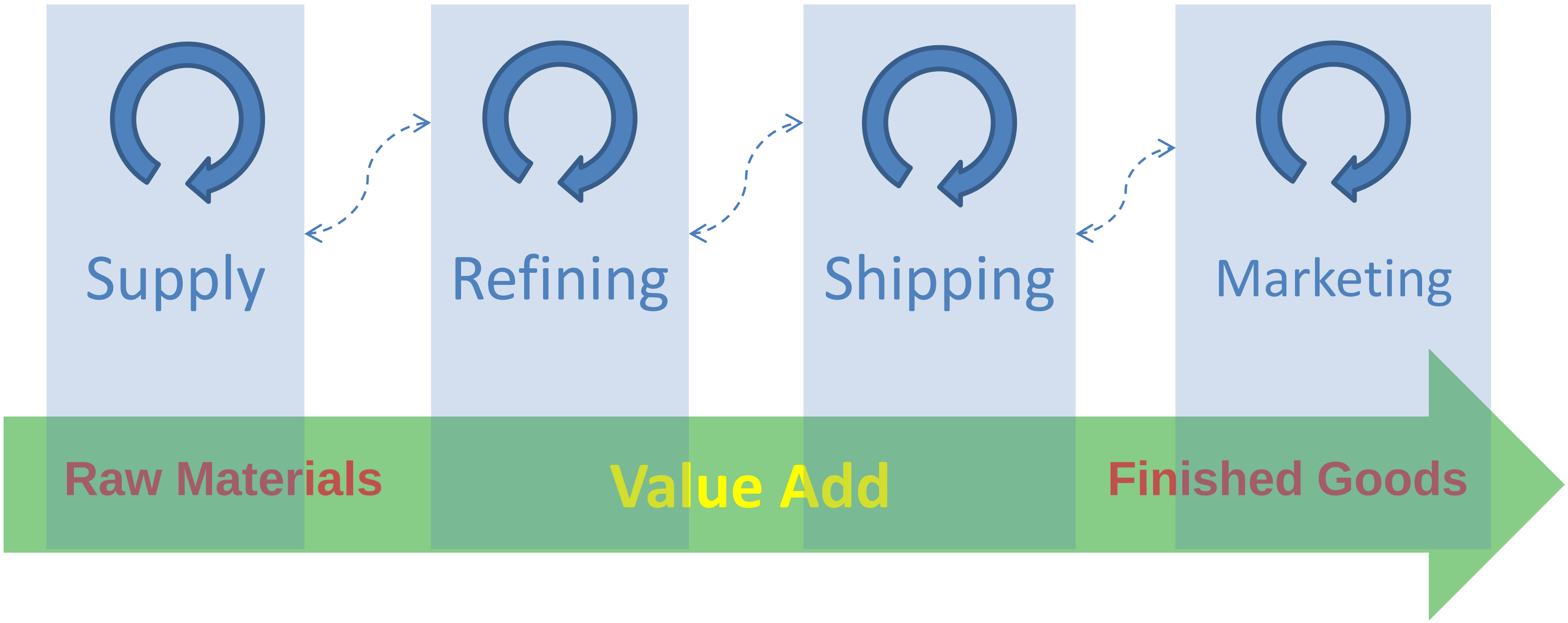
Process, People, Structure

- 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

Rephrasing & Generalizing



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

Planning

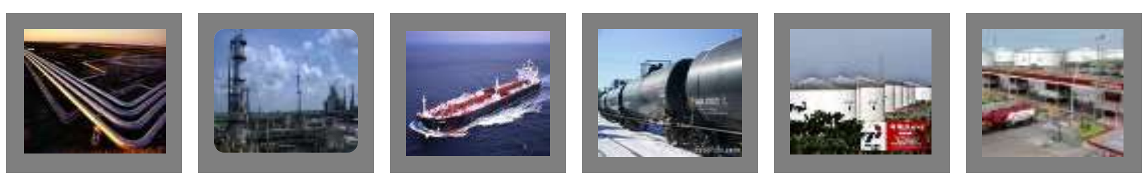
PLANNING & OPTIMIZATION

Monitor
Analysis
Action

DOWNSTREAM
DASHBOARD

Execution

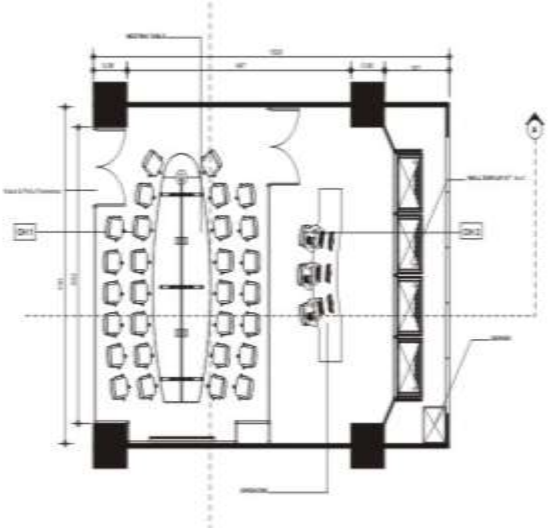
Operations



