Overview of OSIsoft in the Global Power and Utilities Industry

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EMEA Power and Utilities Industry Principal

INDUSTRY FORUM

Agenda

Agenda

- Introduction
- Uses cases
  - CCGT
  - Coal
  - Hydro
  - Renewable
  - T&D
- Summary

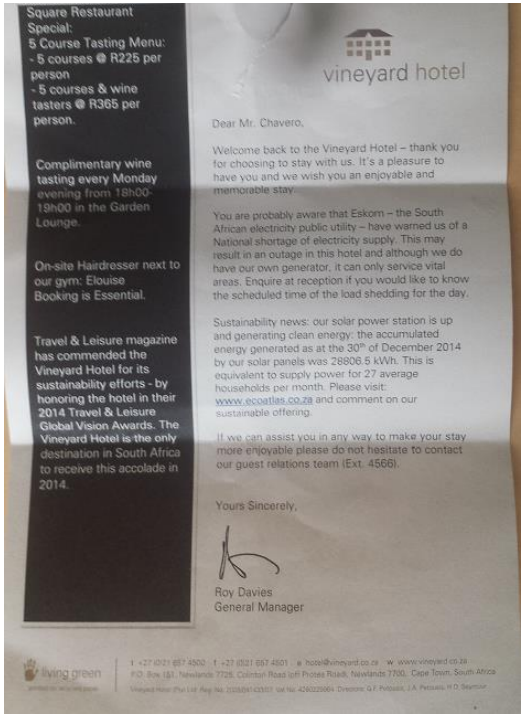
Introduction

Defacto Standard in Power and Utilities

EMEA References PowerGen (non exhaustive)

European T&D references

Big Challenges…



What's coming?

Use Cases

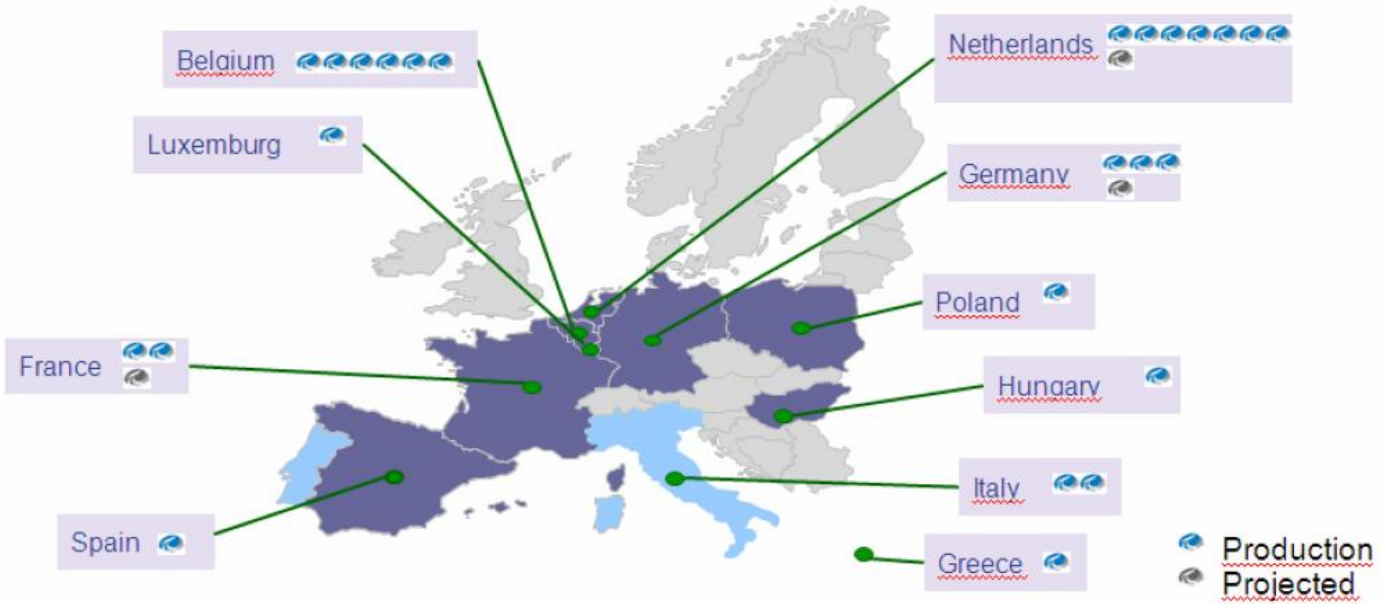
Use Cases

CCGT	Coal	Hydro	Wind	Solar	T&D

Real-Time Infrastructure use cases deployment in leading companies

GDF SUEZ

European PI Systems



Platform core usage

GDF SUEZ

Power Generation

- Generation Reliability coordination
- Production benchmarking
- Power plants installations supervision
- Generation statistics control
- Production deviation control
- Plants emission control
- Green certificates management
- Performance calculations

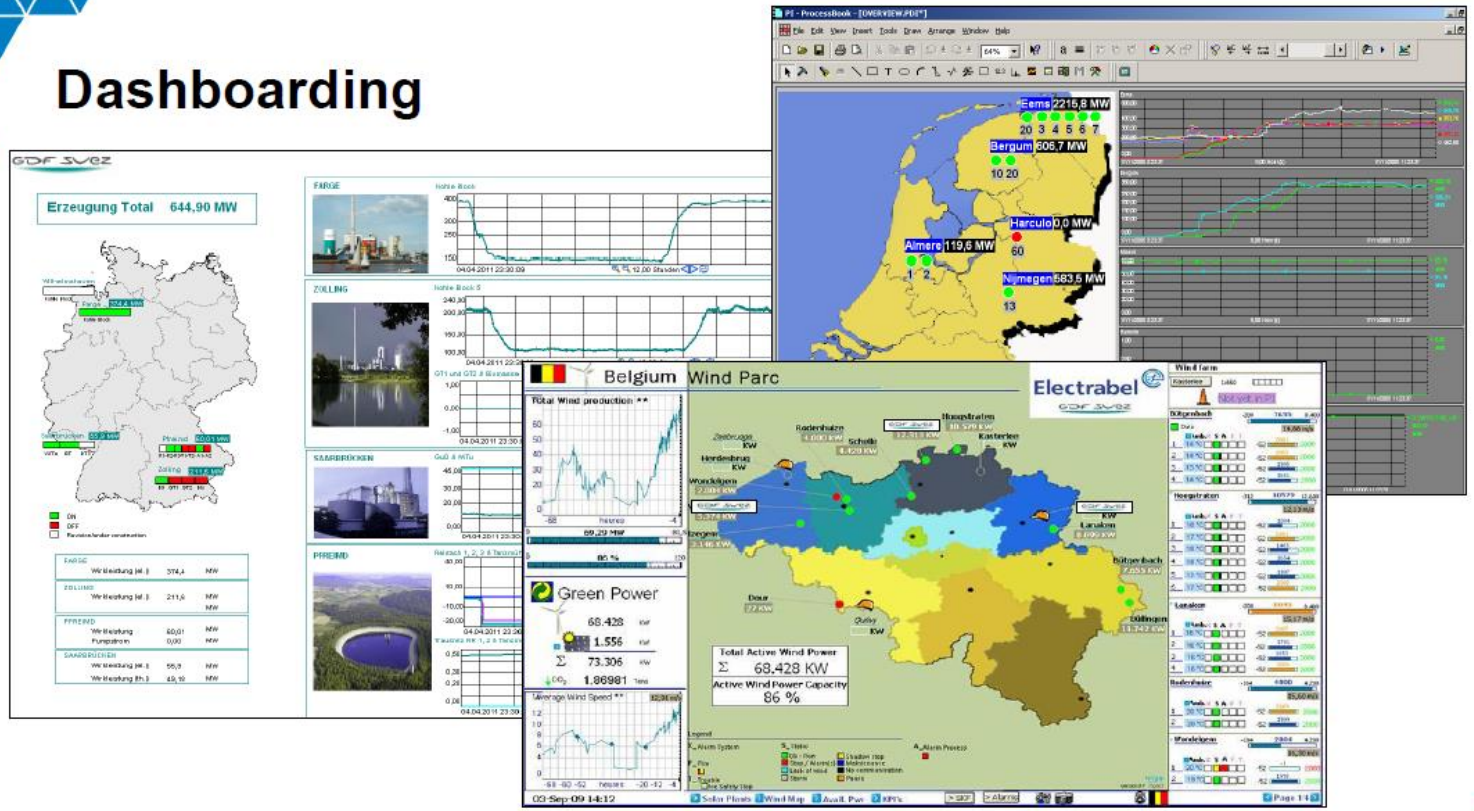
Trading & Portfolio Management

- Gas Nomination
- Gas stocks status
- Gas balancing management
- Fuel invoices control
- Fleet overview and control
- Production regulation control
- Network Ancillary Services regulation
- Spoc[1] of the transmission operator
- Customer short term evolution
- (Un-)Availabilities coordination

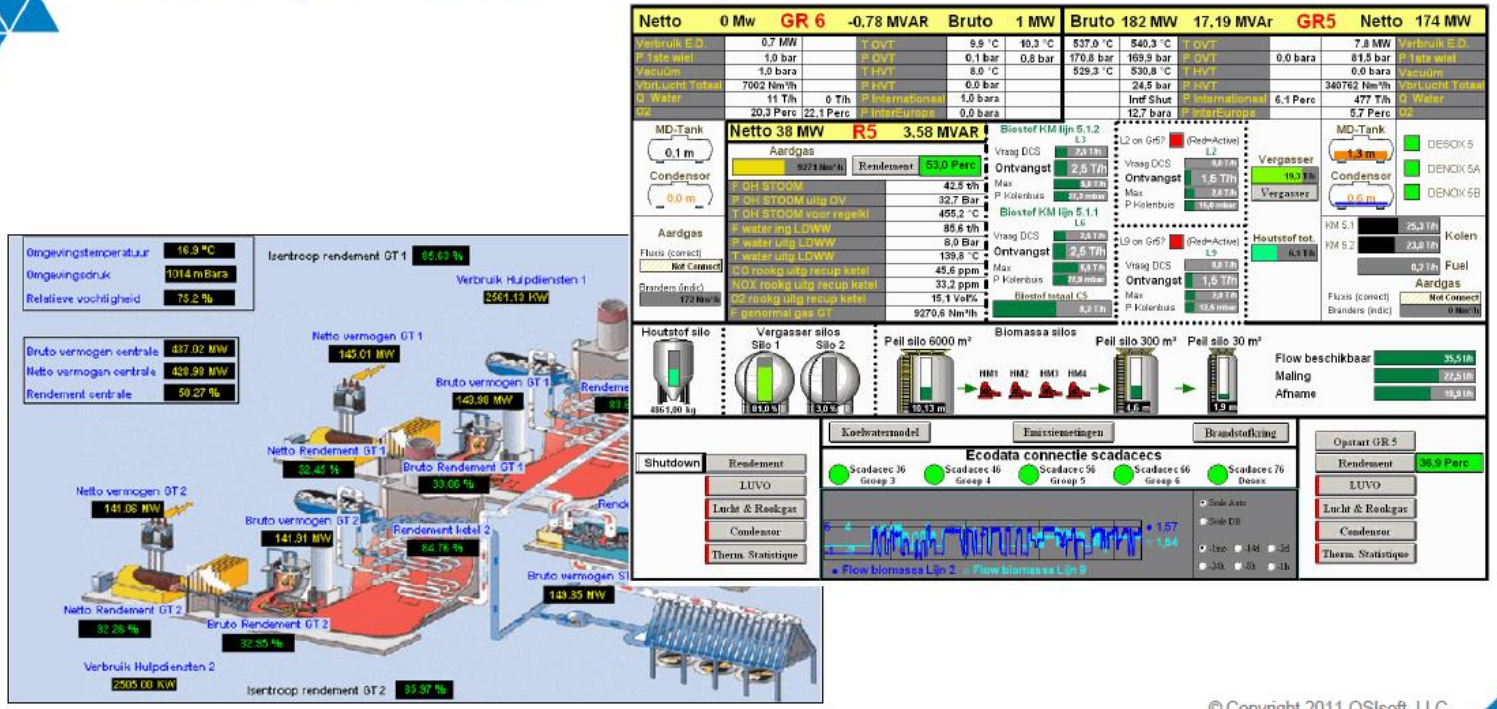
Marketing & Sales

- Client nomination management
- Clients on-line metering
- Clients deviation management
- Clients outages management

