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The Power of Data

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The Power of Data

Infrastructure for Streaming Data and Events: The PI System

Presented by

World's Information

10^{21} bytes
(1 billion TB)

ZETTABYTES

Source: http://www.emc.com/leadership/programs/digital-universe.htm

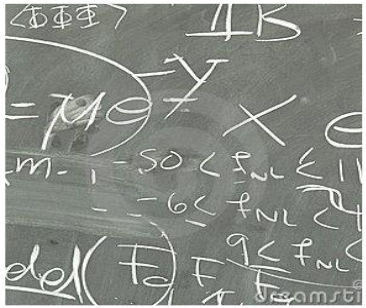
Characteristics of Big Data

Volume

Velocity

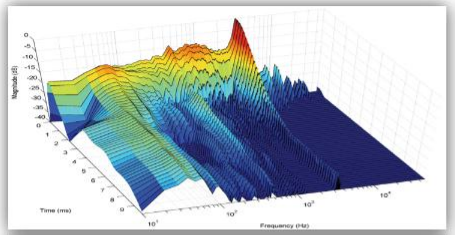
Diversity

Analytics



Structure

PI SERVER 2012



Syncro Phasors

430TB

- 4.8K data streams, 120Hz
- 3 years online
- Unique Events: 55 Trillion
- Estimated Data: 430TB

Data Center

840TB

- 100K cells, 2M breakers
- 10 years online
- Unique Events: 105 Trillion
- Estimated Data: 840TB

Automated Metering

1,410 TB

- 20M meters, 5-min reads
- 7 years online
- Unique Events: 177 Trillion
- Estimated Data: 1,410TB

Fleet Monitoring

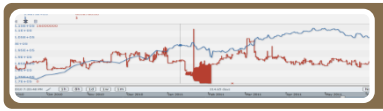
50,460 TB

- 1K assets, 1M points
- 10 years online
- Unique Events: 6,307 Tr
- Estimated Data: 50,460TB

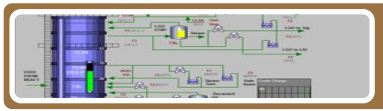
PI System as Infrastructure

Capabilities of the PI System

Acquire – Collect streaming data and events



Historize – Store at resolution of acquisition and trend on demand



Present – Visualize pre-built and ad hoc displays or reports

Analyze – Process data including simple to complex calculations

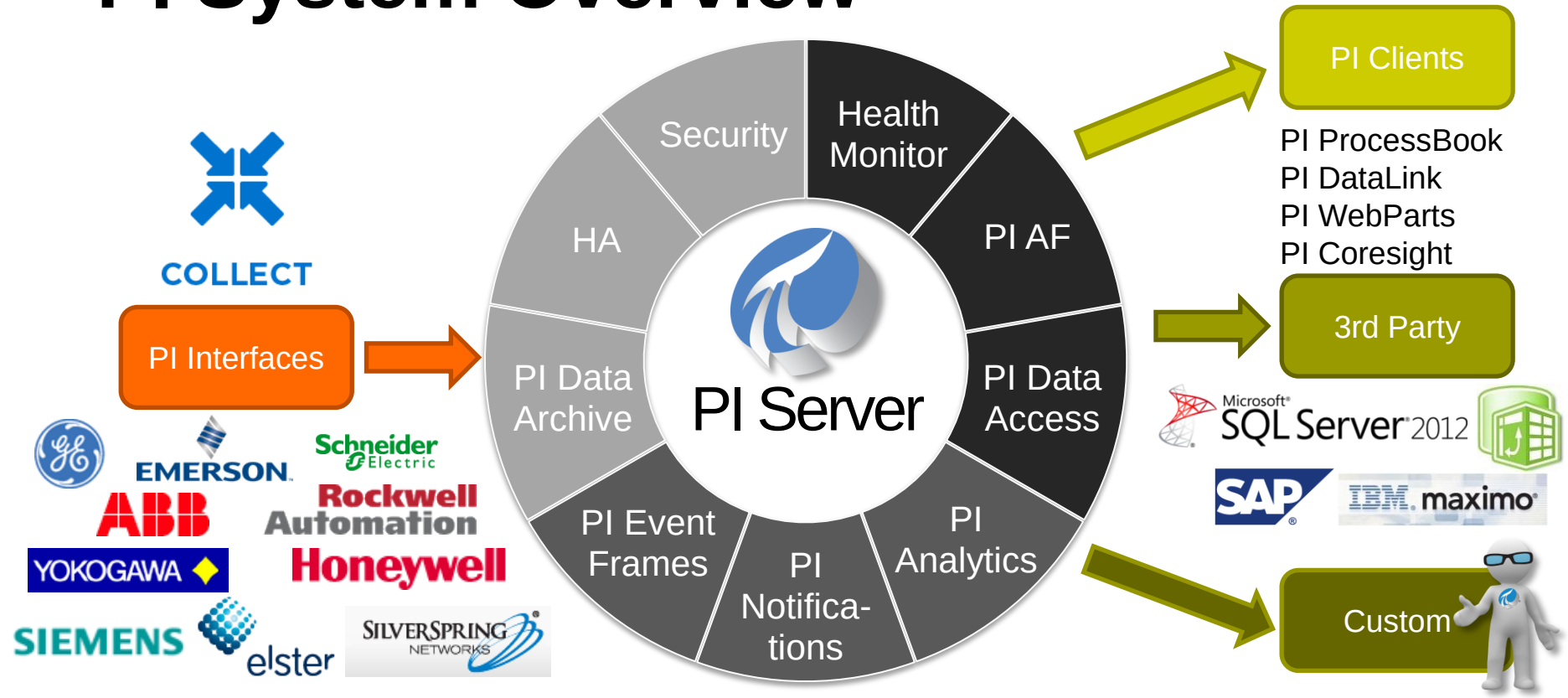
Organize – Structure data and events based on assets

Monitor – Trigger and notify on events

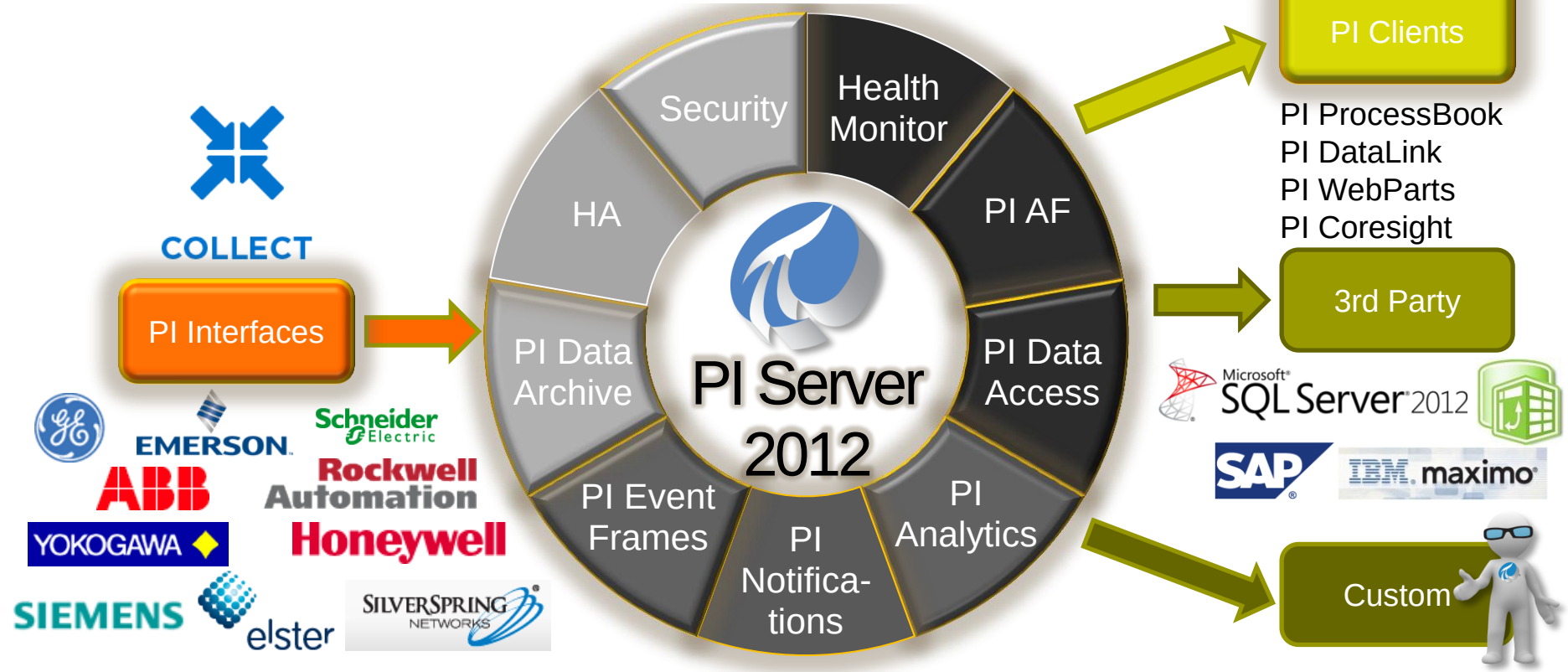
Integrate – Exchange data with external systems