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 Groups, 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 <u>extreme complexity</u>
- designed to <u>secure supply of energy to the country</u>
- 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:

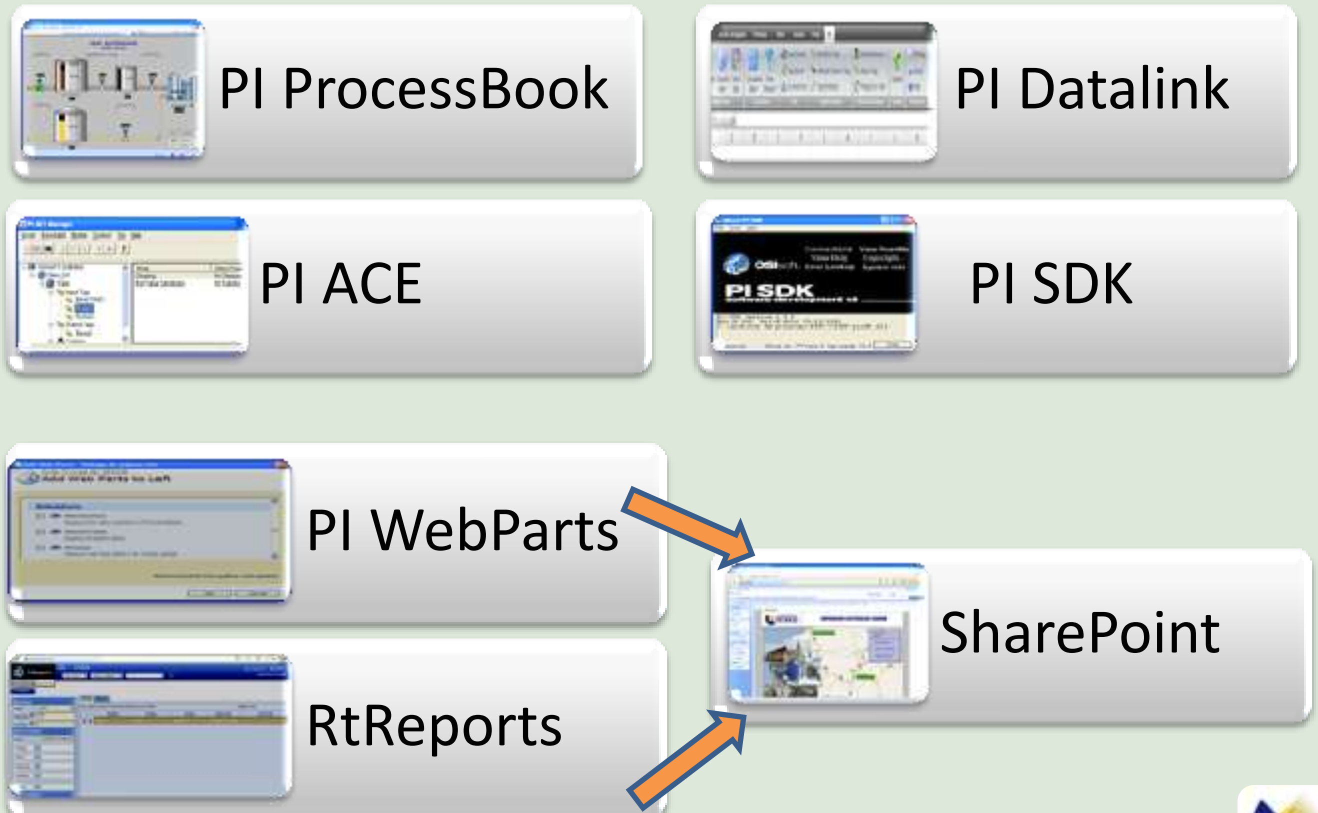
- Pipelines
- Ship-tanks
- Land transfers by car-tanks

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.

