"where PI geeks meet"

OSIsoft®

2009

vCampus | LIVE!

Palace Hotel, San Francisco, CA · Dec. 1-2, 2009

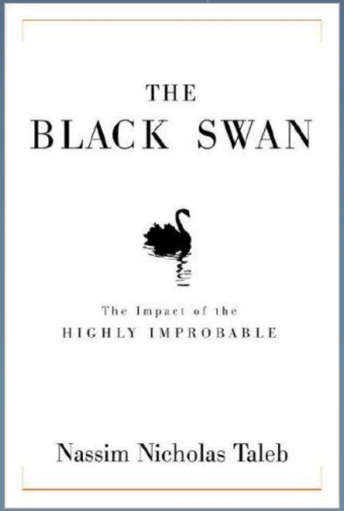
Energy Independence for the Industrial User: How Can Industry Leverage the Smart Grid?

Pat Kennedy
CEO and Founder, OSIsoft

Dave Roberts
Director, Business Development, OSIsoft

The Black Swan - by Nassim Nicholas Taleb

- What is a Black Swan?
  - A bird, a plane, a Western Australian Beer?
  - The Observation: Since all swans that we have seen are white, all swans must be white.
  - Until 1790, and naturalist John Latham, first discovered and described in Australia…the black swan
- Taleb says a black swan is:
  - The event is a surprise (that wasn't expected, or was expected and didn't occur)
  - The event has a major impact
  - After the fact, the event is rationalized by hindsight, as if it had been expected



What are some black swans and their characteristics:

- Good “black swans”
  - Internet
  - Breakup of tele-communications sector
  - Took years to build momentum and fundamental shifts
- Bad “black swans”
  - 9/11
  - Thanksgiving day for the turkey…(don’t be a turkey)
  - Bad actor(s) spending years time preparing, day of event was “first knowledge” for everyone else (especially the turkey)

Chapter 3 - The Speculator and the Prostitute

Mediocristan	Extremistan
Non-scalable	Scalable
Winners get a small segment of the total pie	Winner take all
The most typical member is mediocre	There is no typical member
History Crawls	History makes jumps
Impervious the Black Swan	Vulnerable to the Black Swan
1000lb Man in the Stadium	Bill Gates in the Stadium

Observations on Smart Grid
Utility Perspective

GRIDWEEK

Investing in our Energy Future

Secretary Steven Chu
U.S. Department of Energy
Washington, D.C.
September 21, 2009

85% of our carbon emissions reductions will come from Energy Efficiency!

"We'll fund a better, smarter electricity grid and train workers to build it -- a grid that will help us ship wind and solar power from one end of this country to another."

"Think about it. The grid that powers the tools of modern life -- computers, appliances, even BlackBerrys -- looks largely the same as it did half a century ago."