INTRINSIC VALUES OF THE PI SYSTEM INFRASTRUCTURE

PI System Overview

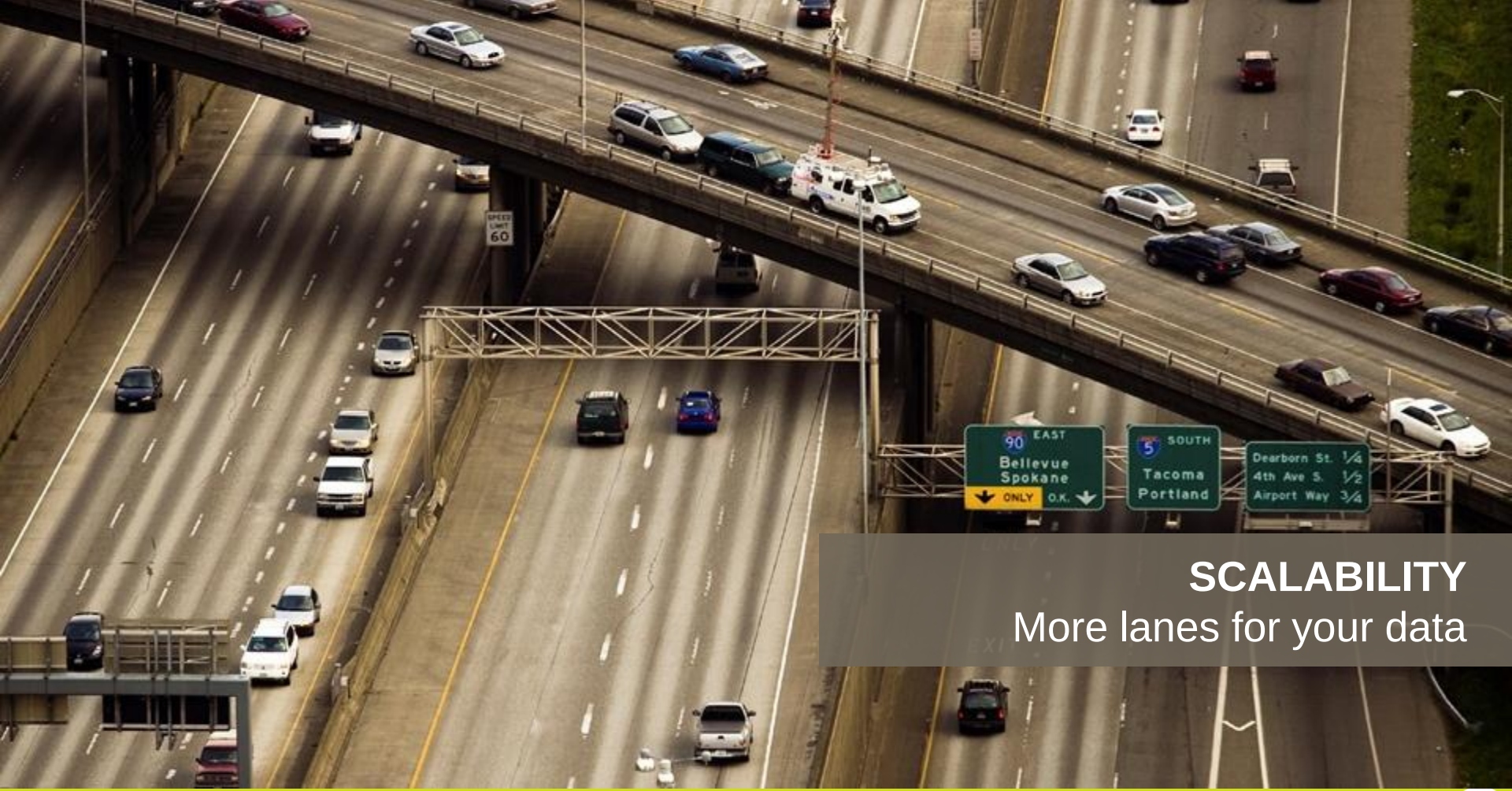


PI System Overview



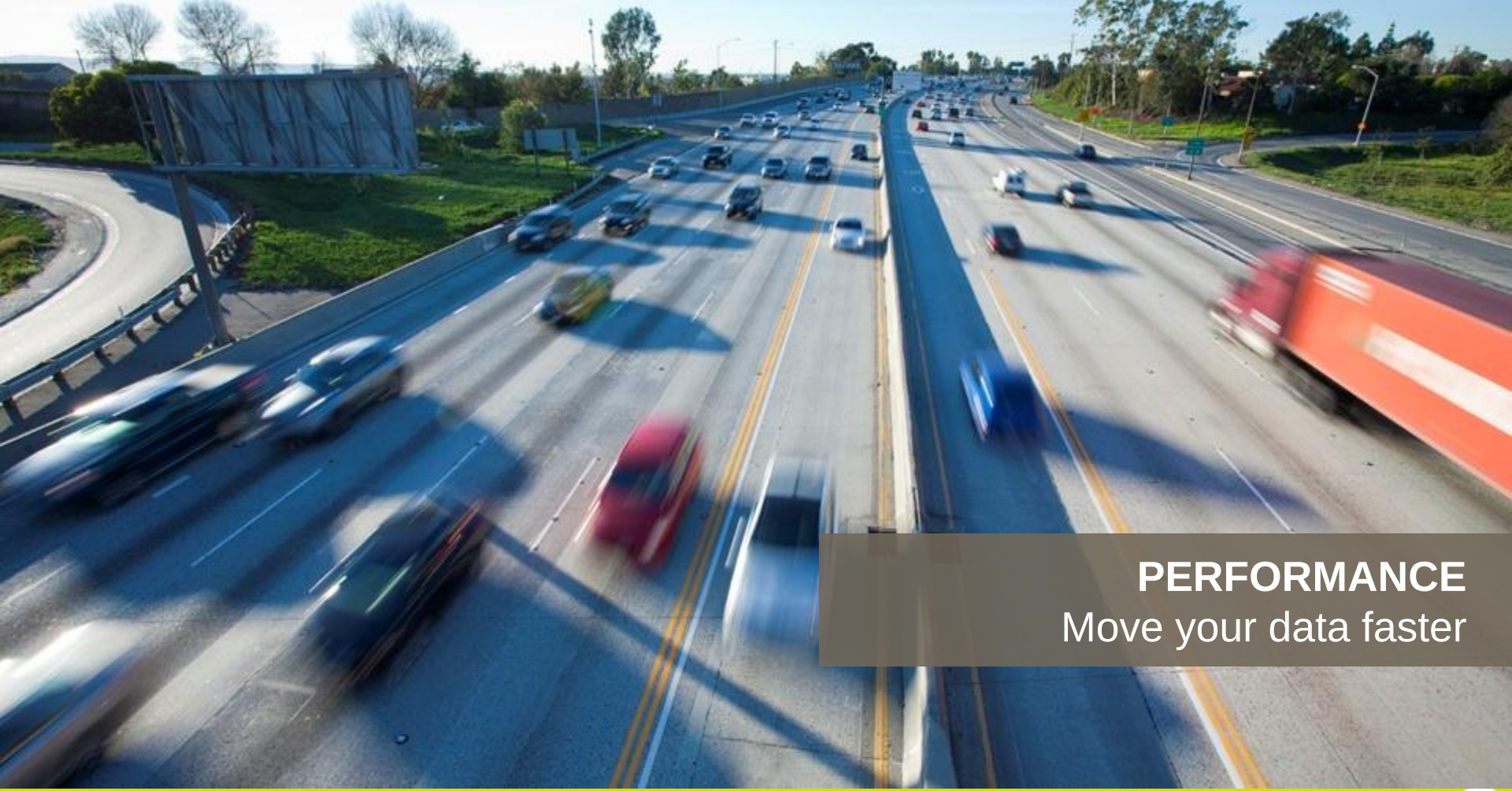
PI Data Archive

INFRASTRUCTURE
Highway for your data



SCALABILITY

More lanes for your data



PERFORMANCE
Move your data faster

RELIABILITY

Most stable system for your data

MANAGEABILITY

Bring all your data online

SECURITY

Better protection for your data

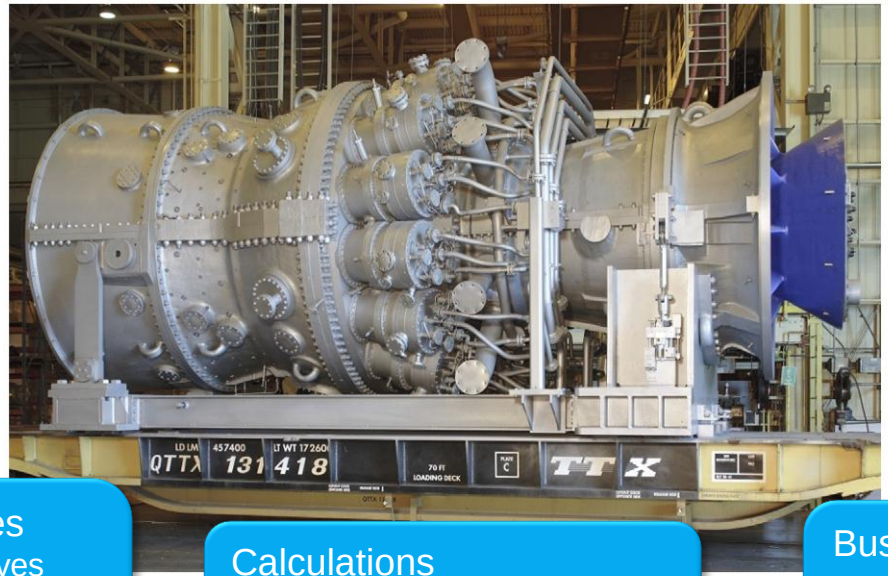
PI Asset Framework

A Complete Picture of Your Asset

Real-time Values
- Inlet pressure
- Inlet flow
- Ambient temperature

Asset Details
- Name
- Make
- Model

External Databases
- Performance curves
- Last service date
- Design documents
- Inspection best practice



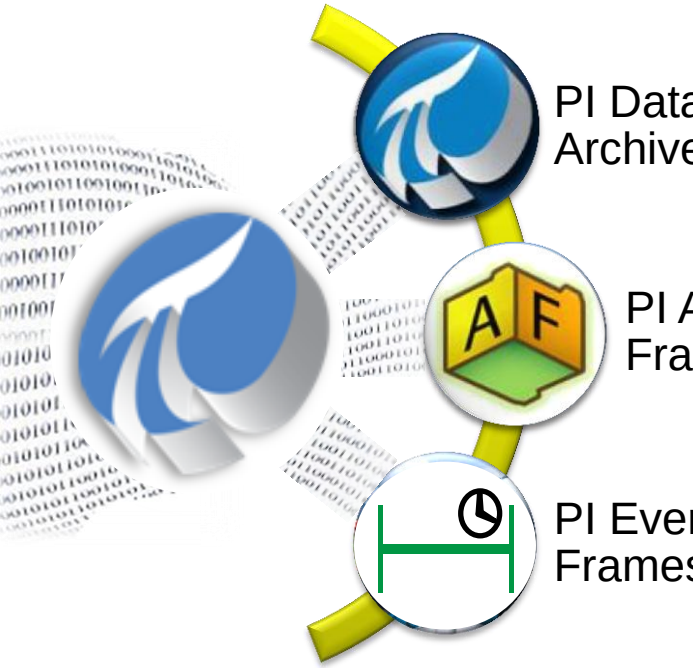
Calculations
- Performance calculations
- KPI's