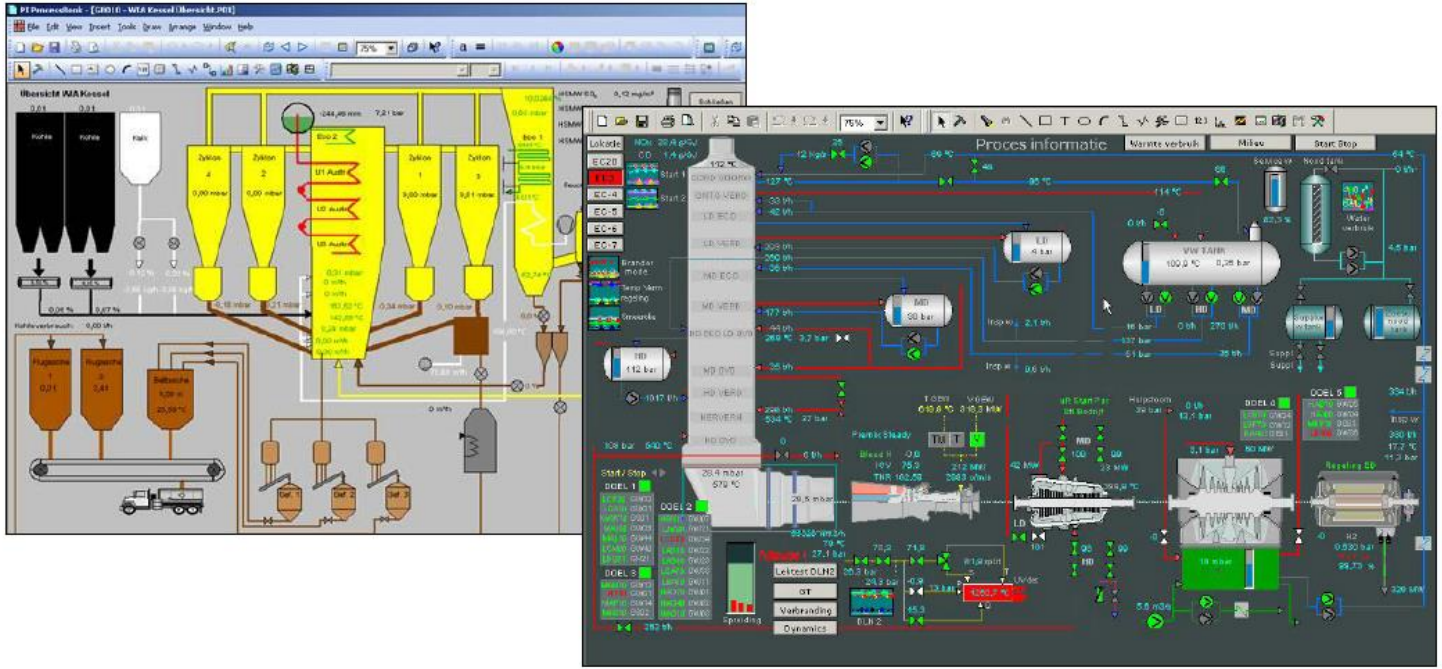
Dashboarding



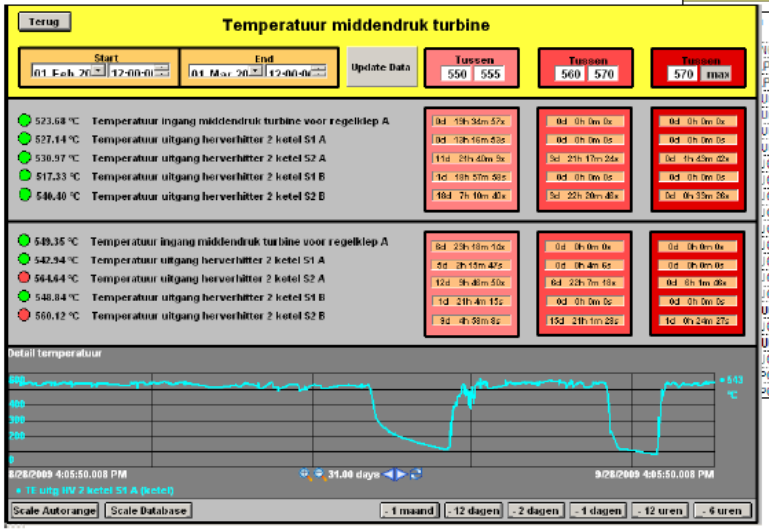
Plant operational 'Cockpits'



Detailed installation monitoring



Lifetime monitoring



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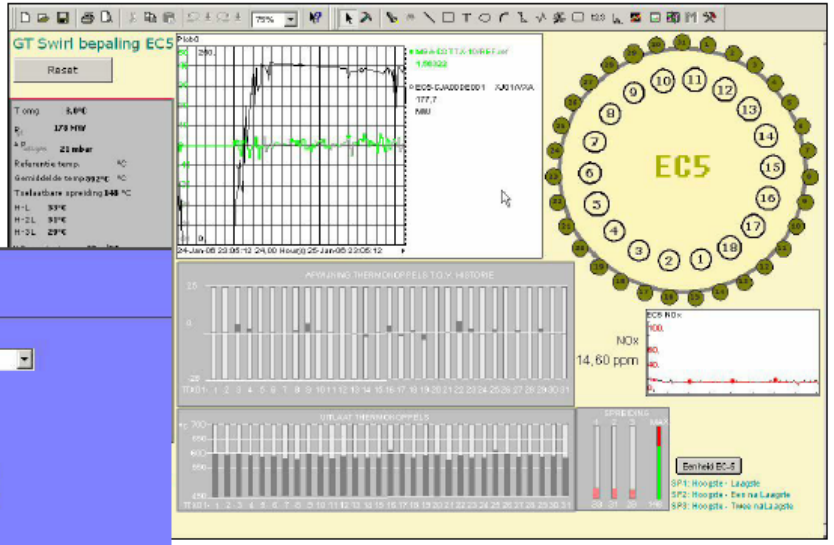
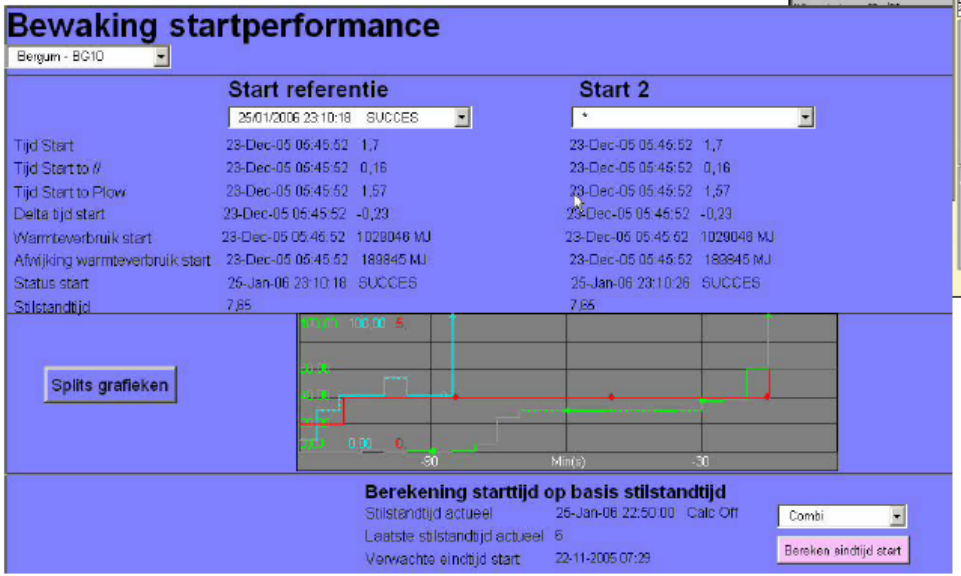
0010-XB01	Ventil trafo uigesch. UIT	1	0	0	0	0	0	0	
P010-XB01	Aanvulwaterpomp 21-IN	1	34	178	774	1178	1464	1848	22
P010-XB01	Aanvulwaterpomp 20-IN	0	0	0	173	194	275	349	
U011-XB01	Aandrijving aspan Aa-IN	1	34	177	770	1167	1321	1698	20
U012-XB01	Aandrijving aspan Ab-IN	1	34	177	770	1167	1321	1698	20
U021-XB01	Aandrijving aspan Ba-IN	1	34	177	770	1167	1321	1697	20
U022-XB01	Aandrijving aspan Bb-IN	1	34	177	770	1167	1321	1697	20
0003-XB01	Motor aandrijving 3Ab hutrecht3A-INSCH	1	34	178	774	1181	1468	1850	22
0049-XB01	V reg K vlg 3Ab hutrecht 3A - INSCH	0	34	178	774	1181	1276	1601	19
0007-XB01	Motor aandrijving 3Ba hutrecht3A-INSCH	1	34	178	774	1181	1468	1850	22
0085-XB01	V reg K vlg 3Bb hutrecht 3A - INSCH	0	34	178	774	1181	1281	1609	19
0010-XB01	Motor aandrijving beata A-IN	1	34	178	774	1181	1357	1739	20
0003-XB01	Motor aandrijving 3Aa hutrecht3B-INSCH	1	34	178	774	1181	1468	1850	22
0049-XB01	V reg K vlg 3Aa hutrecht 3B - INSCH	Intf Shut	0	0	0	0	0	0	
0007-XB01	Motor aandrijving 3Ba hutrecht3B-INSCH	1	34	178	774	1181	1468	1850	22
0010-XB01	Motor aandrijving beata B-IN	1	34	178	774	1181	1357	1739	20
U010-XB01	Aandrijving kolenmolen 3A-IN	0	34	178	774	1181	1278	1604	19
0010-XB01	Aandrijving kolenmolen 3A-IN	0	34	178	774	1181	1278	1604	19
U010-XB01	Aandrijving kolenmolen 3B-IN	1	34	178	774	1181	1275	1591	19
0010-XB01	Aandrijving kolenmolen 3B-IN	1	34	178	774	1181	1275	1591	19
P010-XB01	Smeeroliepomp reductor KV A-IN	1	34	178	774	1181	1468	1850	22
P010-XB01	Smeeroliepomp reductor KV B-IN	1	34	178	774	1181	1468	1850	22

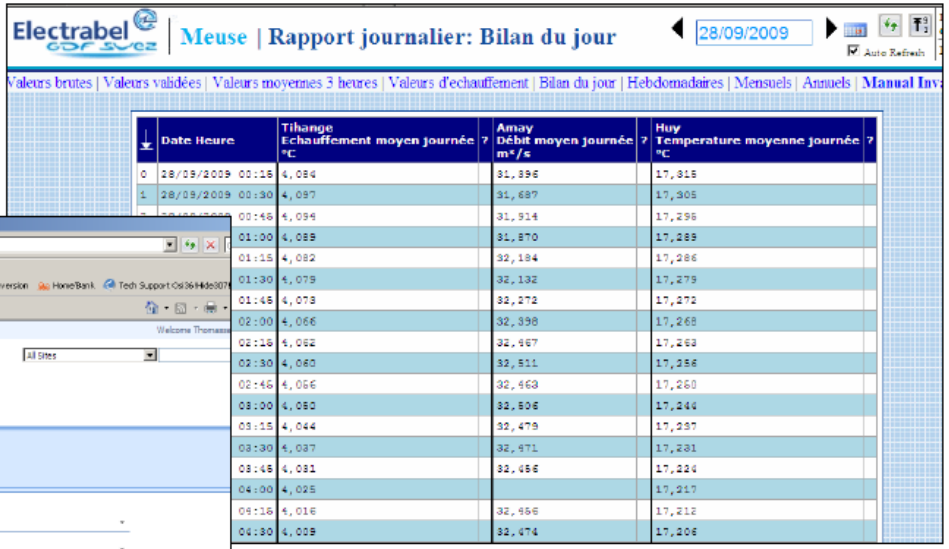
Target follow up for specific sub-processes

Specialized tools





Web publishing



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0	28/09/2009 00:15	4,084		31,896		17,315	
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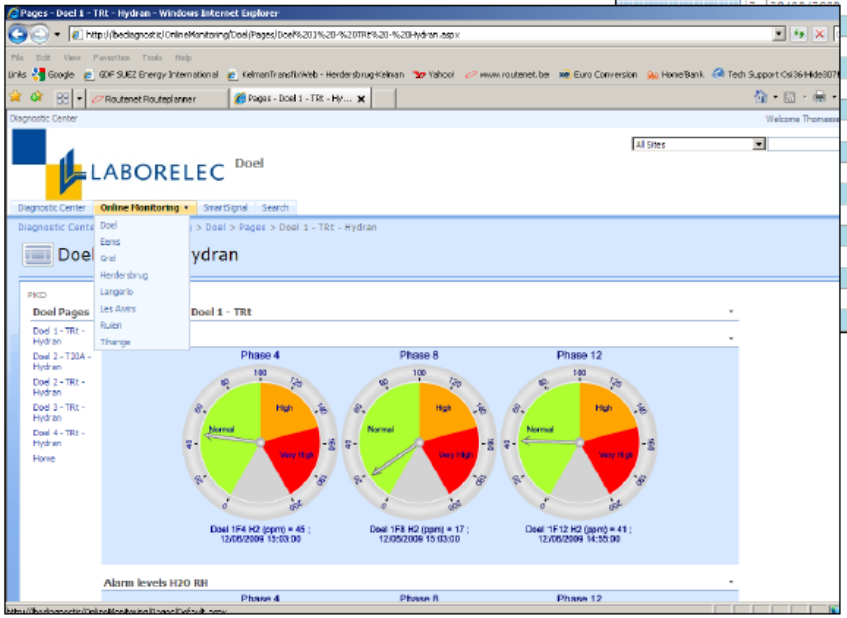
				00:45	4,094	31,914	17,296
				01:00	4,089	31,870	17,289
				01:15	4,082	32,184	17,286
				01:30	4,079	32,132	17,279
				01:45	4,078	32,272	17,272
				02:00	4,066	32,398	17,268
				02:15	4,062	32,467	17,263
				02:30	4,060	32,511	17,256
				02:45	4,056	32,463	17,260
				03:00	4,050	32,506	17,244
				03:15	4,044	32,479	17,237
				03:30	4,037	32,471	17,231
				03:45	4,031	32,456	17,224
				04:00	4,025		17,217
				04:15	4,016	32,456	17,212
				04:30	4,009	32,474	17,206



Benefits: 'Can you make money with the PI System?'