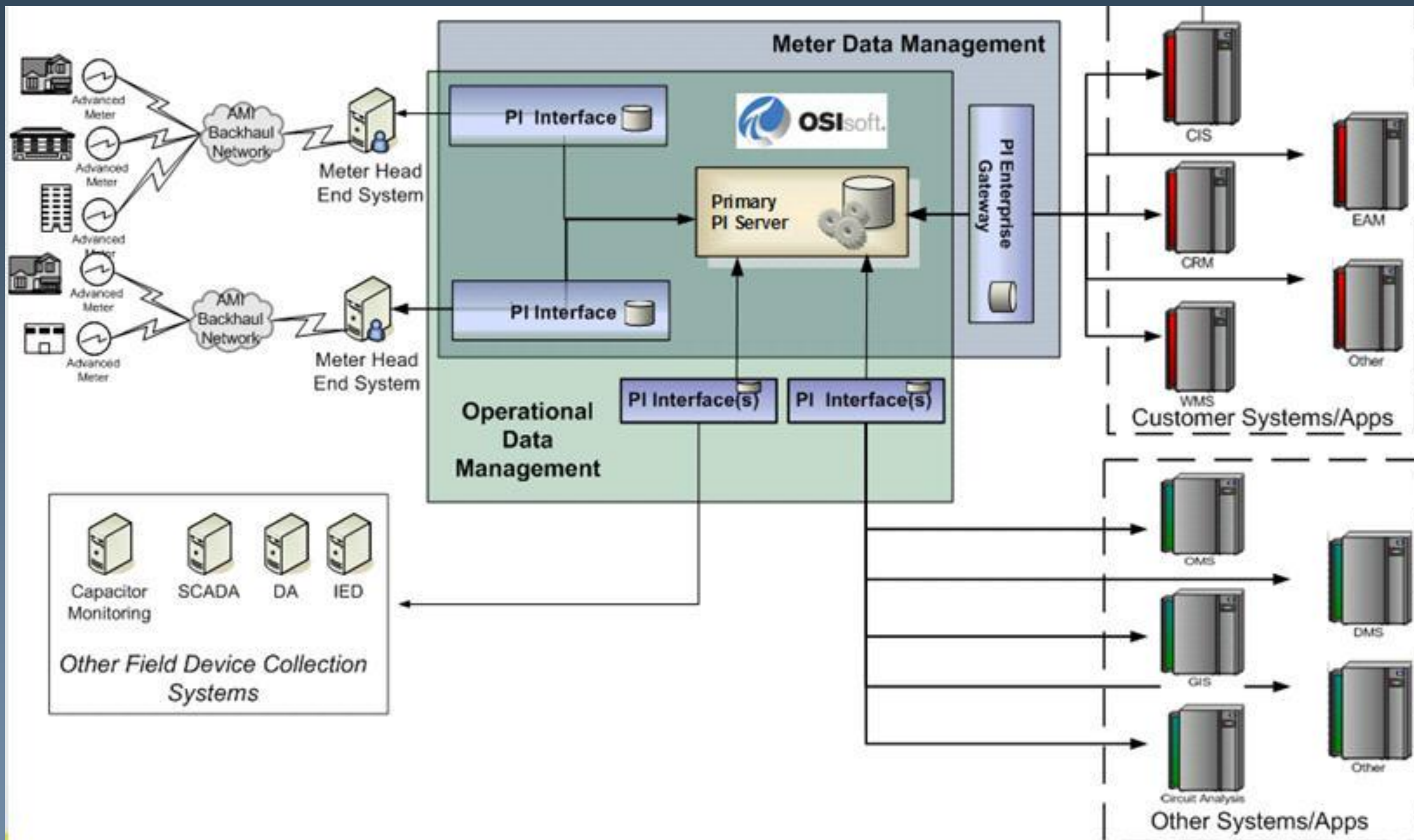
President Barack Obama

To meet the energy challenge and create a 21st century energy economy, we need a 21st century electric grid

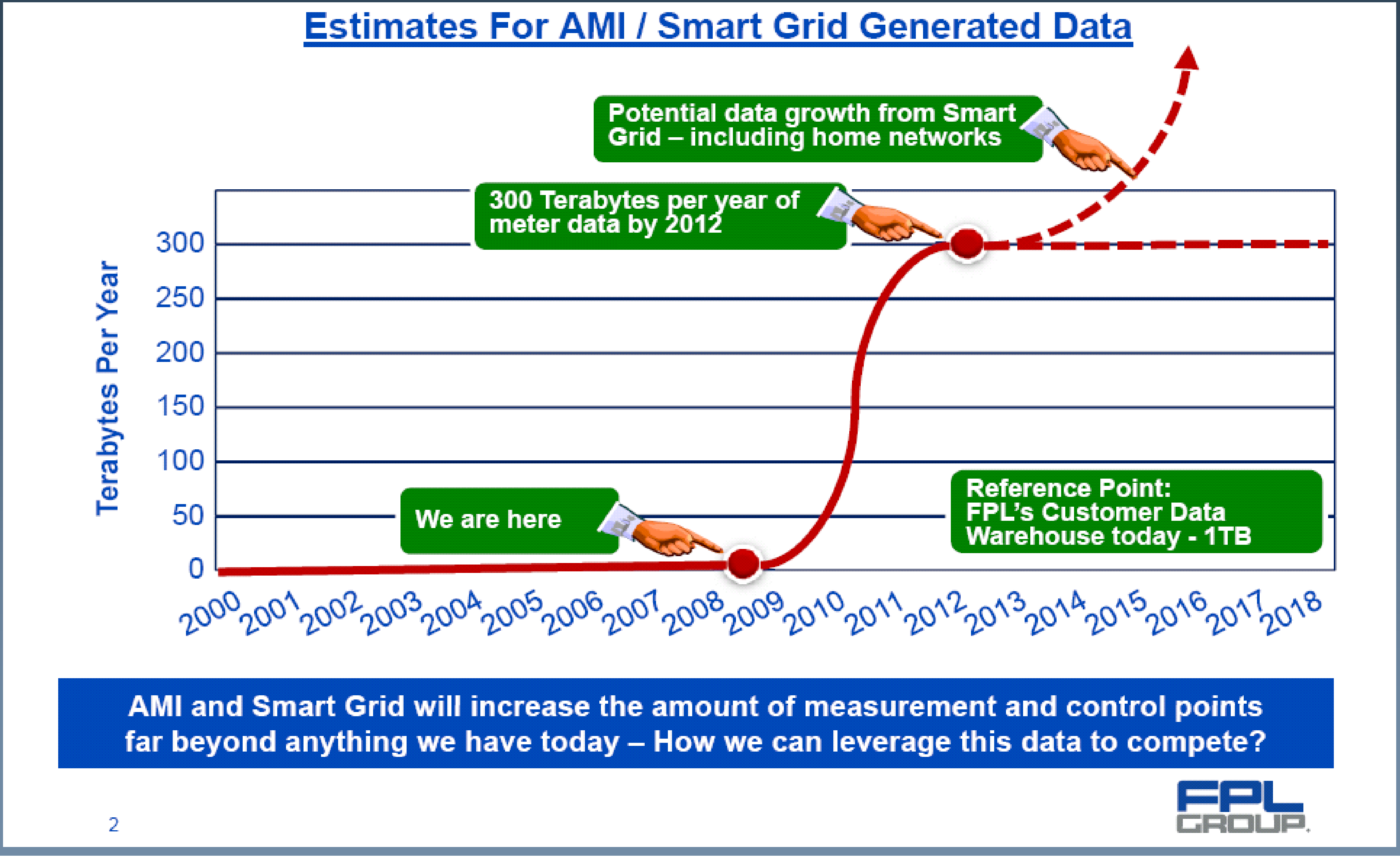
Utility Perspective

- We see a lot of investment in the "Smart Grid"...a lot of this investment goes to AMI projects...
- Primarily driven by the CFO/CIO office, in support of billing requirements
- However, some utilities are starting to see the need for operational level data, and to go "below the meter" and fundamentally changing the utility/user role
- Resulting in Hierarchical Structures, Real-Time Models (CERTS, DER-CAM, DEW, CIM et al) and MASSIVE DATA