Real-time Values
- Exhaust temperature
- Exhaust flow
- Measured MW output

Notifications
- Performance excursions
- Temperature difference
- High temperature

Business Events
- Downtime
- Startup
- Excursions

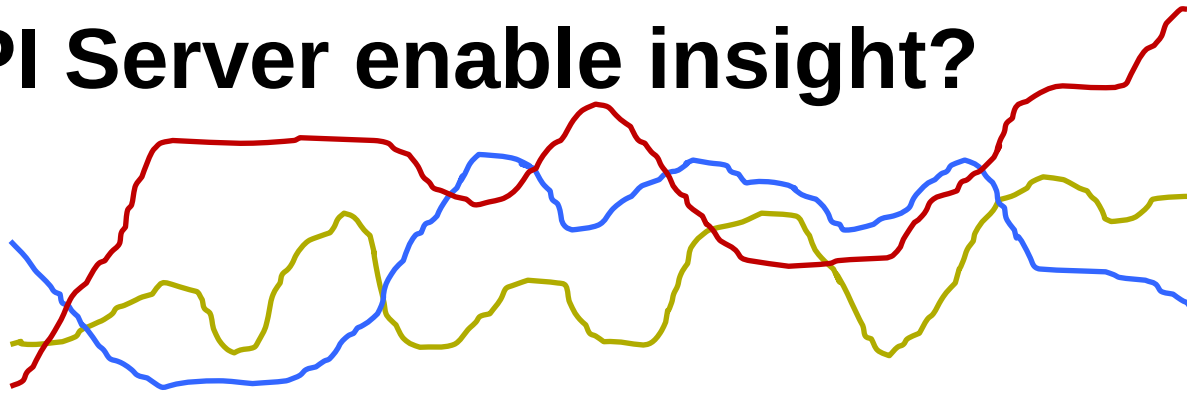
How does the PI Server enable insight?

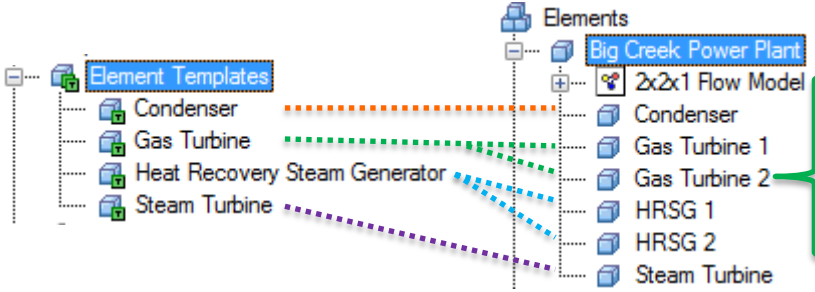


PI Data Archive

PI Asset Framework

PI Event Frames





Element Attributes

- Gas Fuel Flow
- Gas Fuel Presssure
- Gas Fuel Temperature
- Gas Turbine Speed

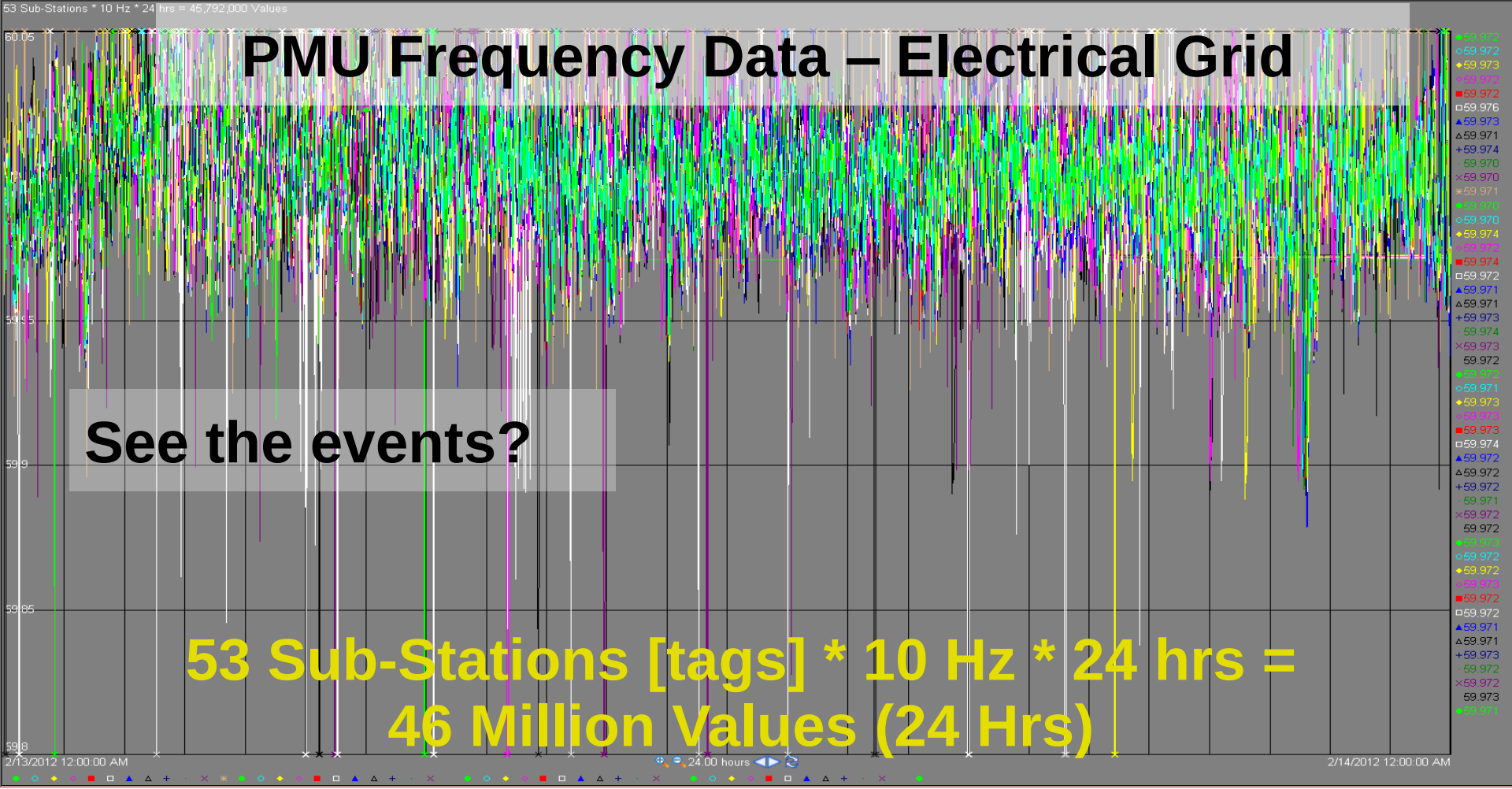
Event Frame Attributes

- Pressure.Avg
- Product Loss
- Reason Code
- Temp.Max

Downtime **Startups** **Shutdowns** **Process Excursions** **Shifts** **Environmental Excursions** **Grade Changes** **Batches**

