OSIsoft.

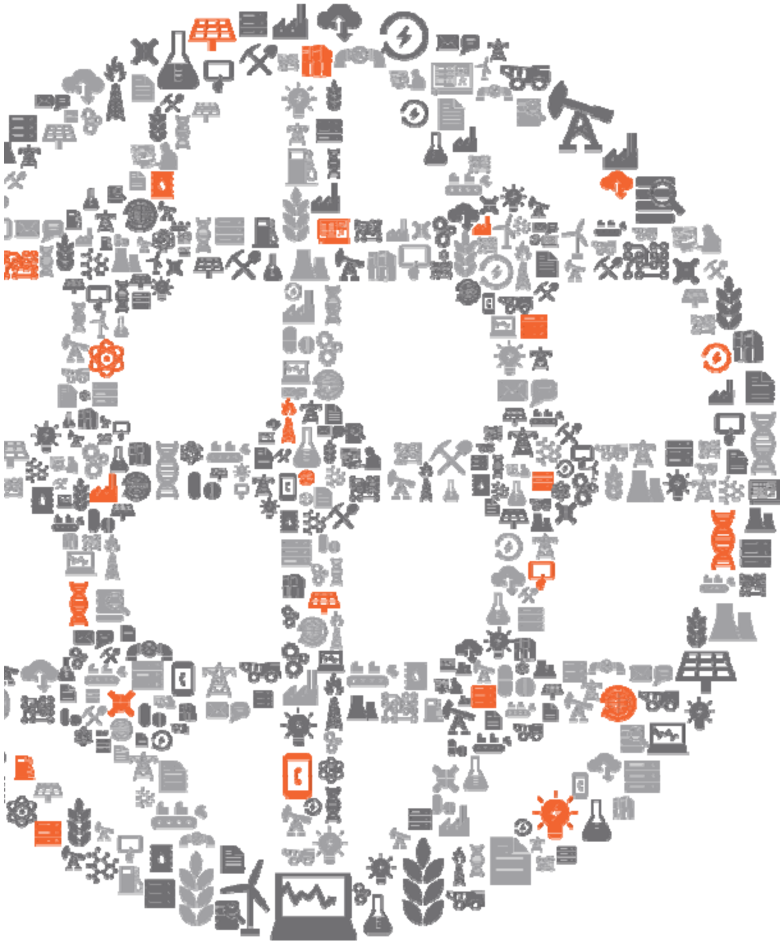
REGIONAL SEMINARS

The Power of Data

THRIVING IN A WORLD OF CHANGE

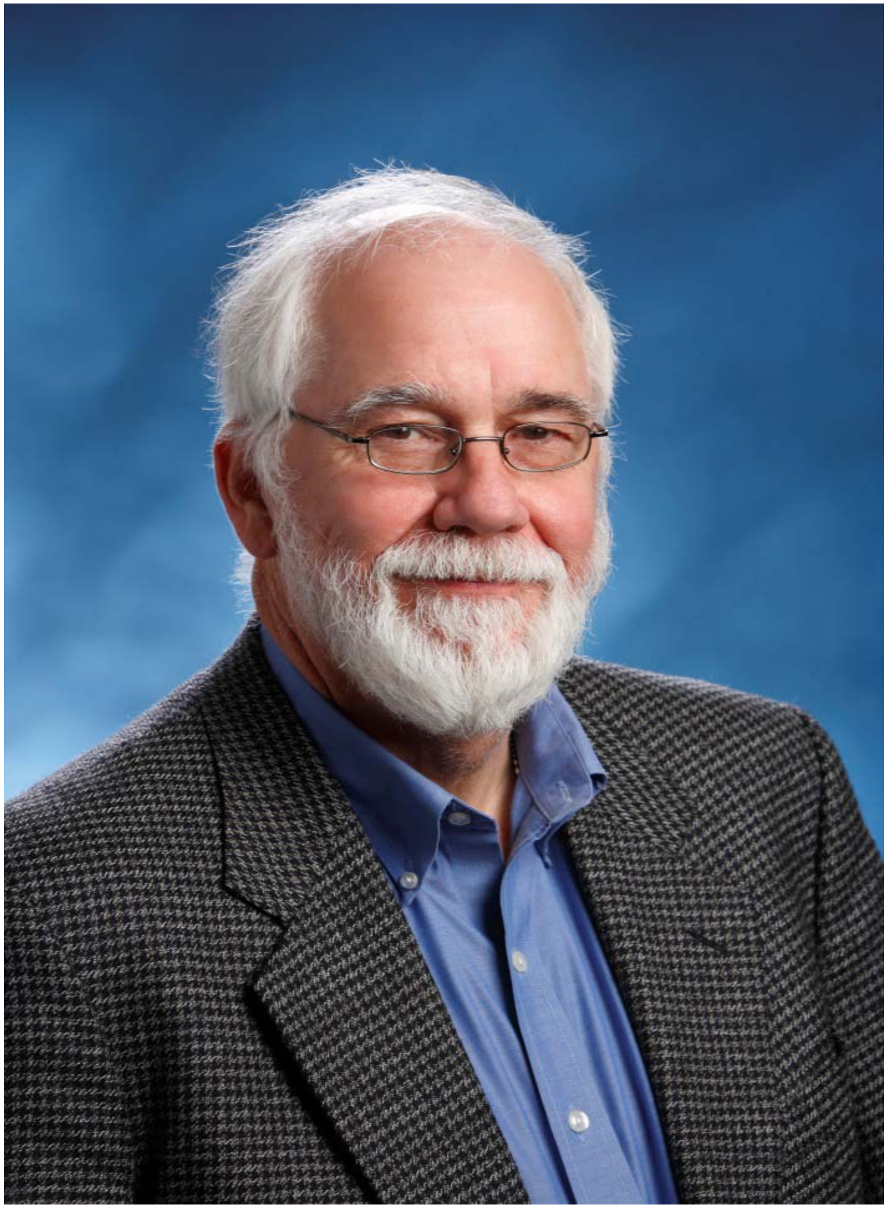
I N D I A

August 22 - 23, 2013
Mumbai, India



Power Generation Key Takeaways from UC 2013

Presented by **Chris Crosby**
Power Generation Industry Principal
22nd August, 2013

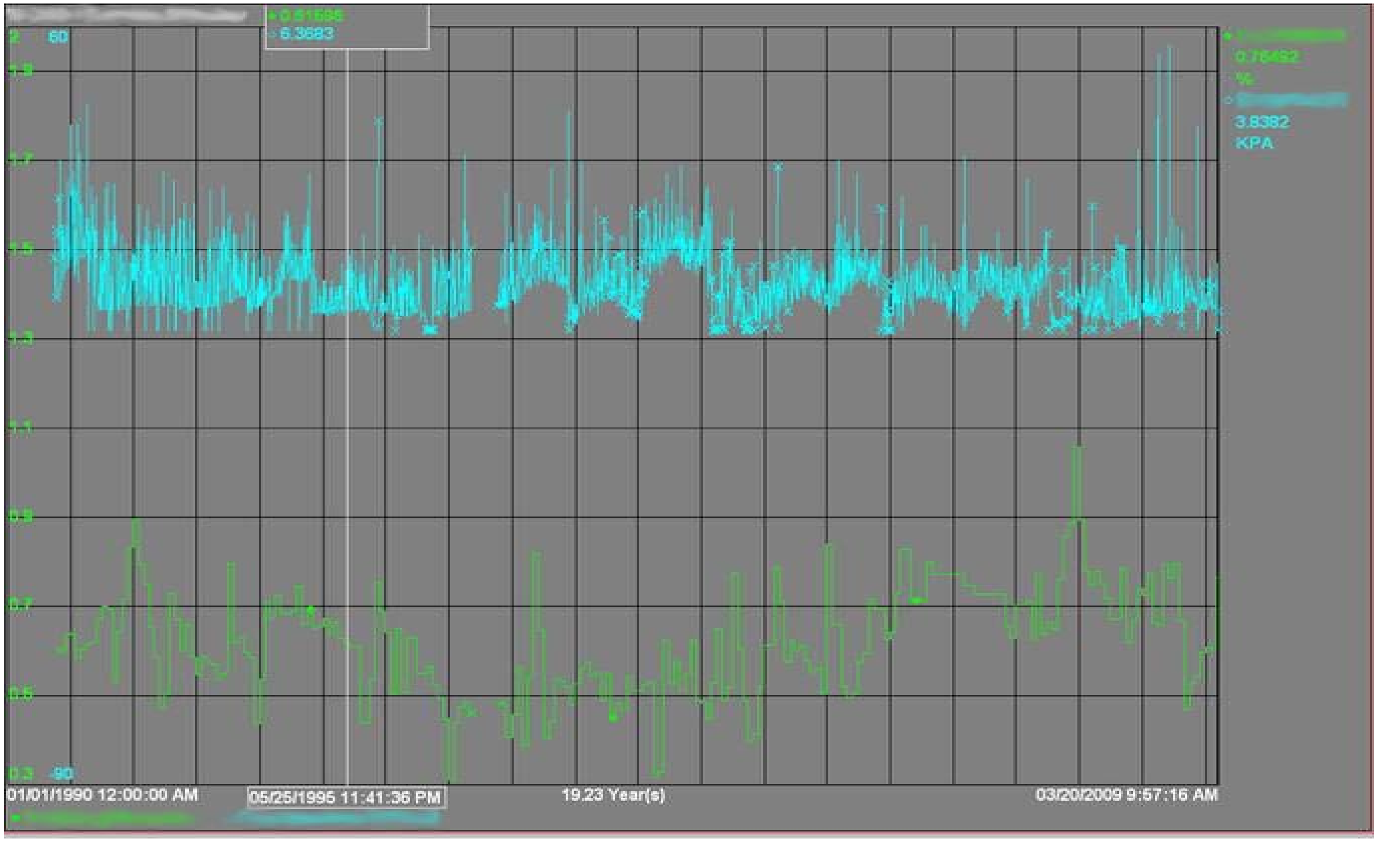


“Our mission is to maximize the VALUE our customers get from our product and services.”
Dr. Patrick Kennedy

“OSIsoft and the PI System exist to make you smarter, enabling better decisions.”

Interesting Statistics…Customer 104, Abitibi Paper: 19 years of continuous data; tag history preserved through 4 control systems and 8 operating systems

"Ninety four of OSIsoft's first one hundred customers that are still in business today are still using PI."



"17 of the first 20 installations of PI software in manufacturing facilities are still current on support and running today!"

"Through all of the 33+ years of technology change, customers who purchased PI have been able to keep all of their PI Archive data through HP, VMS, UNIX, NT and Windows 8 – and soon cloud. Not once have they had to repurchase the software that housed their data and not once have they lost data due to system changes that did not include a seamless migration forward."

Chris Crosby
Power Generation Industry Principal

- Humanitarian
- Energy Scientist
- Technologist

The Humanitarian View

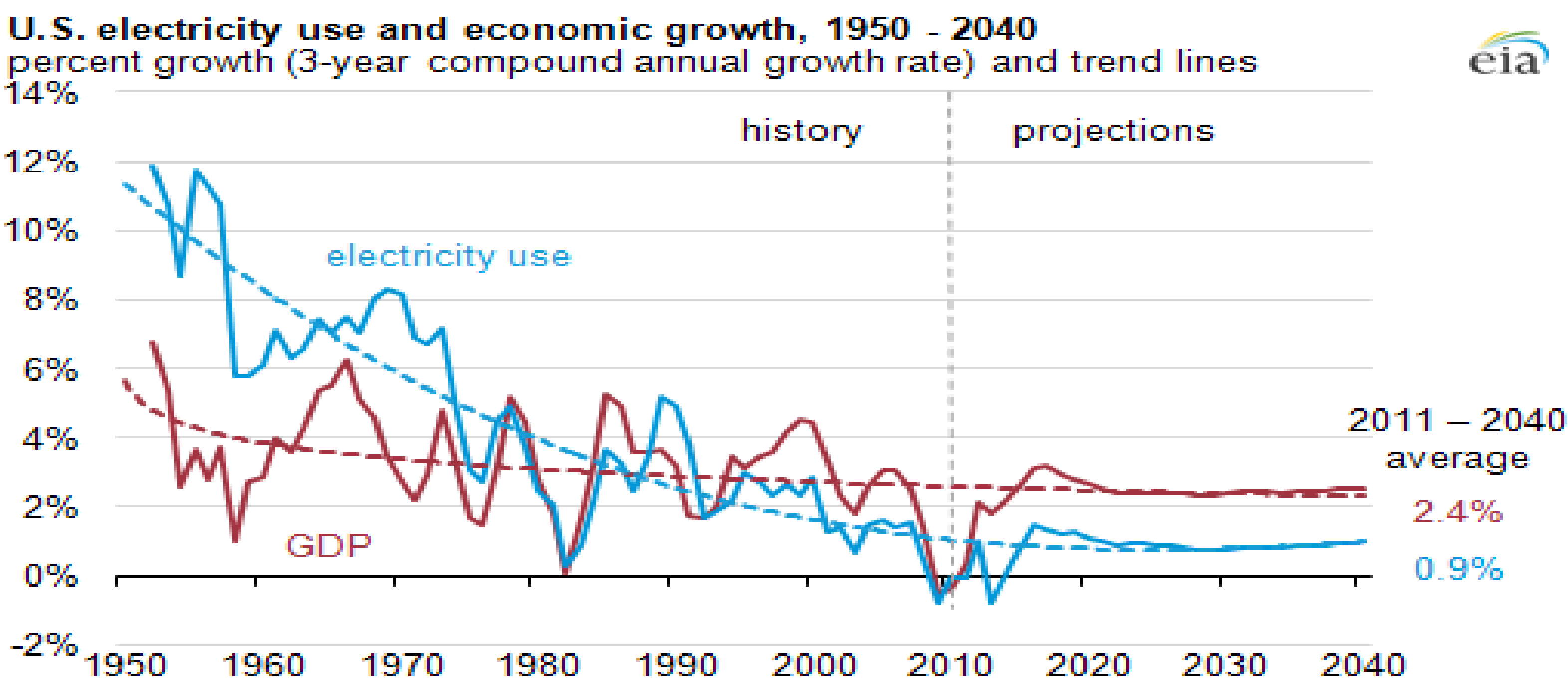
"*Household electricity consumption is widely viewed and accepted as providing substantial standard of living (quality of life) gains.*

by

Roselyne Joyeux and Ronald D. Ripple in *The Evaluation of Standard of Living and the Role of Household Electricity Consumption*

The Economic View

“A country's economy and its energy use, particularly electricity use, are linked. Short-term changes in electricity use are often positively correlated with changes in economic output (measured by gross domestic product (GDP)).” US Energy Information Agency



Nuclear Power - The Safety View

"*We need to work together--both domestically and internationally--to reduce the potential for another accident…I believe industry should consider international cooperation and essential component of ensuring nuclear safety*."

by

Allison Macfarlane, NRC Chairman

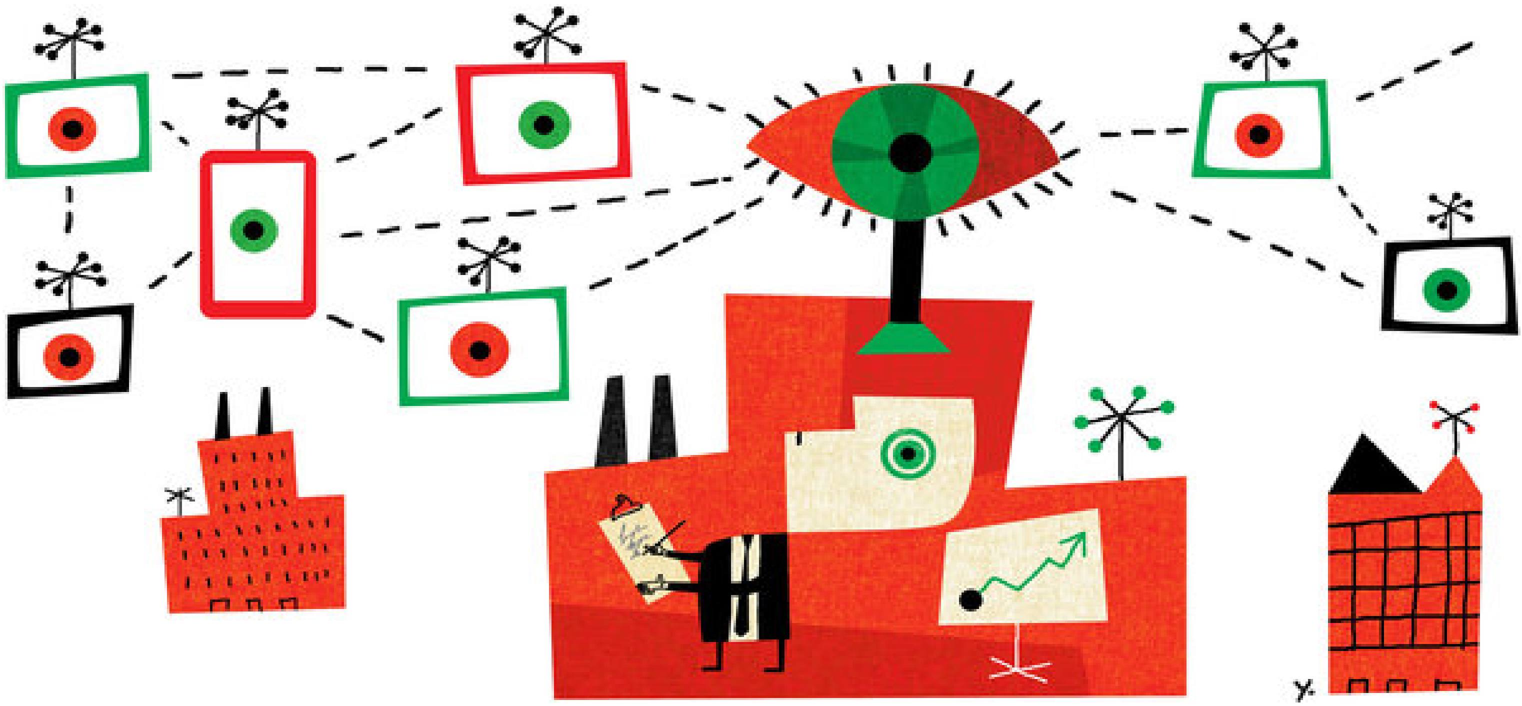
Why Should You Care?

"In this background, people who have decades of experience in project execution and technology experts who can increase the efficiency of the plants to deliver the highest (utilization)…are in high demand for the key positions."

- Essar Power is expanding its capacity…
- Monnet Power Company commissioning 535MW power plant next month…
- Jindal Power Ltd. is strengthening its team to support its expansion…

Reghu Balakrishnan, *Business Standard*, 21st August

No Such Thing as Too Much Information



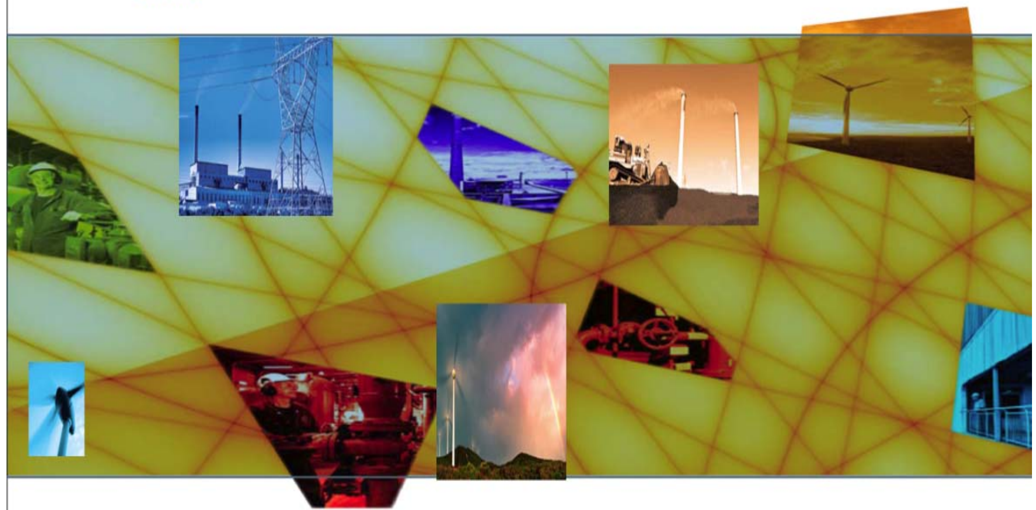
"Data Driven Decision Making Results in a Net Gain of 5 to 6 % on Output and Productivity."