PI as a MDUS and ODMS



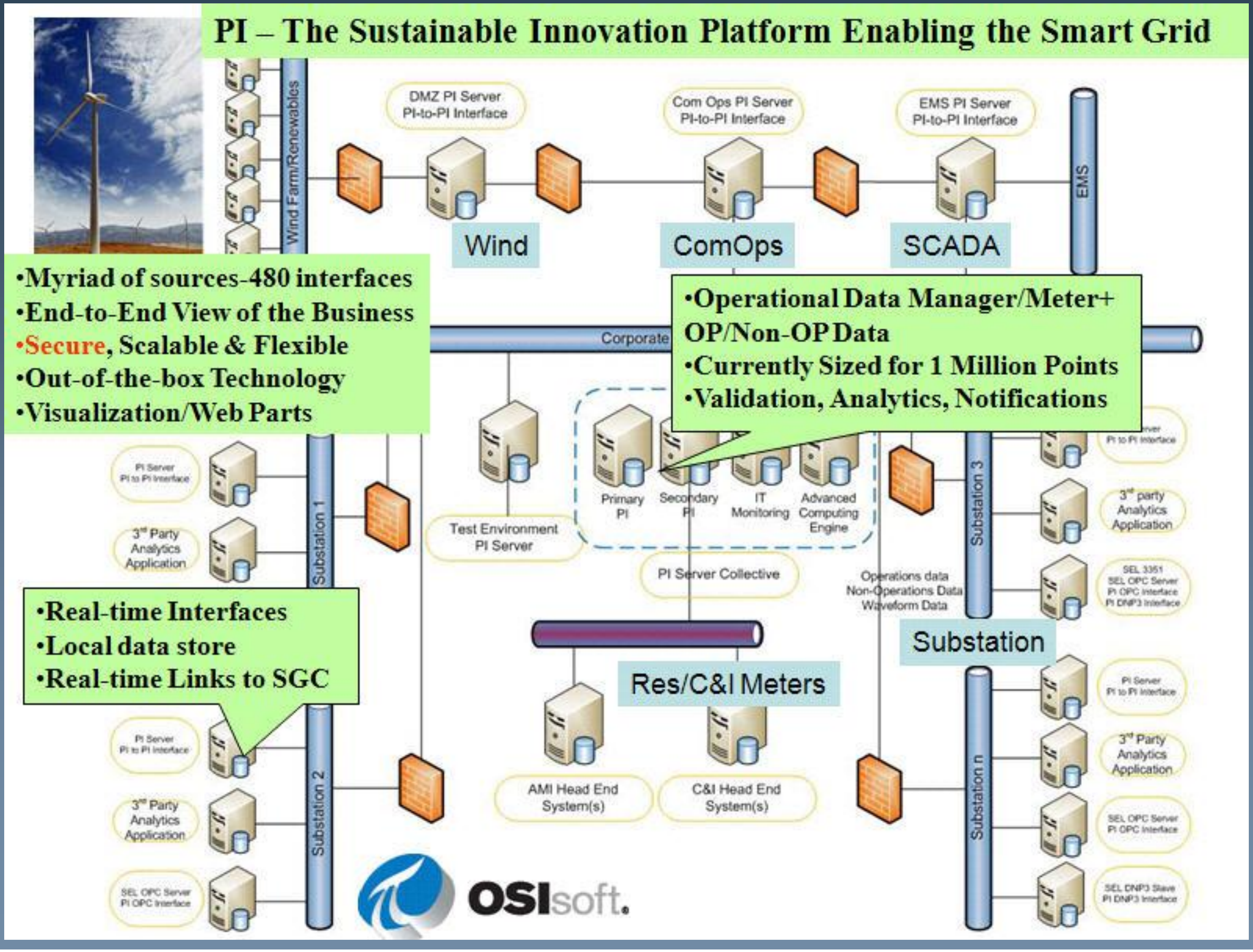
Data, Data, Data and more Data



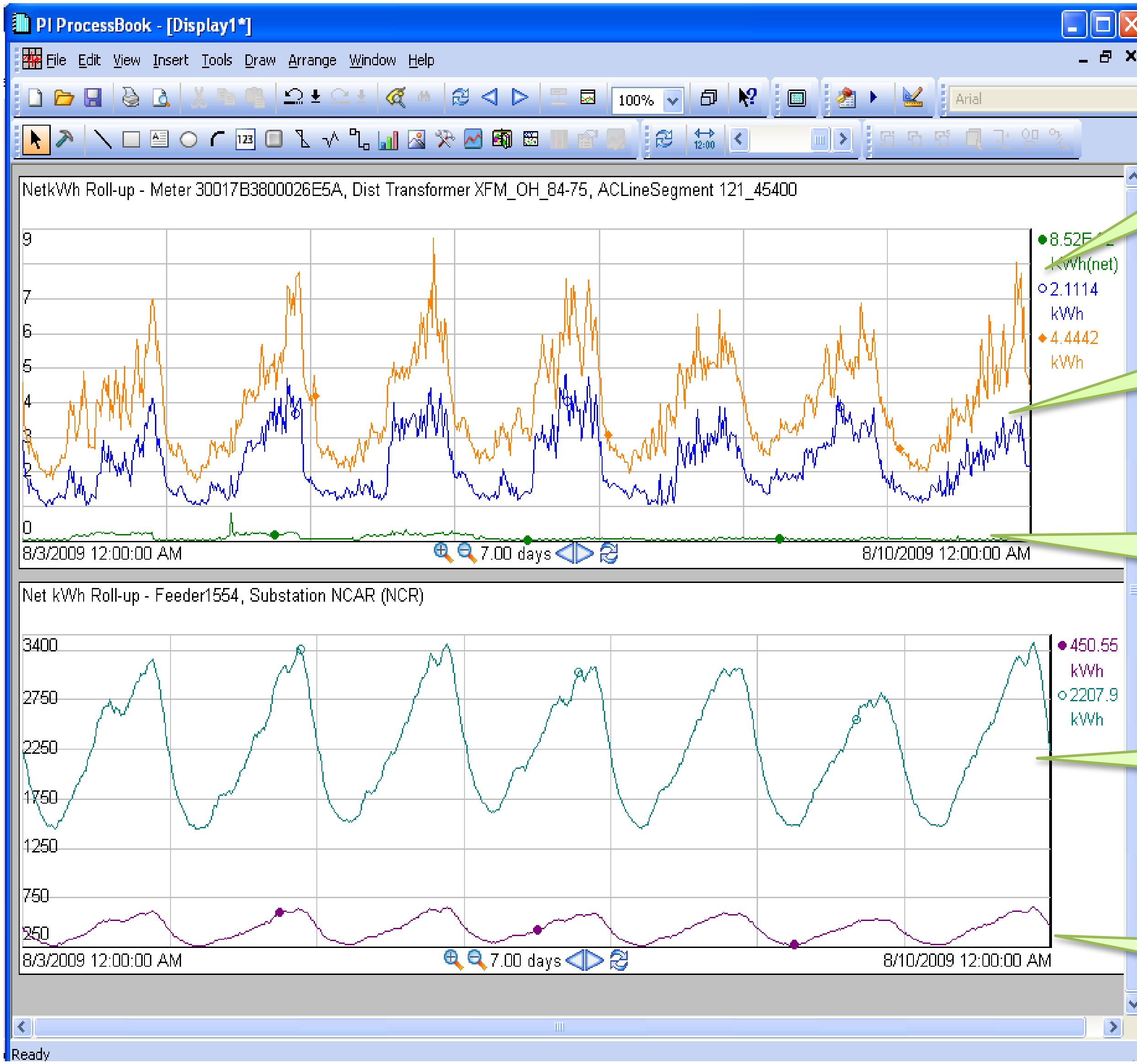
OSIsoft Deliverables for Xcel's SmartGridCity™

- PI OSIsoft used as Operational Data Management System (PI-ODMS):
  - Blend of meter and operations on one system
  - 1 Million Points with 2-second to 15-minute scan/updates
    - Represents 4 substations, 25K customers & 25 feeders
    - End-to-end Seamless View of the grid
    - System of Record for Time-series Data
  - Meter & Substation Data Management
  - Model Management
  - Visualization with Situational Awareness

