Worldwide Fleet Management and Asset Optimization Using the PI System Infrastructure

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OSIsoft Industry Forum 2015

Agenda

E.ON Next Generation

- E.ON Next Generation business activities

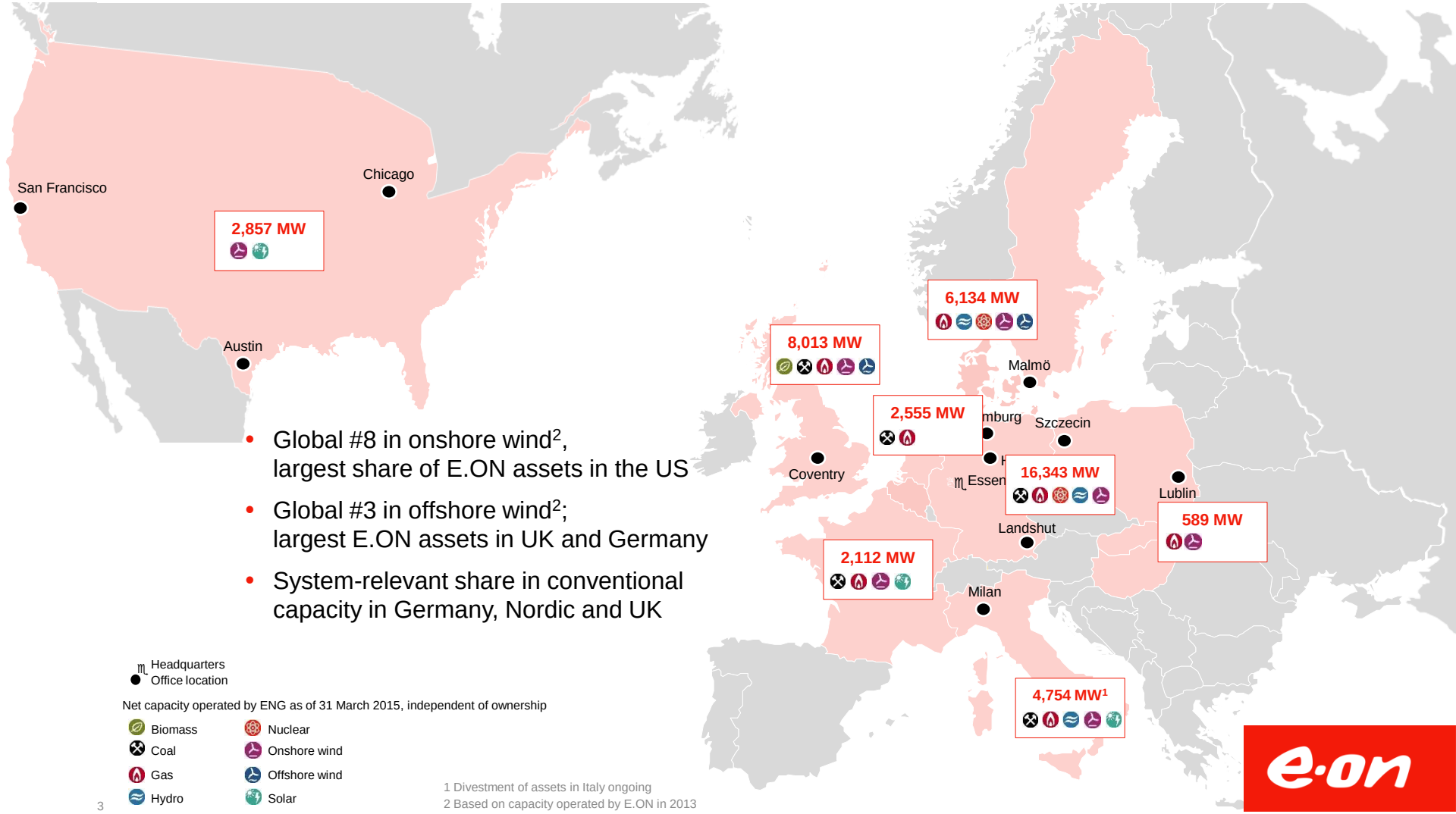
E.ON's PI System

- Conventional PI System
- Renewables PI System
- PI Pilot Hydro

Examples

- Monitoring
- Reporting
- Analysis
- Alerting

Our renewables are top-ranked in global markets and our conventional portfolio ensures security of supply in Europe