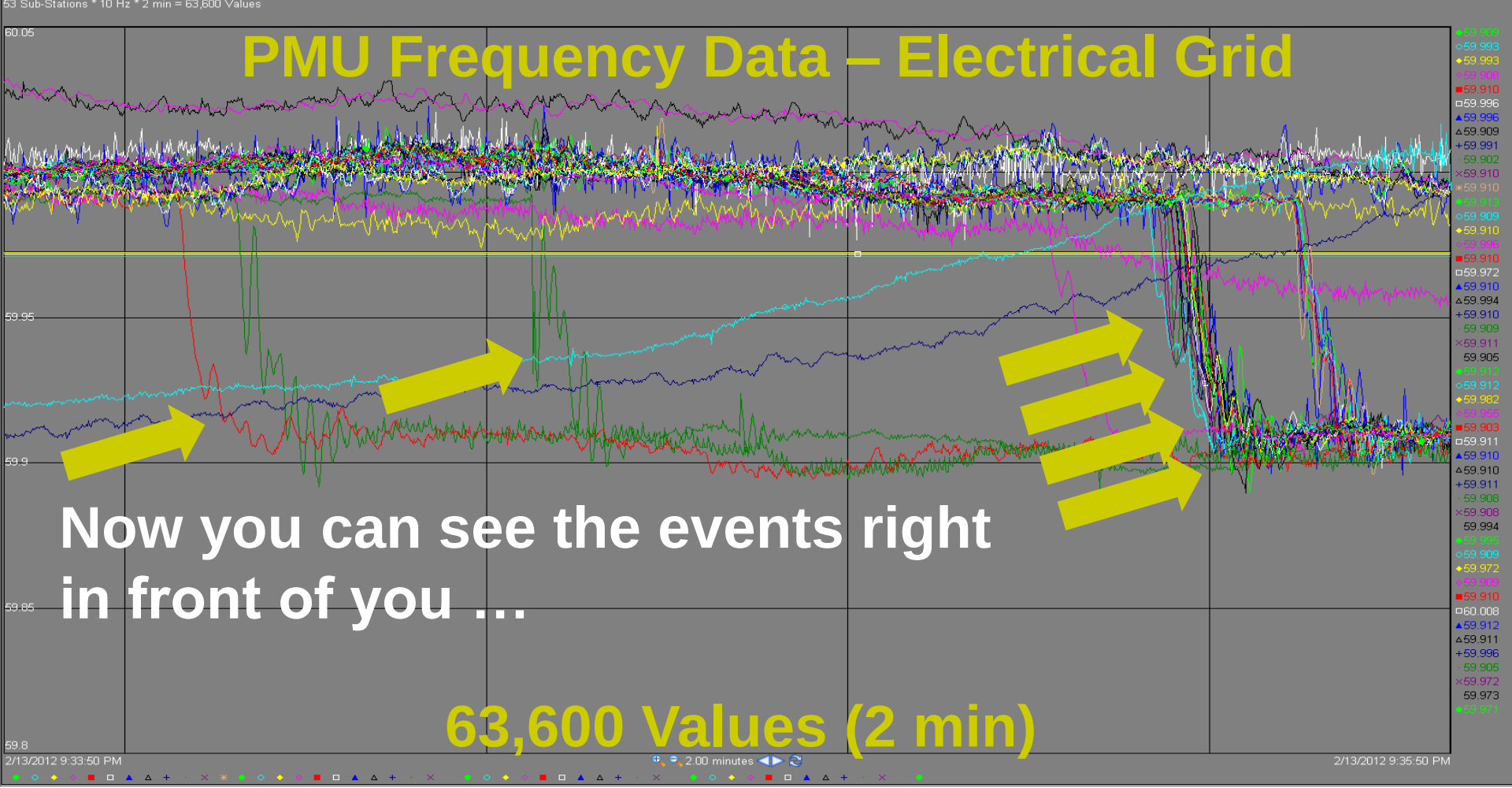
PI Event Frames

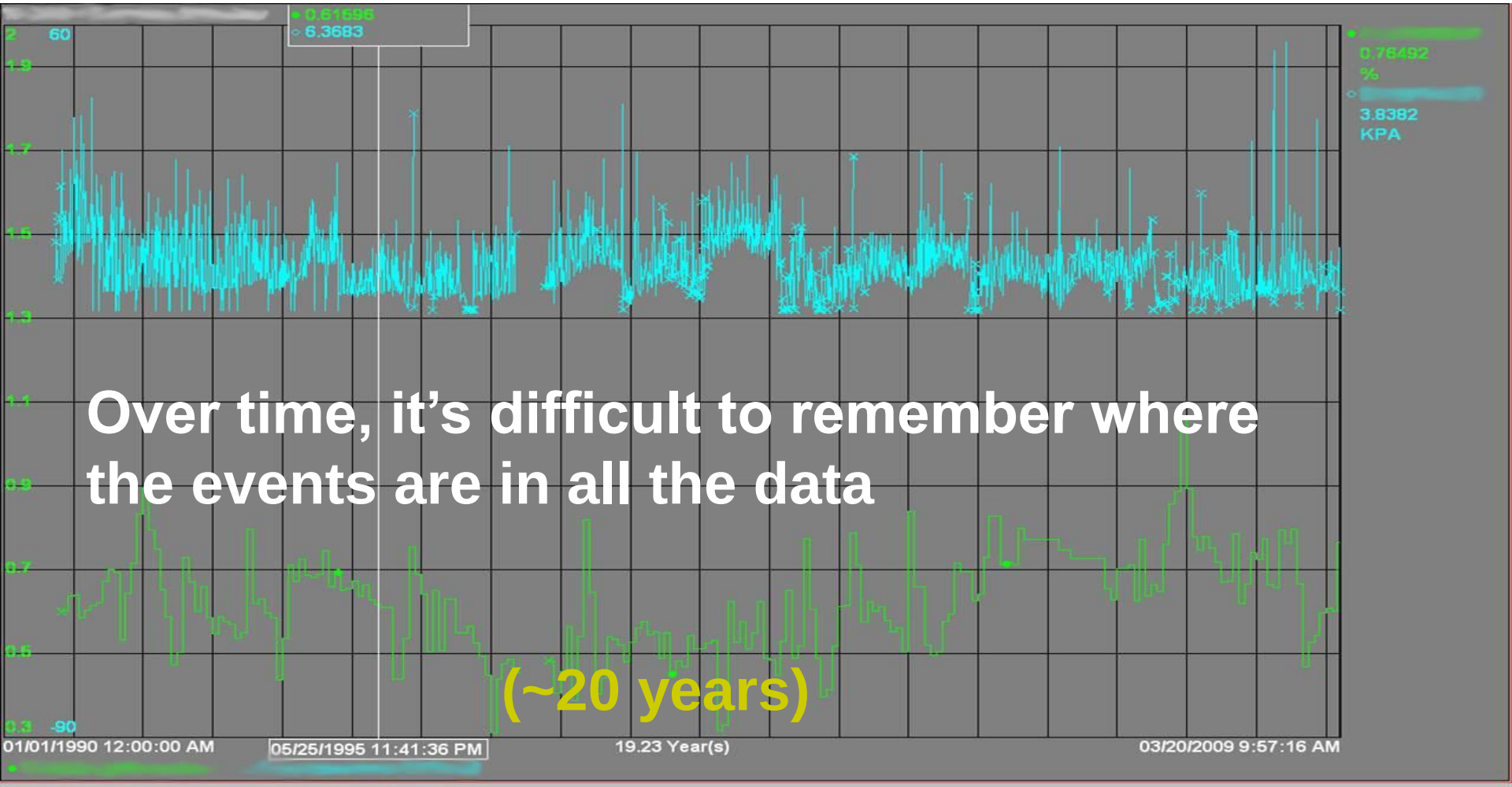
PMU Frequency Data – Electrical Grid



See the events?

53 Sub-Stations [tags] * 10 Hz * 24 hrs = 46 Million Values (24 Hrs)

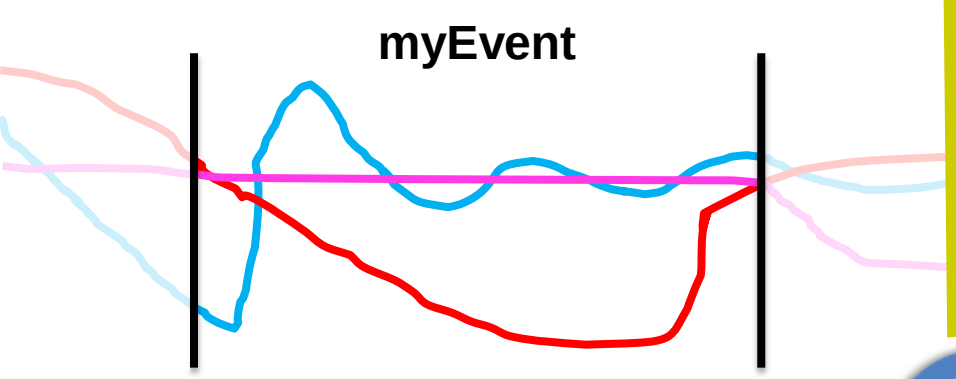




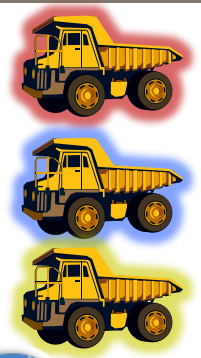
Over time, it's difficult to remember where the events are in all the data

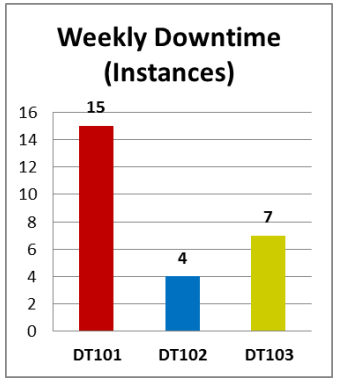
(~20 years)

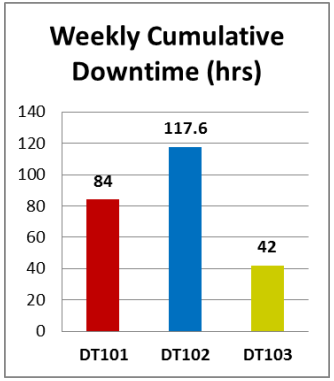
Simplify Data Analysis



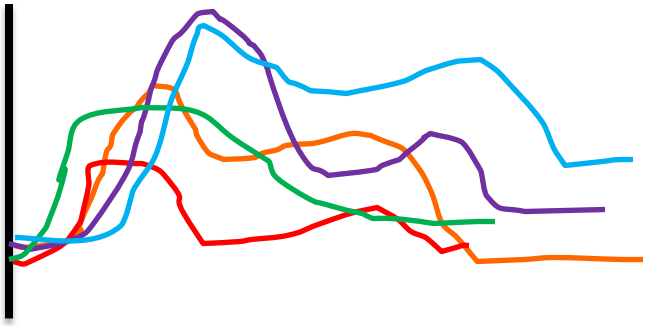
Perform Asset Comparisons







Event Overlay Trend

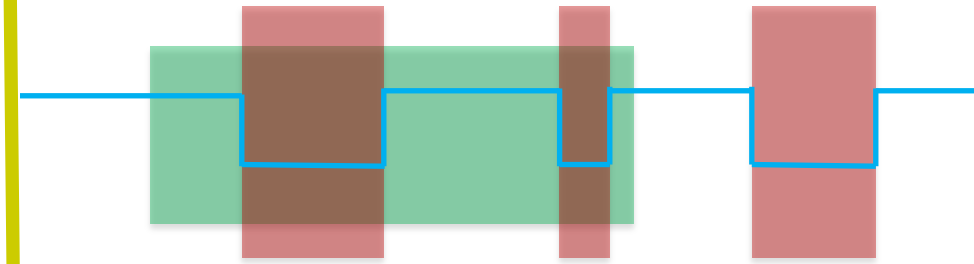


Name	Temp.Max
EF1	122.47
EF2	109.34
EF3	112.73
EF4	98.61
EF5	125.24

Downtime Events

Product XYZ (1)

Downtime (2)