The Innovation Platform for SmartGrid



Understanding the “Roll-up” Mechanism: Net KWh Roll-Up



Orange = All distribution transformers summed to circuit segment

Blue=All AMI Meters summed to distribution transformer

Green = Individual AMI Meter

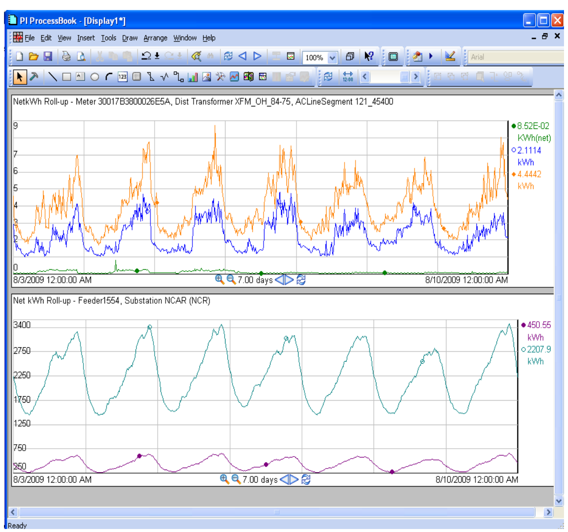
Cyan = total feeders summed to sub

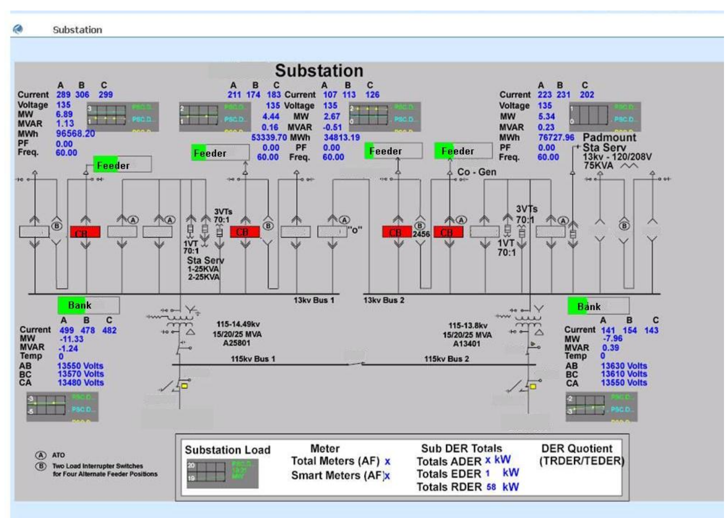
Purple = circuit segment summed up to feeder

Understanding the "Roll-up" Mechanism: Net KWh Roll-Up

•Key Points:

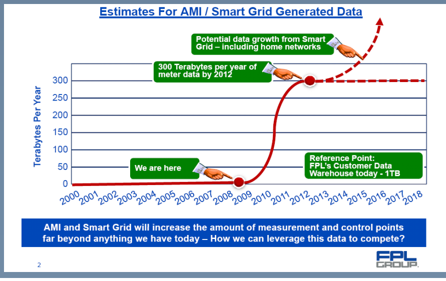
- Each trend shown is aggregated load (kWh) up to the next higher trend from an individual meter, transformer, line segment, breaker, and sub.
- If you overlay the Distribution SCADA load (from PI), the difference would be losses or leakage
- The physical model is in AF (CIM) allowing the aggregation and roll-up of individual loads
- End to End Utility visibility – Basic PI integrating meter and distribution system(s) operational data – ***to the meter….but what about going below the meter***?





Total number of potential measurements (500MW municipality)

- PMUs
  - 20 PMUs on sub transmission (30,000 events per second)
  - 400 PMUs on PCC of microgrids (600,000 eps)
- Each Microgrid (C&I, Data Center, Campus, Hospitals)
  - 400 Microgrids (5000 measurements @ 1 Hz)
- Substations
  - 30 Digital Substations (Digital relays, transformer, breaker monitors)
    - Each with 2000 measurements at subsecond intervals(10,000 eps)
- Smart Meters
  - 50,000 at 10 points each sampling at 15 min
- **Total data rate 2.9 million events/sec**

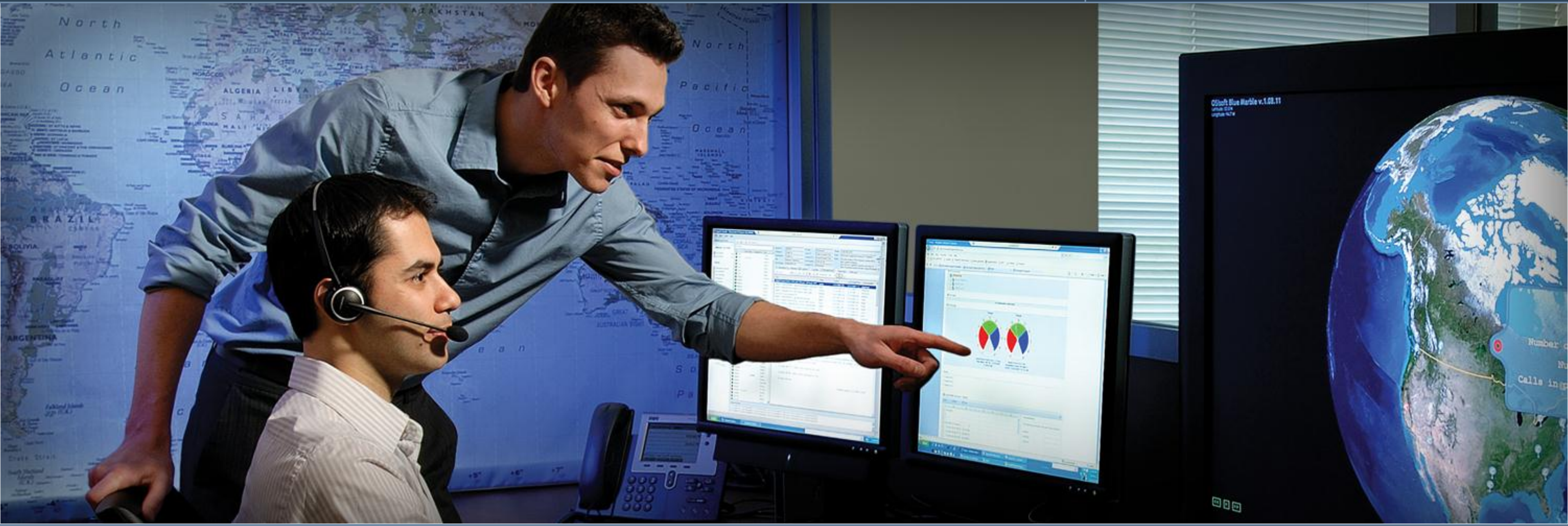


Observations on Smart Grid
Industrial User Perspective

OSIsoft

Regional Seminar Series
Cincinnati

SMART PAPERS



Distributive Generation / Micro Gridding

Dan Maheu
President & COO
SMART Papers Holdings LLC

October 7, 2009

Empowering Business in Real Time.