OSIsoft

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



CORPORACIÓN cenace

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**

CORPORACIÓN cenace

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

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Thank you

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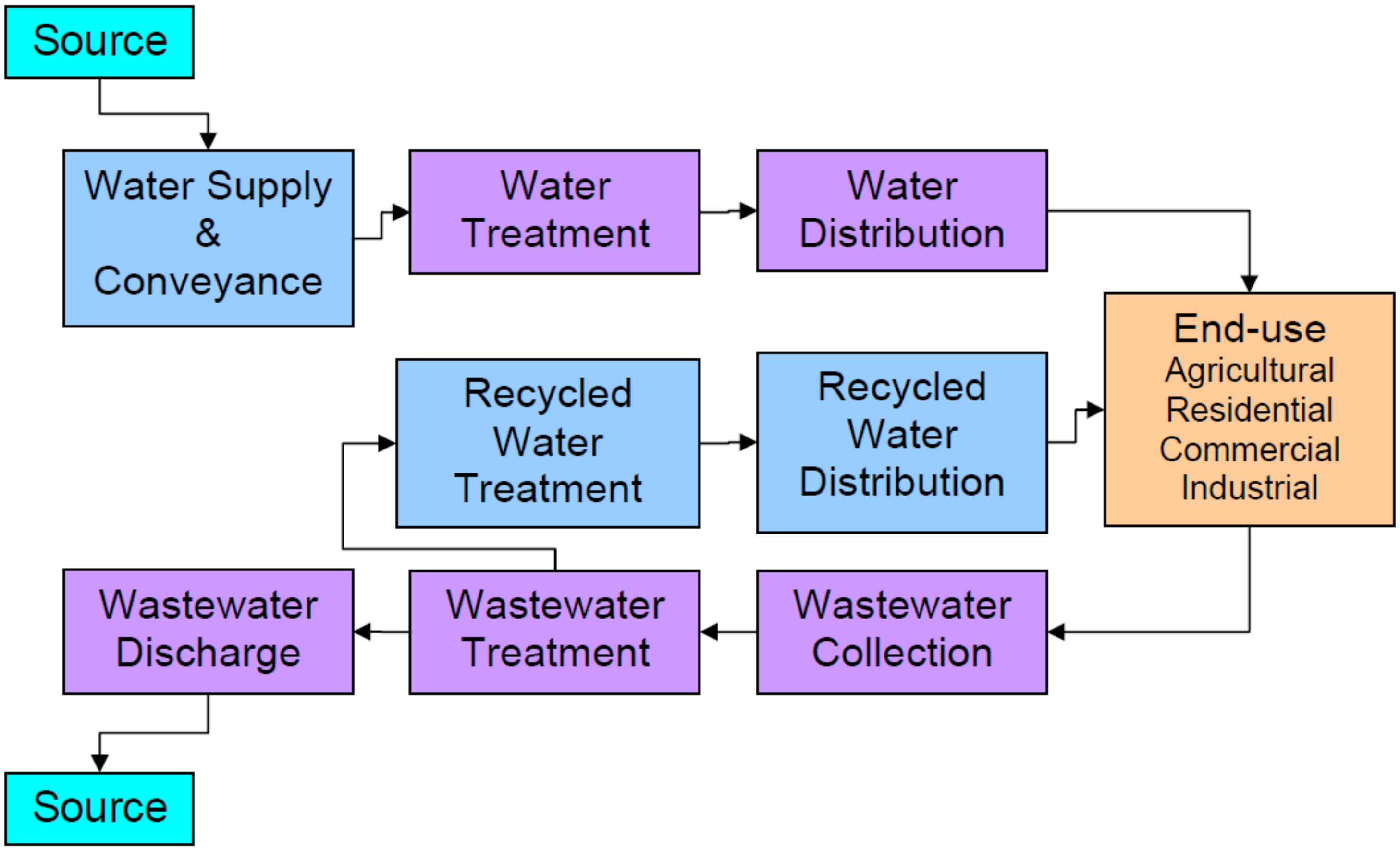
Supporting Slides