Hard to quantify.. But we are sure we do:

- **By monitoring performance of our installation components in detail**

  → Unhide oportunities to improve performance

- **By counting running hours, switching operations, pressure losses in time**

  → Enable proactive maintenance & avoid possible incidents

- **By using PI System data during commissioning of new installations**

  → Compare supplier performance data with ours (force performance improvements or refunds)

Benefits: 'Can you make money with the PI System?'

Hard to quantify.. But we are sure we do:

- **By improving Data Quality**:
  - → Energy Balances, Automated Data Validations
  - → Compare fuel bills and system operator settlement data to our own validated data

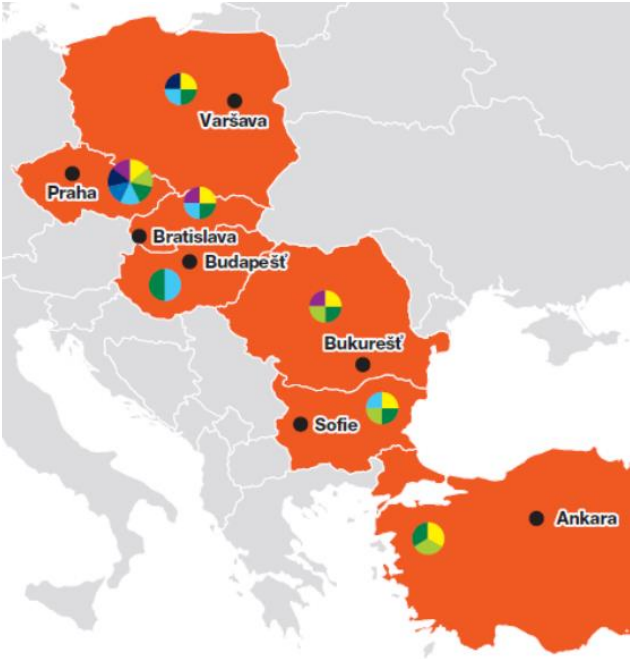
- **By reducing manual workload**
  - → Automated reporting
  - → Avoiding manual input in other systems (PI System can interface with most external systems)

- **By avoiding 3rd party development**
  - → Rich tools for visualisation and calculations: we can do much more ourselves

CEZ

Introduction of CEZ Group

- CEZ Group is an integrated electricity company with operations in a number of countries in Central and Southeastern Europe and Turkey, with its headquarters in the Czech Republic (Installed capacity 15 199 MW).



- CEZ Group currently operates:
- 2 nuclear power plants
- 15 coal-fired power plants
- 35 hydropower plants, including 3 pumped storage plants
- in the Czech Republic.

- 2 locations with wind power plants (Fantanele 600MW)
- 3 coal-fired power plants abroad.

- CEZ is the largest electricity producer in the Czech Republic
  - producing nearly 60 TWh a year (approximately 50% in NPP)

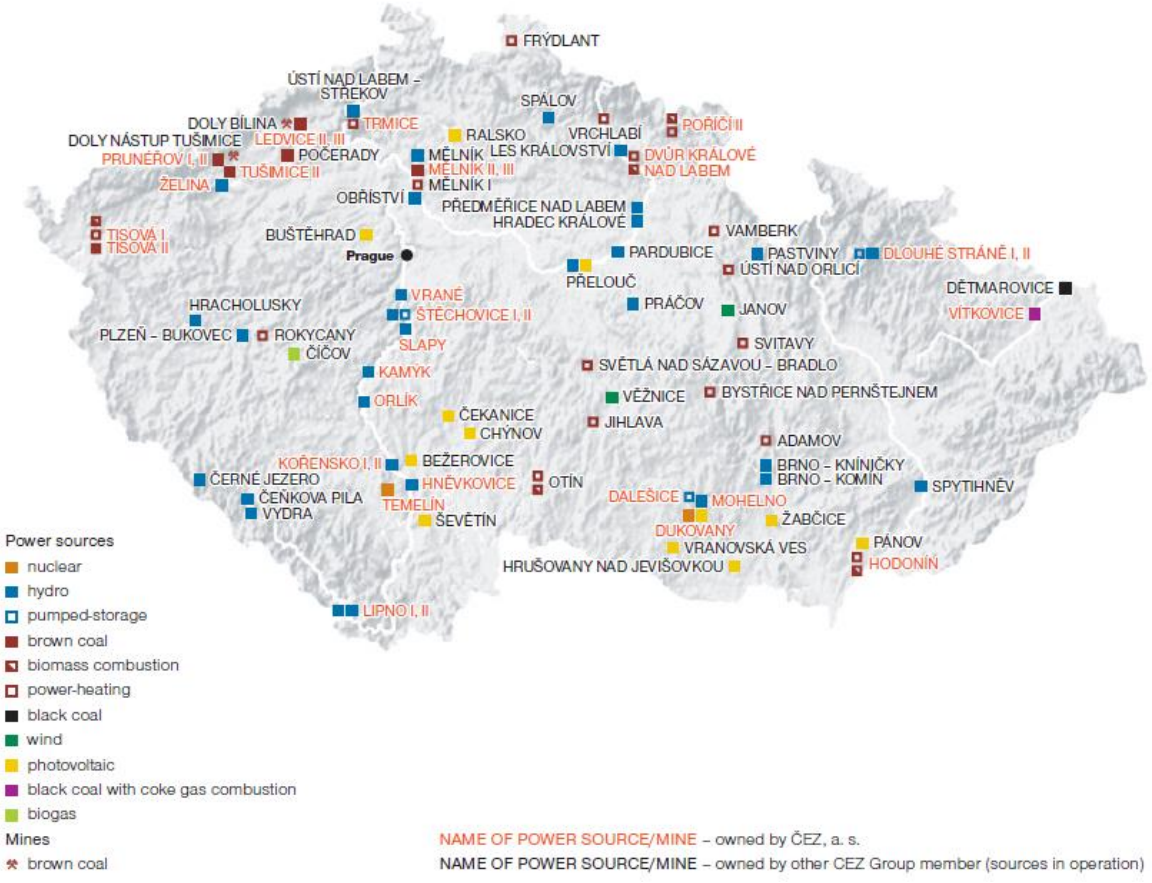
CÚTD Project

(Central storage of process data)

Purpose:

- unification of data base technology data
- savings in other systems and subsequent projects

- The project includes:
  - replacement of existing storage
  - migration of all necessary data from the original storage
  - switching applications to new storage



Project of PowerOPTI

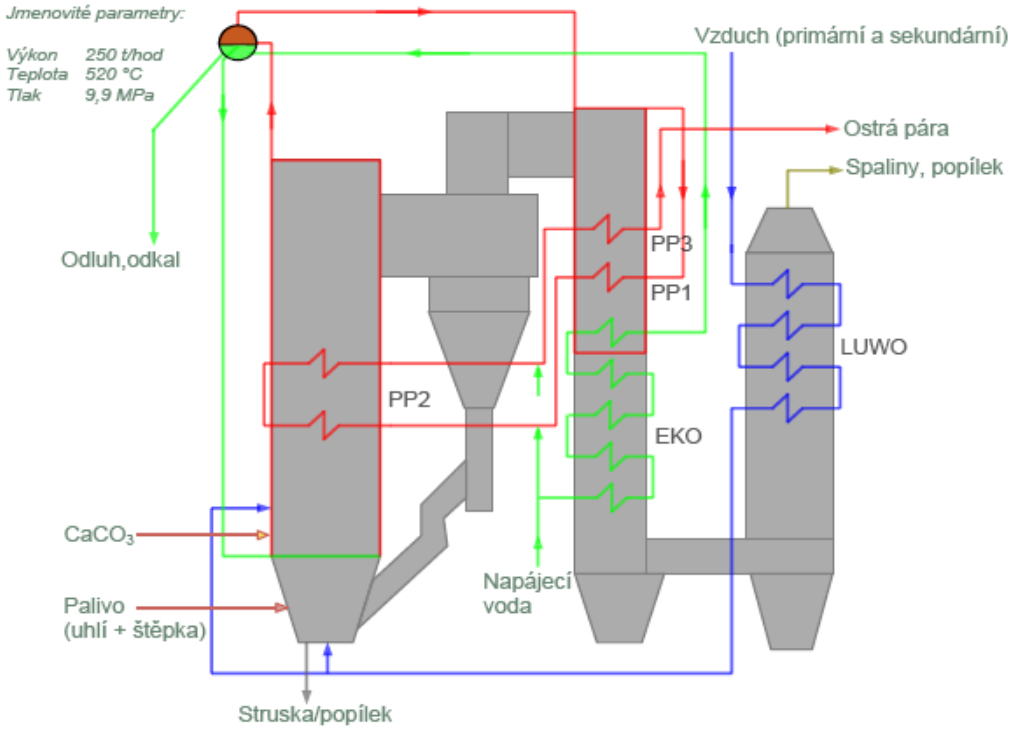
Aim - to get real information about the operation using validation

Implementation process

2012 – model of the boiler FK7

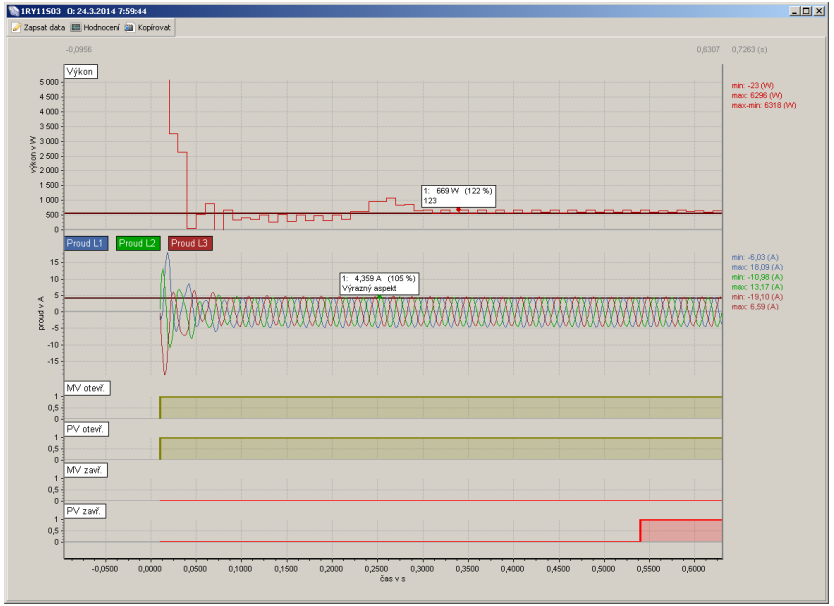
2013 - model of the entire Porici power plant