- Global #8 in onshore wind[2], largest share of E.ON assets in the US
- Global #3 in offshore wind[2]; largest E.ON assets in UK and Germany
- System-relevant share in conventional capacity in Germany, Nordic and UK

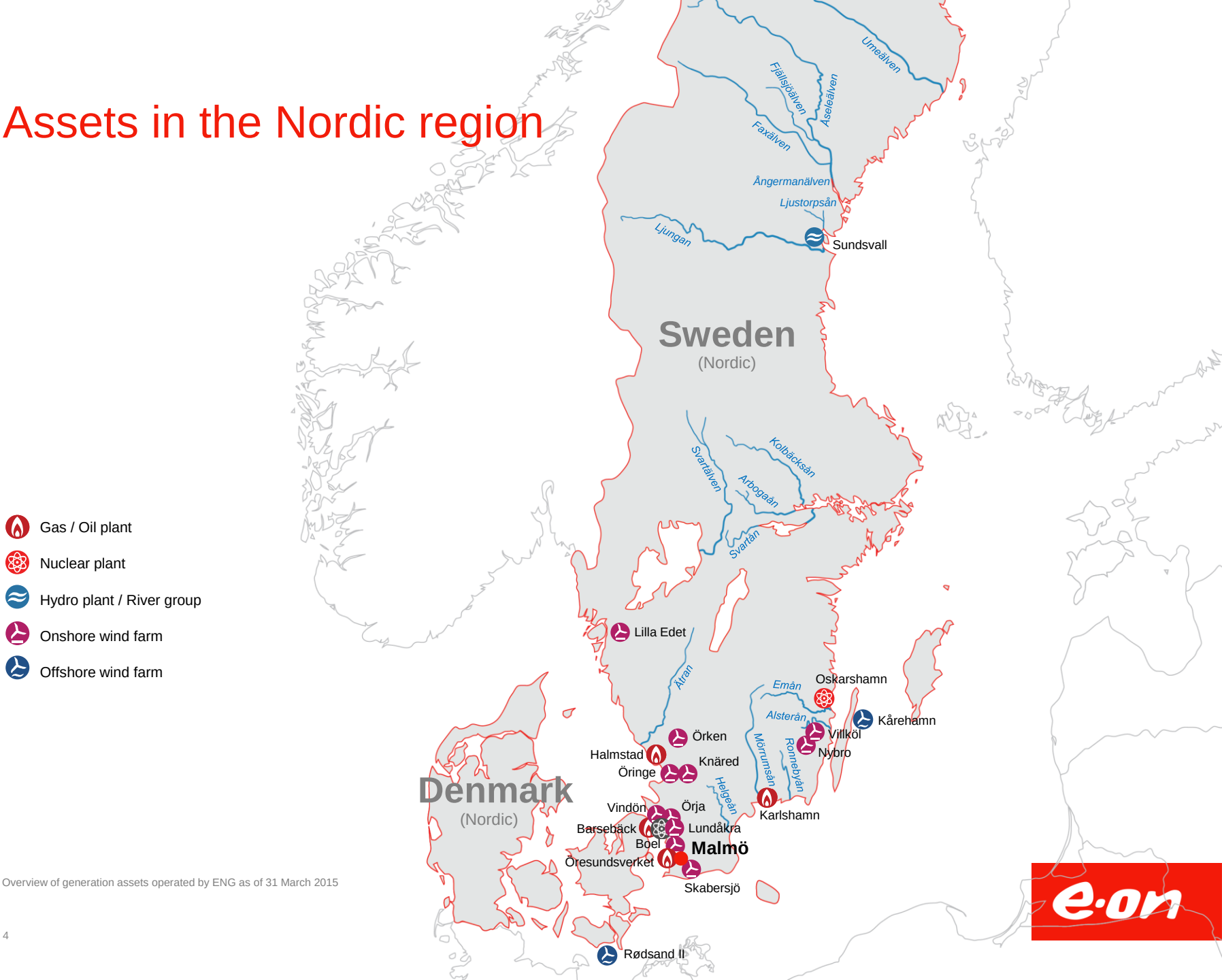
Headquarters
Office location

Net capacity operated by ENG as of 31 March 2015, independent of ownership

Biomass
Coal
Gas
Hydro
Nuclear
Onshore wind
Offshore wind
Solar

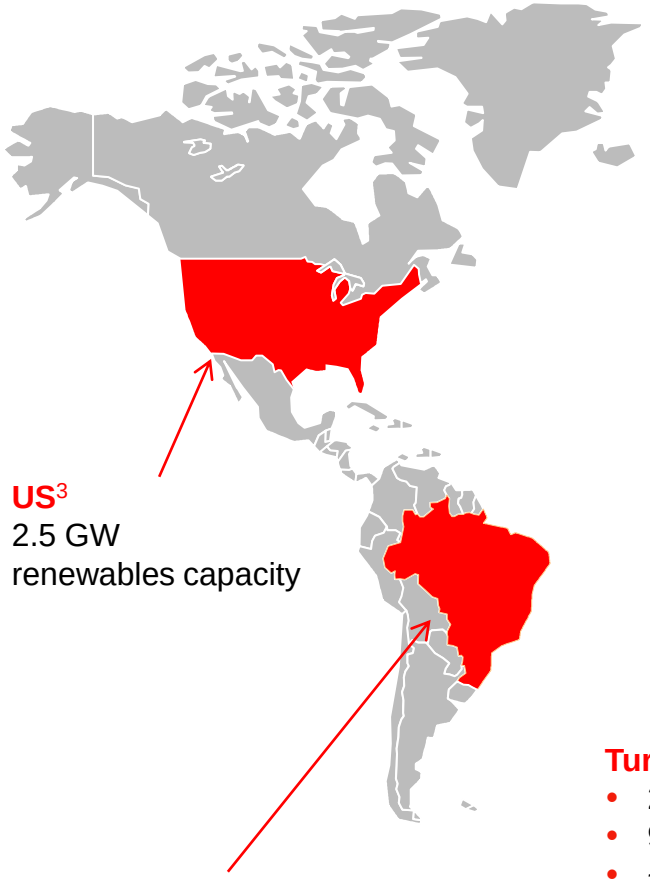
1 Divestment of assets in Italy ongoing
2 Based on capacity operated by E.ON in 2013

Assets in the Nordic region



Overview of generation assets operated by ENG as of 31 March 2015

Non-EU business activities



US[3]
2.5 GW
renewables capacity

Brazil[4]
2 GW generation capacity

Russia[1]
10 GW
generation capacity

Turkey[2]
- 2.4 GW generation capacity
- 9m sales customer
- ~200.000 km combined network length

[1] E.ON Russia view [2] Enerjisa view [3] Accounting view [4] ENEVA view

PI System infrastructure