SMART Power/SMART Paper

- SMART Power Business produces steam from coal and generates electricity through a steam turbine system.
- Supplies SMART Paper manufacturing operation with steam & electricity.
- Produces electricity for sale into the Grid
- SMART Power charges SMART Paper for electric and steam.
- SMART Power generates revenue by selling electricity into the grid through MISO (Midwest Independent Systems Operators) node (SMART.Gen and SMART.Load)
- Registered MISO participant for electric transactions (effective 12/15/2008).
- An Ohio PUCO registered CRES (Competitive Retail Energy Supplier) (effective 6/1/2009)
- Licensed to purchase wholesale electric from MISO and sell it to its customers, currently Paper.
- Power adjusts and reacts to the real time price at its MISO node to adjust generation levels (sell to grid, zero with grid, or purchase from grid).

FERC

- FERC power marketing application submitted, into FERC review process.
- Required for any significant expansion of Grid supply.
- Power expects to receive the license during 3rd quarter 2009.

SMART Power Business Description

Equipment Overview

Boilers

2 coal fired boilers.

Total permitted heat input to the combined units is 603 MMBTU/hr.

The total steam and total electrical needs of Paper are met with the steam plant operating at about 170,000 #/hr.

The additional is used to respond to favorable pricing on the Grid producing up to the current Tie Transformer limit of 20 MW per hr of electric beyond plant needs.

Power can also pull the steam plant back to minimum load of 120,000 #/hr to supply total Paper steam need, reduce electric generation and allow the purchase of 3 to 4 MW/hr from the Grid if market prices are lower than condensed generation costs adjusted for CRES fees.

SMART Power Business Description

OSIsoft.

Electric Grid Interface

Power is connected directly at 69 KV transmission level and owns all assets through the transformer to 69 KV. By law the 69 KV switch is owned by the utility (Duke) as it is part of the public transmission system.

SMART Paper Energy Loads

The electrical station load for Paper is about 6 MW//hr and the Power parasitic load is about 1.7 MW/hr supplying paper rising to 2.5 MW/hr at maximum electric generation and dropping to 1.3 MW/hr when purchasing from Grid.

Paper is charged monthly by Power for its actual electric consumption and actual process steam consumption.

Grid Sales

Power participates in MISO in the real time market, the day-ahead market and routinely evaluates Bilateral agreements. Power has not yet elected to participate in MISO's recently established Ancillary Services segment.

Power is also open to and presenting opportunities for other clients with electrical, steam or other utility needs to locate on its site and be served by Power.

SMART PAPERS

Distributive Generation / Microgridding

Key to Making Distributive Generation Work

Real Time Data

- Assembled into useful operator interfaces
- Management monitoring
- Business evaluation