2014 – final tuning of the model validation

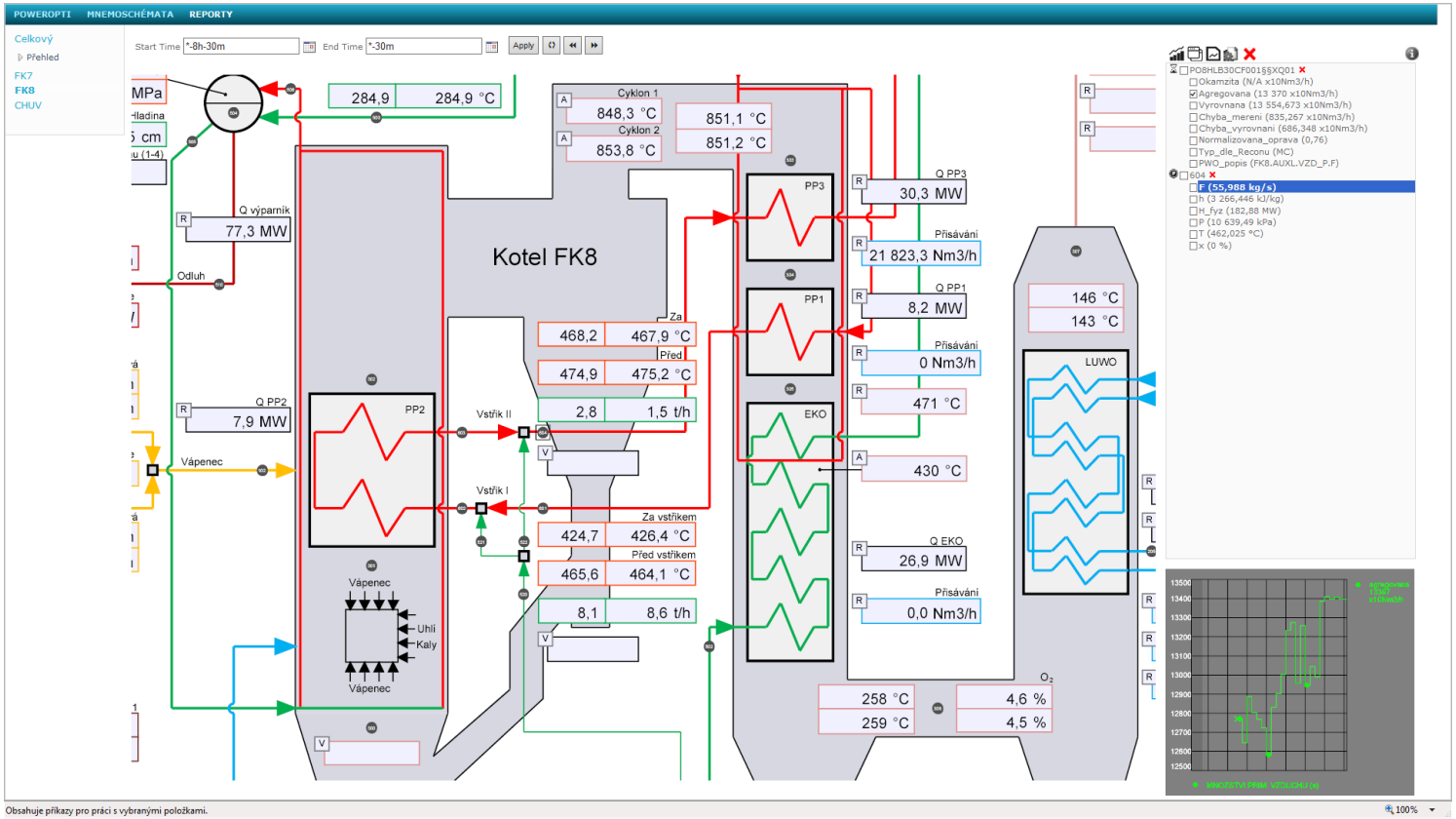


PI System in ČEZ – Platform of Future

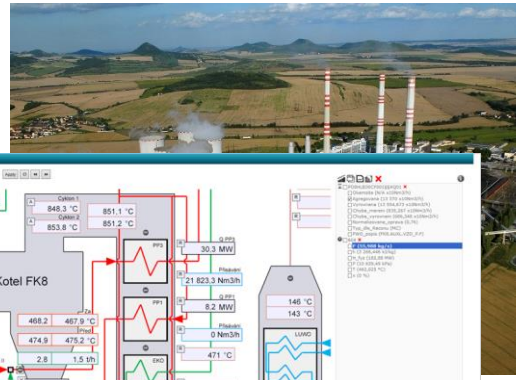
- Single store and hub of all operational data for IS
- SharePoint applications using PI WebParts are preferred
- Developed solutions:
  - **PowerOPTI**
  - Operation Economy
  - Valves Diagnostics
- Solutions in progress:
  - ChemPack
  - Vibro Diagnostics

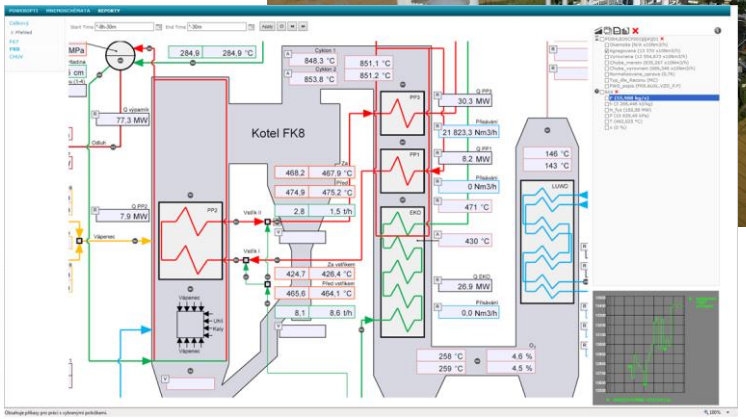


PowerOPTI – PI Webparts



Improving plant performance on a power generation fleet





"using the power of PI System infrastructure we have been able to increase our power plant performance through a centralized data collection program combined with the PowerOPTI Project to achieve high valuable business results as reducing our start-up costs and monitoring faulty equipment conditions on a fleet basis"

Mr Marek Mynařík, CEZ, Production Manager

Business Challenge

- Wide power generation portfolio (Nuclear, coal, hydro and renewable)
- Current Electrical market conditions require efficient power plants with the lower operational and maintenance costs.

Solution

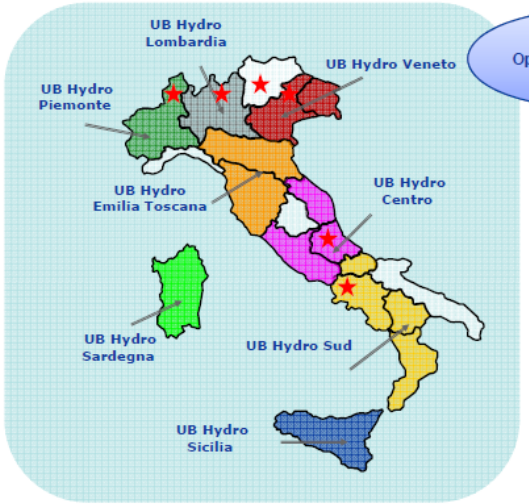
- CUTD Project: Centralized PI Data System for data collection across the power generation fleet.
- PowerOPTI Project using PI Data on Porici Power Plant as starting point

Results and Benefits

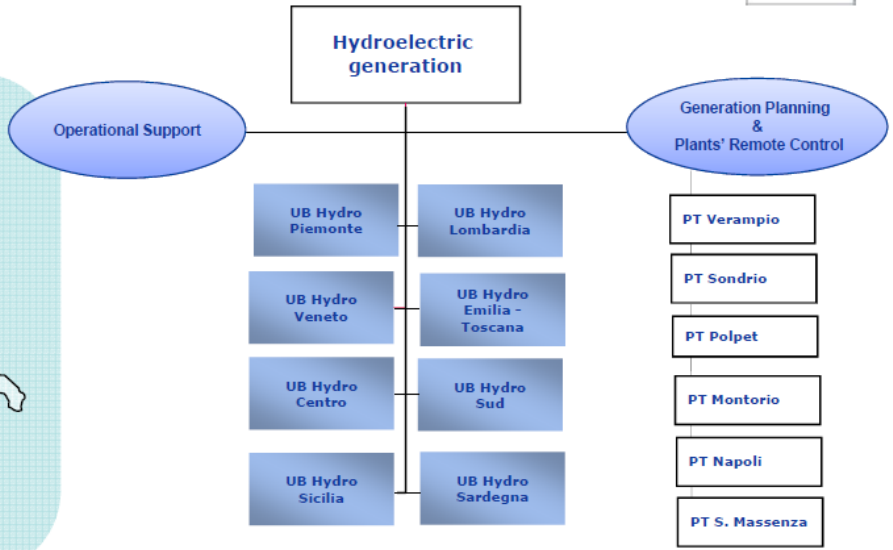
- Real time monitoring of production block condition
- Evaluation of the start-up costs of the production blocks for improvement
- Monthly energy balance reports for performance improvement

ENEL

Hydrolectric Generation Business Area



★ Control Rooms

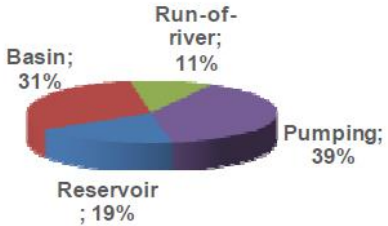


Hydro Business Units	→	8
Remote Control Rooms	→	6
Power plants	→	~200
MW installed	→	~11.000

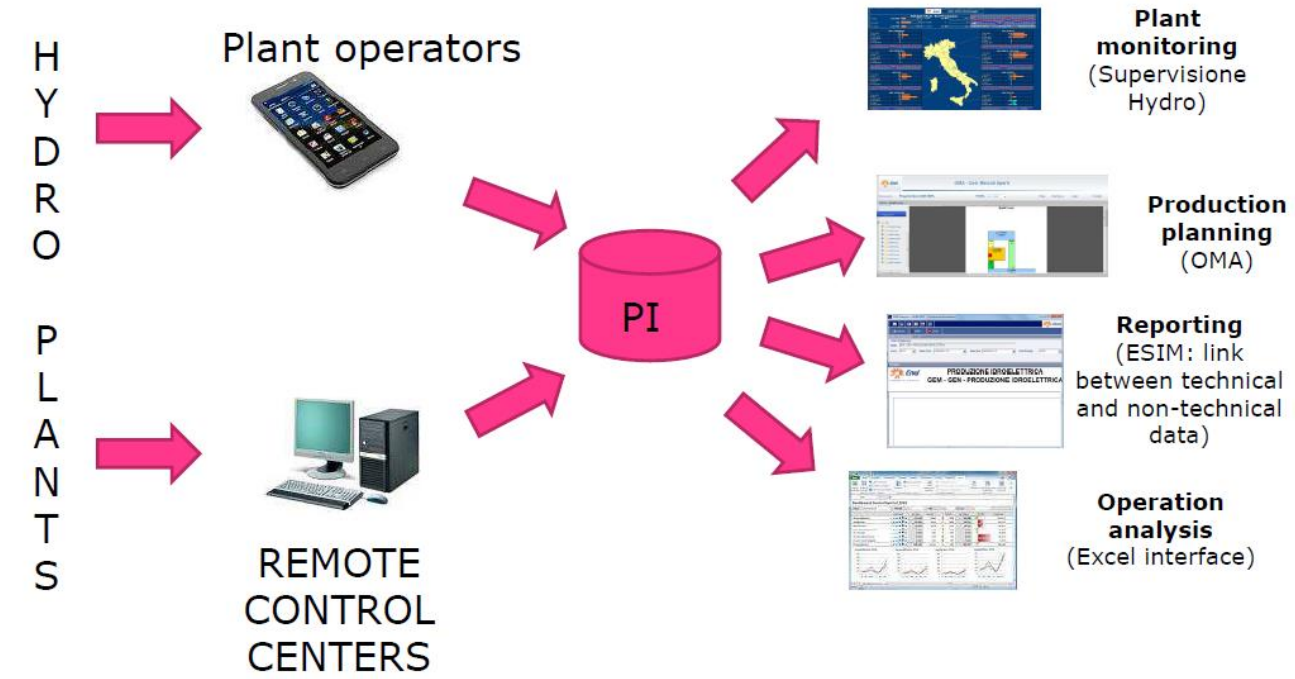
Enel Produzione - Hydro fleet

Tech.	n°	Capacity (MW)
Run-of-river	42	567
Basin	80	2.078
Reservoir	58	1.967
Pumping	17	7.016
Total	197	11.628

Production



Technical information management



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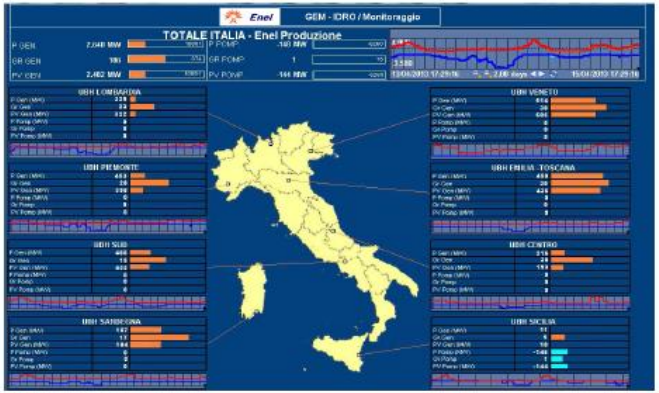
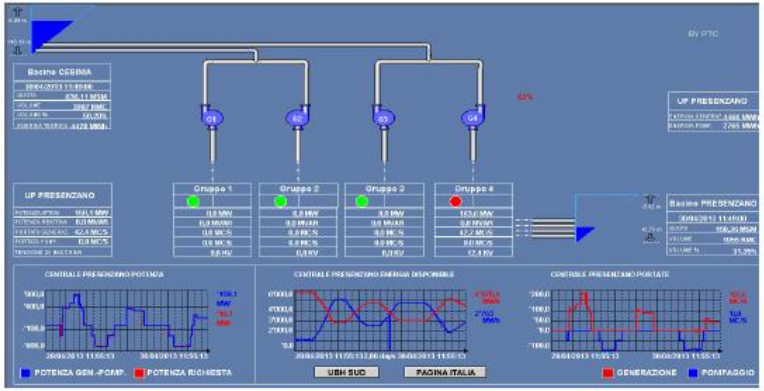
“Supervisione Hydro” 1/2

The system has been developed by Enel using Process Book OsiSoft tool in order to allow the operators access main plants information in real time, both with **synthetic** and **detailed views**.