E.ON's PI System infrastructure is flexible enough to allow different architectures to meet different business needs.

Conventional
(Nuclear, Steam, CCGT, Hydro)

Renewables
(Wind, PV)

Different business needs

E.ON's PI System infrastructure is flexible enough to allow different architectures to meet different business needs.

Conventional
(Nuclear, Steam, CCGT, Hydro)

- Mostly big manned sites. Monitoring is performed at the plant
- Big user group that needs access to the PI system at the plant
- Many users that are familiar with their own signals

Renewables
(Wind, PV)

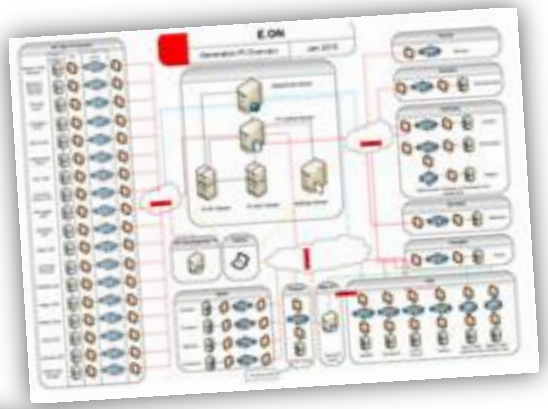
- Mix of manned and unmanned sites.
- Central control rooms US Wind, EU Wind, US PV that require remote access to the data
- High level of harmonisation needed to handle a big mix of non-standardised vendor technologies

Multiple conventional PI Servers

The OSIsoft PI Server is installed in most of the plants and enables users directly interact with their data through DataLink and ProcessBook.