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

OSIsoft PI System: A Vessel for Change in Verve Energy

Francois Mevis, Verve Energy

verve ENERGY



OSIsoft PI System

A Vessel for Change in Verve Energy

Wednesday, 17 April 2013

Contents

- Context
  - •Company
  - •Plant Operational Information Programme
- Programme set up
- Technology implementation
- Business transformation
  - •Organising business transformation
  - •Benefits realisation
- Observations
- Questions and feedback

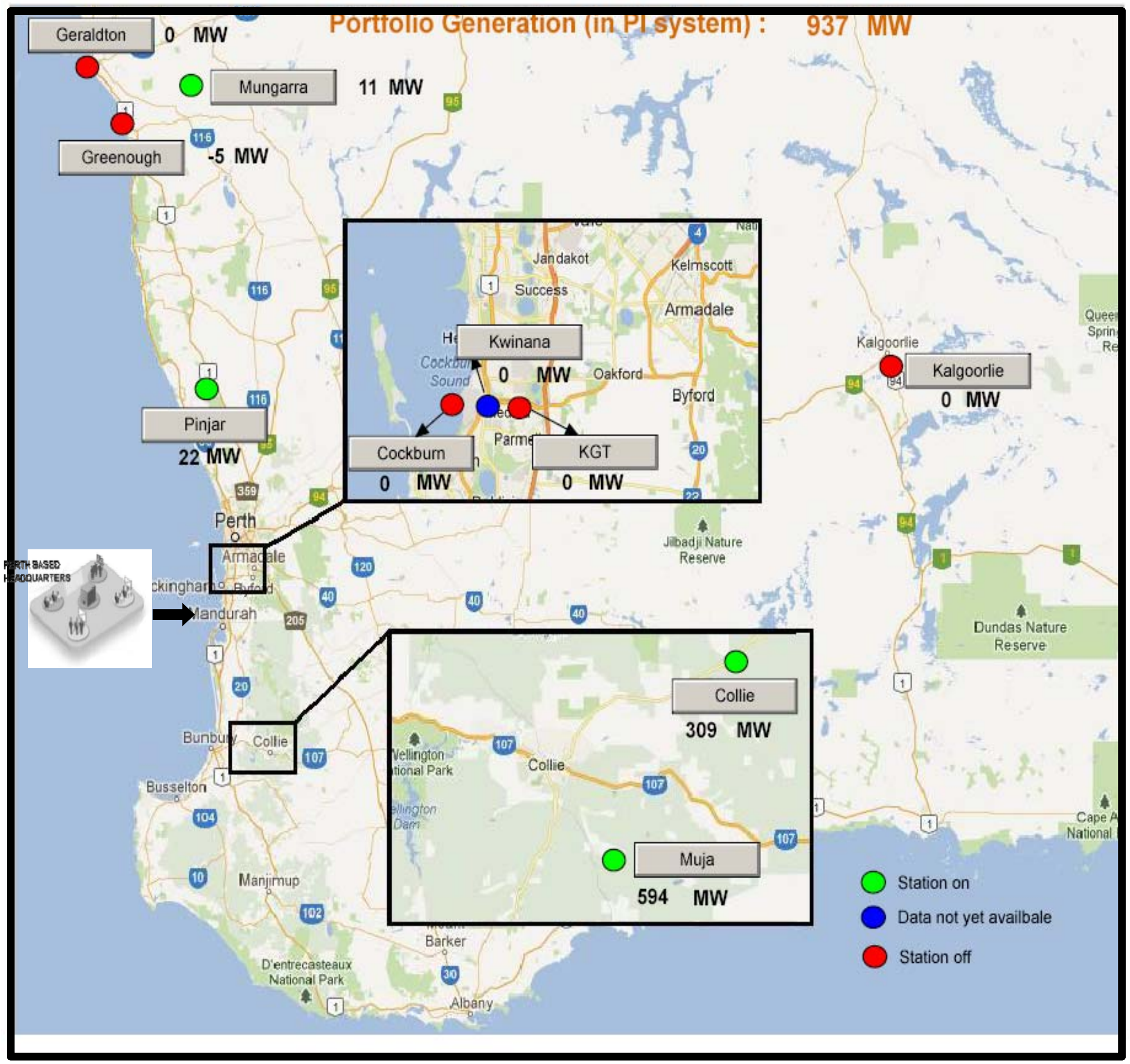
Verve Energy - Organisation

State owned power generator in Western Australia

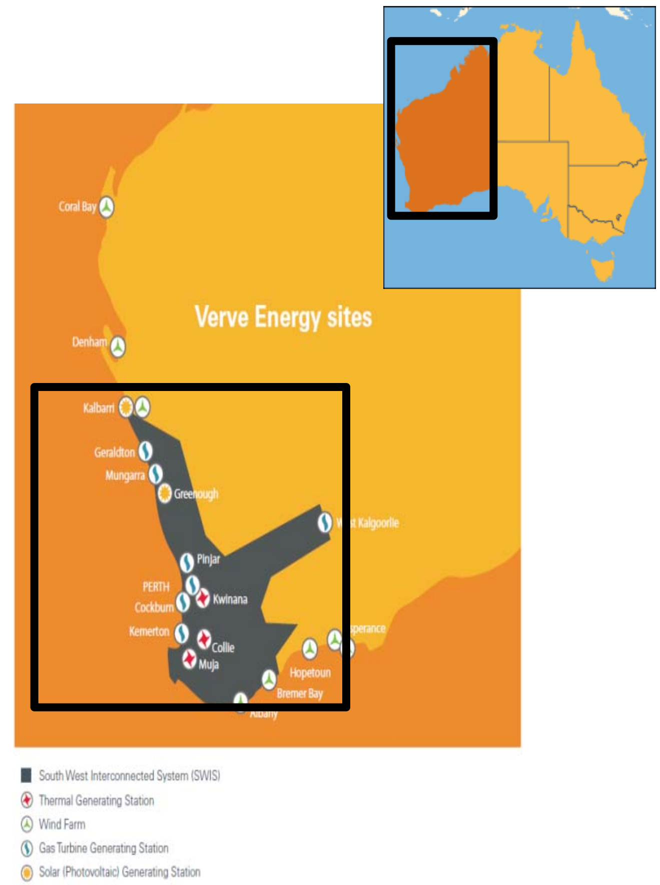
- Current company structure established in 2006 after disaggregation of Western Power
- Approximately 620 staff
- 5 major power station and 20 minor, unmanned sites
- Historically site and location focused

- Nameplate generation capacity is over 3000 MW
- Supply approximately 55% of energy in Western Australia,
- Fuel is predominantly coal and gas, with smaller contributions from oil, wind and solar

Verve Energy Portfolio



- 12 Coal fired units
- 18 Gas Turbines
- Wind farms, Wind-diesel units
- Solar farm



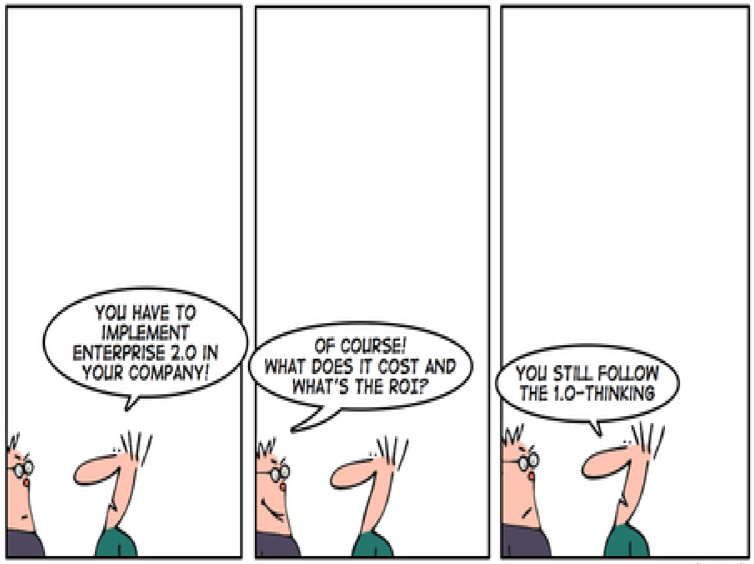
Context - Programme

- What is the problem?
  - Data only accessible on site through different software products
  - No integration and no overview over sites
  - No easy sharing or implementation of solutions
  - Aging workforce - key people will be retiring in next 2 years
  - Demand is becoming more challenging; more mid-merid and peak generation

- What is the purpose?
  - Increase visibility and usability of all operational data through standard toolsets
  - “Stop smart people doing stupid work”

Business Case

- Programme justification
  - Increase fuel efficiency
  - Optimise asset use and maintenance regimes
  - Optimise generation unit dispatch stack
  - Record existing operational knowledge and increase accessibility



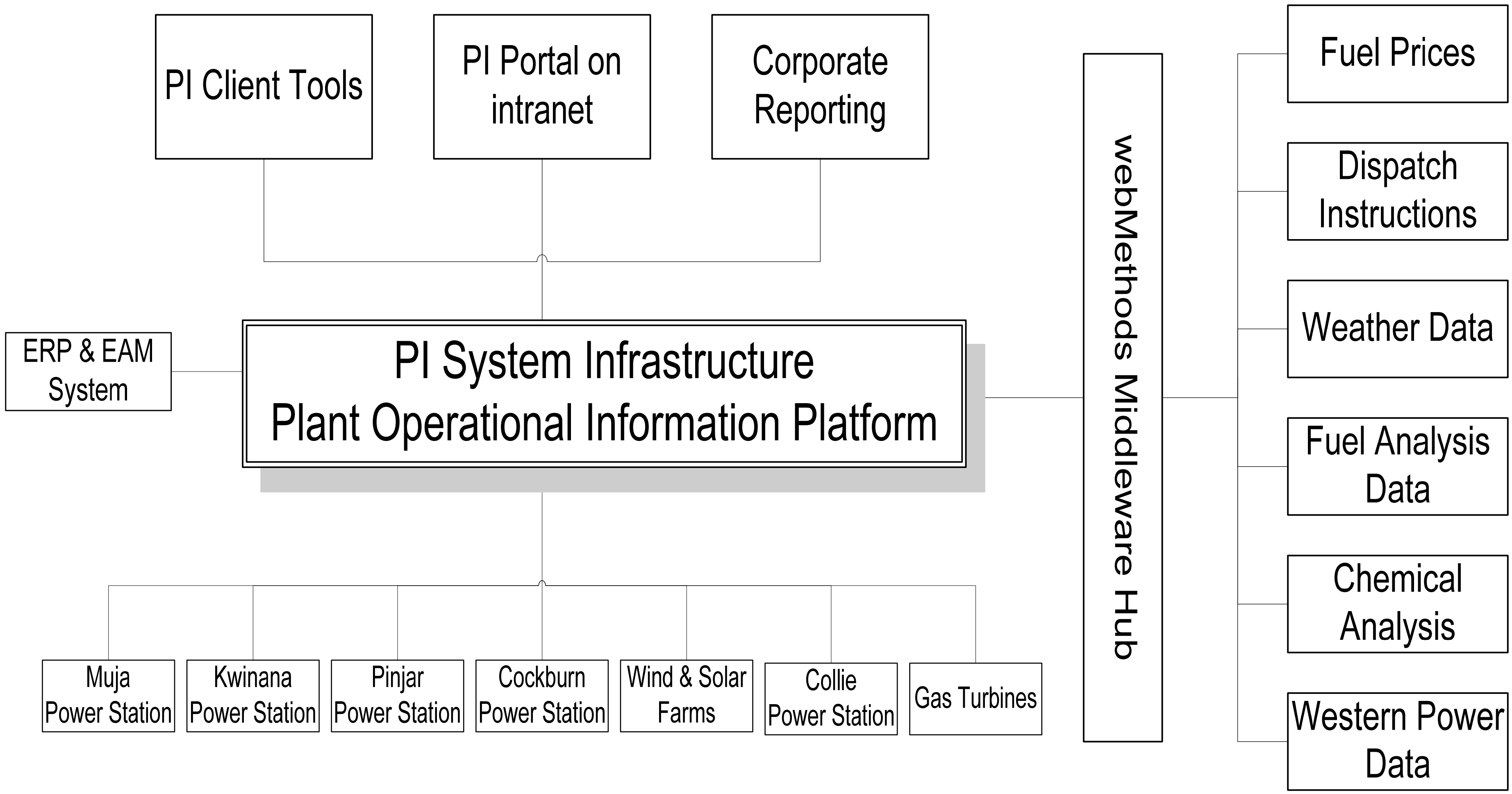
THE CONSULTANTS HANDBOOK PART 7:
SHOW YOUR CUSTOMER THAT YOU ARE THE SMART GUY

- Approach
  - Establish a central information platform for storing and analysis of operational data
  - Establish a 'vessel' for business transformation and benefits realisation

Business Case – 12 months later

Bu

Technology Implementation



Business Transformation

Organising Business Transformation

- Guiding principal:
  "This is foremost a transformational programme, not a technology implementation"

  ➢ "All about the people"

- Target both hierarchical and functional leaders
  - General Managers
  - Chief Engineer, Principal & Senior Engineers
  - "Informal leaders"

Business Transformation

Organising Business Transformation

- Approach to functional leaders
  - Engaged at the start of the programme
  - Trained in use of the system (PI System Visualisation course)

- Establish ‘Key User Group'
  - Monthly formal meetings
  - Chief Engineer, Principal Engineers, and 'Informal leaders' from Finance, Trading & Fuel and Bus Development BU's
  - Align implementation to business requirements
  - Leading in definition of the system, data and user governance framework; and user support structure
  - Identify opportunities for benefits and actively pursue realisation
  - Identify opportunities to re-use solutions in other locations or BU's
  - Ambassadors in the organisation for the programme and the PI system

Business Transformation - KUG

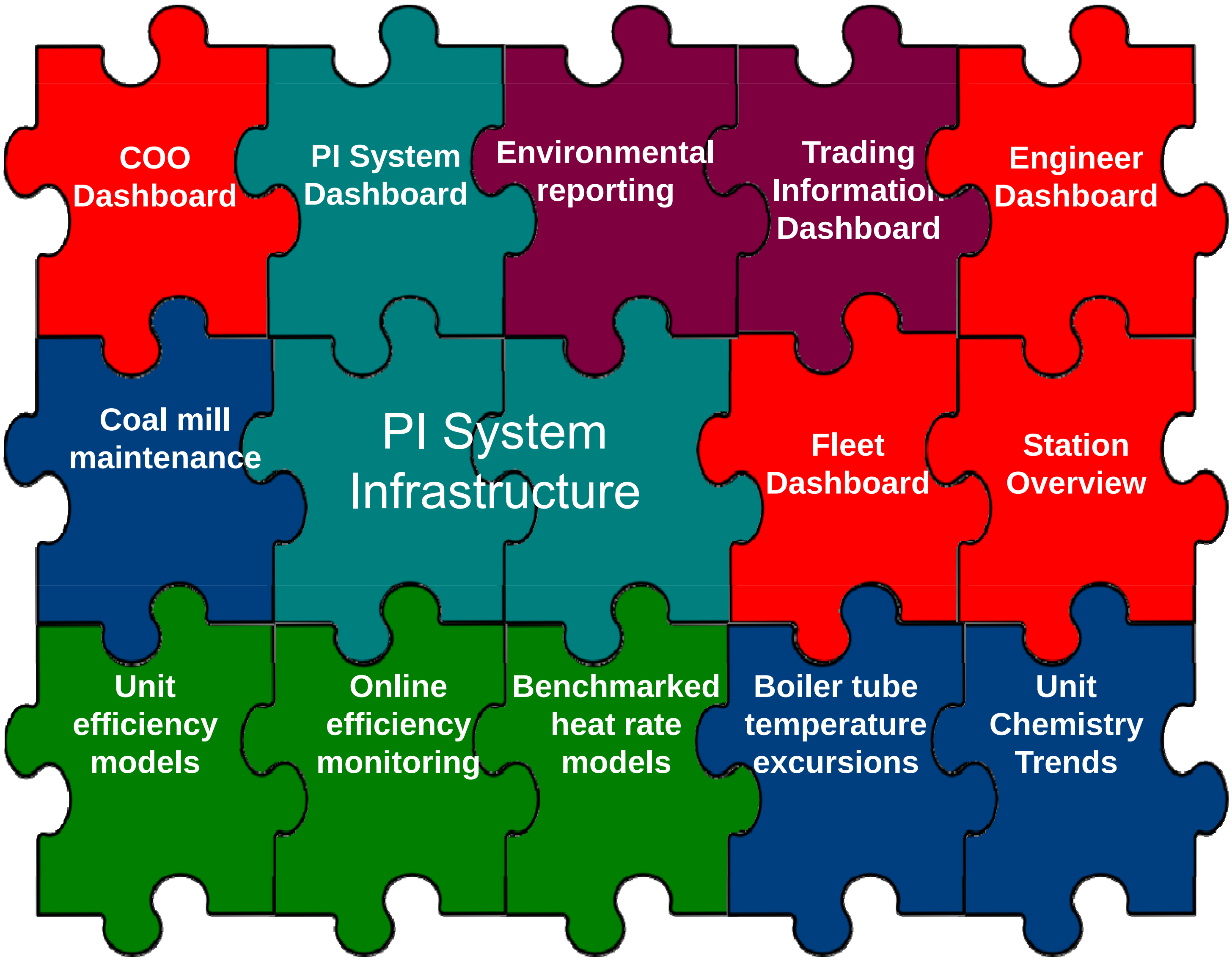
Results Key User Group engagement

- 'Rules of Use' are understood and mandated
  - Data and System Governance document is kept alive
  - Governance roles & responsibilities are described in a RACI matrix
- Initiatives are appearing in multiple parts of the organisation
- Sense of ownership regarding the project and the systems
- Fit for use data organisation
  - Asset hierarchy vs Process hierarchy in PI Asset Framework
  - Use of smart tools to allow quick build and change, eg Optimate's AF mapping tool
- Critical mass of knowledgeable stake holders
  - The Key User group exists of 17 permanent members
  - Currently 70 people have been trained spread over all relevant business units and locations

Business Transformation - Benefits

- Define responsibility and create interest
  - Realisation of benefits is embedded in KPI's
  - Benefits have 'owners'; the programme structure enables and monitors progress
- Enable and support – 'make it easy'
  - Periodic user training
  - Functional support staff ('super users') are located on all sites
  - Existing contractual arrangements with consultancy companies that specialise in the PI System
- Create a process for identifying, starting and tracking of initiatives
  - All initiatives are tracked against a benefits realisation dashboard
  - Programme funds approved initiatives

Business Transformation - Benefits



Capability Development

PI System Infrastructure & data feeds

Integration with Intranet, create awareness

Explore expert systems:

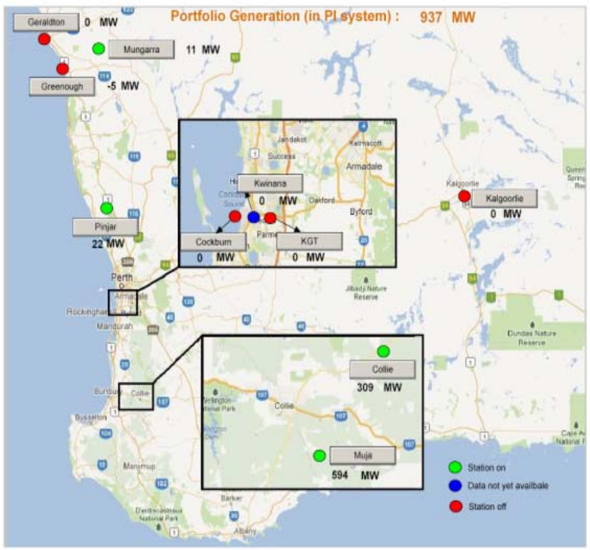
- Performance Optimisation
- Asset use optimisation, predictive monitoring

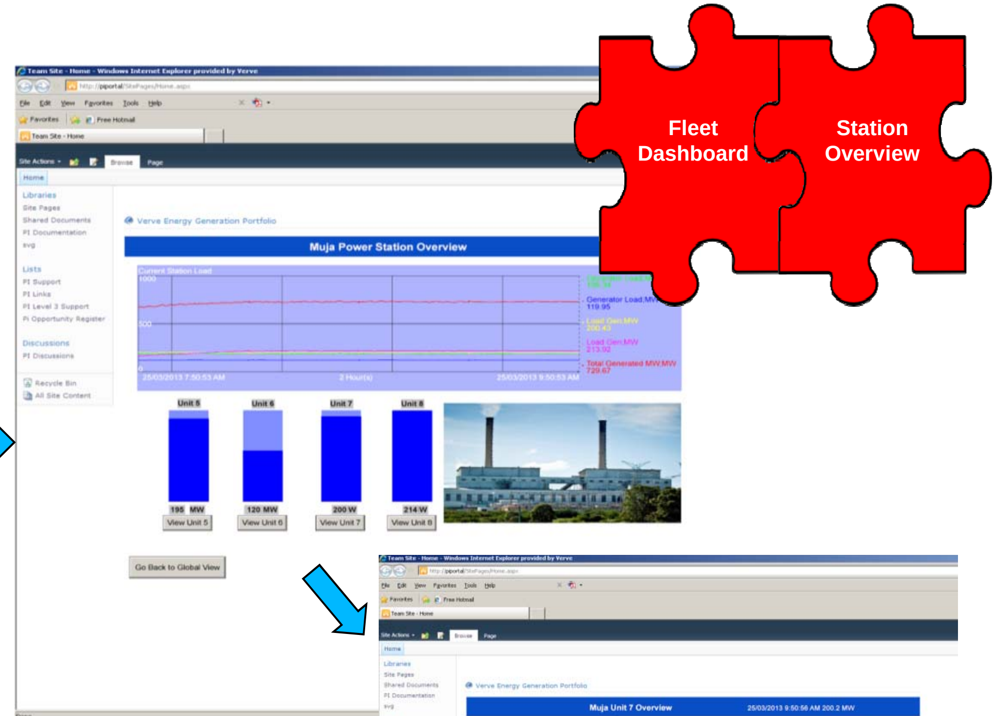
Relate other data sources:

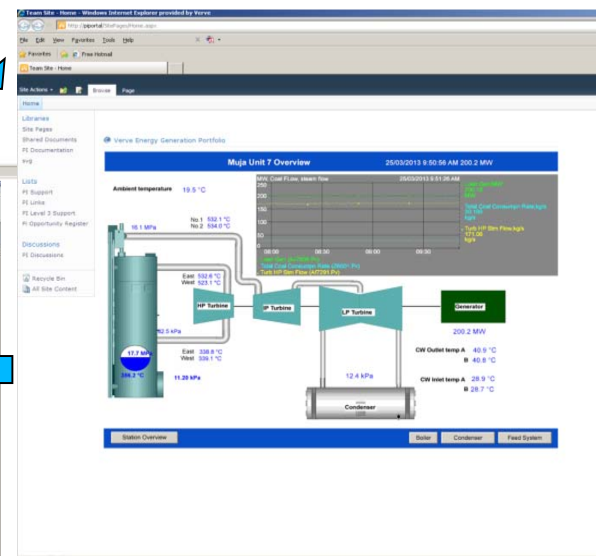
- Advanced analysis & process tuning

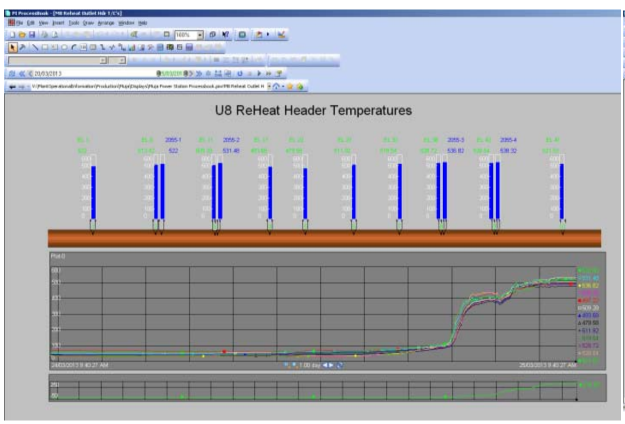
Examples – General Dashboard

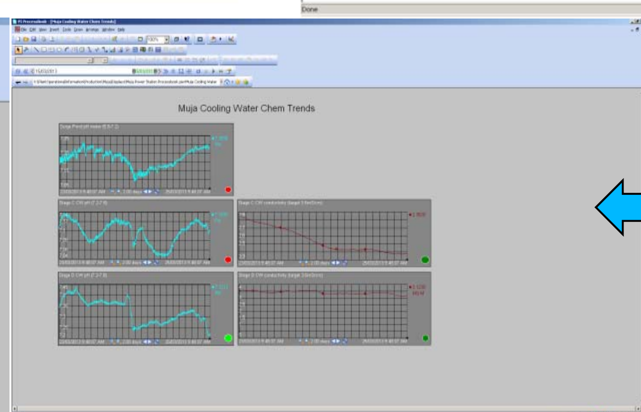
Map overview > Site > Unit > Detail





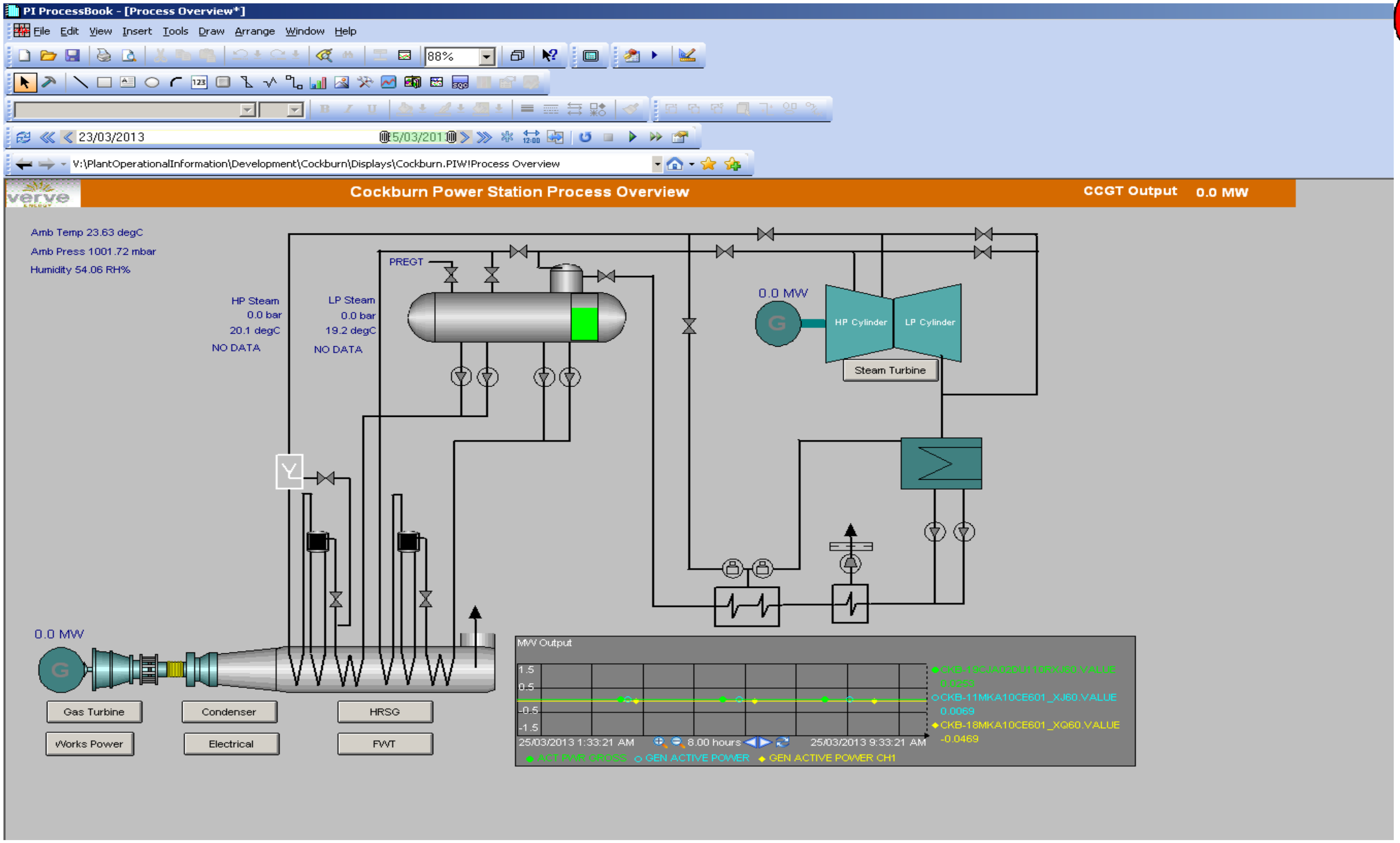


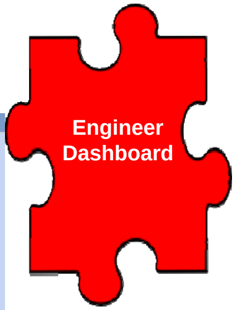




Examples - Role Based Views

Station Overview Cockburn





Examples - Role Based Views

Boiler Tubes over Nameplate Temperature

Boiler tube temperature excursions

Microsoft Excel - U7 Final Stage RH HDR Temps

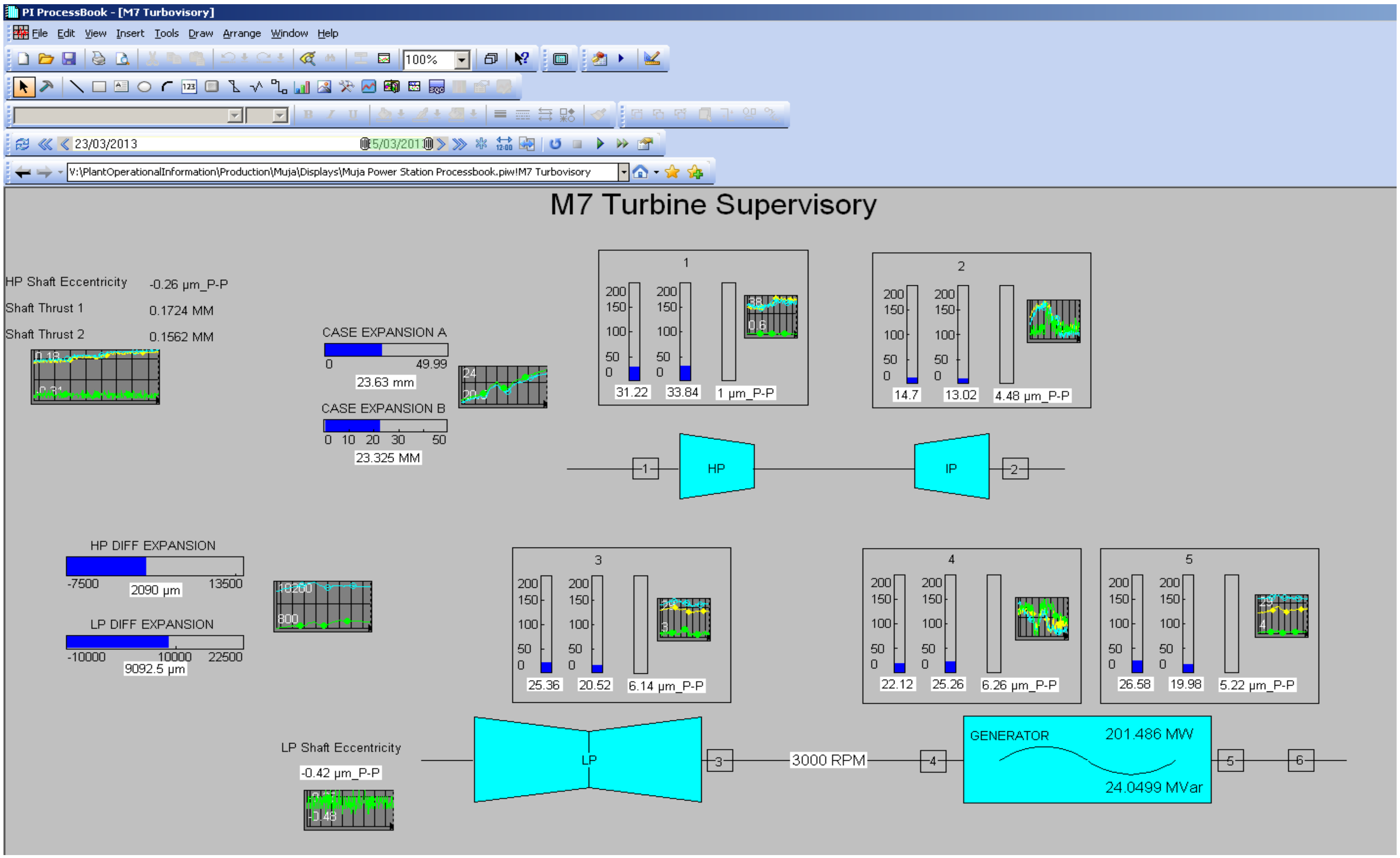
U7 Final Stage R/H Header Temperatures

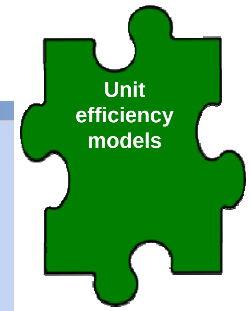
Start Time	1/05/2012
End Time	30/06/2012

Stub T/C's	Maximum Date/Time	Maximum Value	Minutes > 560degC
MPS-7-RHS-TE-2055-1-XQ01	21-May-12 12:14:07	581.94	42.60
MPS-7-RHS-TE-2055-2-XQ01	19-May-12 05:09:55	581.88	849.57
MPS-7-RHS-TE-2055-3-XQ01	11-Jun-12 08:23:11	584.70	1045.75
MPS-7-RHS-TE-2055-4-XQ01	[-11059] No Good Data F	[-11059] No Good Da	0.00
Header T/C's			
MPS-7-RHS-TE-3103-1-XQ01	07-Jun-12 07:24:20	543.96	0.00
MPS-7-RHS-TE-3103-11-XQ01	07-Jun-12 07:24:23	576.42	26.10
MPS-7-RHS-TE-3103-17-XQ01	07-Jun-12 07:22:39	574.20	31.67
MPS-7-RHS-TE-3103-22-XQ01	19-May-12 05:10:06	563.64	27.33
MPS-7-RHS-TE-3103-27-XQ01	19-May-12 05:10:23	574.50	89.72
MPS-7-RHS-TE-3103-32-XQ01	07-Jun-12 07:24:09	577.38	60.40
MPS-7-RHS-TE-3103-38-XQ01	07-Jun-12 07:21:55	577.80	27.97
MPS-7-RHS-TE-3103-42-XQ01	10-Jun-12 11:05:41	552.60	0.00
MPS-7-RHS-TE-3103-47-XQ01	03-May-12 03:44:29	491.94	0.00
MPS-7-RHS-TE-3103-6-XQ01	07-Jun-12 07:24:41	580.68	58.78

Examples - Role Based Views

Generating Unit Supervisory Display

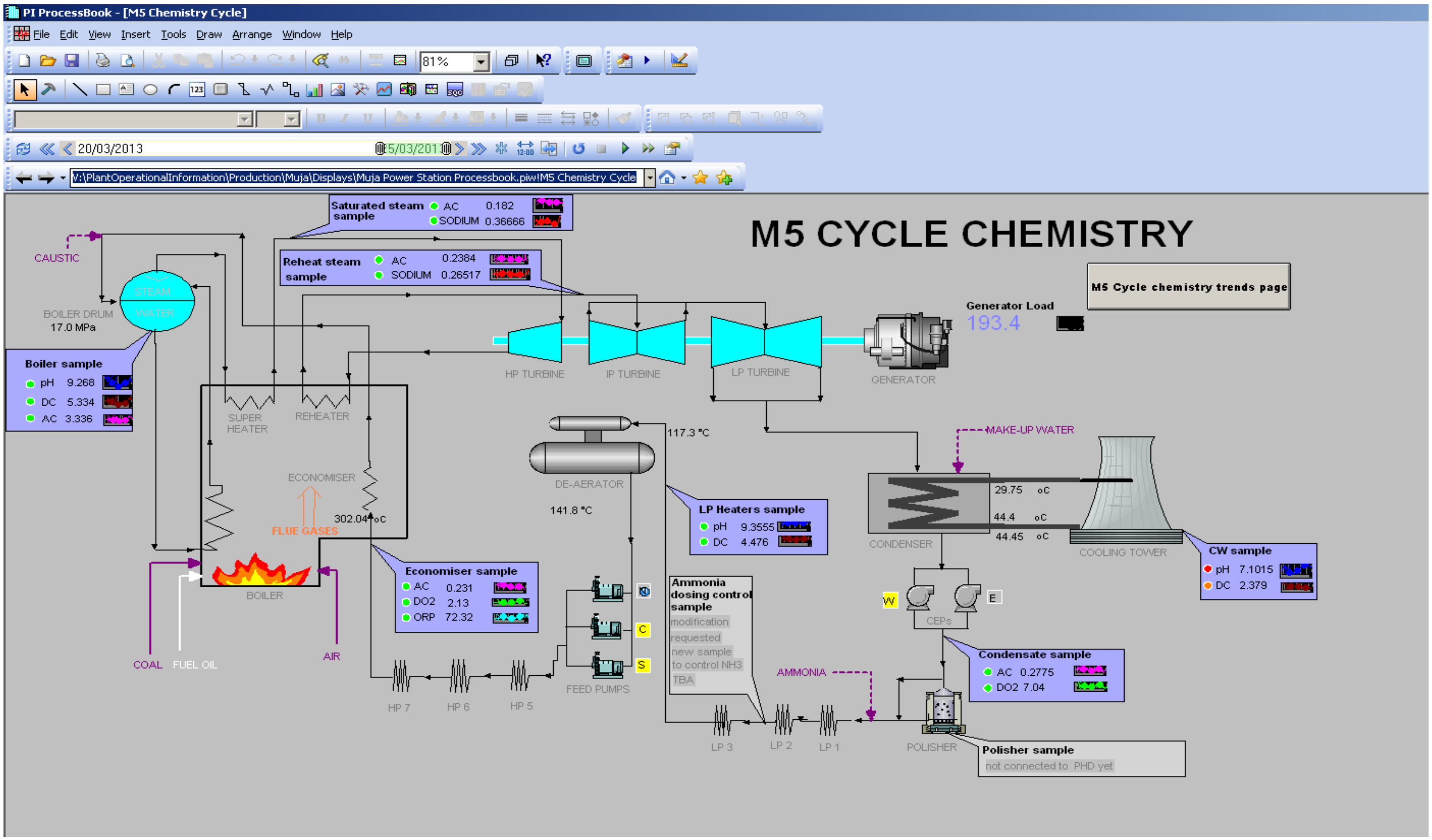




Examples - Role Based Views

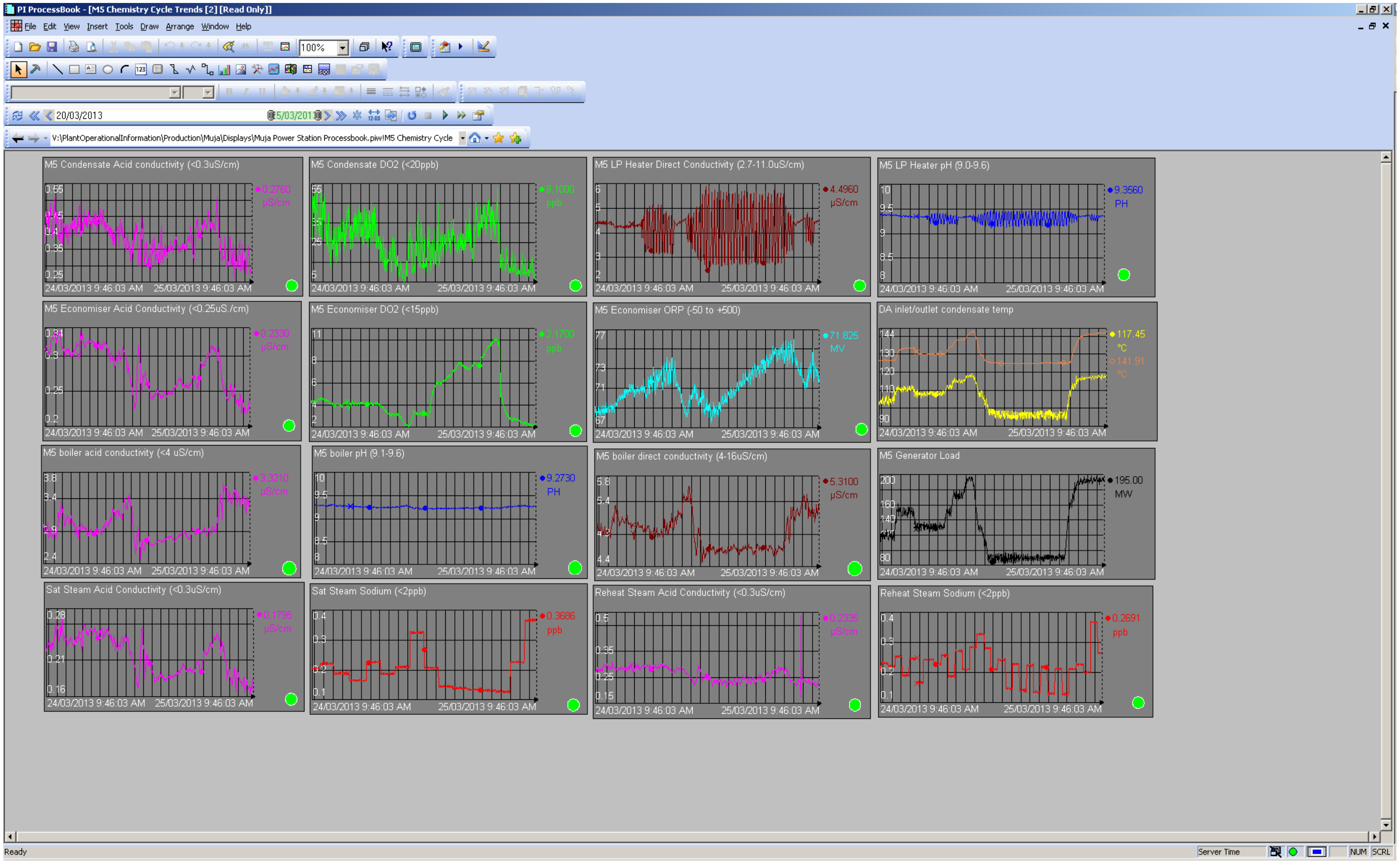
Cycle Chemistry for Muja Unit 5

Unit Chemistry Trends



Examples - Role Based Views

Cycle Chemistry Trends Muja Unit 5



Benefits – Bottom Line

- Substantial part of fuel savings target is underway in less than 12 months – and we are just scratching the surface
- We can see additional value within reach in predictive analysis to improve maintenance and other initiatives
- The intent is not to limit our scope of activities to just one or two projects
- We are having some C-level discussions about the need to support over 10+ initiatives in business improvement running in parallel
  - In January we had 1 benefits realisation initiative that was well defined and economically sound
  - In March we have 22!