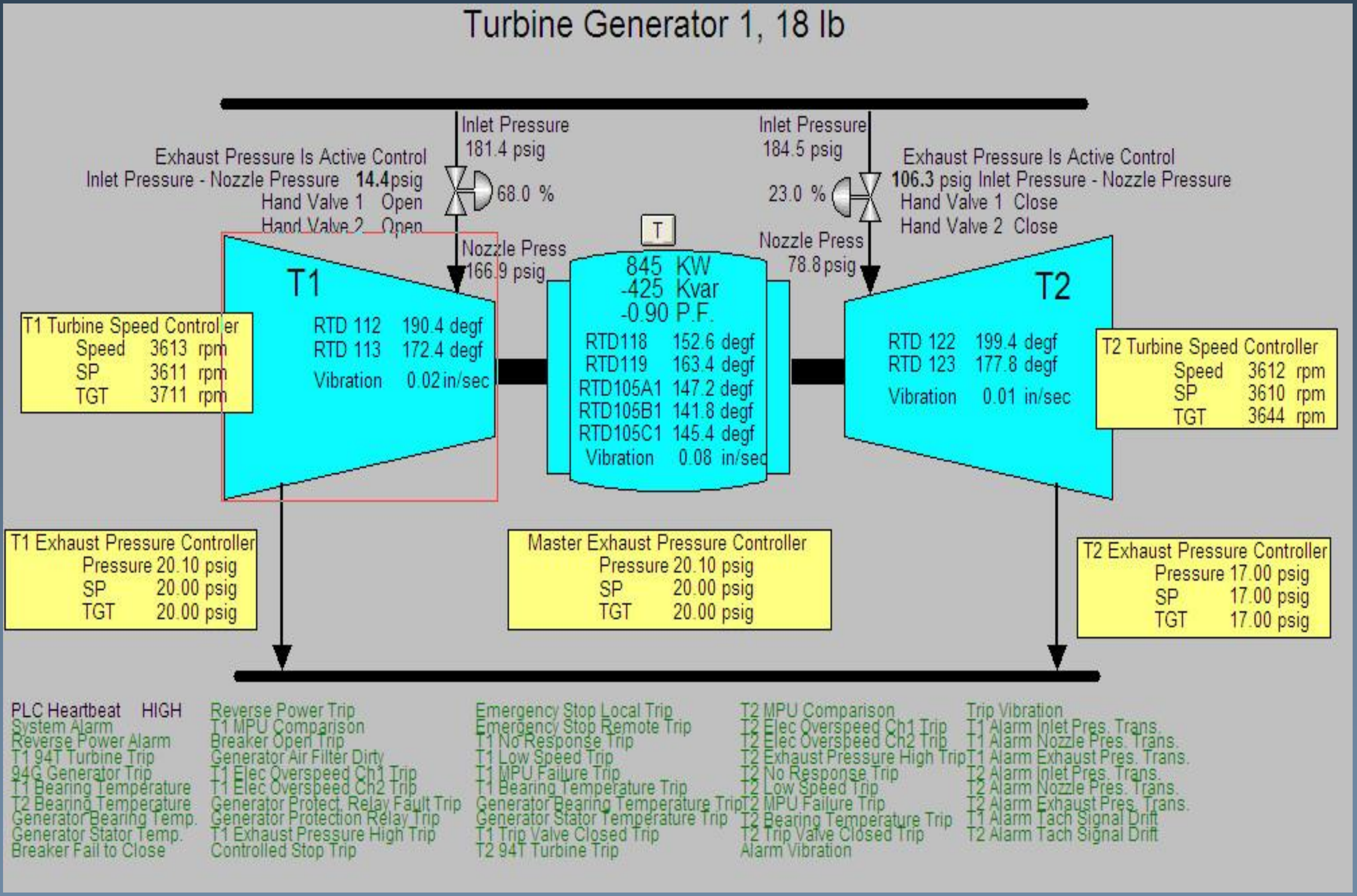
From Multiple Sources

- Internal
- External

What is the role of PI for SMART Power?

Very Typical Uses of PI

Turbine Generators



Distributive Generation / Micro Gridding

Less Typical Use of PI (for a paper mill)

- Operator Real Time Data from the Grid Interface –
  - MW, MVAR, PF, MVA
- Operator Must Control
  - MW and MVARs

Power Factor & VAR Control

		E MW	F MVAR	G PF	H MVA
20J:9005	**Tieline (+ = buy)**	-3.43	-0.48	-0.99	3.46
	Generation				
78:J2280	Process Turbines (- sign = generate)	-0.76	0.40	-0.89	
73:J0240	TG3	0.00	0.00	0.00	
75:J0312	TG5	0.00	0.00	0.00	
76:J0312	TG6	0.91	2.15	-0.39	
97:W1010	TG7	4.80	2.10	0.92	
98:W1010	TG8	4.99	3.10	0.85	
78:MILLTOTGENMW.C	**Total Generation**	11.47	6.94		
	Utilities Consumption				
78:J2145	10 Boiler (cir 1A)	-0.42	-0.56	0.60	
78:J2210	Boiler Plant (cir 11A)	-0.37	-0.22	0.85	
78:J2180	69 & 70 Air Compressors (cir 13A)	0.00	0.00	1.00	
78:J2235	14 Boiler substation (cir 17A)	-0.52	-0.49	0.71	
78:J1672	480V Steam Plant (cir 4A14-6)	-0.16	-0.15	0.71	
78:J1677	480V Turbine Plant (cir 4A14-14)	-0.01	-0.00	1.00	
	Condensing Turbine Process	-0.58	-0.31	78:CONDTURBAUXMW.C	
	Total Utilities Consumption	-2.05	-1.74	78:SMARTPOWERELECUSEMW.C	

Other Measurements (not in the balance

CB 352 Grid Interconnect

78:J2010 3.35 0.32 0.93

Condensing Turbine Area net (minus is to mil

78:J2035 -9.22 -4.92 -0.88

go to MW trend

go to MVAR trend

Distributive Generation / Micro Gridding

Operator Real Time Data of Power Pricing at the Grid Node

Key Data

- 5 Minute Price
- Average for the Hour to Date
- Working Average
- Decision Points