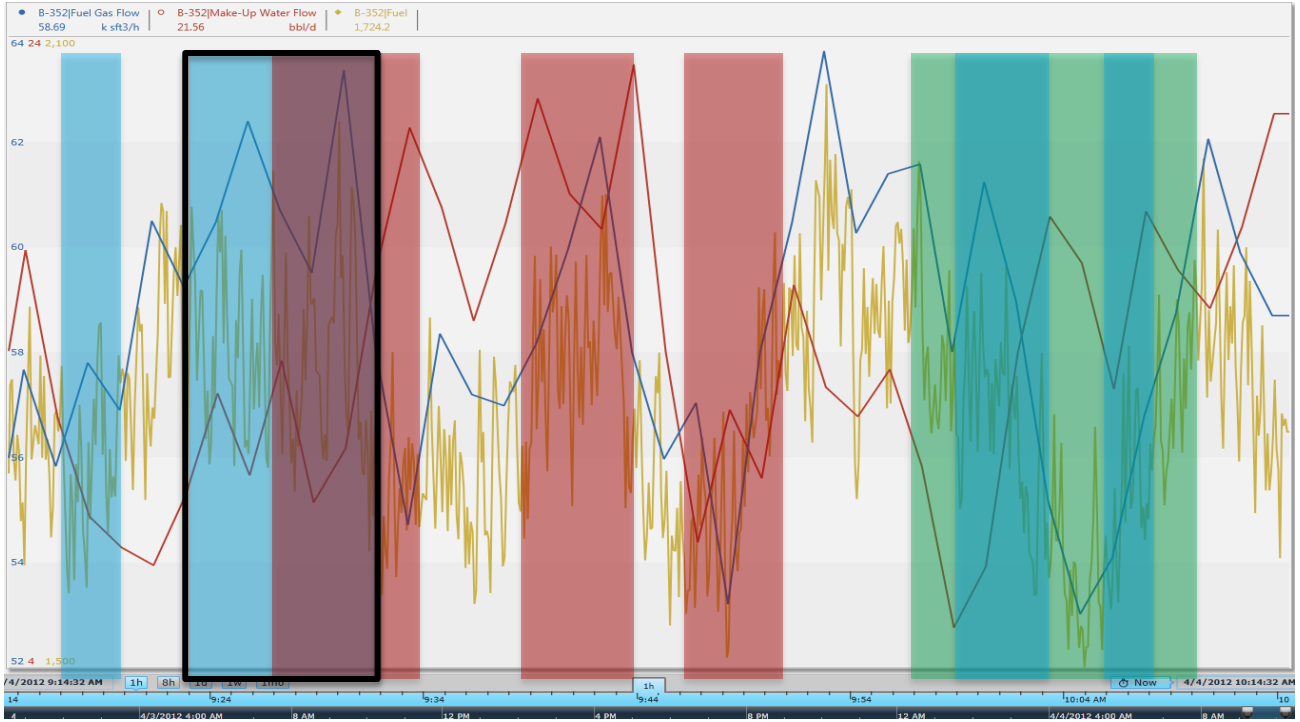


Perform Event Comparisons

Discover Event Interrelationships

PI Event Frames = *events* + *related data*

Excursions (4) Downtime (3) Product XYZ (1)

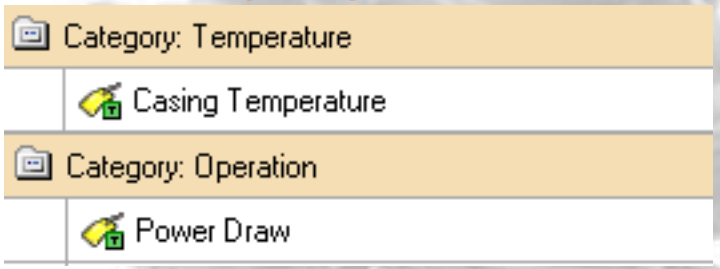


Event Attribute	Value
Name	Ex 20121215-0002
Start	15-Dec-2012 10:35:02
End	15-Dec-2012 10:47:26
Duration	12 min, 24 sec
Asset	Boiler-459
Excursion Type	High Violation
Fuel Gas Flow.Avg	37.12 k sft3/h
Fuel.Start	823.48 k sft3/ton
myPIKPI.Max	47.19 bbl/d

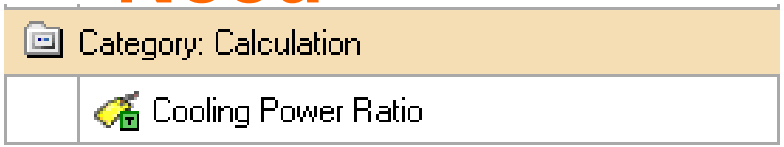
PI Analytics

PI Analytics – Streaming calculations

Have



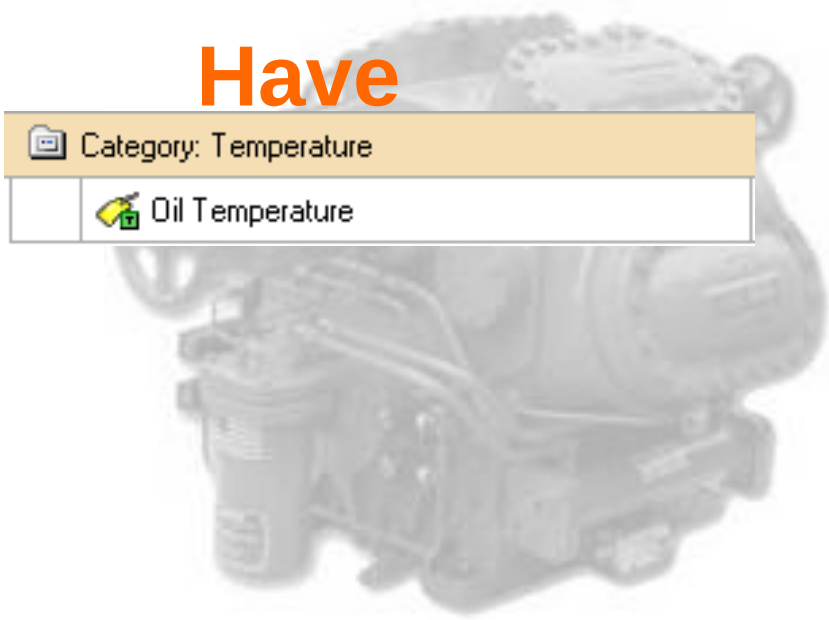
Need



"What is the hourly temperature average per total power draw that hour?"

PI Analytics – Compare asset performance

Have



Need

Category: Calculation

Oil Temperature Rate of Change

"How fast is this thing heating up?"

PI Analytics – Choose the best for you

Configure

- PI AF Formula Data Reference
- PI AF Point Data Reference summary
- PI Client calculations

Programmatic

- PI Advanced Computing Engine (PI ACE)

- PI Performance Equations
- PI Totalizers
- PI Statistical Quality Control (SQC)

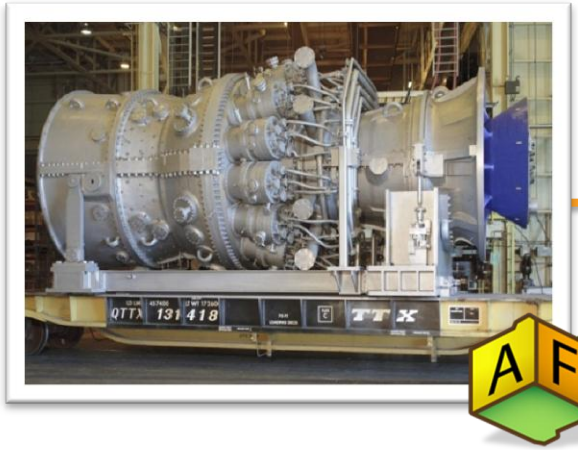
On-demand

Schedule & Store

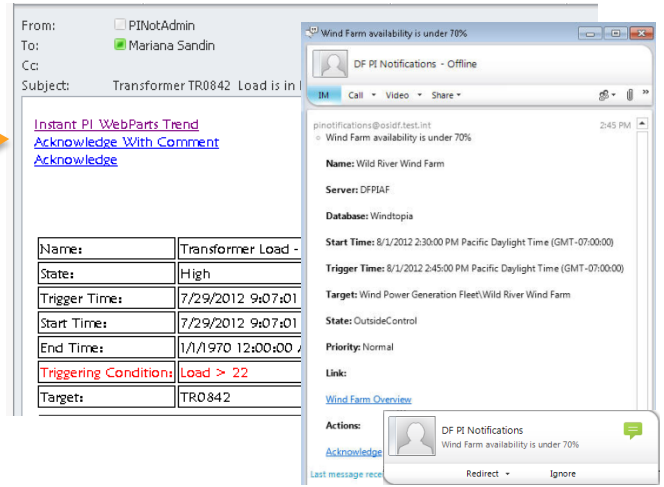
PI Notifications & PI Data Access

PI Notifications – keeps you informed of your assets

"One of the turbine's exhaust thermocouples has been acting up… Let's keep an eye on it and create a work order for maintenance if it fluctuates more than 5% in 5 seconds. Make sure Bob is notified of this also."