Observations

Technology implementation, if adequate preparation is done, is not a major issue -- business transformation is the hard part

- The basis of data management has to be in place
  - Ownership of data
  - Change management in data feeds
  - Naming conventions, hierarchy structures
  - Establish a 'publish' process for reports, PI ProcessBook displays, web pages
- Training is key
  - Classroom training (baseline)
  - Advanced 'training' (value add)
- Allow for a learning curve
  - Allow experiments (and accept occasional rework); avoid "analysis – paralysis"
  - Facilitate exchange of ideas and solutions, both inside as with the external user community

Observations

Formalise and facilitate benefits realisation:

- Make it important
- Make it easy
- Make it visible

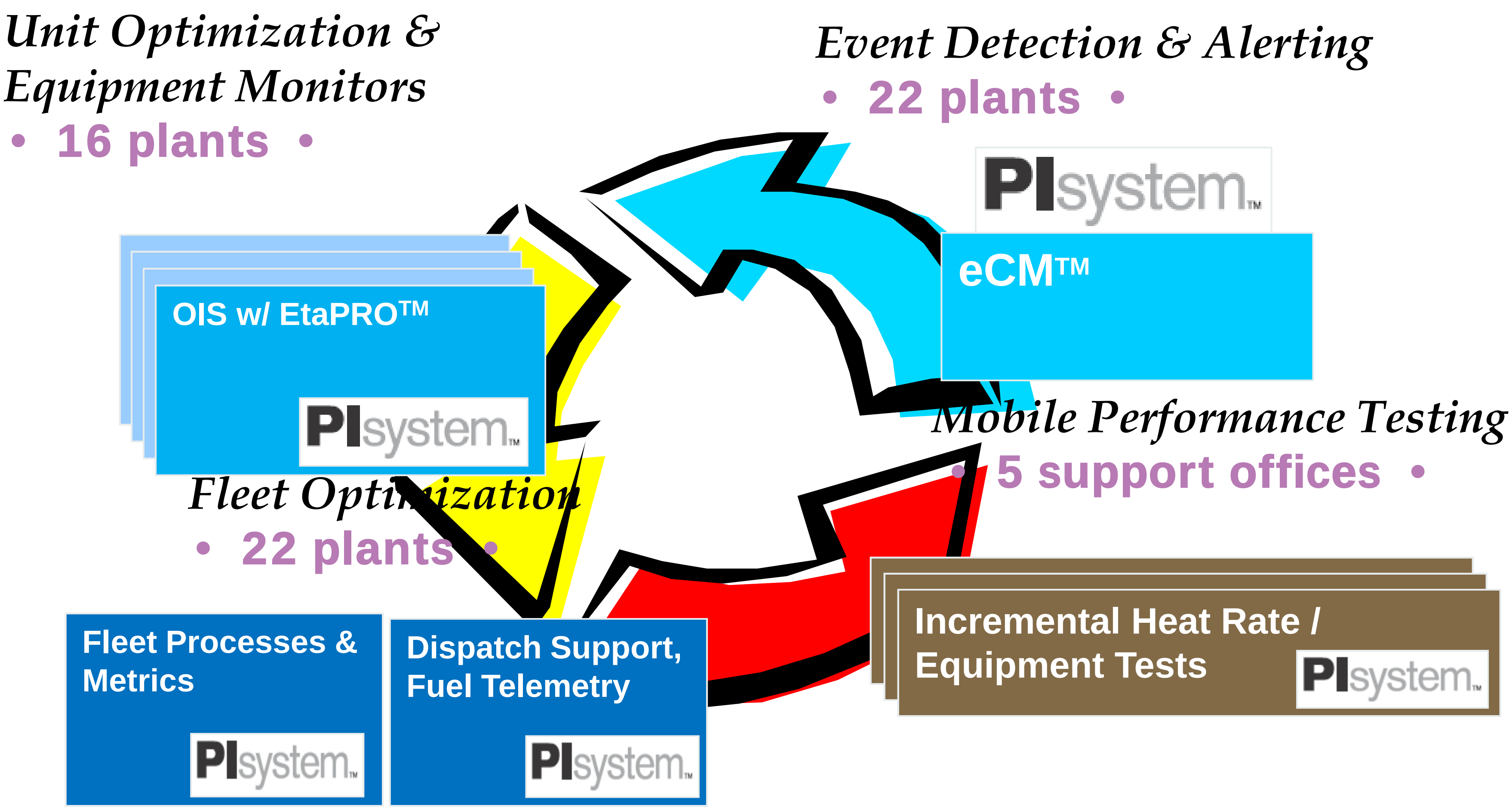
Power Plant Startup Monitoring and Optimization

Presented by **Steve Winsett, Entergy OIS Program Manager**

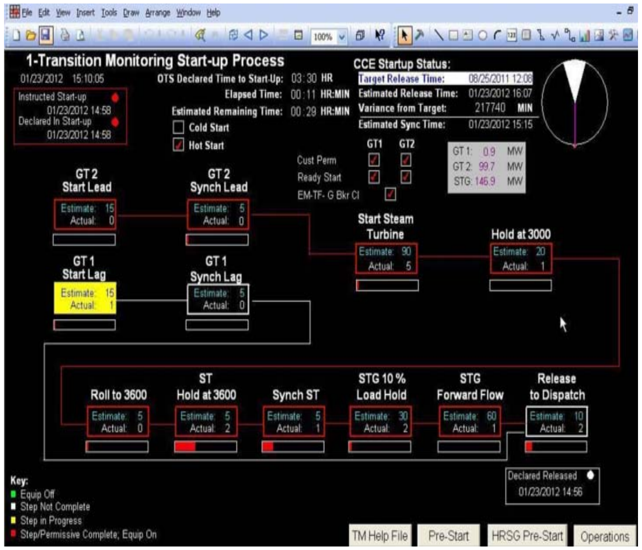
Entergy
THE POWER OF PEOPLE®

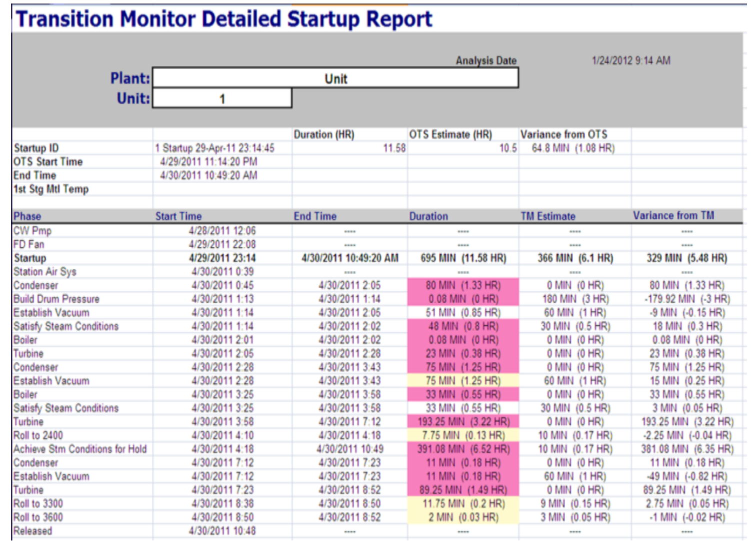
Entergy’s PI Solutions

• • • • • • • • Plant Real-time Monitoring & Diagnostics • • • • • • • •



Power Plant Startup Monitoring and Optimization





Transition Monitor Detailed Startup Report

			Analysis Date	1/24/2012 9:14 AM
Plant:	Unit			
Unit:	1			

		Duration (HR)	OTS Estimate (HR)	Variance from OTS	
Startup ID	1 Startup 29-Apr-11 23:14:45	11.58	10.5	64.8 MIN (1.08 HR)	
OTS Start Time	4/29/2011 11:14:20 PM				
End Time	4/30/2011 10:49:20 AM				
1st Stg Mtl Temp					

Phase	Start Time	End Time	Duration	TM Estimate	Variance from TM
CW Pmp	4/28/2011 12:06	----	----	----	----
FD Fan	4/29/2011 22:08	----	----	----	----
Startup	**4/29/2011 23:14**	**4/30/2011 10:49:20 AM**	**695 MIN (11.58 HR)**	**366 MIN (6.1 HR)**	**329 MIN (5.48 HR)**
Station Air Sys	4/30/2011 0:39	----	----	----	----
Condenser	4/30/2011 0:45	4/30/2011 2:05	80 MIN (1.33 HR)	0 MIN (0 HR)	80 MIN (1.33 HR)
Build Drum Pressure	4/30/2011 1:13	4/30/2011 1:14	0.08 MIN (0 HR)	180 MIN (3 HR)	-179.92 MIN (-3 HR)
Establish Vacuum	4/30/2011 1:14	4/30/2011 2:05	51 MIN (0.85 HR)	60 MIN (1 HR)	-9 MIN (-0.15 HR)
Satisfy Steam Conditions	4/30/2011 1:14	4/30/2011 2:02	48 MIN (0.8 HR)	30 MIN (0.5 HR)	18 MIN (0.3 HR)
Boiler	4/30/2011 2:01	4/30/2011 2:02	0.08 MIN (0 HR)	0 MIN (0 HR)	0.08 MIN (0 HR)
Turbine	4/30/2011 2:05	4/30/2011 2:28	23 MIN (0.38 HR)	0 MIN (0 HR)	23 MIN (0.38 HR)
Condenser	4/30/2011 2:28	4/30/2011 3:43	75 MIN (1.25 HR)	0 MIN (0 HR)	75 MIN (1.25 HR)
Establish Vacuum	4/30/2011 2:28	4/30/2011 3:43	75 MIN (1.25 HR)	60 MIN (1 HR)	15 MIN (0.25 HR)
Boiler	4/30/2011 3:25	4/30/2011 3:58	33 MIN (0.55 HR)	0 MIN (0 HR)	33 MIN (0.55 HR)
Satisfy Steam Conditions	4/30/2011 3:25	4/30/2011 3:58	33 MIN (0.55 HR)	30 MIN (0.5 HR)	3 MIN (0.05 HR)
Turbine	4/30/2011 3:58	4/30/2011 7:12	193.25 MIN (3.22 HR)	0 MIN (0 HR)	193.25 MIN (3.22 HR)
Roll to 2400	4/30/2011 4:10	4/30/2011 4:18	7.75 MIN (0.13 HR)	10 MIN (0.17 HR)	-2.25 MIN (-0.04 HR)
Achieve Stm Conditions for Hold	4/30/2011 4:18	4/30/2011 10:49	391.08 MIN (6.52 HR)	10 MIN (0.17 HR)	381.08 MIN (6.35 HR)
Condenser	4/30/2011 7:12	4/30/2011 7:23	11 MIN (0.18 HR)	0 MIN (0 HR)	11 MIN (0.18 HR)
Establish Vacuum	4/30/2011 7:12	4/30/2011 7:23	11 MIN (0.18 HR)	60 MIN (1 HR)	-49 MIN (-0.82 HR)
Turbine	4/30/2011 7:23	4/30/2011 8:52	89.25 MIN (1.49 HR)	0 MIN (0 HR)	89.25 MIN (1.49 HR)
Roll to 3300	4/30/2011 8:38	4/30/2011 8:50	11.75 MIN (0.2 HR)	9 MIN (0.15 HR)	2.75 MIN (0.05 HR)
Roll to 3600	4/30/2011 8:50	4/30/2011 8:52	2 MIN (0.03 HR)	3 MIN (0.05 HR)	-1 MIN (-0.02 HR)
Released	4/30/2011 10:48	----	----	----	----

Business Challenges

- Startups for each unit were occasional and inconsistent
- Personnel can be shared plant-to-plant
- Aging workforce/new employees

Solution

- Implemented series of PI Processbook displays
- Using PI Batch, created Batches to track startups and times
- Developed reporting spreadsheet using the PI-SDK

Results

- Startups easier to track outside of plant
- More procedurally consistent startups
- Startup accuracy improved by roughly 95%

Power Plant Startup Monitoring and Optimization

PI ProcessBook & Performance Equations:

- Determine/display start-up progress
- Accumulate actual elapsed time
- Calculate "% complete"
- Track status of plant equipment & conditions

PI Batch:

- "Back-bone" of the start-up monitor
- Facilitates reporting

PI Manual Logger (Future):

- To capture water analysis from grab samples during start-up

PI-DataLink/PI-SDK:

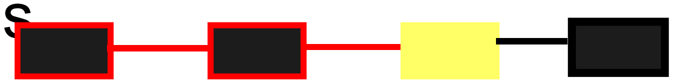
- Start-up Reports

Power Plant Startup Monitoring and Optimization

PI-Processbook

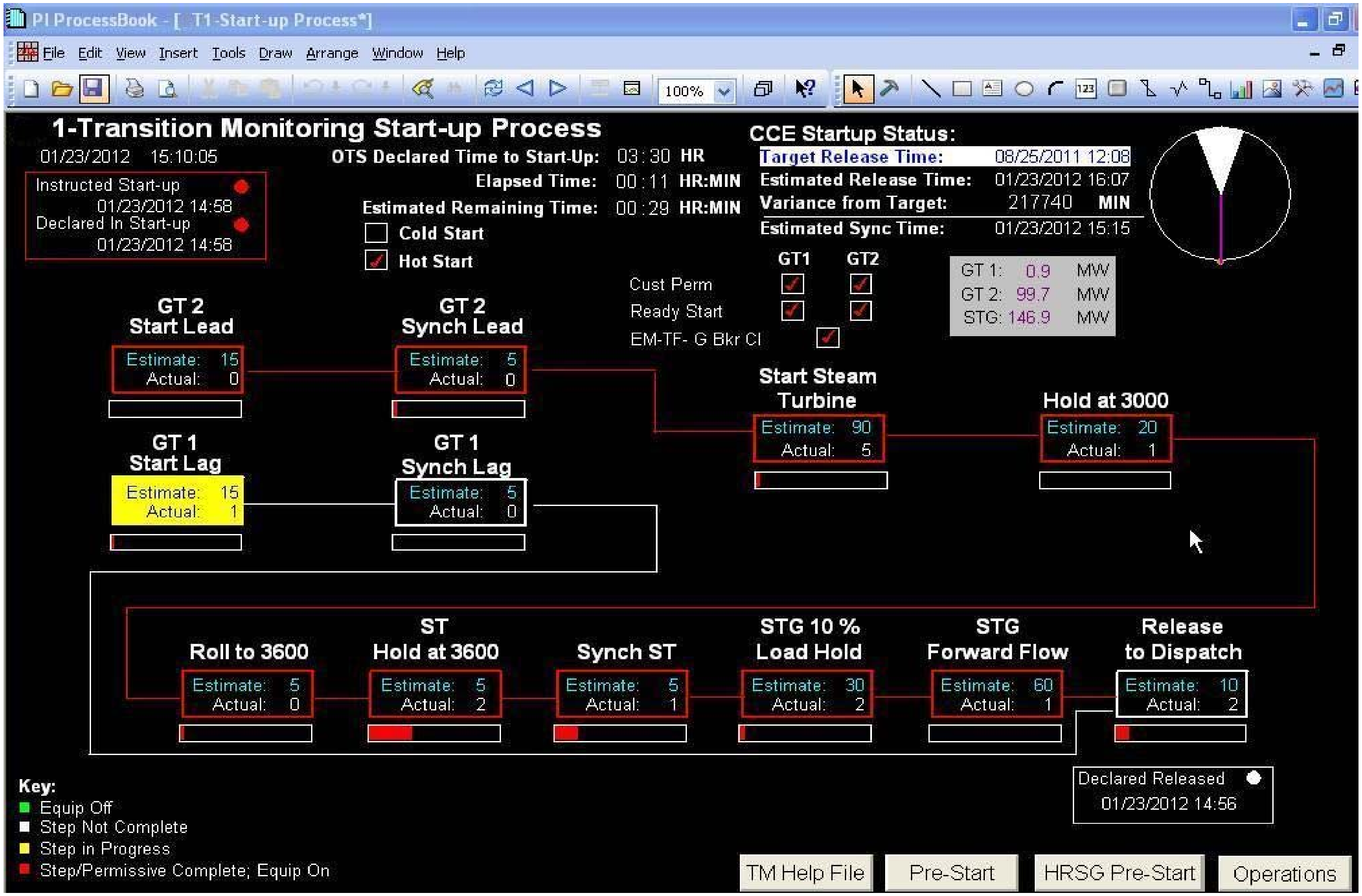
- Graphically illustrate the start-up process
- Track progress
  - Durations, milestones, “time remaining”