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

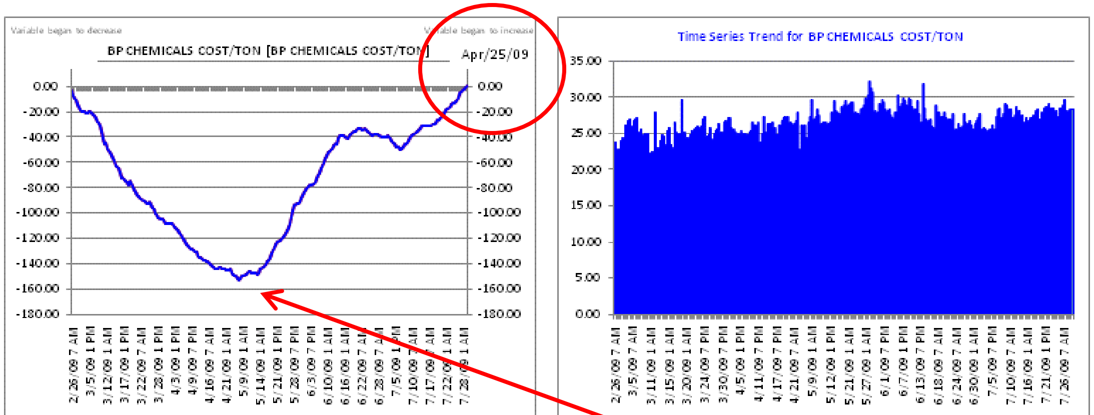
	Electricity (GWh)	Natural Gas (Million Therms)	Diesel (Million Gallons)
Water Supply and Treatment			
Urban	7,554	19	?
Agricultural	3,188		
End Uses			
Agricultural	7,372	18	88
Residential / **Commercial** / **Industrial**	27,887	4,220	?
Wastewater Treatment	2,012	27	?
Total Water Related Energy Use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

Source: California Energy Commission

Boise Inc. - Cost CUSUM and TimeSeries

C:\Clients\Pulp & Paper\Boise\I Falls\2010\BP\Feb\BP\Webpage.html - Windows Internet Explorer

View CUSUM and TimeSeries Charts



View Max/Min Correlations

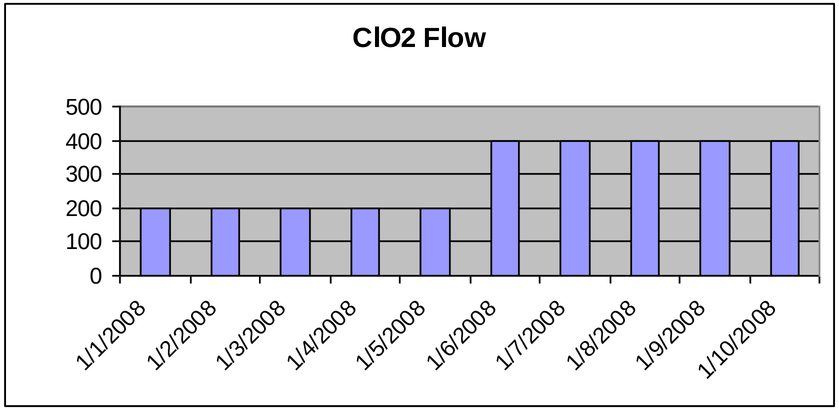
View Significant Changes Since Last Run and Dead Tags

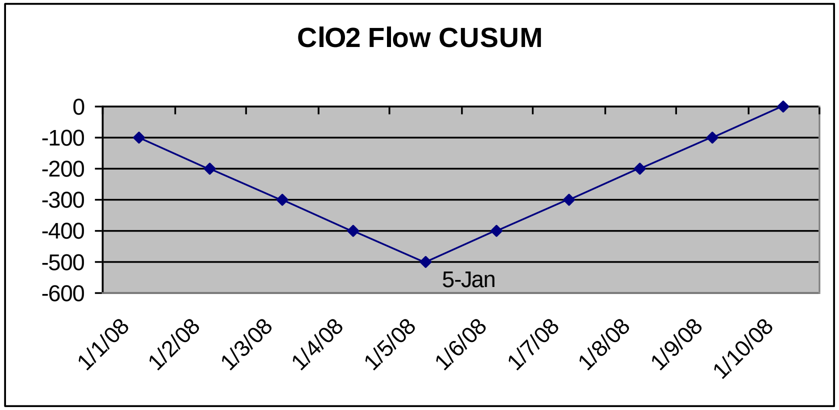
View top 25 R^2 Correlations

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