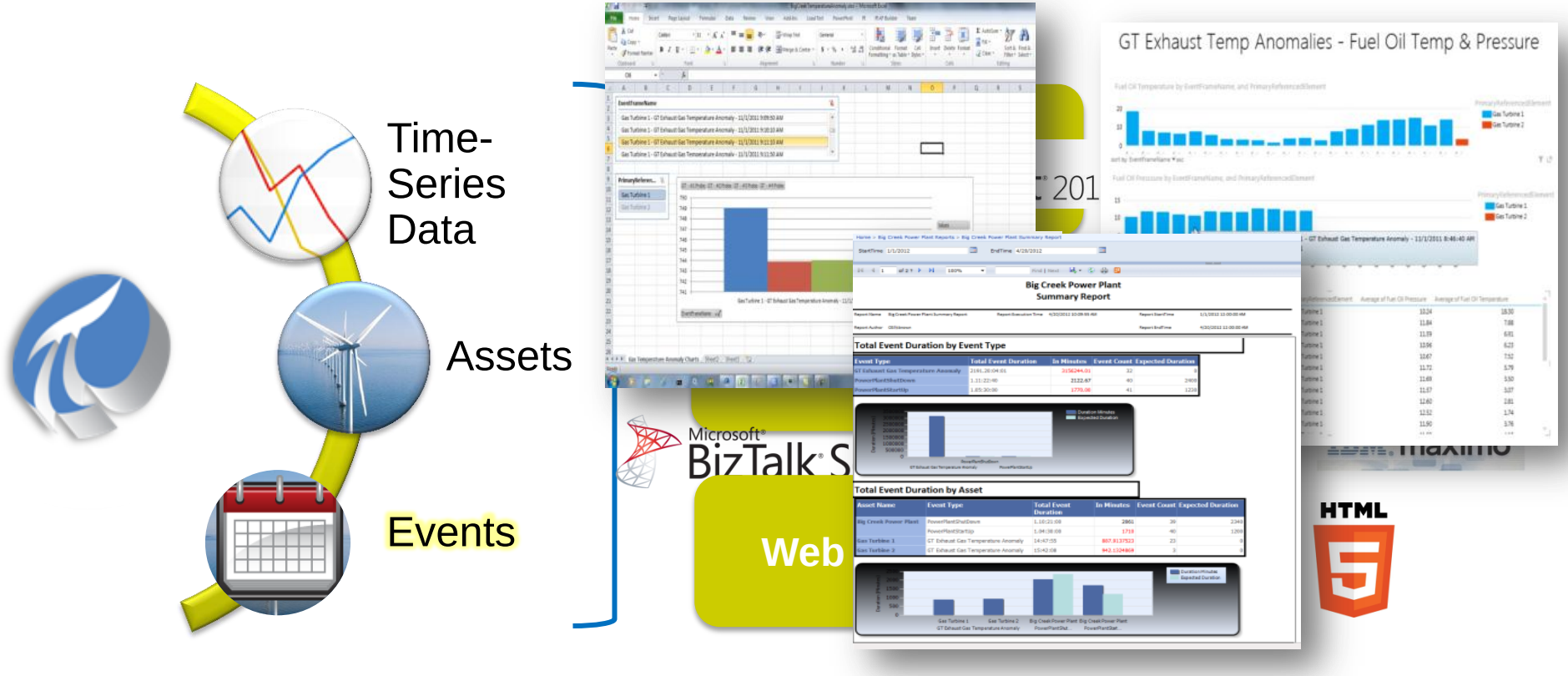


DELIVER



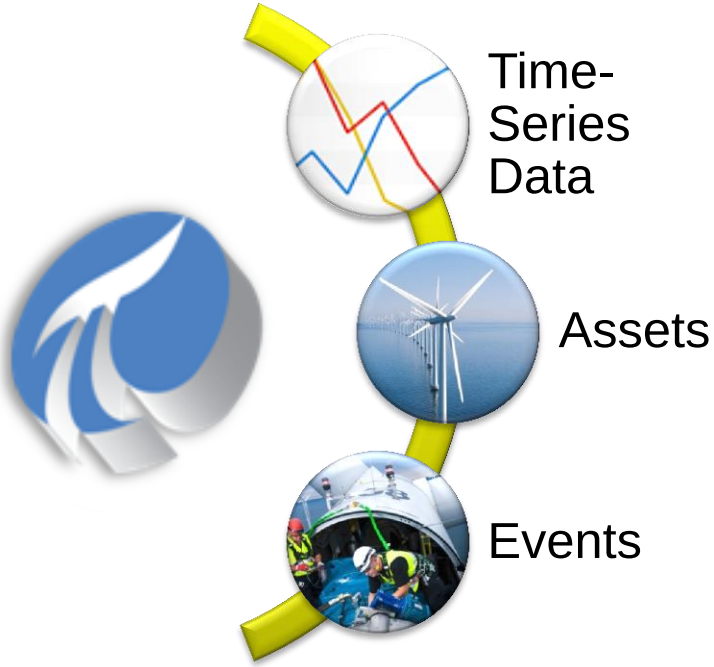
Web Service

PI Data Access – Integrate your events

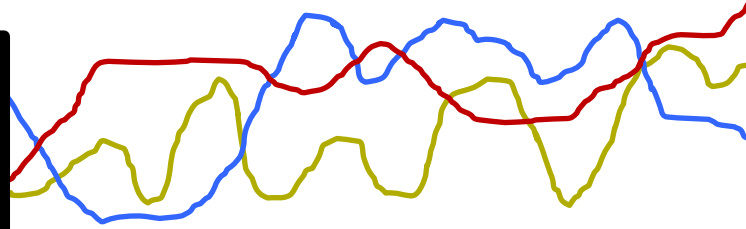


PI Clients

How does the PI Server enable insight?

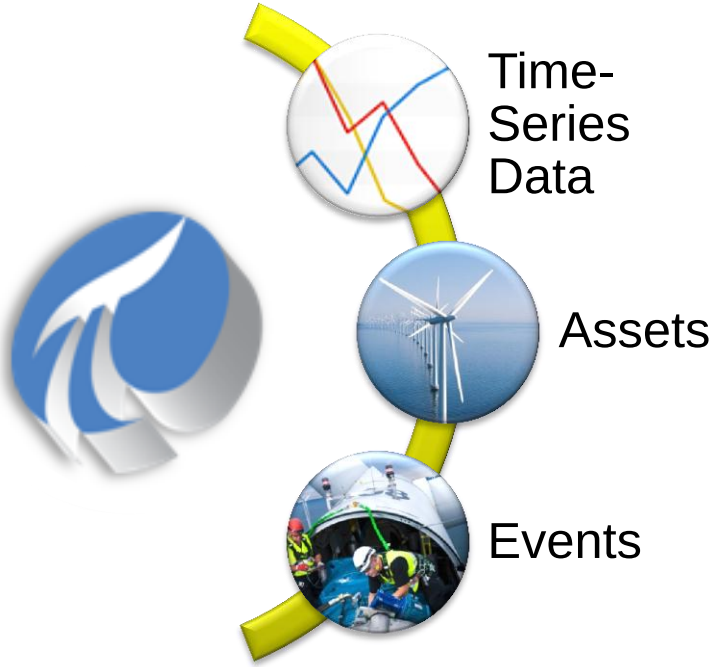


Store Full Data Fidelity



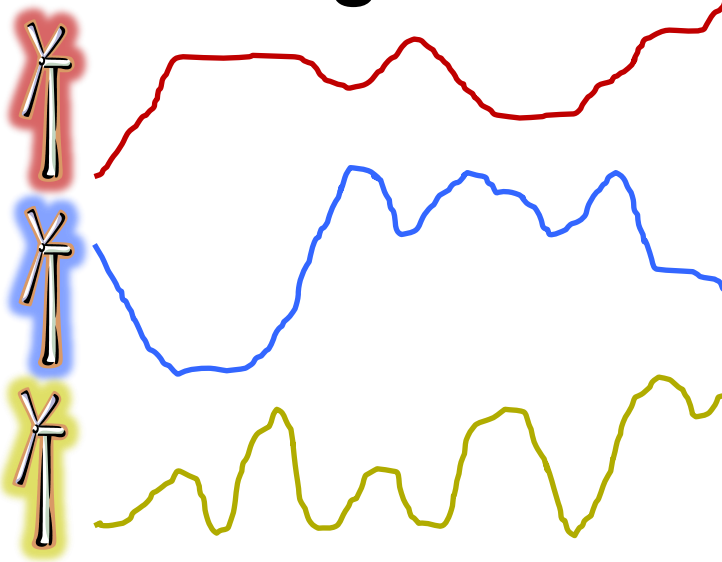
- Stores the raw data (not summaries)
- Enables ALL the possible analyses
- Don’t miss critical information needed for analysis / reporting

How does the PI Server enable insight?



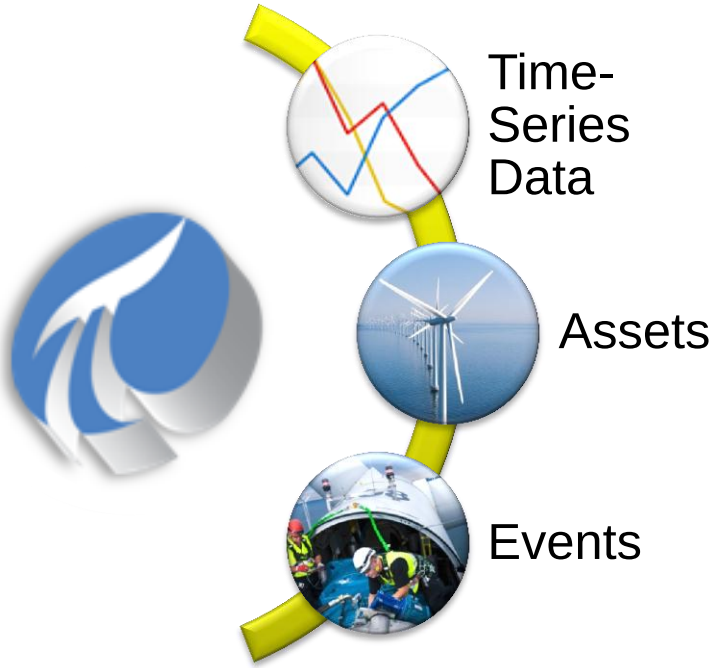
Store Full Data Fidelity

Perform Asset Comparisons



Asset	Current	Day.Peak	Week.Total	Month.Avg
WT101	1.22 MW	1.97 MW	13.32 MW	1.93 MW
WT102	0.56 MW	1.53 MW	15.56 MW	2.21 MW
WT103	0.72 MW	1.78 MW	9.34 MW	1.59 MW

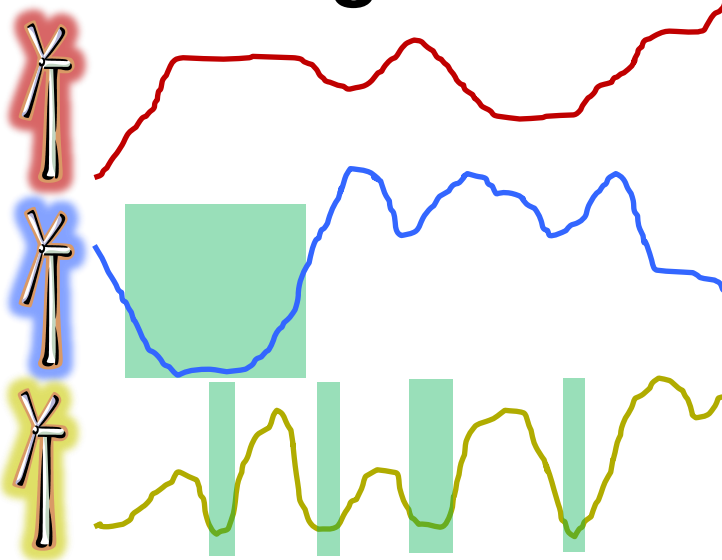
How does the PI Server enable insight?