- Link to operating procedures

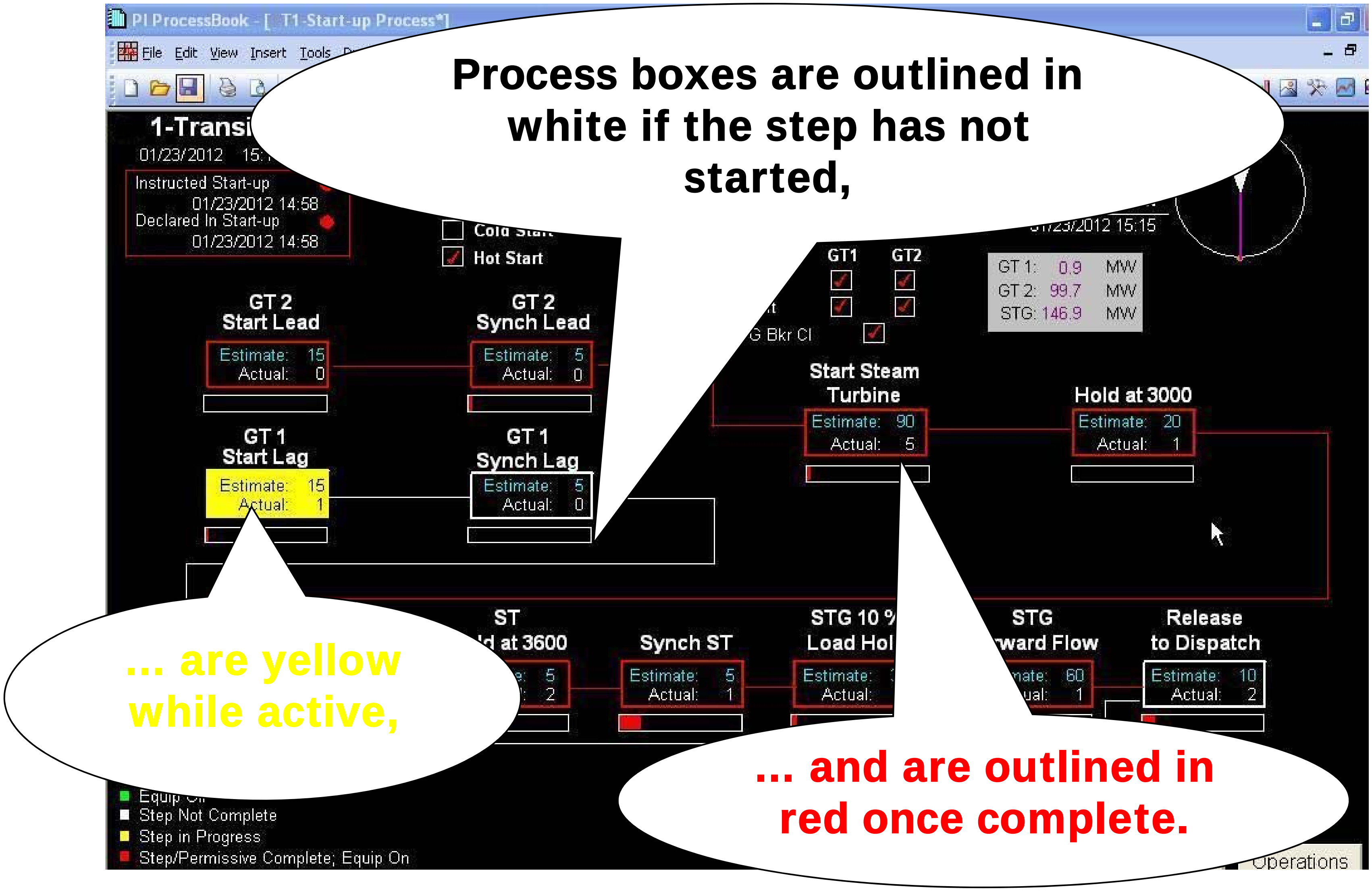


- Display key process data
- “Replay” startups for process improvement

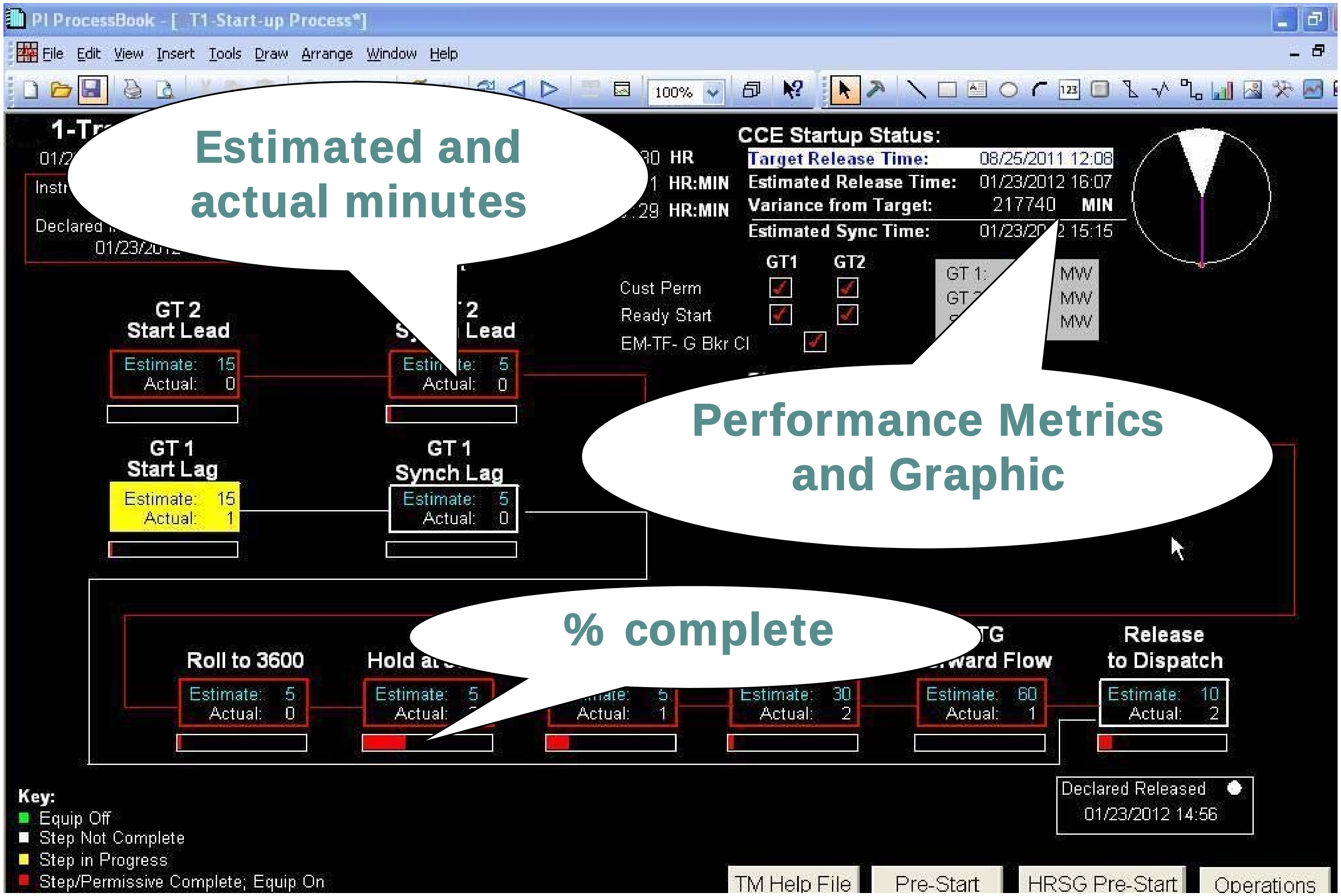
Power Plant Startup Monitoring and Optimization



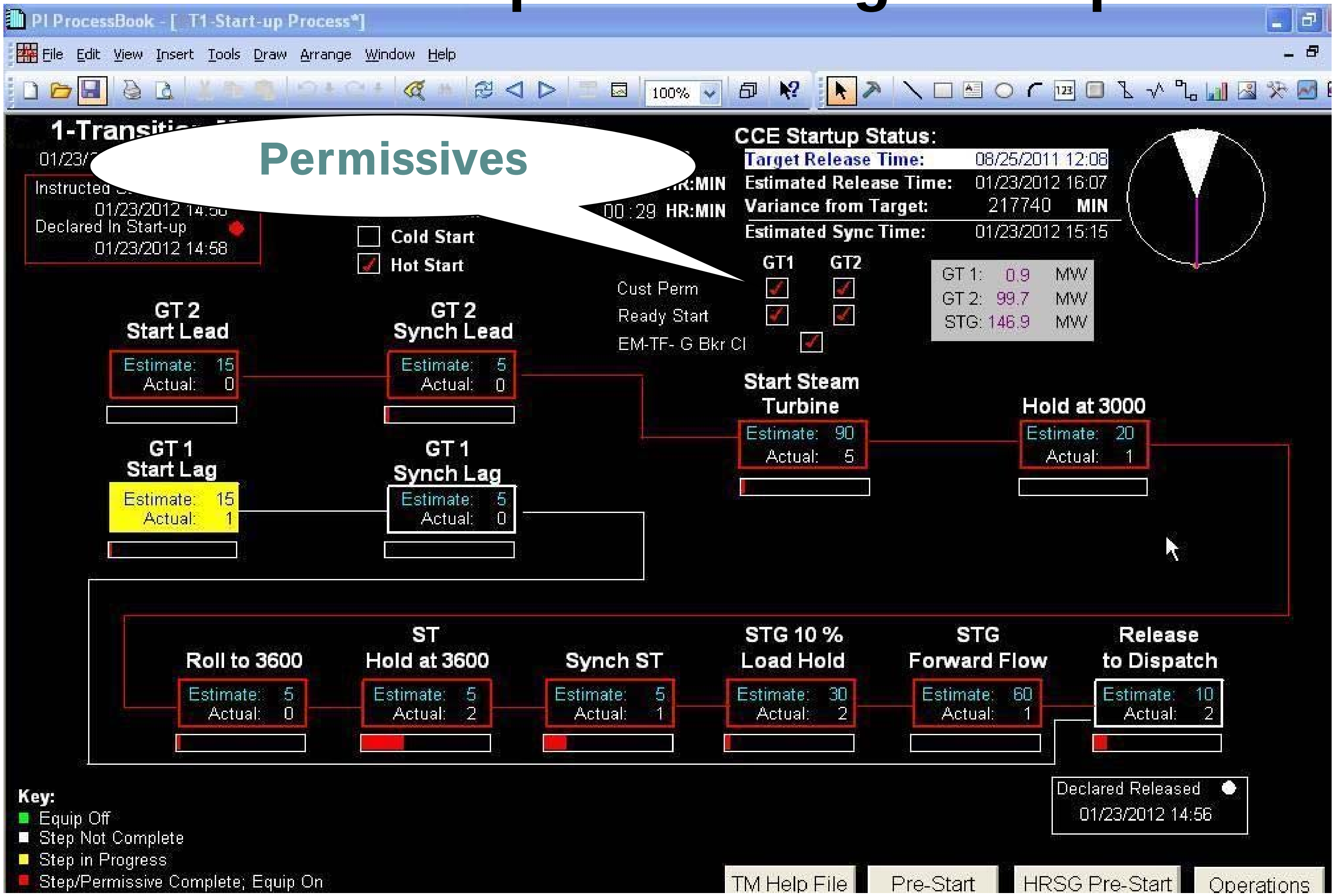
Power Plant Startup Monitoring and Optimization



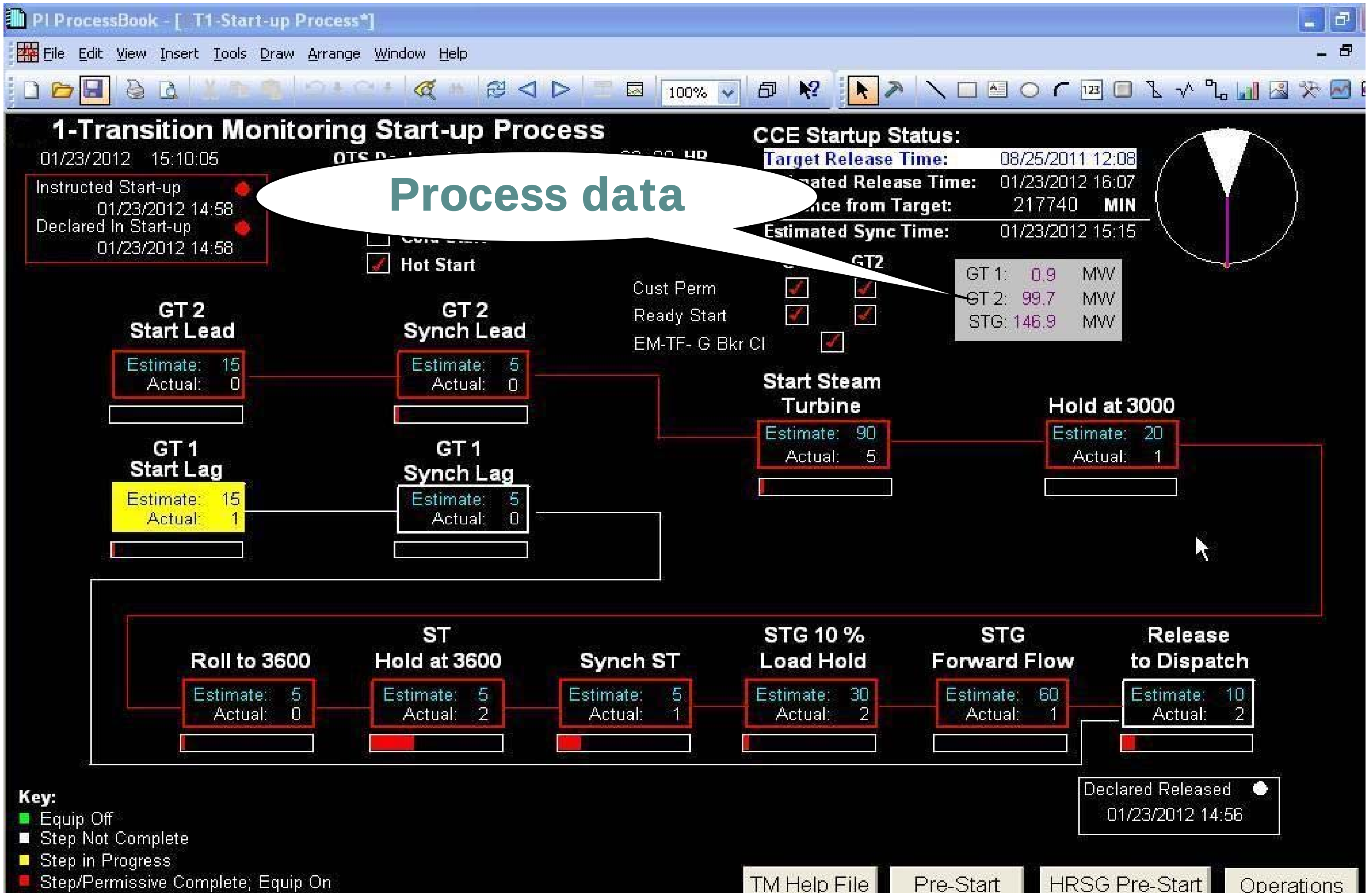
New PI Solution: Transition Monitor



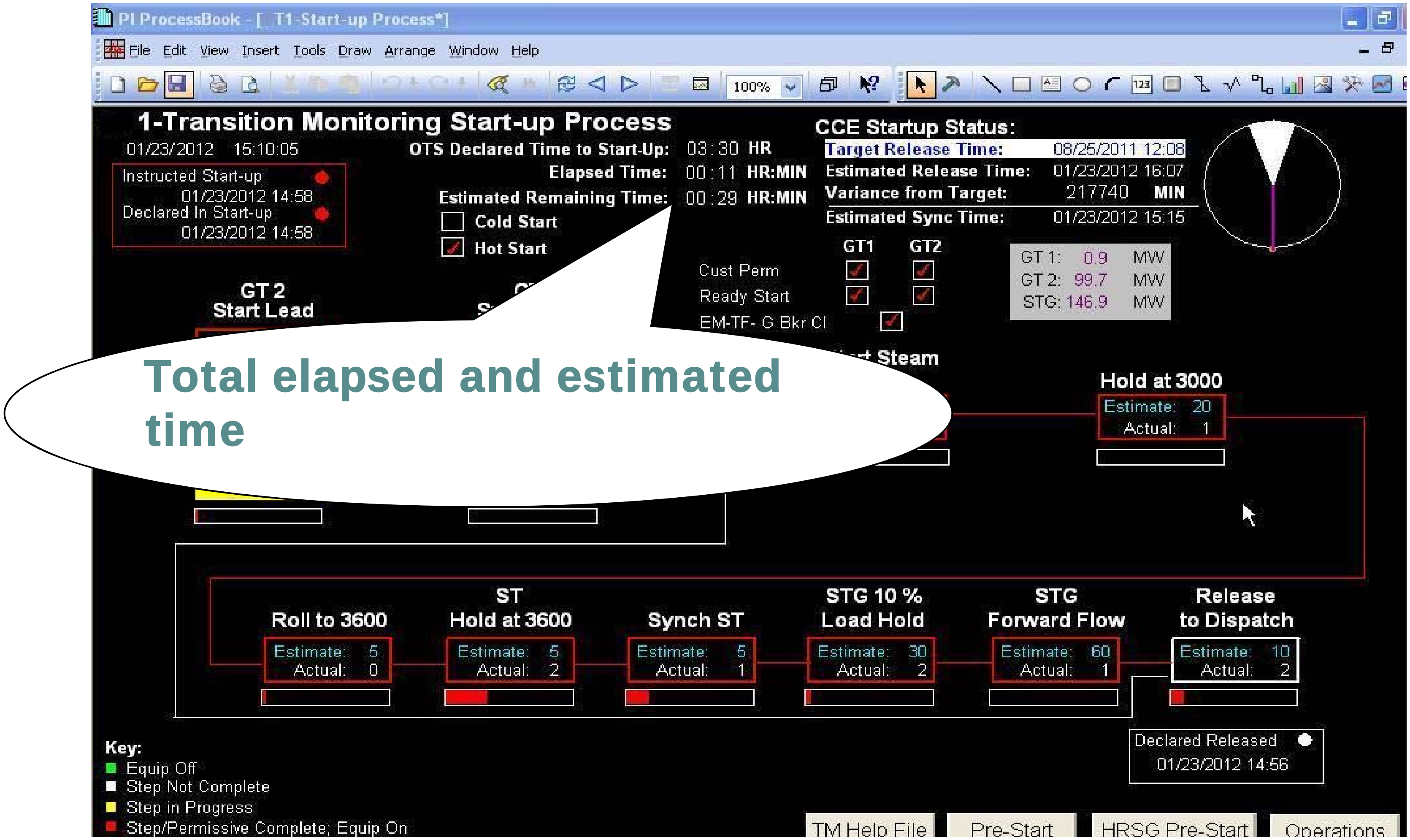
Power Plant Startup Monitoring and Optimization



Power Plant Startup Monitoring and Optimization



Power Plant Startup Monitoring and Optimization



Power Plant Startup Monitoring and Optimization

1-Startup Details - Roll To 3600
01/23/2012 13:57:35

Estimate: 5 MIN
Actual: 0 MIN

Permissives: Lube Oil Header Temp > 100 Deg F
RH Bowl > 250 Deg F
Differential temp of RH Metal temp and Steam temp < 500

Steps:

1. Select speed rate of 720 rpm/min. and select 3600 rpm target.

NOTE: Select speed of 720 rpm/min so that turbine goes through critical at 1200 to 3200 rpm at a faster pace.

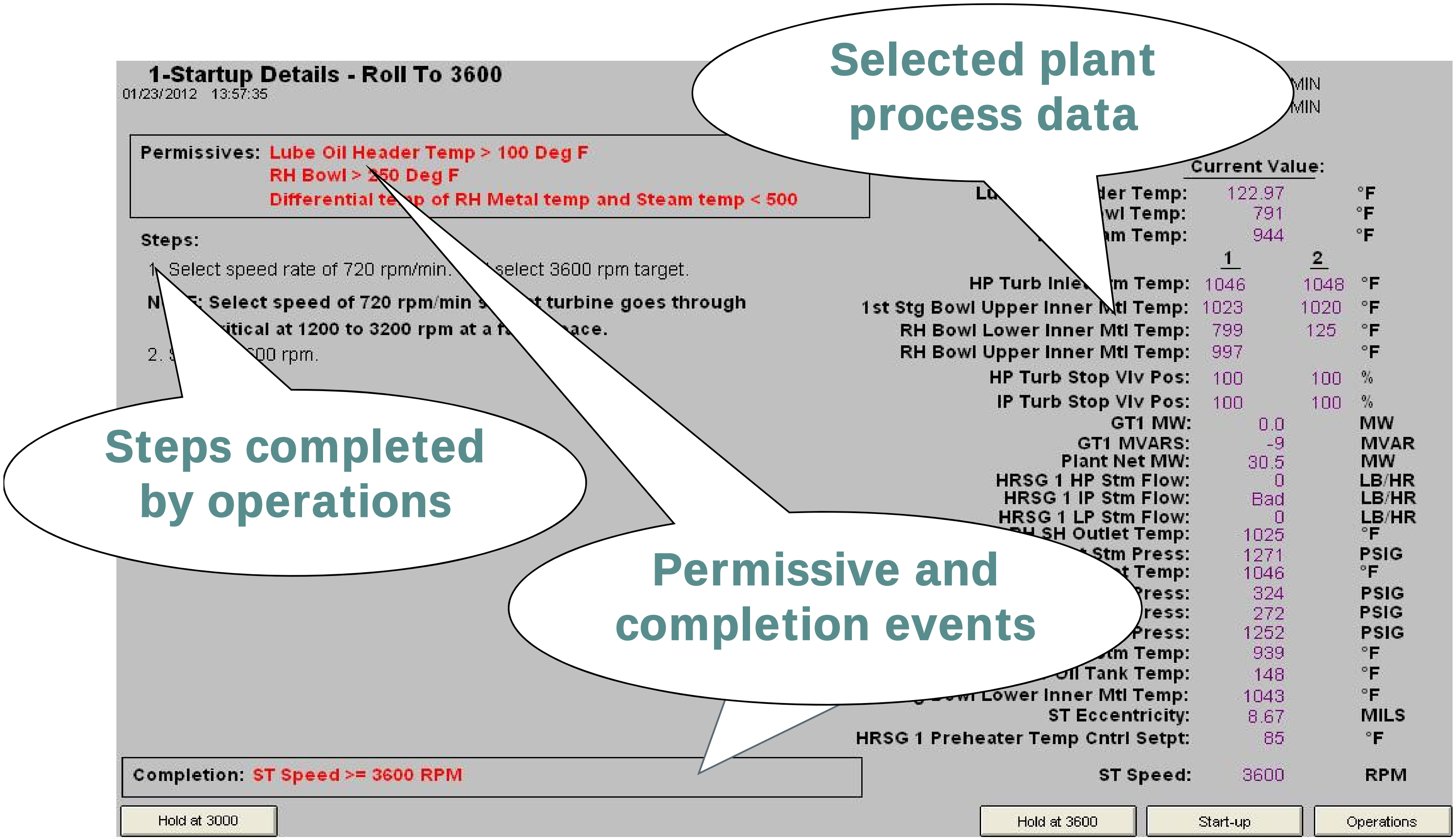
2. STG at 3600 rpm.