All sites send a subset of their data to a central PI server, which currently has around 250.000 tags in the database.

This data can then be viewed additional via the E-ON PI Portal Web pages.

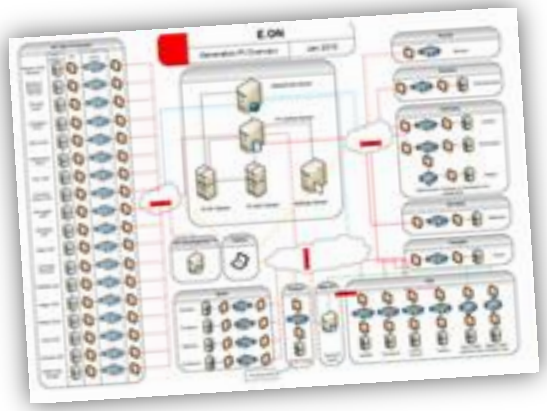


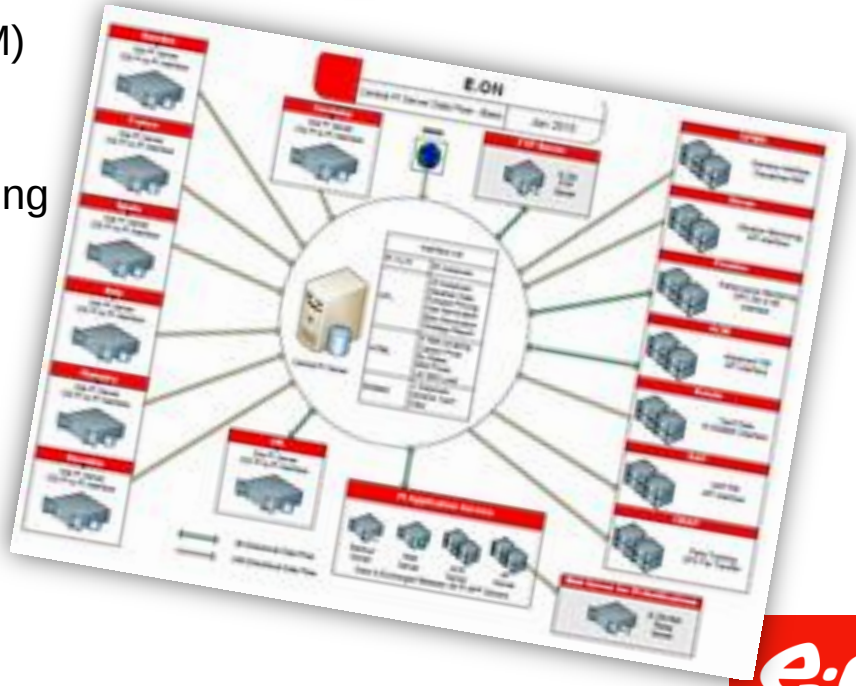
PI as an Integration Layer

The central server not only collects data from the plants but also provides weather, pricing and nomination data back to the sites.

Additional it acts as interface to multiple third party applications for:

- Plant Management (SAP PM)
- Parts Tracking
- Advanced condition monitoring
- Performance monitoring
- Vibration Monitoring