Store Full Data Fidelity

Perform Asset Comparisons

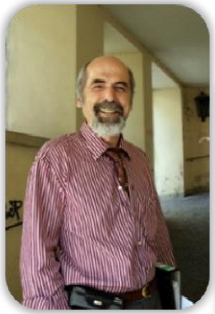
Perform Asset & Event Comparisons



Asset	# Downtime	Total Downtime
WT101	0	00:00:00
WT102	1	08:21:23
WT103	4	06:47:35

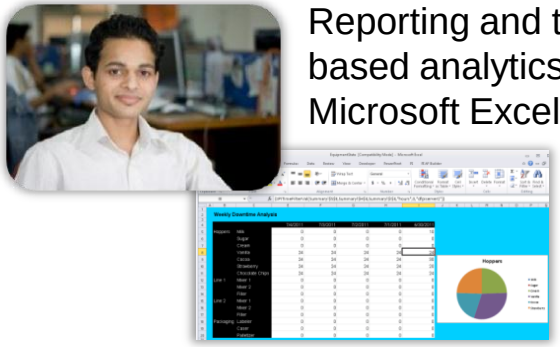
Visualization Landscape

PI Coresight:
Ad Hoc Analysis & Collaboration



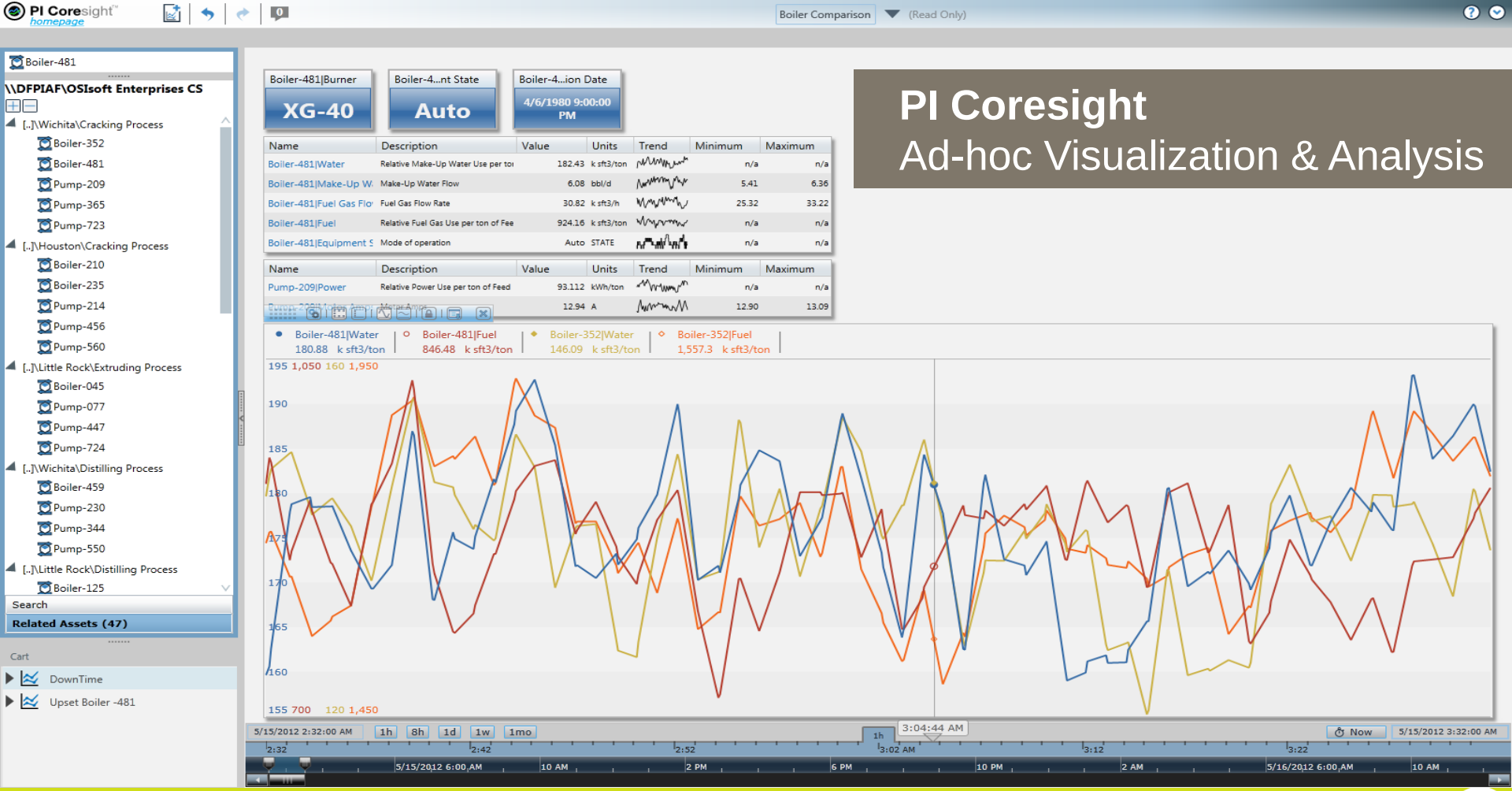
PI WebParts: Composite Apps, Shared broadly

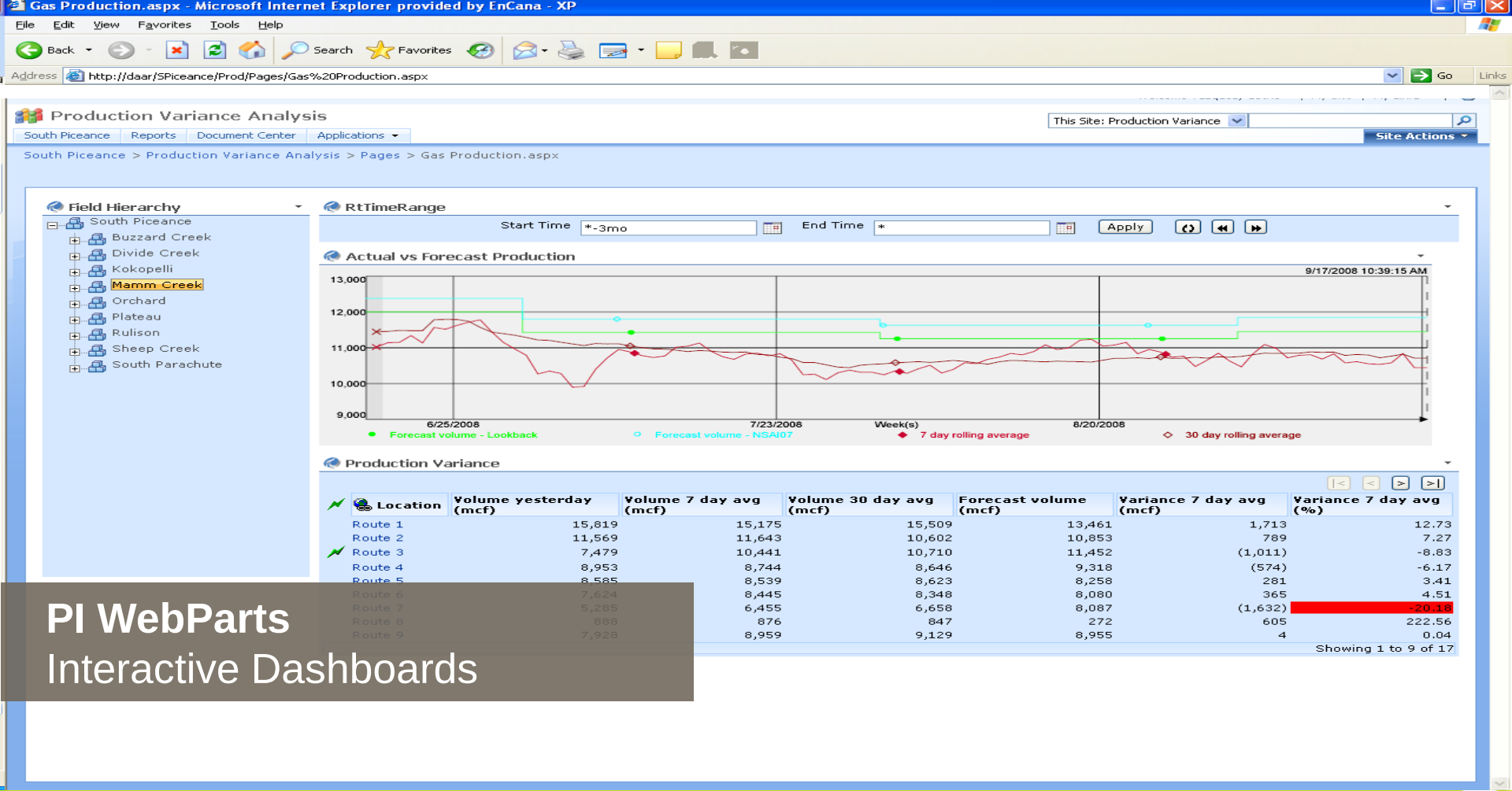
PI ProcessBook:
Display authoring and Process monitoring