	Current Value:		
Lube Oil Header Temp:	122.97		°F
RH Bowl Temp:	791		°F
RH Steam Temp:	944		°F
	1	2	
HP Turb Inlet Stm Temp:	1046	1048	°F
1st Stg Bowl Upper Inner Mtl Temp:	1023	1020	°F
RH Bowl Lower Inner Mtl Temp:	799	125	°F
RH Bowl Upper Inner Mtl Temp:	997		°F
HP Turb Stop Vlv Pos:	100	100	%
IP Turb Stop Vlv Pos:	100	100	%
GT1 MW:	0.0		MW
GT1 MVARS:	-9		MVAR
Plant Net MW:	30.5		MW
HRSG 1 HP Stm Flow:	0		LB/HR
HRSG 1 IP Stm Flow:	Bad		LB/HR
HRSG 1 LP Stm Flow:	0		LB/HR
HRSG 1 RH SH Outlet Temp:	1025		°F
HRSG 1 HP SH Out Stm Press:	1271		PSIG
HRSG 1 HP SH Outlet Temp:	1046		°F
HRSG 1 IP SH Press:	324		PSIG
IP Turb Inlet Stm Press:	272		PSIG
HP Turb Inlet Stm Press:	1252		PSIG
IP Turb Inlet Stm Temp:	939		°F
Lube Oil Tank Temp:	148		°F
1st Stg Bowl Lower Inner Mtl Temp:	1043		°F
ST Eccentricity:	8.67		MILS
HRSG 1 Preheater Temp Cntrl Setpt:	85		°F
ST Speed:	3600		RPM

Completion: ST Speed >= 3600 RPM

Hold at 3000 | Hold at 3600 | Start-up | Operations

Power Plant Startup Monitoring and Optimization



Tracking Start-ups using PI Batch

Design Requirements:

- Well-defined start and end points
  - Valve open/closed
  - Flow > set limit
  - Pump on/off

- Consistently-followed procedures

Power Plant Startup Monitoring and Optimization

Transition Monitor Startup Report

Analysis Date 1/24/2012 9:14 AM

Plant: Unit

Unit: 1

From: 01/01/11 **To:** 01/02/12

Details

To view a det[illegible] the desired startup

Select startup for details

x	Startup ID	P[illegible] Start Time	OTS Start Time	End Time	[illegible] Declaration) (HR)	OTS Estimate (HR)	TM Estimate (HR)	Variance from OTS	Variance from TM
	1 Startup 12-[illegible]-11 23:31:45	2/12/2011 11:31:20 PM	2/12/2011 11:31:20 PM	2/13/2011 2:35:20 AM	3.07	2.99	6.1	4.8 MIN (0.08 HR)	-181.8 MIN (-3.03 HR)
x	1 Startup 29-Apr-11 23:14:45	4/29/2011 11:14:20 PM	4/29/2011 11:14:20 PM	4/30/2011 10:49:20 AM	11.58	10.5	6.1	64.8 MIN (1.08 HR)	328.8 MIN (5.48 HR)
	1 Startup 22-Nov-11 09:14:45	11/22/2011 9:14:23 AM	11/22/2011 9:14:23 AM	11/22/2011 12:07:22 PM	2.88	2.01	9.16	52.2 MIN (0.87 HR)	-376.8 MIN (-6.28 HR)
	1 Startup 22-Nov-11 13:13:45	11/22/2011 1:13:22 PM	11/22/2011 1:13:22 PM	11/22/2011 2:44:22 PM	1.52	1.01	6.1	30.6 MIN (0.51 HR)	-274.8 MIN (-4.58 HR)

Power Plant Startup Monitoring and Optimization

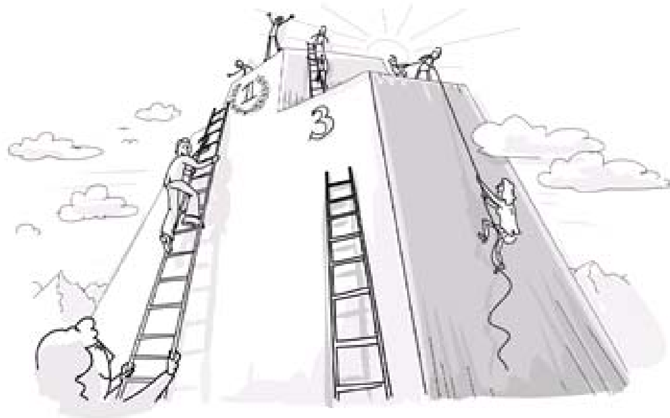
Analysis Date 1/24/2012 9:14 AM

Plant: Unit

Unit: 1

		Duration (HR)	OTS Estimate (HR)	Variance from OTS	
Startup ID	1 Startup 29-Apr-11 23:14:45	11.58	10.5	64.8 MIN (1.08 HR)	
OTS Start Time	4/29/2011 11:14:20 PM				
End Time	4/30/2011 10:49:20 AM				
1st Stg Mtl Temp					

Phase	Start Time	End Time	Duration	TM Estimate	Variance from TM
CW Pmp	4/28/2011 12:06	----	----	----	----
FD Fan	4/29/2011 22:08	----	----	----	----
Startup	**4/29/2011 23:14**	**4/30/2011 10:49:20 AM**	**695 MIN (11.58 HR)**	**366 MIN (6.1 HR)**	**329 MIN (5.48 HR)**
Station Air Sys	4/30/2011 0:39	----	----	----	----
Condenser	4/30/2011 0:45	4/30/2011 2:05	80 MIN (1.33 HR)	0 MIN (0 HR)	80 MIN (1.33 HR)
Build Drum Pressure	4/30/2011 1:13	4/30/2011 1:14	0.08 MIN (0 HR)	180 MIN (3 HR)	-179.92 MIN (-3 HR)
Establish Vacuum	4/30/2011 1:14	4/30/2011 2:05	51 MIN (0.85 HR)	60 MIN (1 HR)	-9 MIN (-0.15 HR)
Satisfy Steam Conditions	4/30/2011 1:14	4/30/2011 2:02	48 MIN (0.8 HR)	30 MIN (0.5 HR)	18 MIN (0.3 HR)
Boiler	4/30/2011 2:01	4/30/2011 2:02	0.08 MIN (0 HR)	0 MIN (0 HR)	0.08 MIN (0 HR)
Turbine	4/30/2011 2:05	4/30/2011 2:28	23 MIN (0.38 HR)	0 MIN (0 HR)	23 MIN (0.38 HR)
Condenser	4/30/2011 2:28	4/30/2011 3:43	75 MIN (1.25 HR)	0 MIN (0 HR)	75 MIN (1.25 HR)
Establish Vacuum	4/30/2011 2:28	4/30/2011 3:43	75 MIN (1.25 HR)	60 MIN (1 HR)	15 MIN (0.25 HR)
Boiler	4/30/2011 3:25	4/30/2011 3:58	33 MIN (0.55 HR)	0 MIN (0 HR)	33 MIN (0.55 HR)
Satisfy Steam Conditions	4/30/2011 3:25	4/30/2011 3:58	33 MIN (0.55 HR)	30 MIN (0.5 HR)	3 MIN (0.05 HR)
Turbine	4/30/2011 3:58	4/30/2011 7:12	193.25 MIN (3.22 HR)	0 MIN (0 HR)	193.25 MIN (3.22 HR)
Roll to 2400	4/30/2011 4:10	4/30/2011 4:18	7.75 MIN (0.13 HR)	10 MIN (0.17 HR)	-2.25 MIN (-0.04 HR)
Achieve Stm Conditions for Hold	4/30/2011 4:18	4/30/2011 10:49	391.08 MIN (6.52 HR)	10 MIN (0.17 HR)	381.08 MIN (6.35 HR)
Condenser	4/30/2011 7:12	4/30/2011 7:23	11 MIN (0.18 HR)	0 MIN (0 HR)	11 MIN (0.18 HR)
Establish Vacuum	4/30/2011 7:12	4/30/2011 7:23	11 MIN (0.18 HR)	60 MIN (1 HR)	-49 MIN (-0.82 HR)



Let's climb the performance ladder to the top

Next Generation SCADA

Ensuring the real-time monitoring and control of rapidly growing Portfolio of Renewable Assets

Uwe Fischer
Head of Asset Information Systems
E.ON Climate&Renewables GmbH (EC&R)

Consistent strategy to

industrialize

renewables

From 400 to

4,800 MW

865

colleagues

Pioneer

in Offshore Wind

Global #3

Global #8

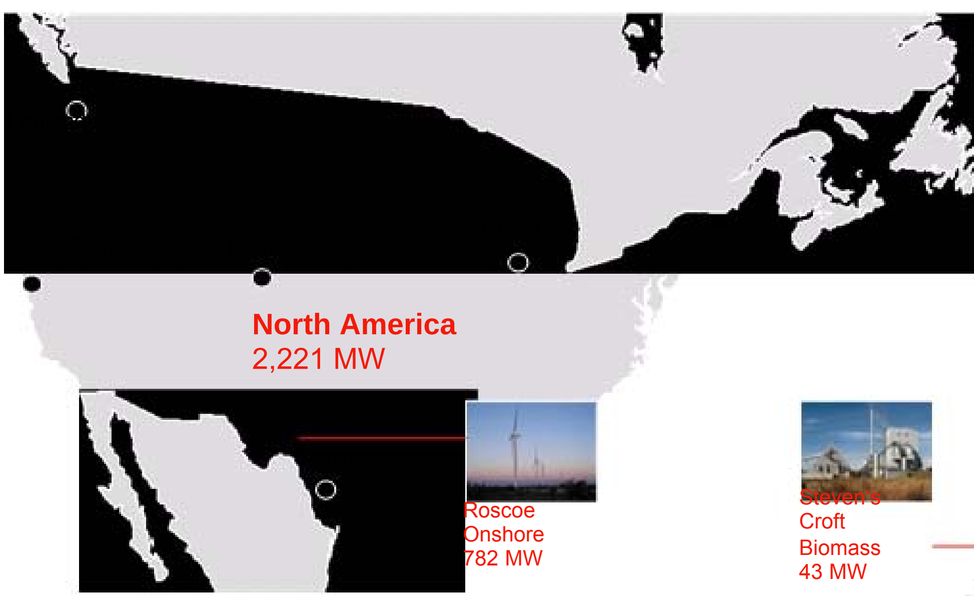
in Onshore Wind

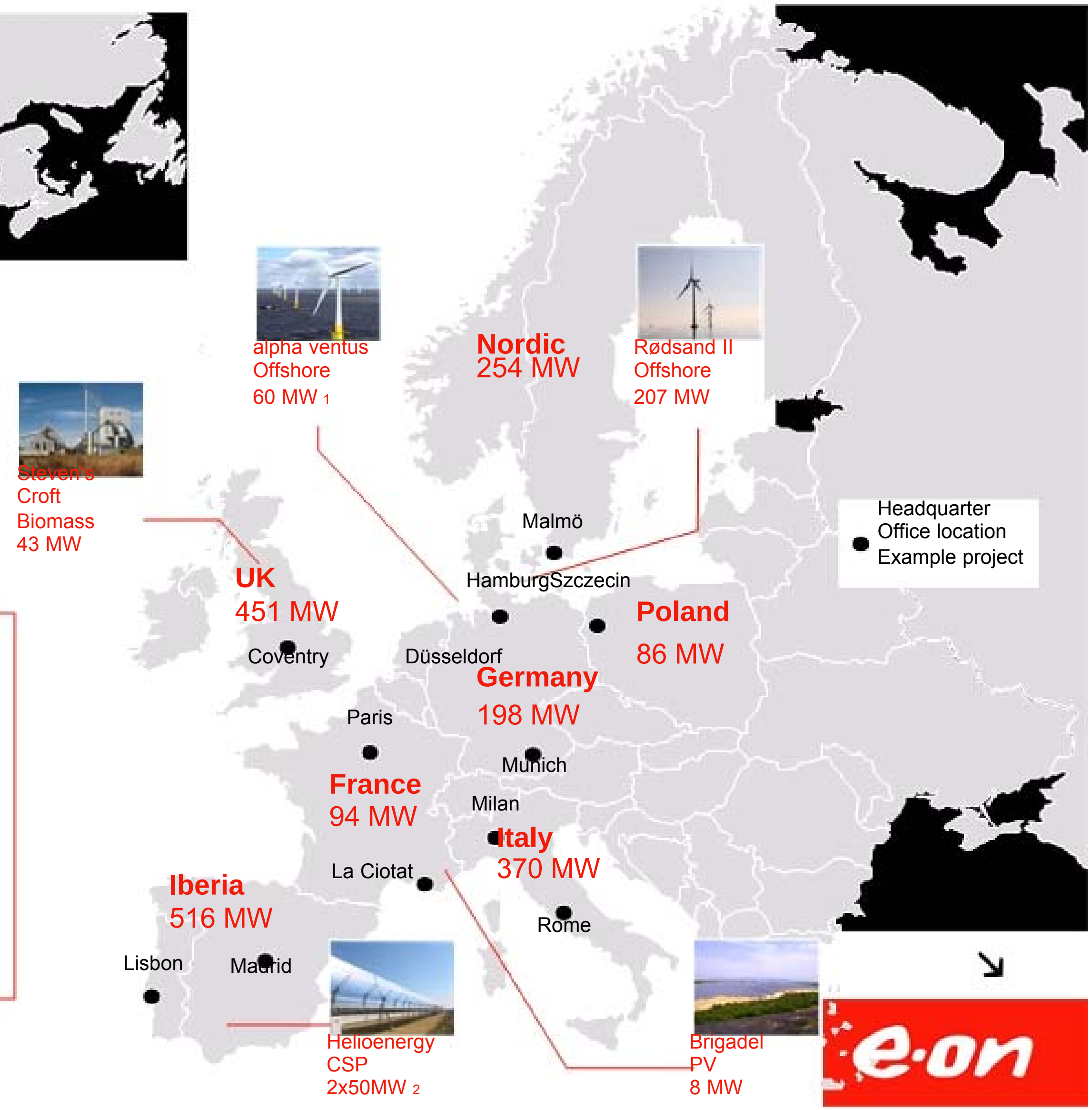
From “an experiment” to

“a pillar of E.ON’s future”

e·on

EC&R currently operates a geographically balanced portfolio of more than 4.2 GW renewables capacity in Europe and North America

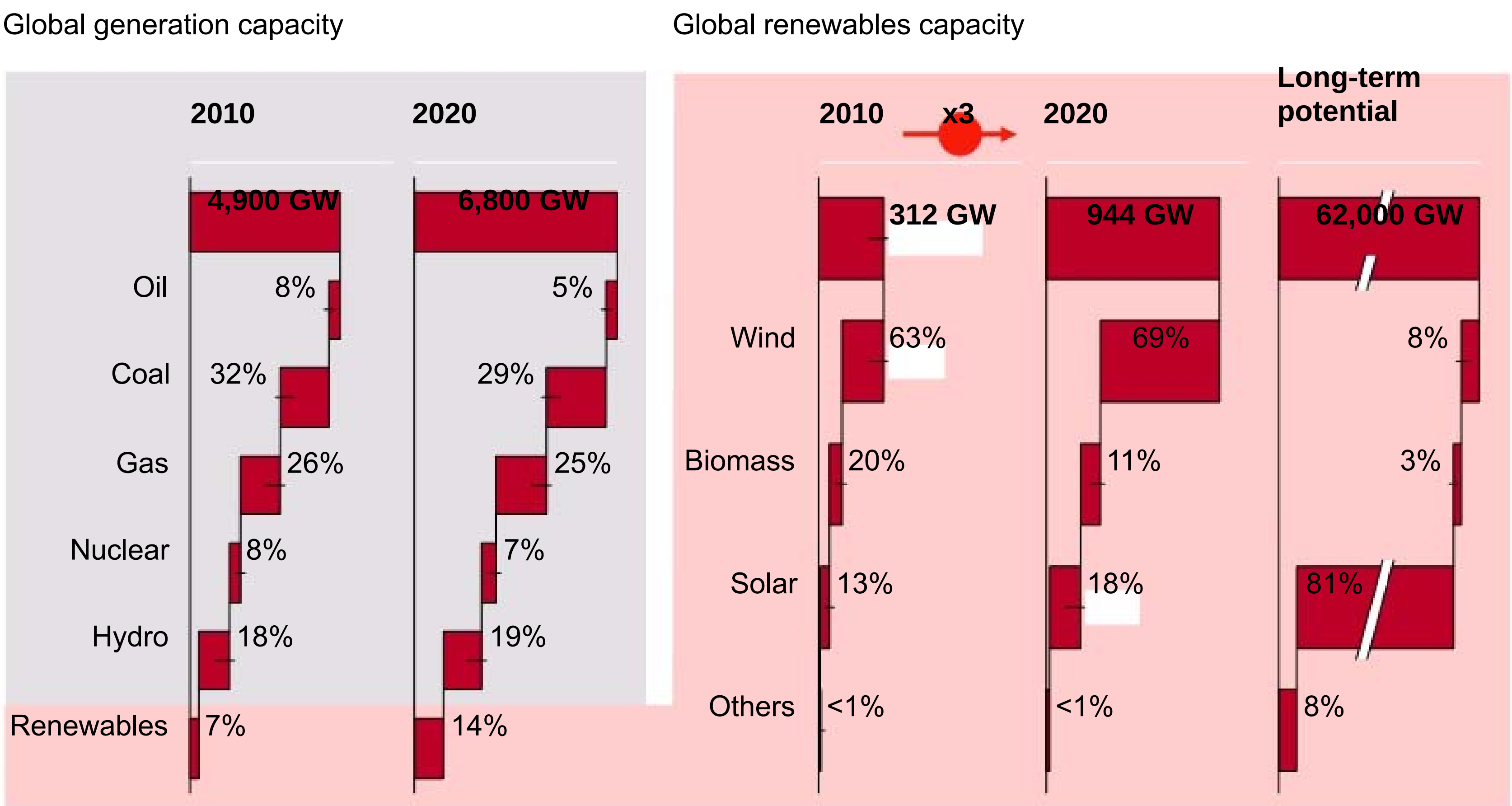




Key facts

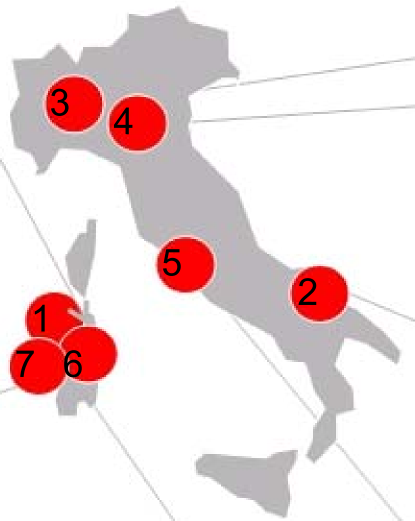
- Assets with 4,190 MW total capacity
- 10.2 TWh electricity produced in 2011, equivalent to demand of ~2.6m homes
- Global #8 in onshore wind
- Global #3 in offshore wind
- Present in 11 countries
- 804 employees, 36 nationalities

Renewables have significant worldwide potential: Installed capacity is expected to again grow 3-fold by 2020



Sources BNEF, IHS Emerging Energy Research (July 2011 Base Case), World Energy Council

In Italy, 7 parks with a total capacity of ~46 MW were commissioned within only 1.5 years, but 120MW/year in US



Fiumesanto 2 - 18 MW

Fiumesanto 5 -11.2 MW

Fiumesanto Parking -1.4 MW

Frugarolo - 2.8 MW

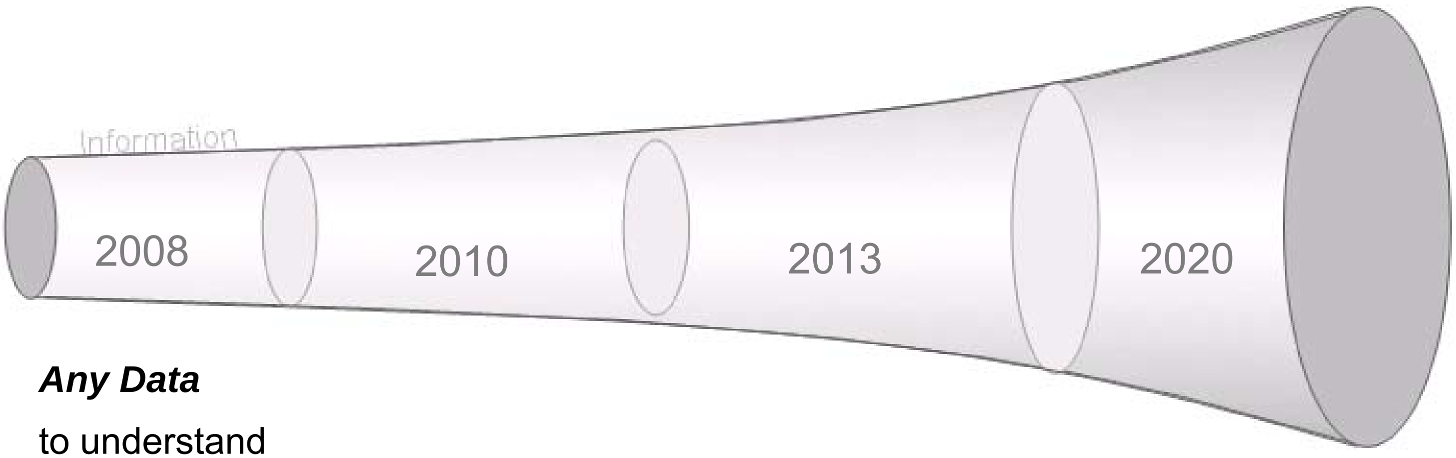
Nepi - 4.0 MW

Costa - 2.7 MW

Civitella - 6.1 MW

Evolving challenges in the SCADA Architecure

Time



Scope

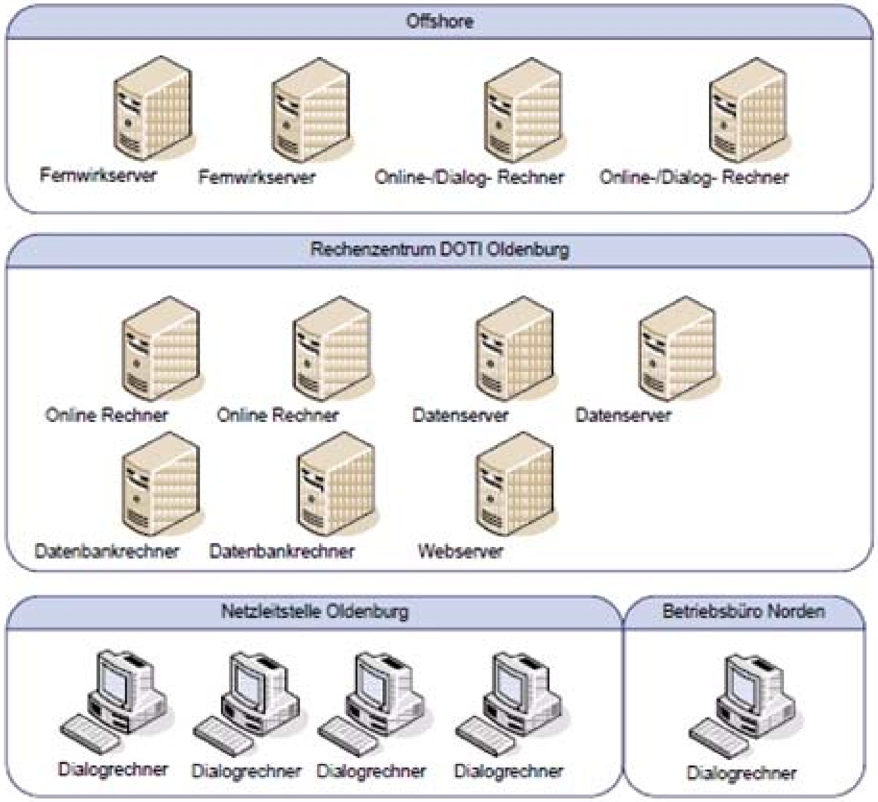
Any Data
to understand
and build
Business

medium OPC, USB, email …

System Landscape for 12 Windturbines in 2008

Each Windpark was built autark and enabled to perform the local required operation.