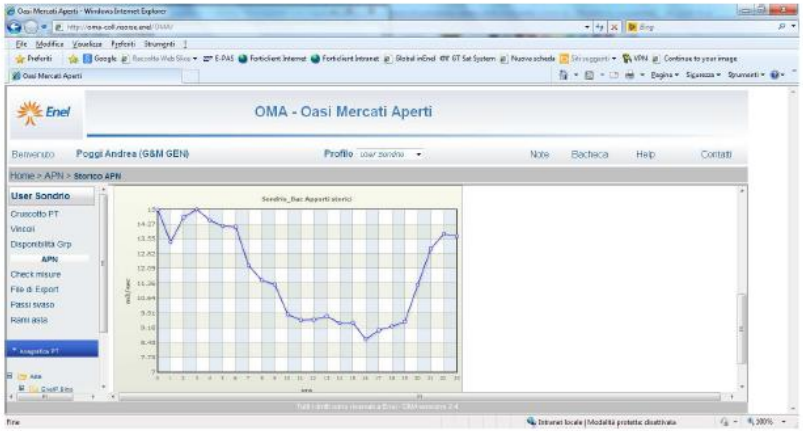
“Supervisione Hydro” 2/2

The main features and advantages of the system are:

- Visualization of **real time** situation and **historical trends**
- Easy implementation of **dedicated views** and **dedicated calculations**, especially views not useful for remote control rooms operators but only for plants operators (both for usual and temporary needs). For example:
  - view for flood management
  - view for water management in case of drought
  - view for imbalance analysis
  - view for power plants tests
- Flexible implementation of different **aggregated data** (by geography, by technology, by market participation, etc.)
- System available also on **tablet** and **smartphone**.

OMA (Production Planning)

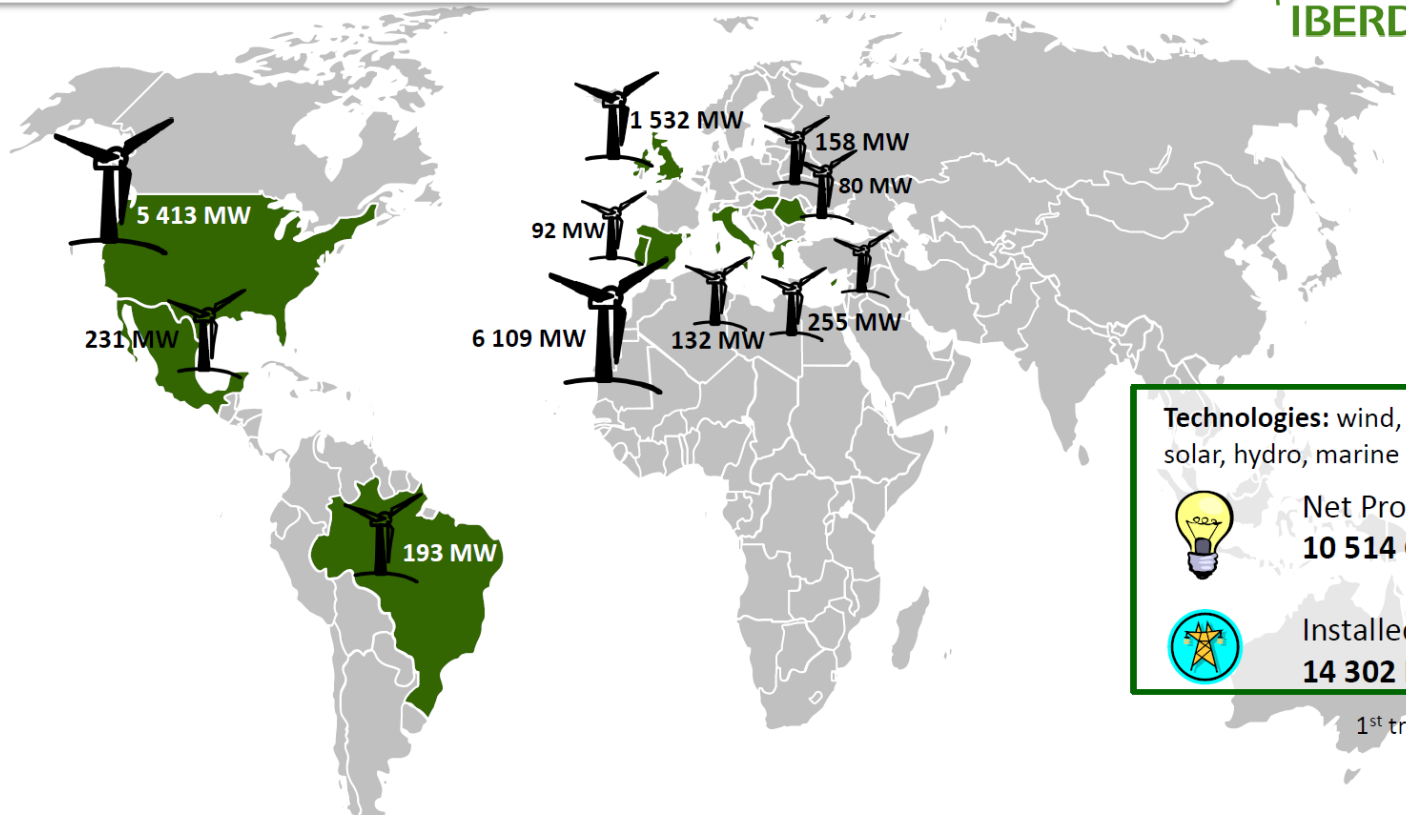
In order to offer Enel's generation fleet in an optimal way in the Italian electricity market, hydro plants need to elaborate in advance many data to determine minimum and maximum power and energy outputs. The tool used in Enel for this goal is OMA and all data necessary about water availability (reservoirs levels, natural flows and discharged flows) come from PI archive.



IBERDROLA

IBERDROLA RENEWABLES

IBERDROLA



Technologies: wind, offshore, solar, hydro, marine (waves)

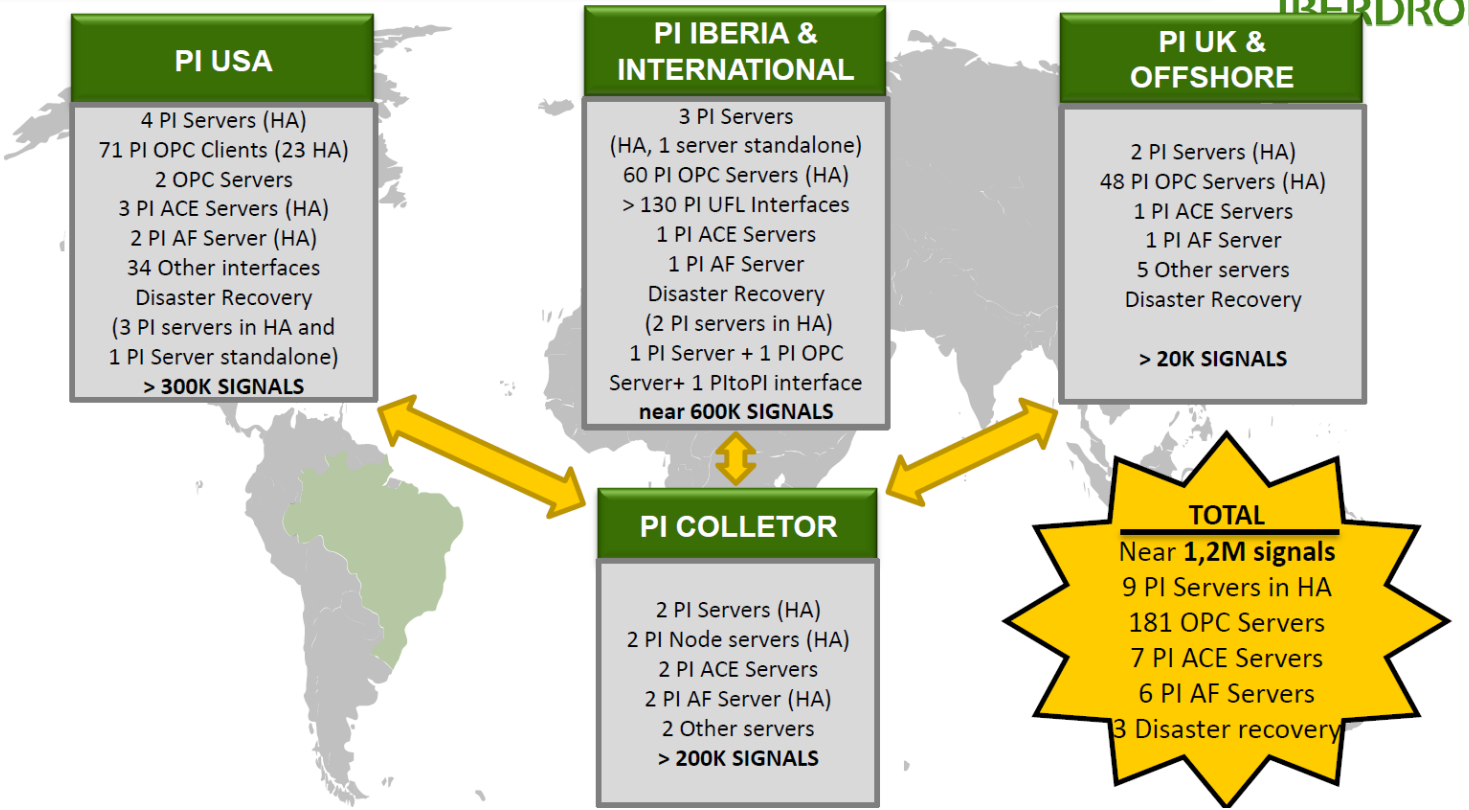
Net Production
10 514 GWh

Installed Capacity
14 302 MW

1st trimester 2014

PI SYSTEMS IN IBERDROLA RENEWABLES

IBERDROLA



PI USA

4 PI Servers (HA)
71 PI OPC Clients (23 HA)
2 OPC Servers
3 PI ACE Servers (HA)
2 PI AF Server (HA)
34 Other interfaces
Disaster Recovery
(3 PI servers in HA and
1 PI Server standalone)
> 300K SIGNALS

PI IBERIA & INTERNATIONAL

3 PI Servers
(HA, 1 server standalone)
60 PI OPC Servers (HA)
> 130 PI UFL Interfaces
1 PI ACE Servers
1 PI AF Server
Disaster Recovery
(2 PI servers in HA)
1 PI Server + 1 PI OPC
Server+ 1 PItoPI interface
near 600K SIGNALS

PI UK & OFFSHORE

2 PI Servers (HA)
48 PI OPC Servers (HA)
1 PI ACE Servers
1 PI AF Server
5 Other servers
Disaster Recovery

> 20K SIGNALS

PI COLLETOR

2 PI Servers (HA)
2 PI Node servers (HA)
2 PI ACE Servers
2 PI AF Server (HA)
2 Other servers
> 200K SIGNALS

TOTAL

Near **1,2M signals**
9 PI Servers in HA
181 OPC Servers
7 PI ACE Servers
6 PI AF Servers
3 Disaster recovery

INITIAL SITUATION AND EVOLUTION

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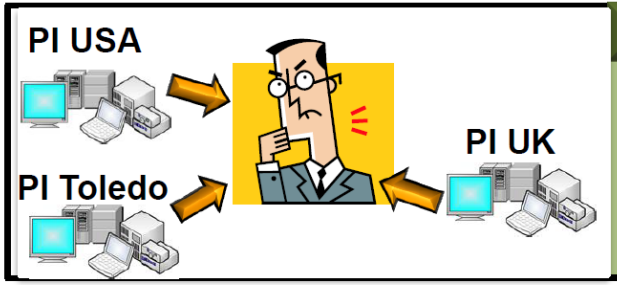
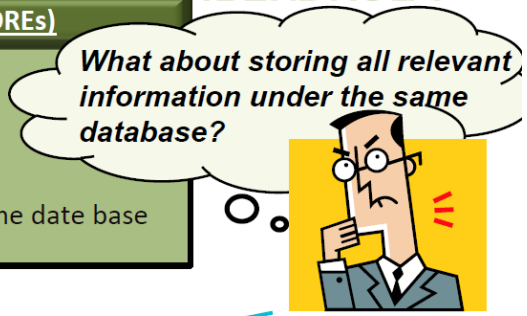


Three independent PI Servers (COREs)

- Different PI System architectures
- Different standard
- Different purchase conditions
- Information is not stored under the same date base



Enterprise Agreement

Normalize the architecture across the sites

Fleet upgrades to latest versions of all PI System assets

Develop High Availability and disaster recovery

Ensure that maximum efficiency and reliability in the servers

Training & guidance on best practices

Results

- PI Collector
- Global indicators calculations and tools developing are simple due to the standardization between PI System
- Relevant information is accessible and easy to find
- Taking advantage of our Know how
- Taking advantage of synergies
- Reinforce global use of PI System

STANDARD

IBERDROLA

Standardization

Indicators calculations for a globalized fleet.	Compare apples with apples
Implementation from all the asset on the in-house tools	The different location is no longer a problem
Allows the creation of scorecards	Global picture of the Business
Facilitates the creation of PI AF hierarchy	All the relevant information in one place
Single PI System	Increases the efficiency

EXAMPLE 1: Potential Generation

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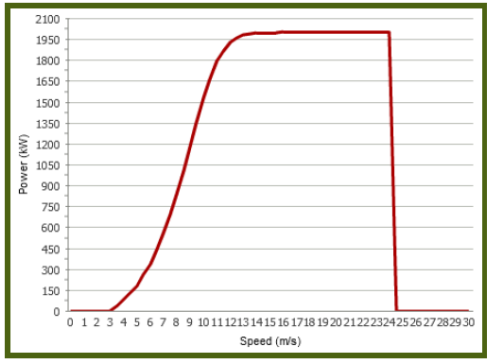
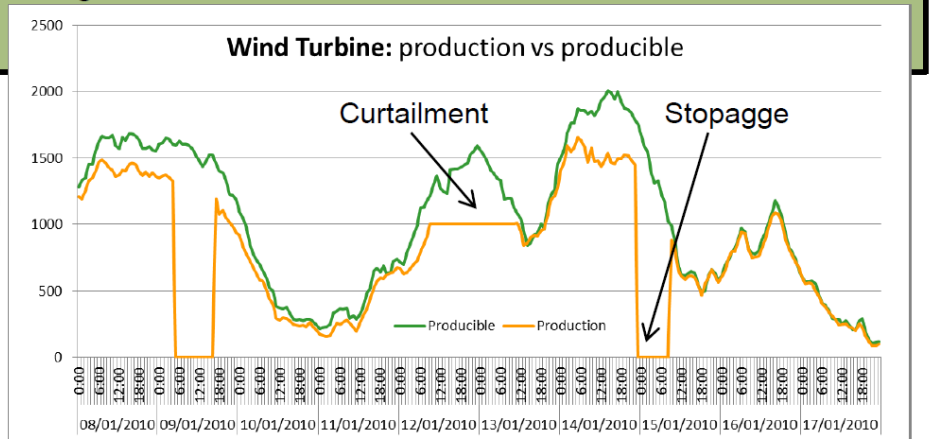
Potential generation:

- It is the indicator which calculates the **potential generation energy which can be produced in a facility at a 100% availability.**
- It is calculated in a **10 minute basis in real time**.
- The WTG wind speed and the power curve are the base to calculate real time potential generation.
- Every time there is better wind speed data (communication failures recoveries, etc.), it is updated.
- It is calculated at both wind farm level and wind turbine generator level.
- PI AF helps this calculation to improve efficiency.