Sources: Power Marketer, ISO via Internet

MicroGrid:
The Industrial User on the Smart Grid

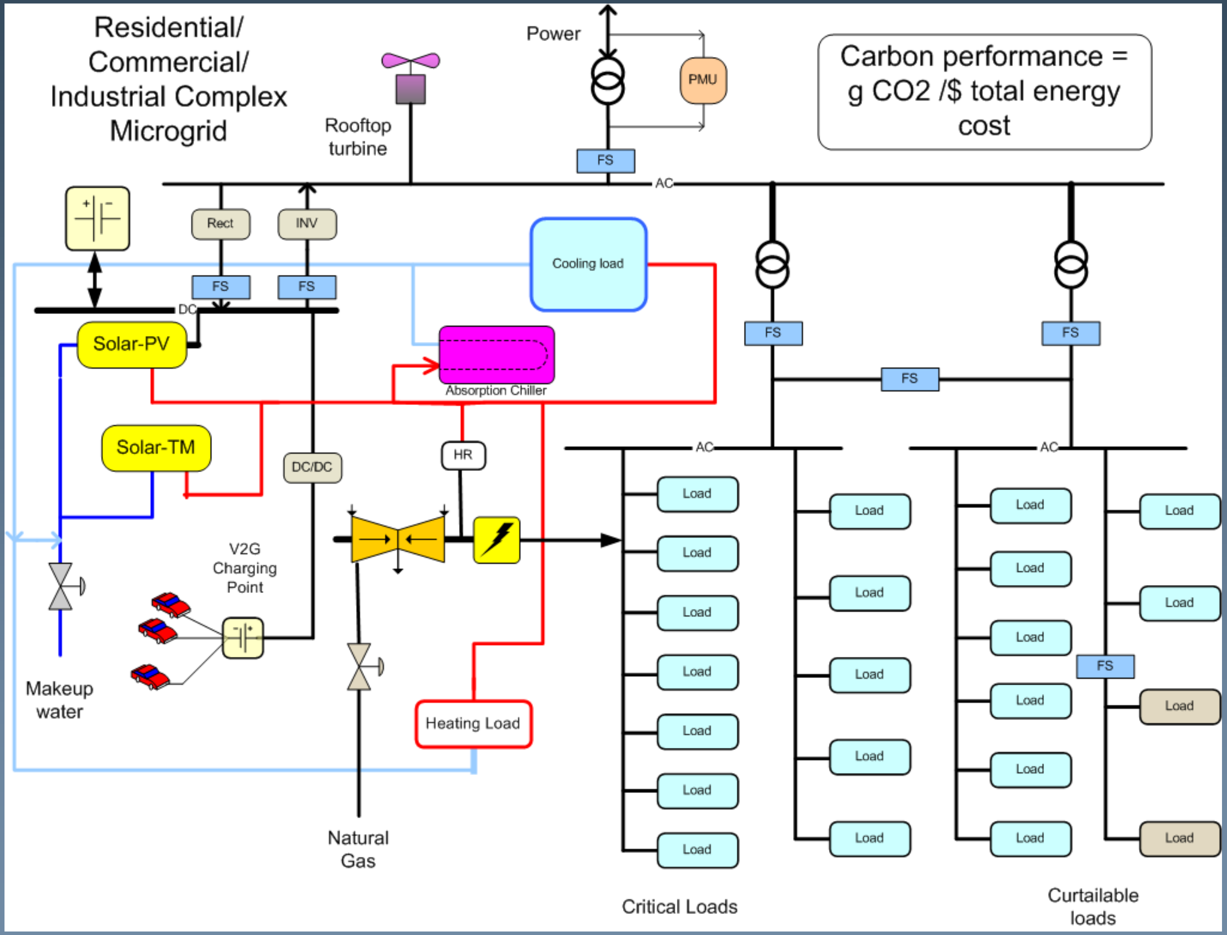
The Perfect Mix…

- Tremendous regional renewable energy resources
- Large Commercial & Industrial Base
- Renewable Portfolio Standard
- Increasing Intermittency Challenges
- Electricity/Carbon as a product cost increasing
- “Smart” grids as an enabling technology

Microgrids as a Solution?

- What is a Microgrid? It is a collection of generation sources and loads that can be separated seamlessly ("islanded") and bumplessly (e.g. usually contain some form of high speed storage) from the main grid and reconnected and during this time, frequency and load balance are controlled locally in the Microgrid.
- Typical Microgrids can be large factories with internal power generation, large industrial or commercial complexes and other facilities with backup power generation such as universities, hospitals and data centers, renewable or V2G (Vehicle to Grid) energy power, and distributed renewable energy sources from solar or wind.

What is a Microgrid - Commercial/Industrial Perspective



Functions of the Microgrid

- Direct control of loads and sources
  - Direct connection to each building EMS
  - Sends direct orders to building EMS
- CERTS voltage control, power factor and frequency of microgrid while disconnected
- Accurate revenue meter with TOU bins (0.025 percent accuracy)
- Provide local frequency control when connected to grid
- Provide DC charging bus for PHEVs/EVs
- Provide V2G, B2G functions while connected
- Provide Browser views of energy/power consumption to enterprise employees including carbon footprint.
  - Encourage employee conservation/awareness
  - Real time display of performance

Candidate "Sites" for Microgrids

- Typically <10MW Peak Load Sites, however larger can be accommodated with policy change:
  - Factories
  - Hospitals
  - Industrial and Large Commercial Facilities
  - Data Centers
  - Shopping Malls & Big Retailers
  - Universities (e.g. UCSD as active case example)
- High energy intensity per square foot facilities, <u>ideally with a heat load</u>

Expectations from Smart Grid Projects

- Increased renewable integration
- Increased reliability
- Lower power losses
- Lower customer prices
- Integration with existing systems
  - IT infrastructure
  - Operational systems
- Reduce carbon footprint (g/kWh)

Closing Thoughts & Dinner Discussion Topics

- Can the smart grid enable innovation "at the edge" much in the same way breaking up the telecoms did?
- Can Commercial & Industrial users achieve "Energy Independence"?
- Do Microgrids represent a Black Swan for the utility industry?
- That's a lot of data…what would you do with it?
- Do you live in Mediocristan or Extremistan?

OSIsoft®

vCampus | 2009 LIVE!

"where PI geeks meet"

THANK YOU.