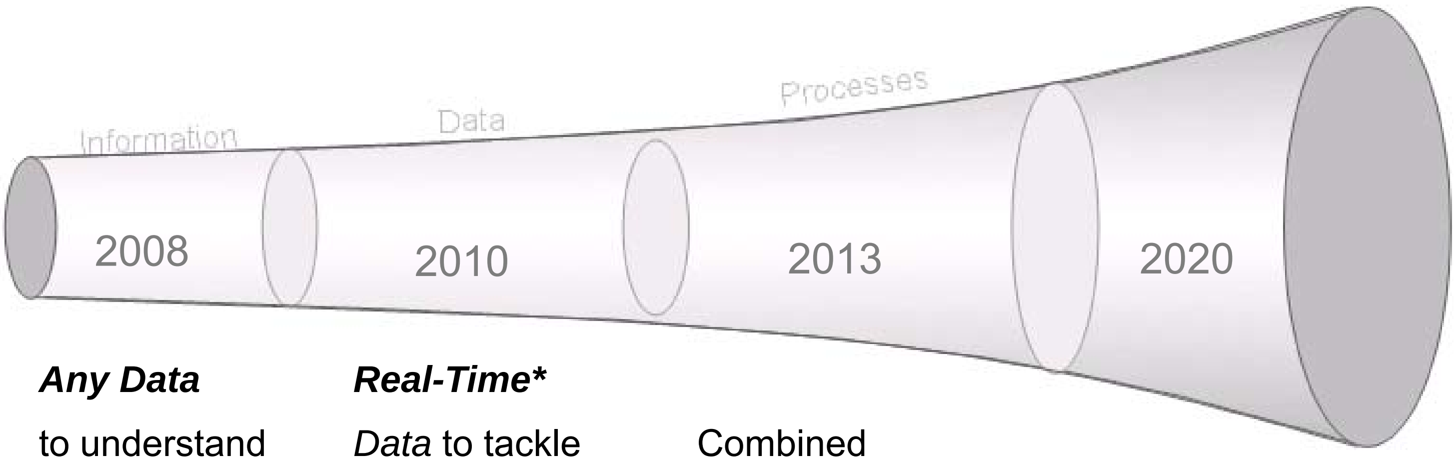
- Data Collection
- Reporting
- Data Visualisation



More servers than wind technicians!

Evolving challenges in the SCADA Architecure

Time

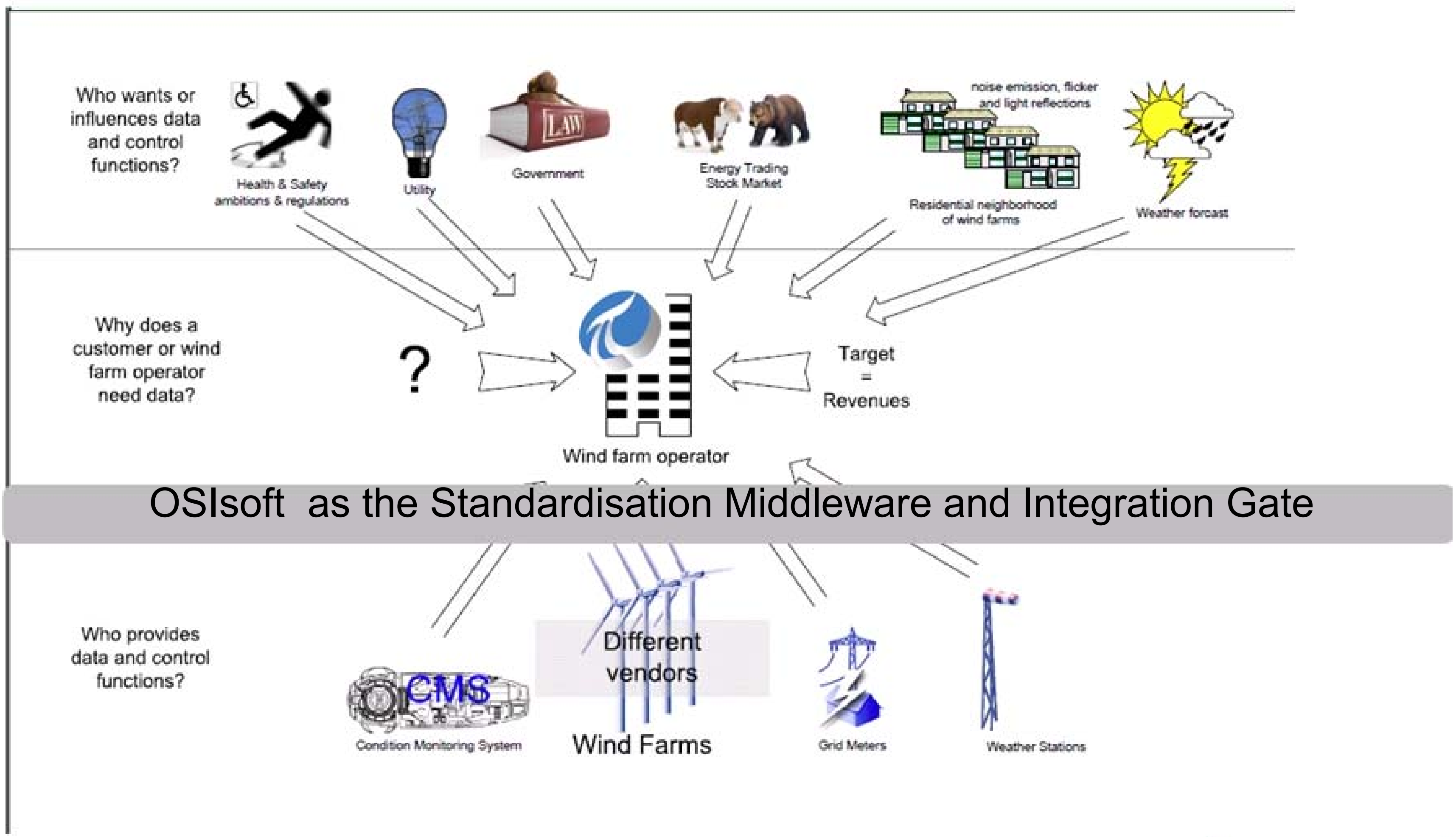


	2008	2010	2013
Scope	***Any Data*** to understand and build Business	***Real-Time**** *Data* to tackle performance Yields and to Steer	Combined ***bidirectional Real-Time*** Data to predict Power, Failures and allow Control
medium	Paper, email …	OPC, IEC…	OPC, SOAP ….

*Chose OSIsoft PI System in 2010

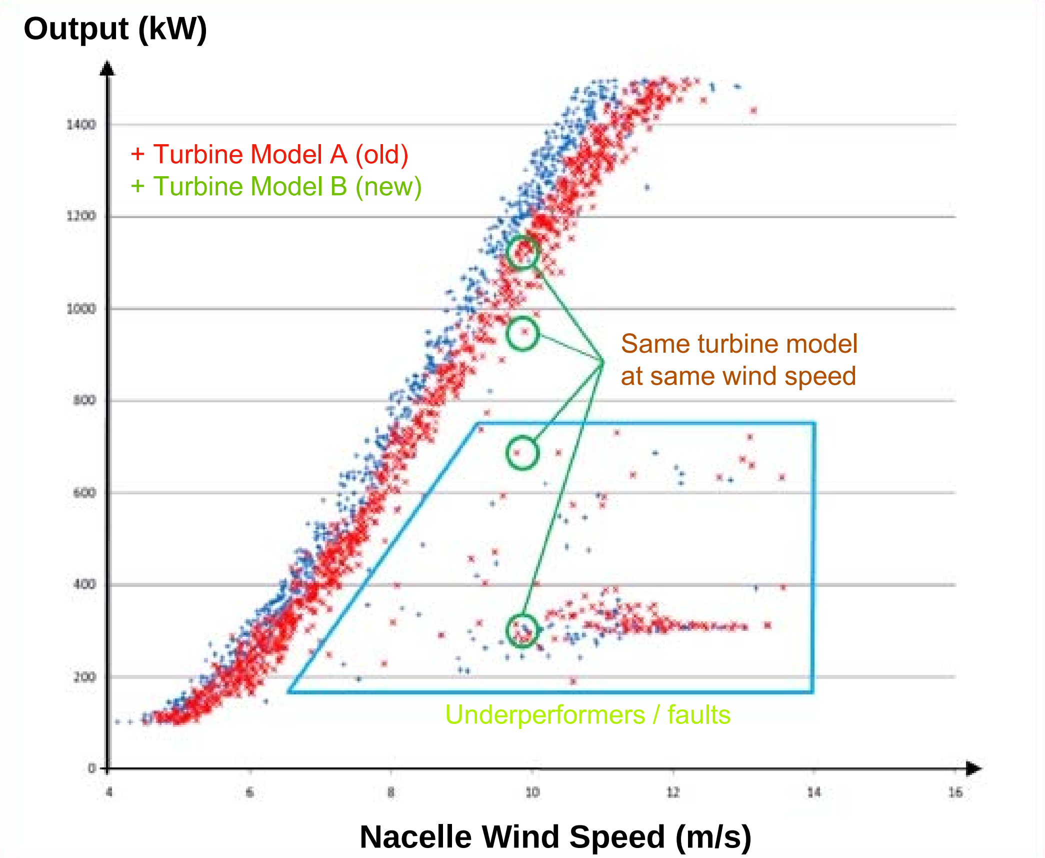
e·on

A Windfarm Operator is faced with different requests from various stakeholders and needs customized info



At 98% availability the challenge is to find the next challenge – compare 3,000 turbines

Performance of two wind turbine generator models



Challenge

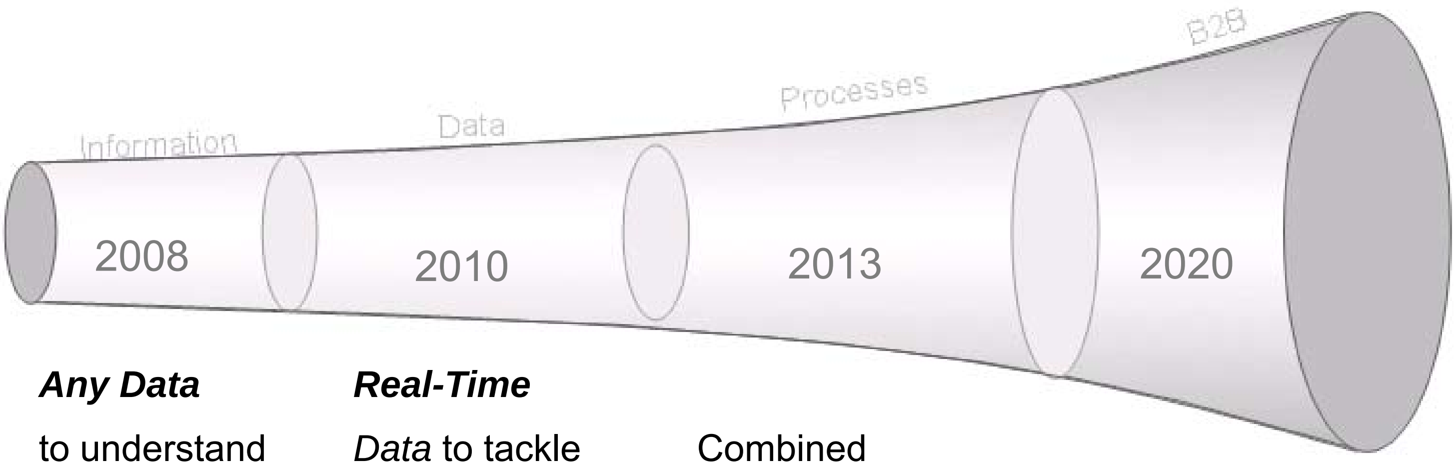
Improving turbine underperformance:

- 15-30% difference in output at same wind speed
- 5-10 times the potential of improved availability

Source: E.ON SCADA (Supervisory Control and Data Acquisition)

Evolving challenges in the SCADA Architecure

Time



Scope

Any Data to understand and build Business

Real-Time *Data* to tackle performance Yields and to Steer

Combined ***bidirectional*** ***Real-Time*** Data to predict Power, Failures and allow Control

Automated, Integrated, ***Control Data Exchange*** And distributed Data handling to enable the SmartWorld and intercompany Interaction

medium

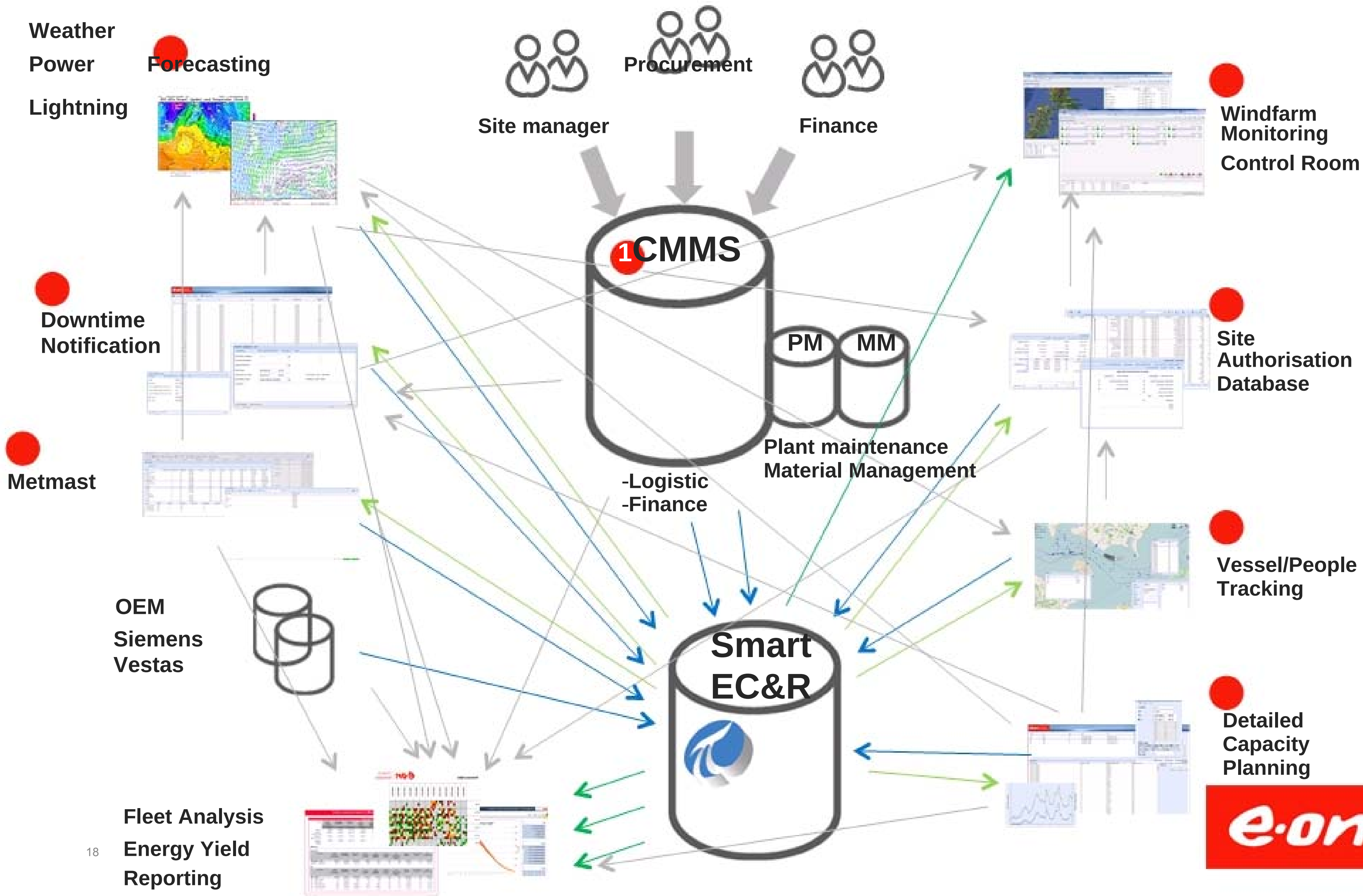
Paper, email …

OPC, IEC…

OPC, SOAP ….

Osisoft PI, B2B Integration (SOAP…

Multi HMI's and Single Data Base - Interaction of Tools



Scope of EC&R's multi Dimension SCADA ➔➔ **SmartECR**

- **Extensively standardized** Systems for all decentral SCADA Assets
  (~200 independent Data Feed from Wind, Biomass, CSP and PV Assets)
- **Single Datacenter** and centralized Security Management
  (24/7 support from European and American staff)

- **Single Real Time Database** sized for ~1,000,000 Datapoints per second
  (hourly Data Cleaning, Export and Reporting to enhance speed)
- **Data Exchange Infrastructure with all** state of the art **capabilities**
  (hourly exchange of Production and 72h Forecast Data with Trading and external service providers)

- **In-house Application Development** to gain the value from the Data and the Engineering and Operation expertise
  (Business Process specific Screens and Tools as a competitive advantage)

SmartECR: Customized Global Business Processes on a Central PI Data Foundation

e·on

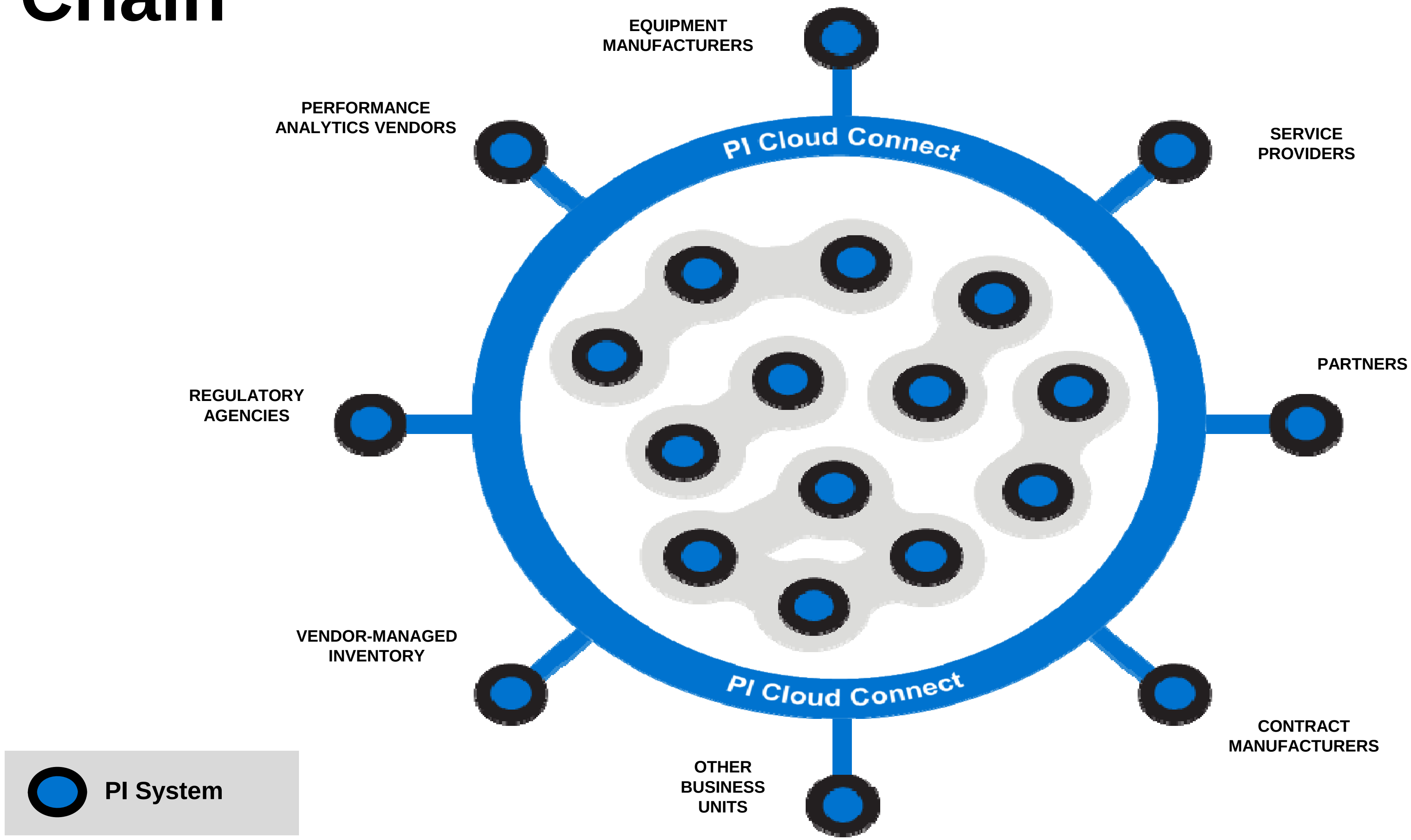
Connected Supply Chain – PI Cloud Connect

"Allow customers to furnish data from a system they own so they can be better served by their vendors."