EXAMPLE 3: Global Dashboard

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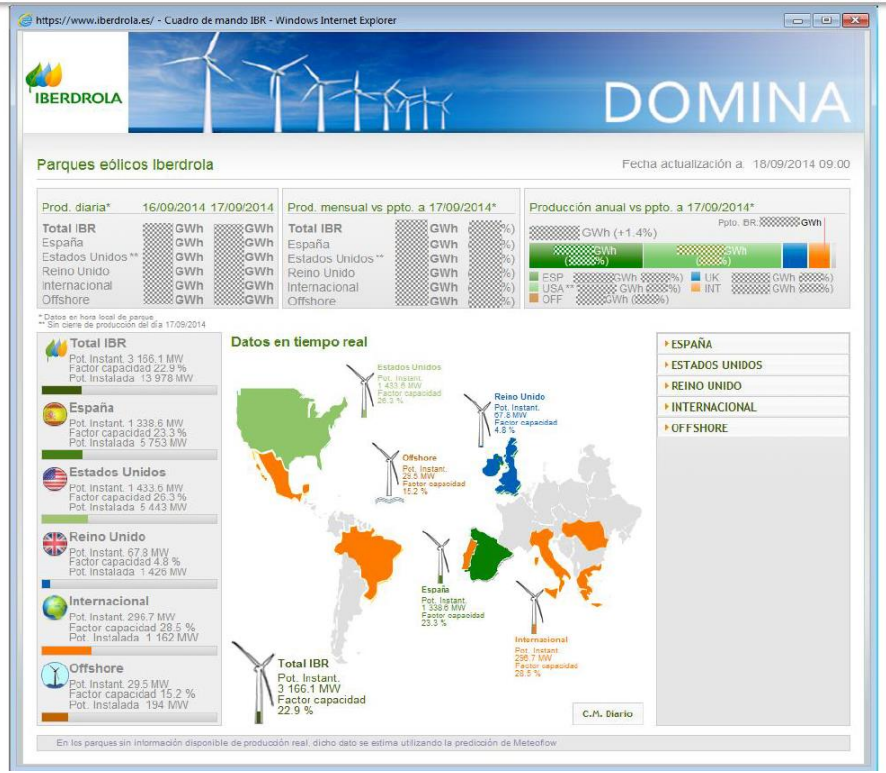
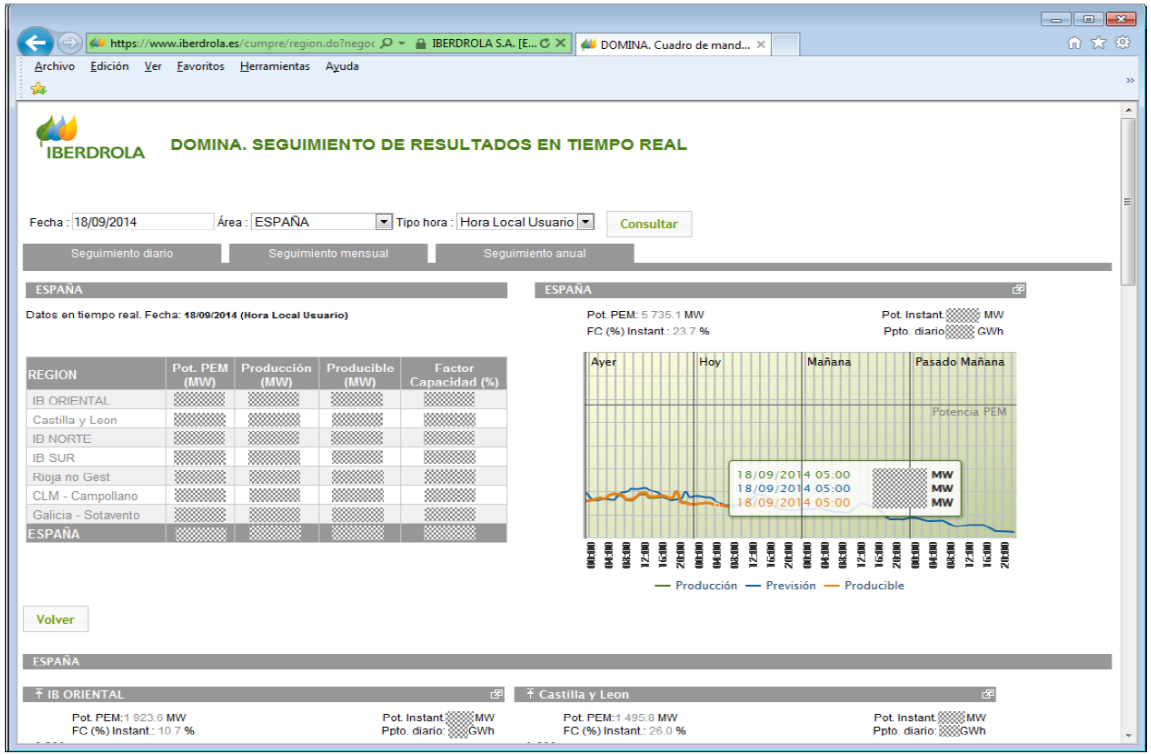
Global Dashboard:

- A web based tool **developed in-house which gives the big picture of the Business.**
- **Gathers the most relevant KPIs and assets information**.
- Facilities well organized.
- **Flexible tool**. The displayed data can vary depending on the user needs.
- **Historical data available.**
- Easy to use.
- Nice design.

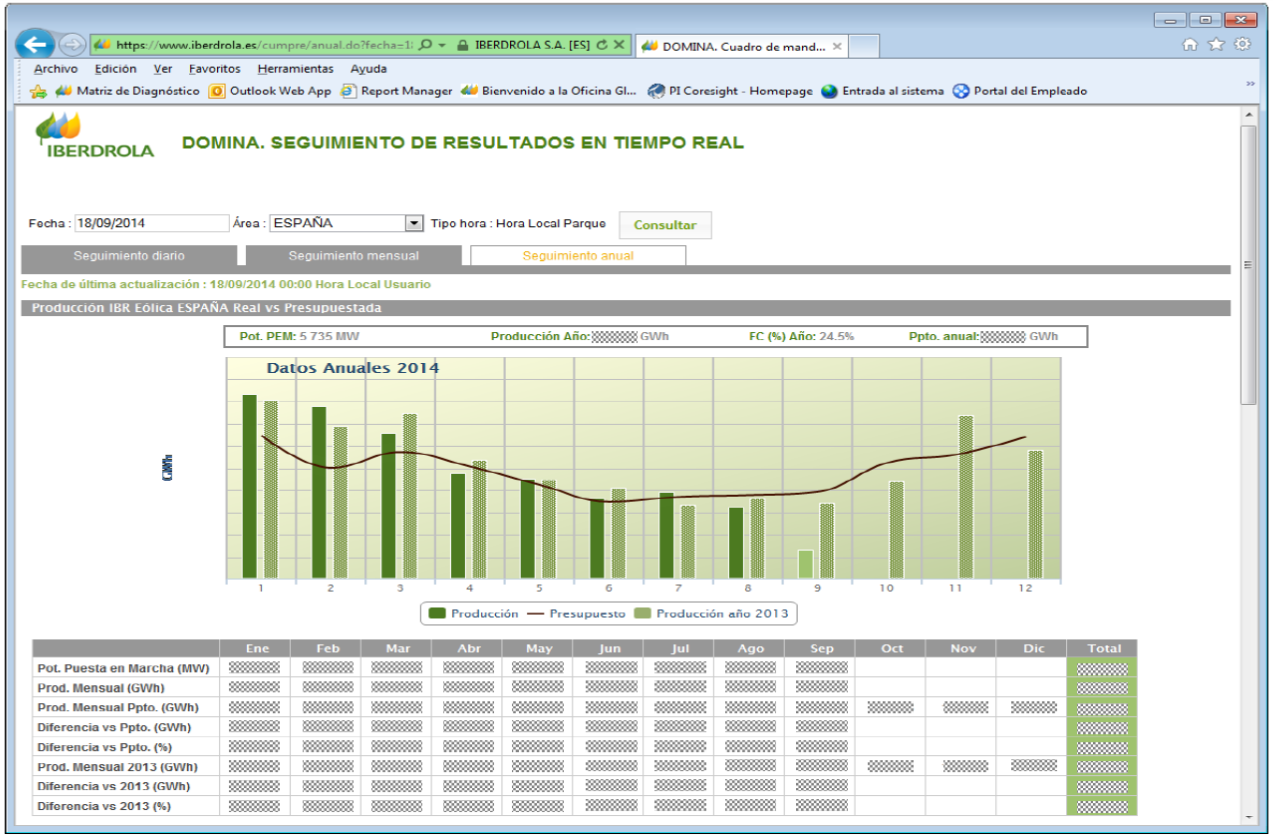
EXAMPLE 3: Global Dashboard



EXAMPLE 3: Global Dashboard



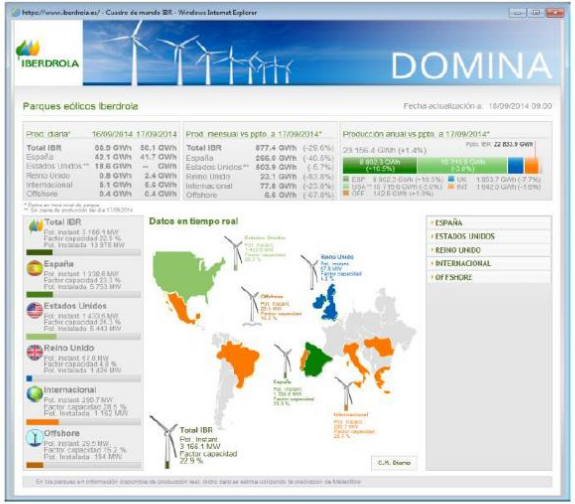
EXAMPLE 3: Global Dashboard



PI System standardization in the Iberdrola Renewables Business

"…standardization and the PI COLLECTOR approach have allowed us to deliver worldwide consistent best practice in the way we operate. We now have the necessary tools to keep on redefining excellence and to continuously improve…"

IBERDROLA



Business Challenge

- Huge fleet
- Assets all around the globe and different organizations.
- Standard procedures needed.
- Benchmark between countries.
- Need to potentiate the know-how and synergies.

Solution

- Standardization across sites
- Creation of PI COLLECTOR
- Enterprise Agreement
- Ensure maximum efficiency and reliability

Results and Benefits

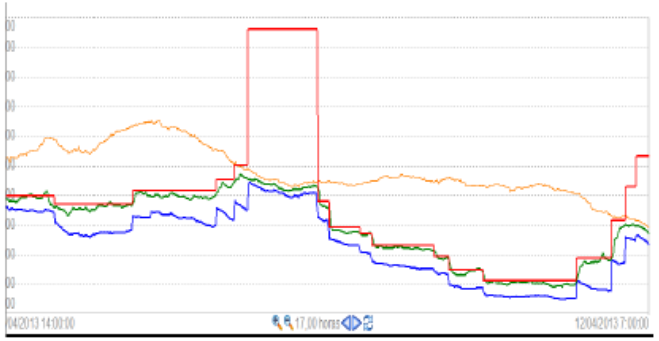
- Reliable indicators and processes at real time
- Web scorecard
- Improve in forecast accuracy
- Increase in efficiency

PI System usage to improve Curtailment Strategies

"… Along this month generation has been increased in more than 50 GWh, which would not have been generated if we had followed the former curtailment strategies."