PI DataLink:
Reporting and table based analytics in Microsoft Excel

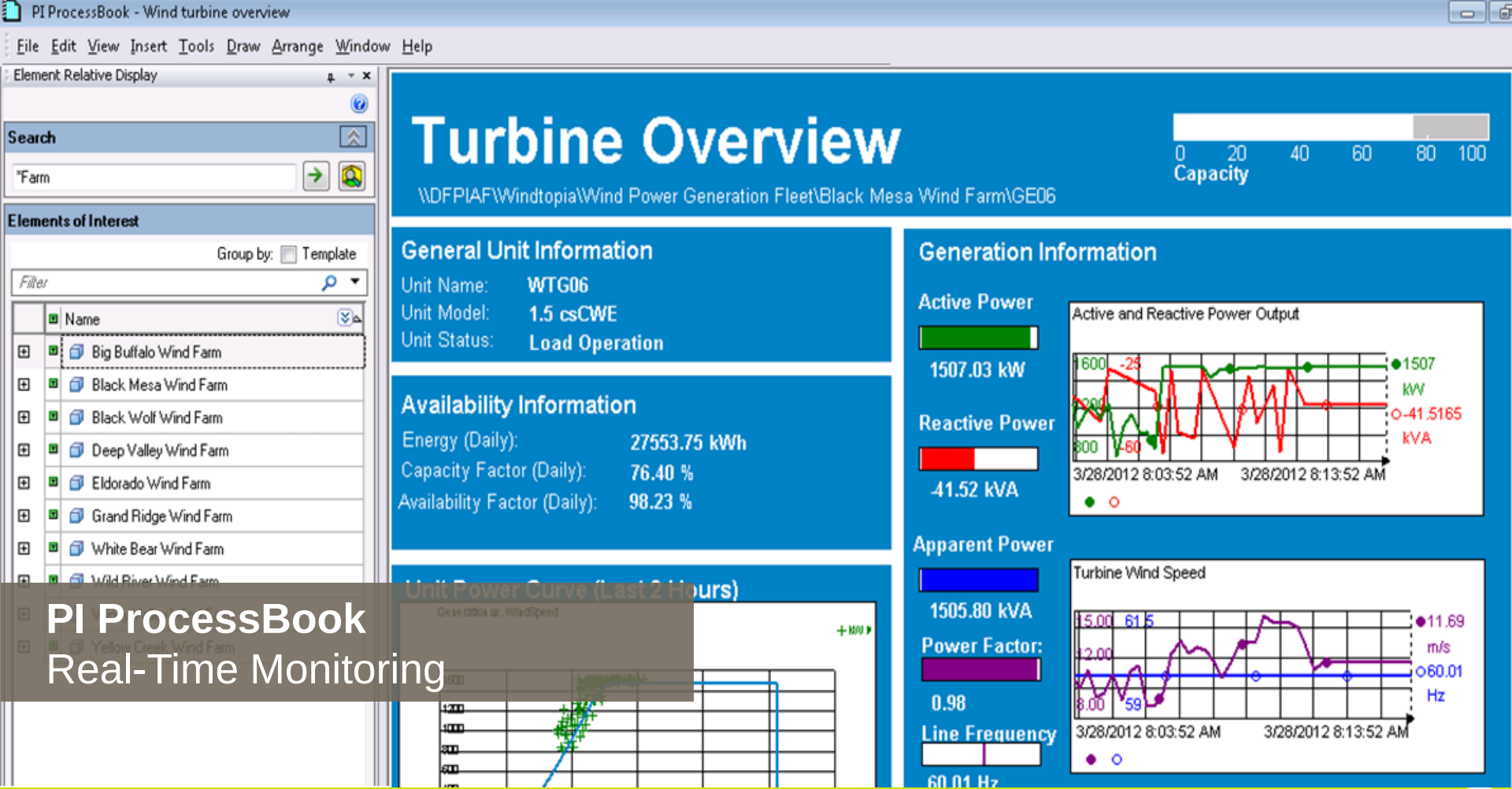
PI Coresight
Ad-hoc Visualization & Analysis





PI WebParts

Interactive Dashboards



PI ProcessBook
Real-Time Monitoring

	A	B	C	D	E	F
1	**2008 CO2 Emissions (lbs)**					
2	**AQMD Unit ID:**	**Facility ID:**	**Type:**	**January**	**February**	**March**
15	D-15	K-26	Major	0	98,684	3,375,547
16	D-16	K-27	Major	0	69,113	2,639,550
17	D-83	H-6	Process	96,274	56,349	13,120
18	D-84	H-20	Process	37,588	13,418	2,701
19	D-175	H416	Process	244,634	151,862	5,328
20	D-176	H417	Process	19,283	2	0
21	D-177	H418	Process	225,835	95,620	0
22	E-173 (M24)	AC	R219	64,400	46,711	13,942
23	E-15	Air Compressor	R219	1,302	22	897
24	E-16	Generator	R219	143	0	18
25	E-18	Air Compressor	R219	1,109	292	11,618
26	E-18B	Air Compressor	R219	16,188	320	13,096
27	E-22	Trash Pump	R219	0	0	0
28	E-23	Trash Pump	R219	0	0	0
29	E-24	Trash Pump	R219	3,129	3,054	1,046
30	E-25	Steam Cleaner	R219	649	0	0
31	E-27	Welder	R219	5,869	123	4,269
32	E-28	Light Plant	R219	-1	4	113
33	E-29	Generator	R219	0	0	0
34	E-30	Welder	R219	11,904	125	3,404
35	E-31	Air Compressor	R219	1	2	0
36	E-32	Generator	R219	0	0	0
37	E-33	Pressure Washer	R219	0	0	0
38						
39		*Major*		10,320	997,616	10,645,707
40		*Large*		276,570	278,036	452,744
41		*Process*		964,375	565,436	85,566
42		*Gasoline*		5,685	3,369	13,578
43	*R219*	*Diesel*		34,610	572	20,881
44		*Nat. Gas*		64,400	46,711	13,942
45	Major, Large, Process, Natural Gas all in MMSCF					
46	Gasoline, Diesel in gallons					

DAILY PRODUCTION REPORT - Papermachine

Daily Report For :	23-Jul-07					
SHIFT FOREMAN	John Smith	Mike Jones	Peter Richards			
FIBRE INPUT	**Shift 1**	**Shift 2**	**Shift 3**	**Total**	**Spec**	**Unit**
Base NSSC - Grubbens	15	50	50	115		BDT
Total fibre input				115.00		BDT
FIBRE TO FAN PUMPS	**Shift 1**	**Shift 2**	**Shift 3**	**Total**	**Spec**	**Unit**
Liner pulp	10	40	50	100		BDT
Base K4	15	55	80	150		BDT
Base NSSC	25	70	60	155		BDT
Base broke	1	5	15	21		BDT
Total fibre to fan pumps	51	170	205	426		BDT
PAPER PRODUCTION				End of day		
Grade (Shift start)	ML140	ML140	ML225	ML225	Spec	Unit
Standard speed	500	500	490			m/min
Actual Average speed	390	520	505			m/min
Gross Pope Production	40	180	220	440		t/day
Bone Dry Production	35	160	200	395		BDt/day
Fibre Loss on Machine	16.0	10.0	5.0	31		BDt/day
PM Production Over Scale	38	180	220	438		t/day
Saleable PM Production	10	160	220	390	400	t/day
Rewinder Production	0	0	10	10		t/day
Total Saleable	10	160	230	400		t/day
Broke	20	5	0	25		t/day
Hold Reels	8	15	0	23		t/day
Second Cut	0	0	0	0		t/day
Jumbo's on Kitchen R				12		tons
DOWNTIME	240	15	0			

PI DataLink
Personalized Reports

- Factory 1 Batch Cycle Time
- Factory 1 Batch Trend Comparison DLES
- Factory 1 Batch Trend Calcs

Add new link

Alarm Query Time Range

Start Time: 2/3/2010 12:00:00 AM

End Time: 2/4/2010 12:00:00 AM

Apply

Select a Unit

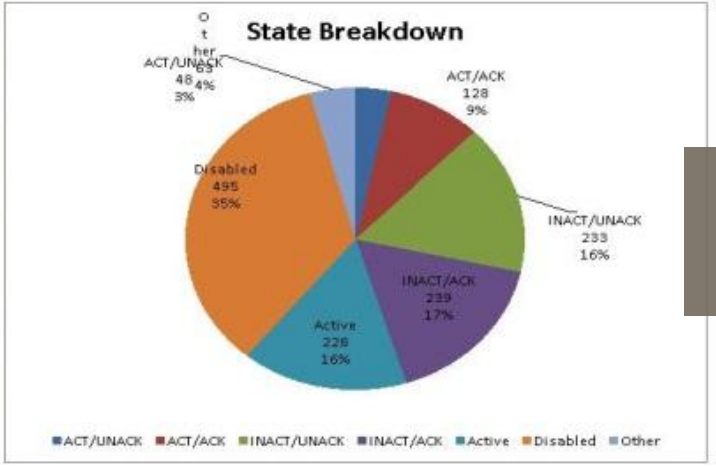
- All Factory 1 Units
  - All Units
  - BF008
  - BF009
  - CIP005
  - CIP006
  - TA001
  - TA002

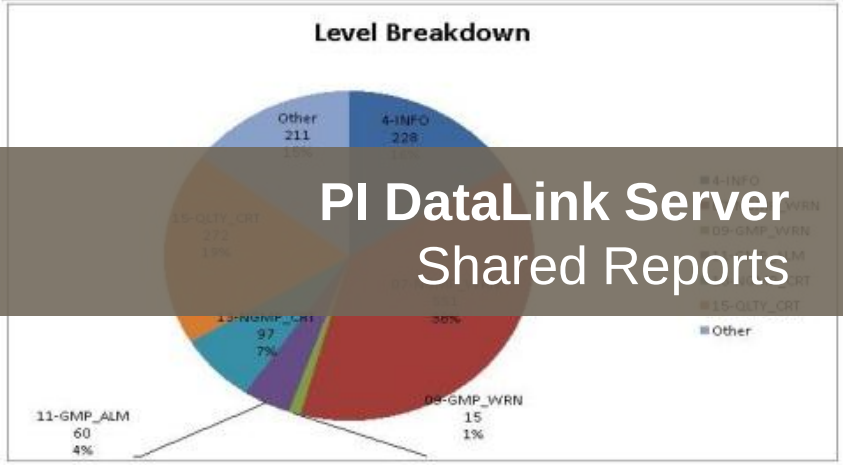
Excel Web Access - BioPharma Factory 1 Alarm Events

Open | Update | Find

Unit: BioPharma\Factory 1\All Factory 1 Units\TA002 Start Time: 2010-02-03T00:00:00 # Values: 1434

Tag: BioPharma:TA002.AE.All End Time: 2010-02-04T00:00:00





PI DataLink Server
Shared Reports

When There's No Such Thing as Too Much Information

Net Gain – Output and Productivity 5 % to 6 % higher in DDD (Data Driven Decision Making)

Reference: Brynjolfsson, et al., MIT, How does Data-Driven Decision making Affect Firm Performance, 2011.
http://www.nytimes.com/2011/04/24/business/24unboxed.html

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