Dr. Pat Kennedy

PI Cloud Connect goal: Provide a simple, secure framework for key stakeholders and suppliers to obtain the data they need.

Infrastructure for the Connected Supply Chain



Leveraging the "Power of PI" as a Third Party NOC Platform

Presented by **Steve Hanawalt, Power Factors LLC**

Outline

- Power Factors Overview
- The Problem
- A Proposed Solution
- How it Works
- Features & Benefits
- Technical Issues
- Summary and Next Steps

Power Factors Overview

- Headquartered in San Leandro, California
- 50 years/30 GW fossil power O&M experience
- 12 years/1 GW solar power O&M experience
- Providing services to over 3 GW of solar projects in the US, Europe and South America
- Solar Power 3rd Party NOC service provider

Bringing the PI System to the solar marketplace

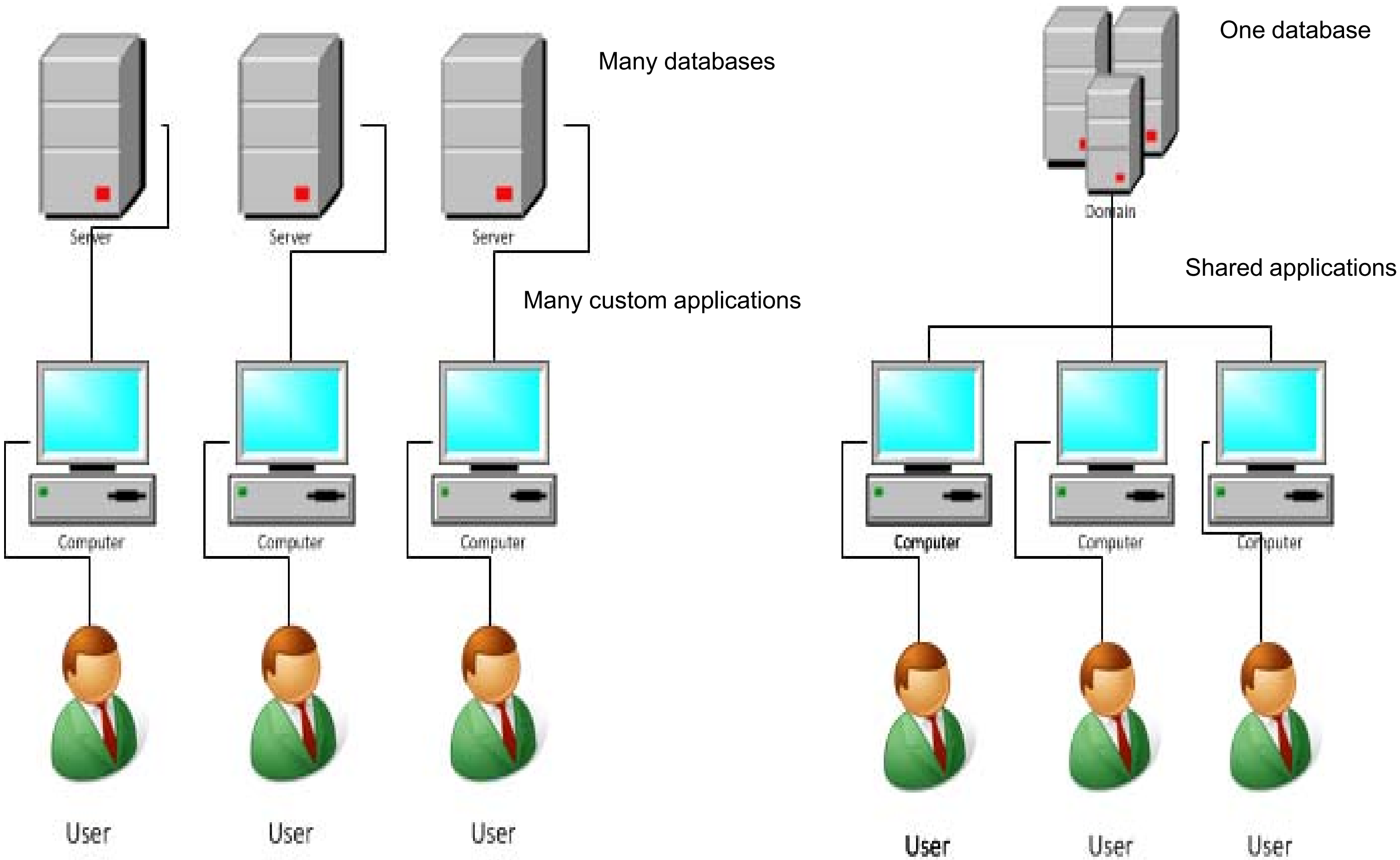
The Solar Power Problem

Same	Different
• Generates electricity • Grid interconnection requirements • Needs to be maintained and monitored • Lots of data	• Spans a vast size and customer class • Fuel is free • Labor drives O&M phase economics • Traditional monitoring system deployment methods too costly

Solving the Problem - Technology

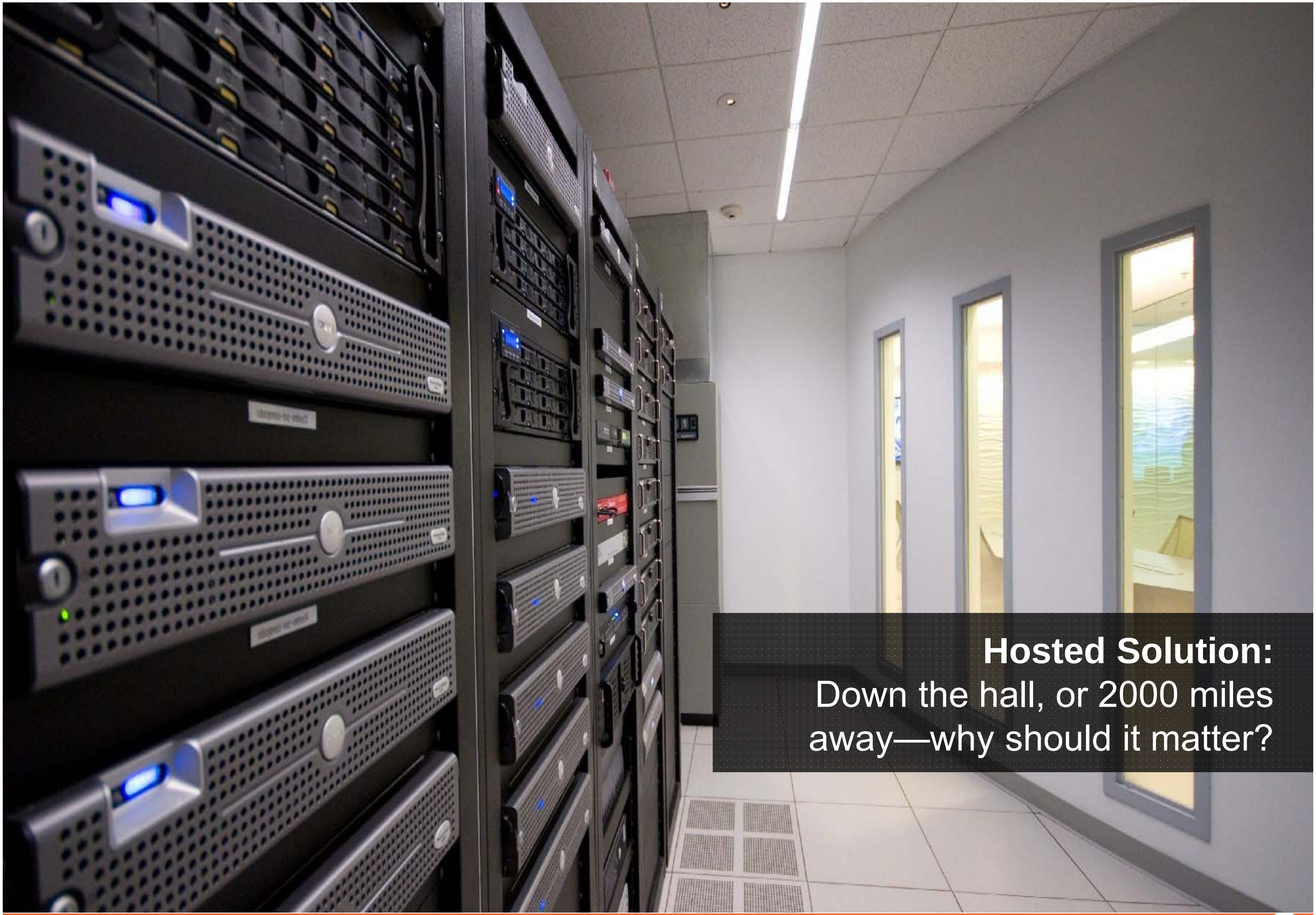
- How do we drive labor out of the equation?
  - Technology and automation
- How do we make IT cost effective for solar?
  - Reduce the per customer cost of implementation
- How do we reduce IT implementation costs?
  - Change the way we deliver and price technology

Proposed Solution



Traditional single tenant model

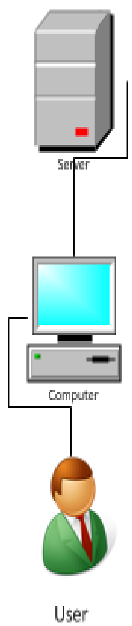
Proposed multi-tenant model

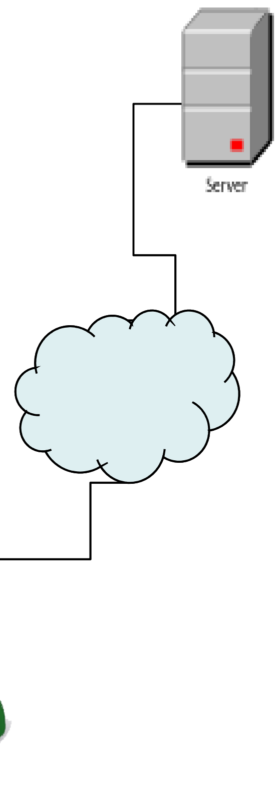

Hosted Solution:
Down the hall, or 2000 miles away—why should it matter?

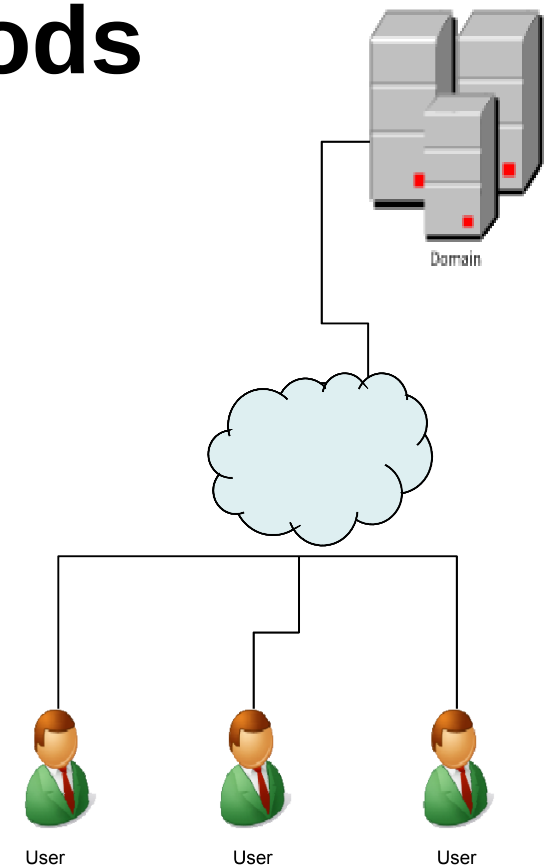
Value Proposition

- Multi-tenant model brings the benefits of the PI System at a lower cost and risk model than a traditional implementation
- Tenants benefit from best-in-class analytics/performance optimization
- Tenants benefit from services that may be too costly to support internally
  - 24/7 Help Desk, high availability implementation, large pool of technical support

PI System Delivery Methods





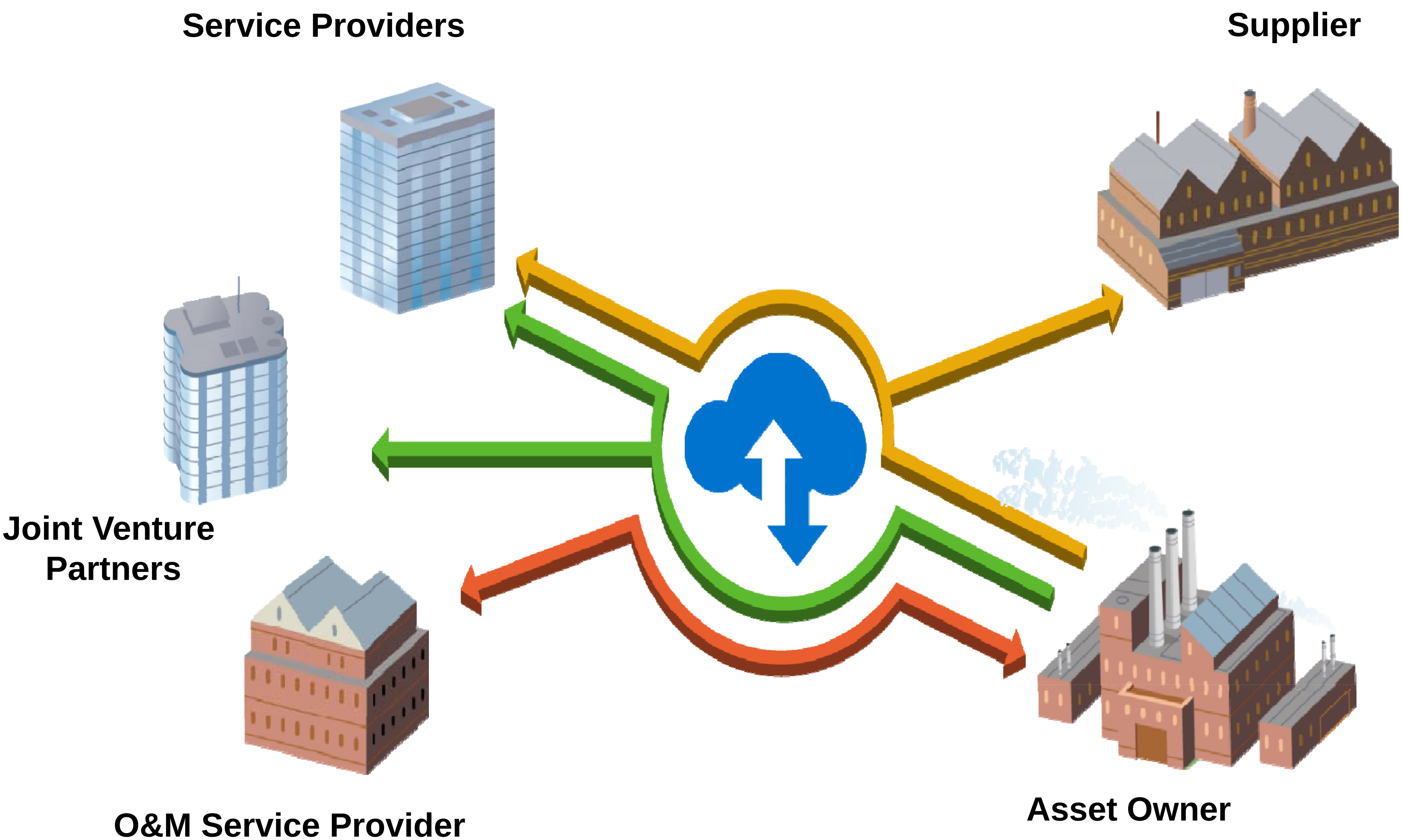


Cloud implementation

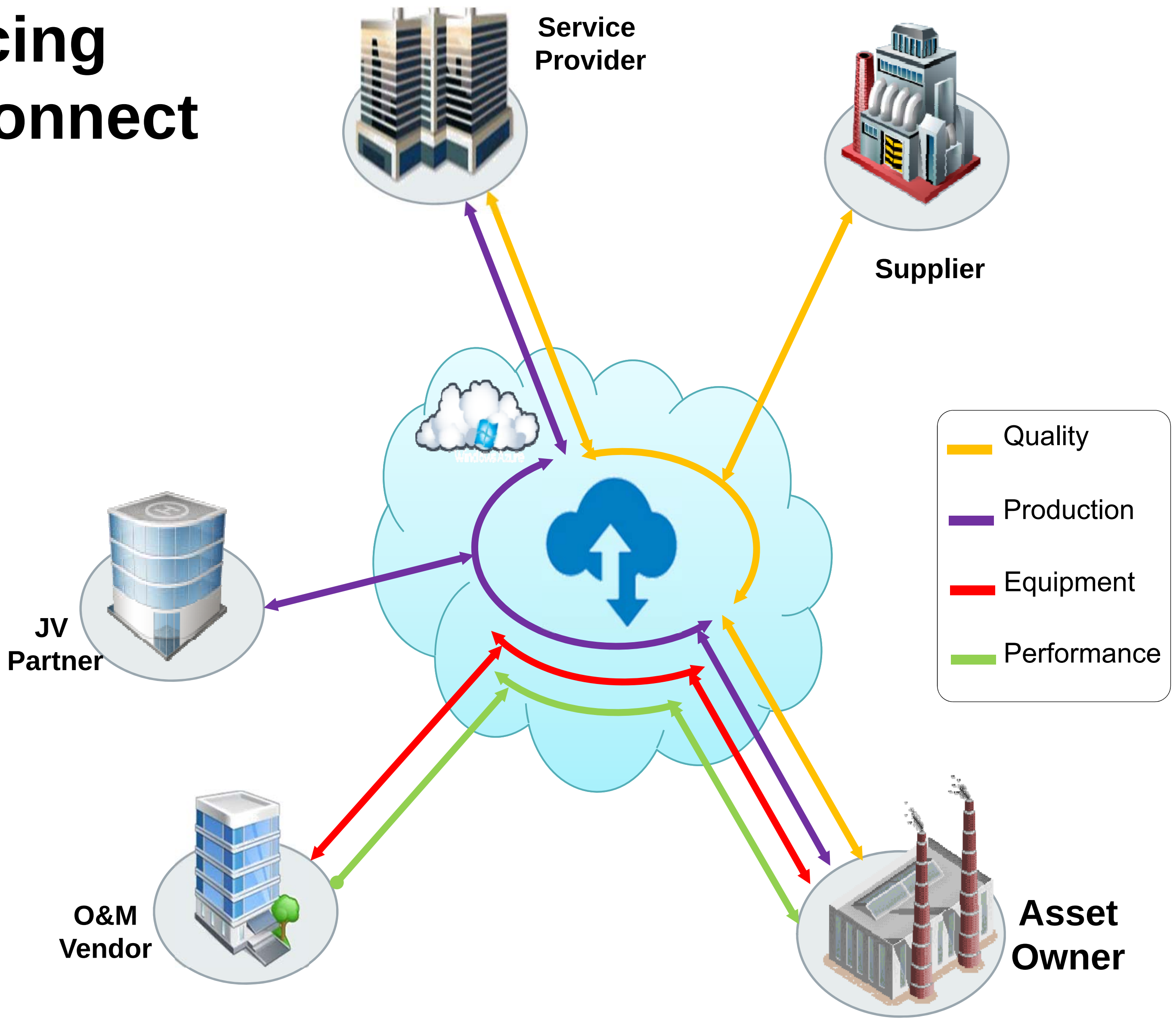
On-premise implementation

Hosted implementation

The First Step - PI Cloud Connect

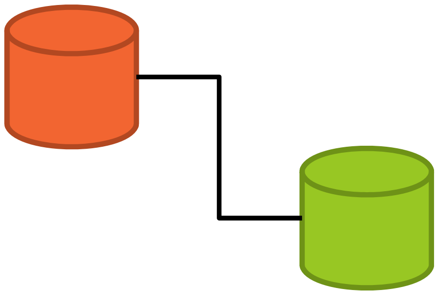


Introducing PI Cloud Connect



Challenges and Opportunities

- Data flow
  - Connecting publishers and subscribers
  - Infrastructure requirements
- Data synchronization
  - Data model
  - Meta data
  - Contract entitlements
  - Integration with other applications



Summary

- New ways of deploying technology delivers the PI System value proposition to new categories of asset classes
- Power Factors is leading the deployment of the PI System to the solar marketplace
- Power Factors PV performance and PI System expertise rapidly delivers hosted solutions at a lower TCO

THANK YOU

Brought to you by