"This means an important benefit to our company. And also a few other facts such as less mechanical wear of our turbines, less urgent works on site, … which are more difficult to quantify"

Gustavo Moreno
CORE Manager



Business Challenge

- Reduce inefficiencies
- To use aggregate real time data for real time decision making during curtailment issued by TSO

Solution

- PI AF training, design, planning and deployment
- CoE help with PI ACE deployment
- Calculated data inserted in PI Servers

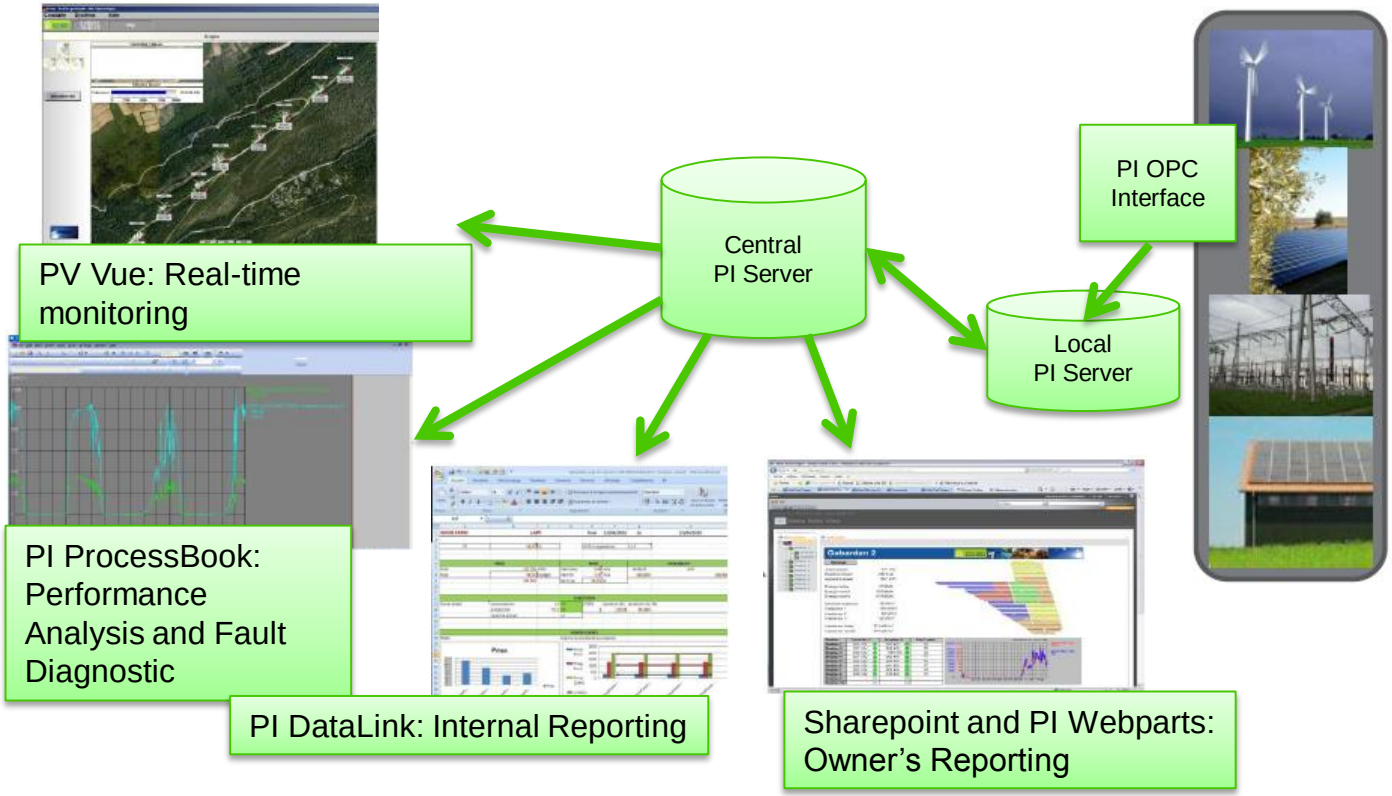
Results and Benefits

- Average increase in energy generation: 30% with peaks above 60%
- Other benefits not quantified yet

IBERDROLA

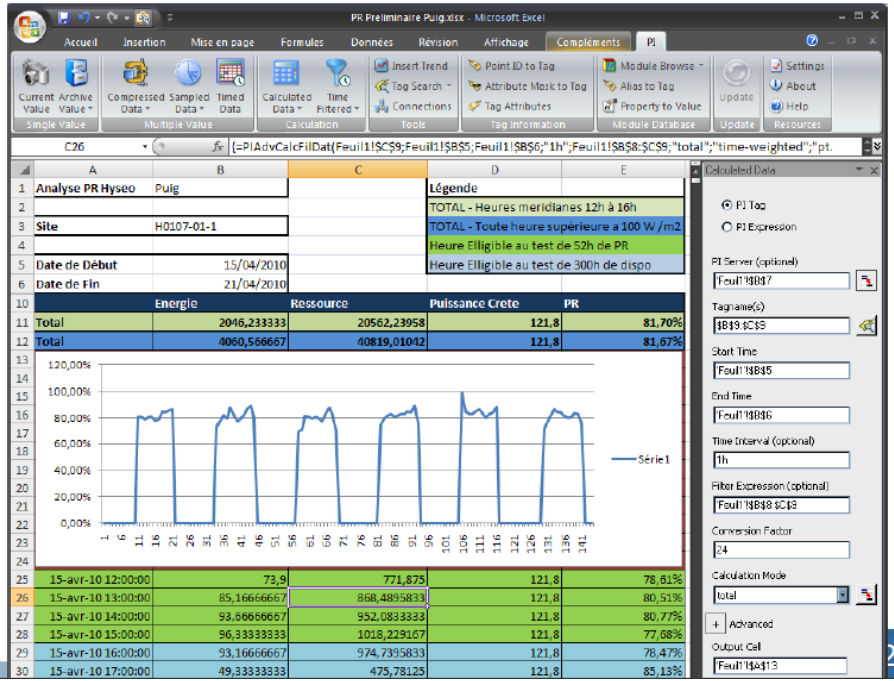
EDF-EN

EDF-en: Single tool for Asset Monitoring



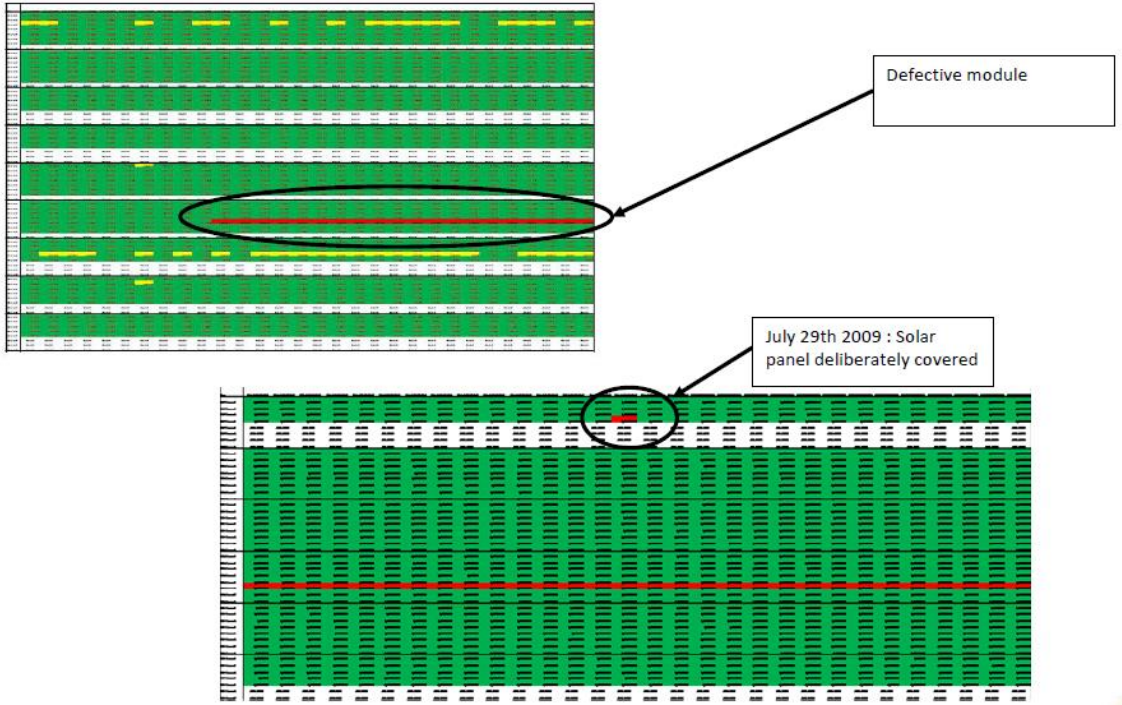
Asset Management

- Daily Capacity Factor
- Daily Performance Ratio



PV Diagnostics using PI

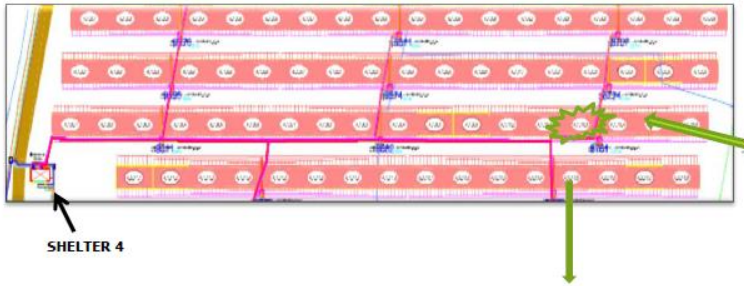
- Remote identifications of defective strings



PV Diagnostics using PI

EXAMPLE : NARBONNE-SHELTER 4 (2)

RESULT :



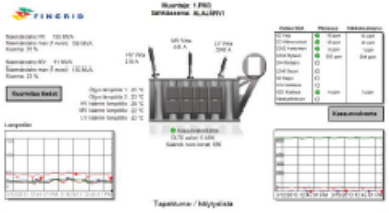
Site visit following detection in PI

FINGRID

Our vision of the Condition Monitoring System

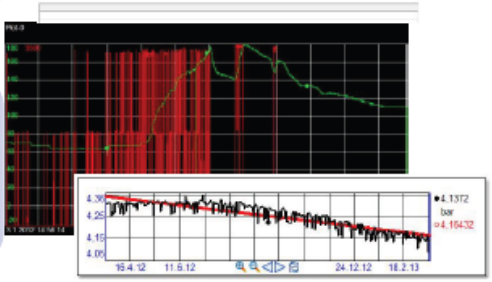
Smart visualization

- different kind of displays
- traffic lights based on alarm values
- gauges, embedded trend windows
- drill-down UI



Easy analysis tools

- differences between two points
- maximum, minimum
- ratios (e.g. gas ratios)
- trend curves

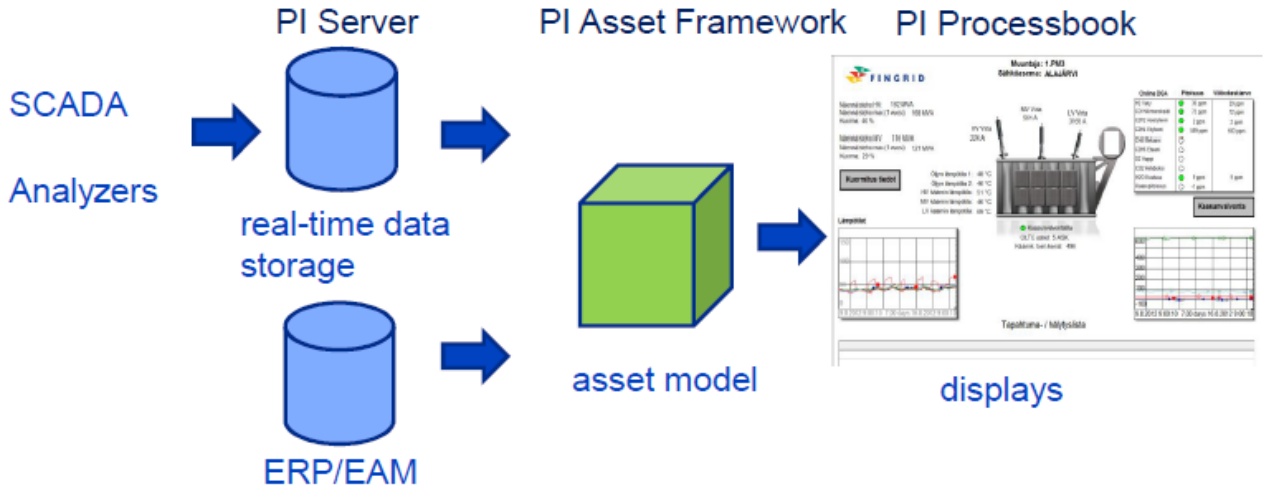


Automatic alarms

- notifications and alarms based on trigger rules
- generate tasks to our asset management system in the future

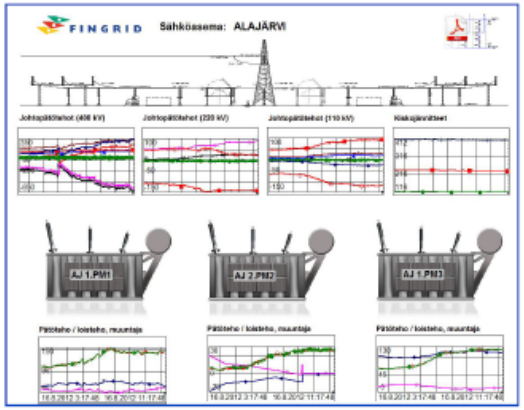
12.6.2014 Kari Suominen

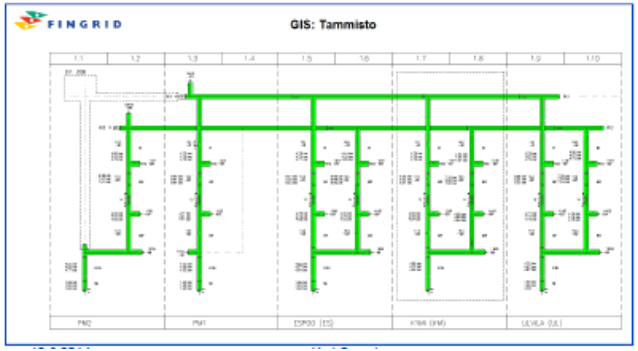
How it works ?

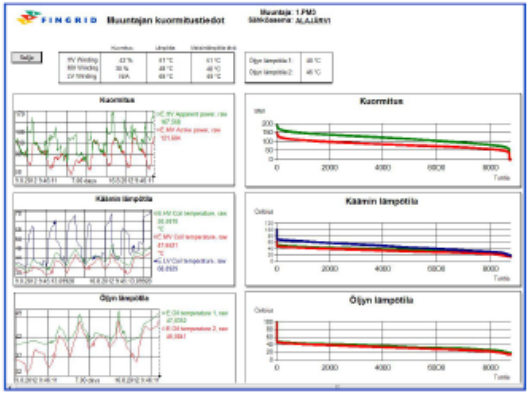


- Transformers, breakers, GIS, serie capacitors, reserve powerplants
- ~ 5 years of online data and ~ 20 years of offline data is ready to be used
- Light implementation by existing PI tools = system is easily configurable and users can make own displays

How does it look like?





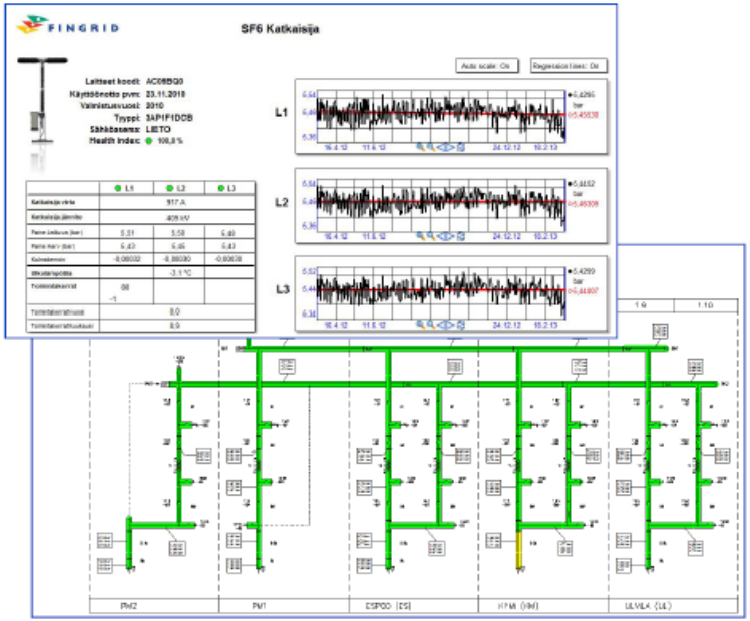


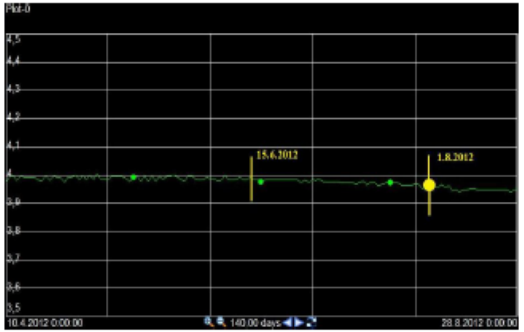
Transformer fault

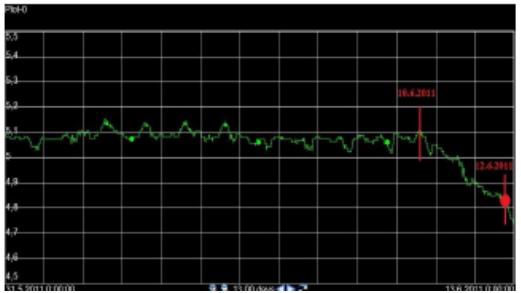
- Increasing oil gas ratio was noticed and taken under observation in May 2012. Strong correlation between LV current and oil gas ratio was detected by CMS and confirmed with diagnostics measurements. The early notice gave time to react and remedial actions were launched in time.

SF6 gas leaks in breakers and GIS

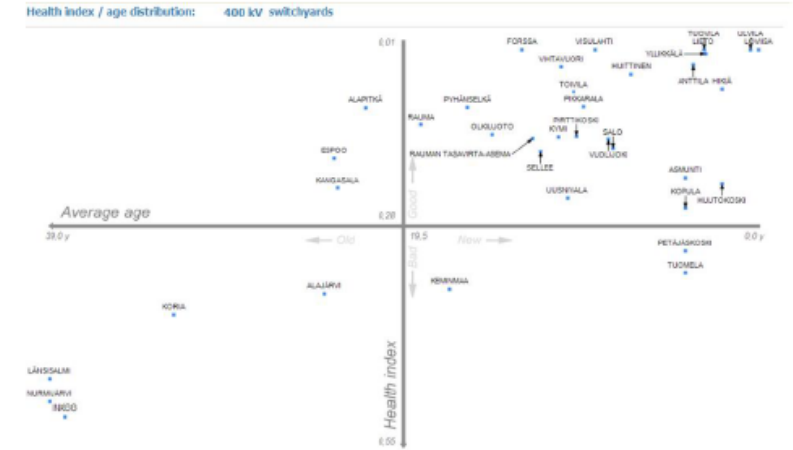
- Several gas leaks and detector failures has been detected by monitoring and automatic notifications.







Health index analysis tool for substations



Circuit breaker average	HIKIÄ 400 kV	Average age	Standard deviation	HUITTINEN 400 kV	Average age	Standard deviation	HUUTOKOSKI 110 kV	Average age	Standard deviation
Disconnector average		2.0 y	0.0		7.0 y	0.0		23.4 y	11.4
Earthing switch average					7.0 y	0.0		34.0 y	8.9
Current transformer average	6	3.8 y	0.7	6	7.0 y	0.0	8	38.1 y	11.8
Voltage transformer average	3	3.8 y	4.1	3	7.0 y	0.0	3	38.3 y	4.8
Total	9	4.0 y	3.6	9	5.1 y	3.1	11	33.0 y	8.9
		3.7 y	4.9		7.3 y	1.8		33.1 y	9.4

Circuit breaker average	HEATOKOSKI 400 kV	Average age	Standard deviation	IMATRA 110 kV	Average age	Standard deviation	RIKSD 110 kV	Average age	Standard deviation
Disconnector average		2.0 y	0.0		30.3 y	3.1		28.5 y	12.3
Earthing switch average					30.2 y	11.0		38.7 y	10.0
Current transformer average	3	6.7 y	10.9	3	32.3 y	9.2	3	12.5 y	15.0
Voltage transformer average	3	3.7 y	6.6	3	31.5 y	8.1	3	31.8 y	14.1
Total	6	2.0 y	0.0	6	27.7 y	4.9	6	41.0 y	0.0
		3.5 y	6.4		30.8 y	6.7		32.1 y	14.3

Circuit breaker average	ESKDO 400 kV	Average age	Standard deviation	ESKMARK 110 kV	Average age	Standard deviation	ESKIMM 110 kV	Average age	Standard deviation
Disconnector average		38.1 y	1.1		29.8 y	9.7		4.0 y	0.0
Earthing switch average		38.2 y	0.9		30.2 y	5.7	1	4.0 y	0.0
Current transformer average	8	37.5 y	5.0		36.9 y	3.3		4.0 y	0.0
Voltage transformer average	1	21.7 y	0.7	1	9.9 y	19.8	1	4.0 y	0.0
Total	11	36.1 y	1.0	1	15.5 y	12.8	1	4.0 y	0.0
		33.9 y	8.0		22.8 y	15.4		4.0 y	0.0

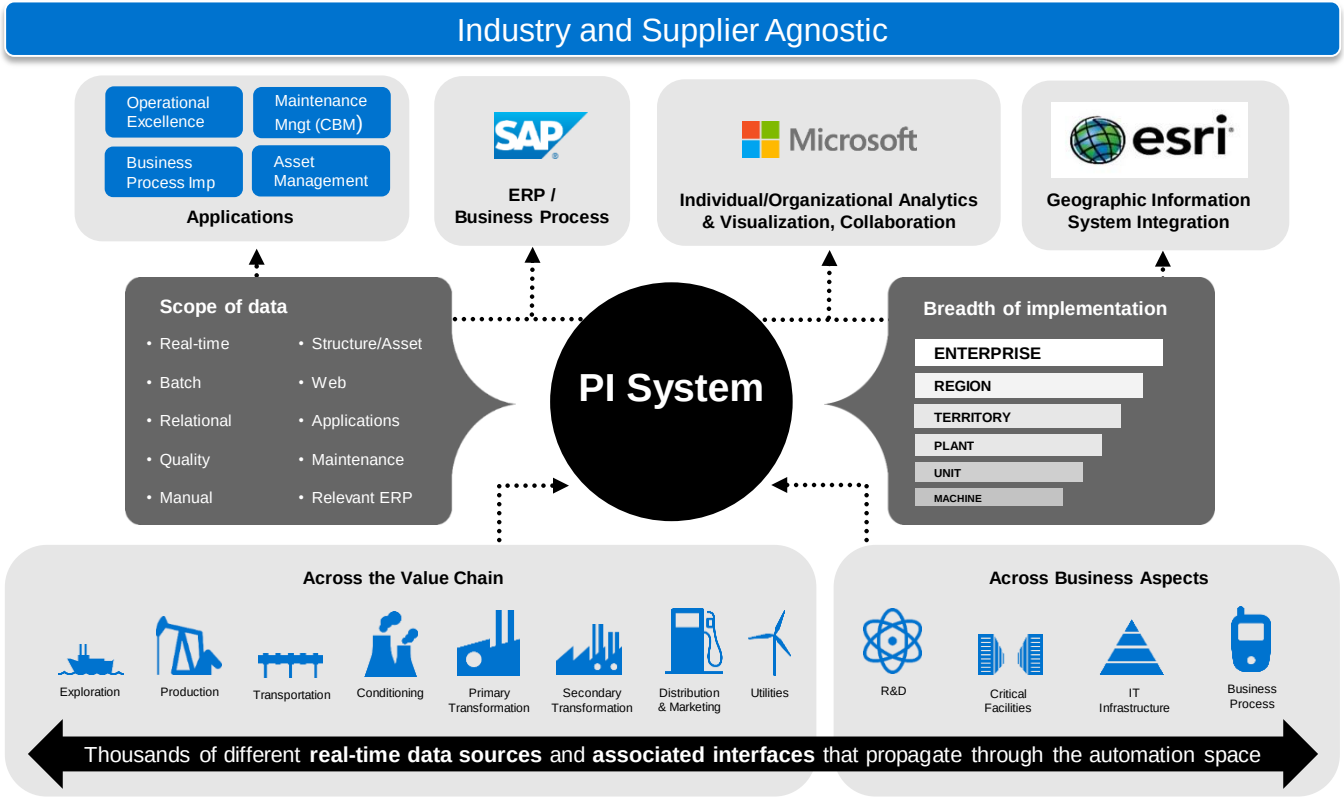
- 'Health index' identifies the priority in terms of additional maintenance or need of renewal
- Especially essential when the population of components is very large, e.g. circuit breakers and disconnectors.
- Based on the defect statistics in the asset management system over a long time period (>20 years) and weighting coefficients
- The tool enables the user to update all these views and visualize the affects by changing easily the free choice factors and source variables.
- This analysis can strengthen already known component weaknesses but may also point out additional needs for further clarification from different perspectives.

12.6.2014 Kari Suominen

Summary

Business Impacts: An agent for change

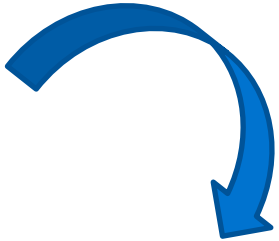
CCGT	Coal	Hydro	Wind	Solar	T&D
GDF SUEZ		Enel	IBERDROLA	energies EDF nouvelles	FINGRID
Increased performance and reduction of manual workload	**reduction** of the **start-up costs** and **monitoring faulty equipment** conditions	**Increased** accuracy on **production planning** and real-time awareness	Up to **60% improvement** on **curtailment strategies** and **fleet portfolio optimization**	**Reduced unplanned outages** and **increased availability** by faster fault detection	**2 transformer fault detection paid-off** all the investment



- Operational Excellence Program (OEP)
- Smart Asset Management (SAM)
- Condition Based Maintenance (CBM)
- Business Process Improvement (BPI)

OSIsoft.

Expected Outcomes



Performance

Downtime

Margin

Miguel Chavero

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- EMEA P&U Industry Principal
- OSIsoft, LLC

THANK YOU

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