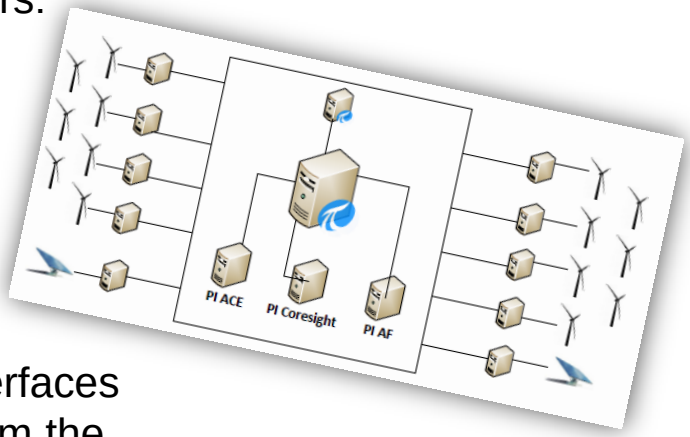




Renewables PI System

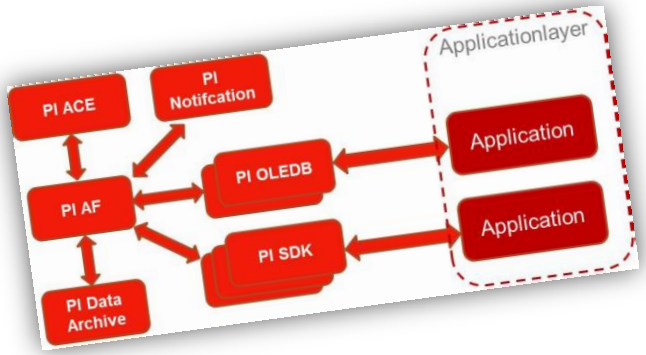
The renewables PI architecture contains 3 PI servers:

- EC&R Central (300k Tags)
- US Meter (5k Tags)
- Development (5k Tags)



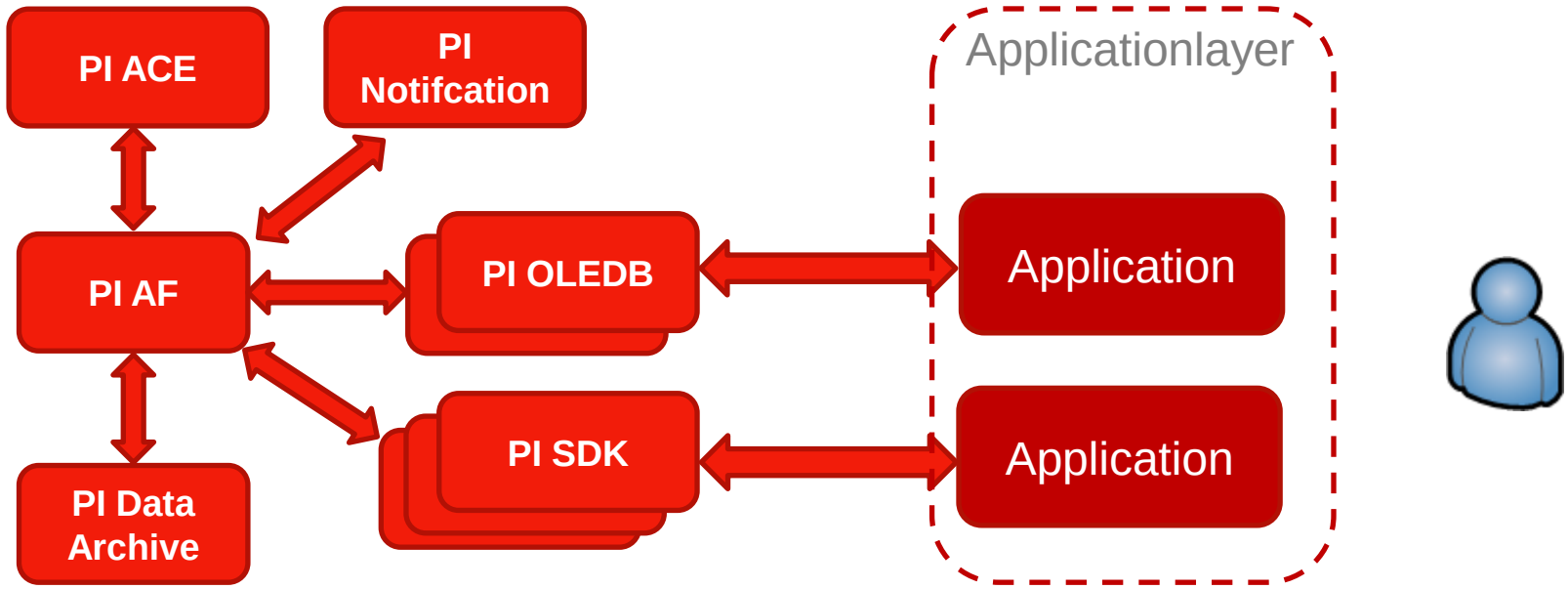
At more than 140 locations different types of PI Interfaces (OPC / PI to PI / RDBMS / Modbus) collect data from the OEM systems and send it to the central PI server.

The data can be access by PI ProcessBook, DataLink and Coresight. The most extensive usage happens through the PI SDK and PI OLEDB Interface.



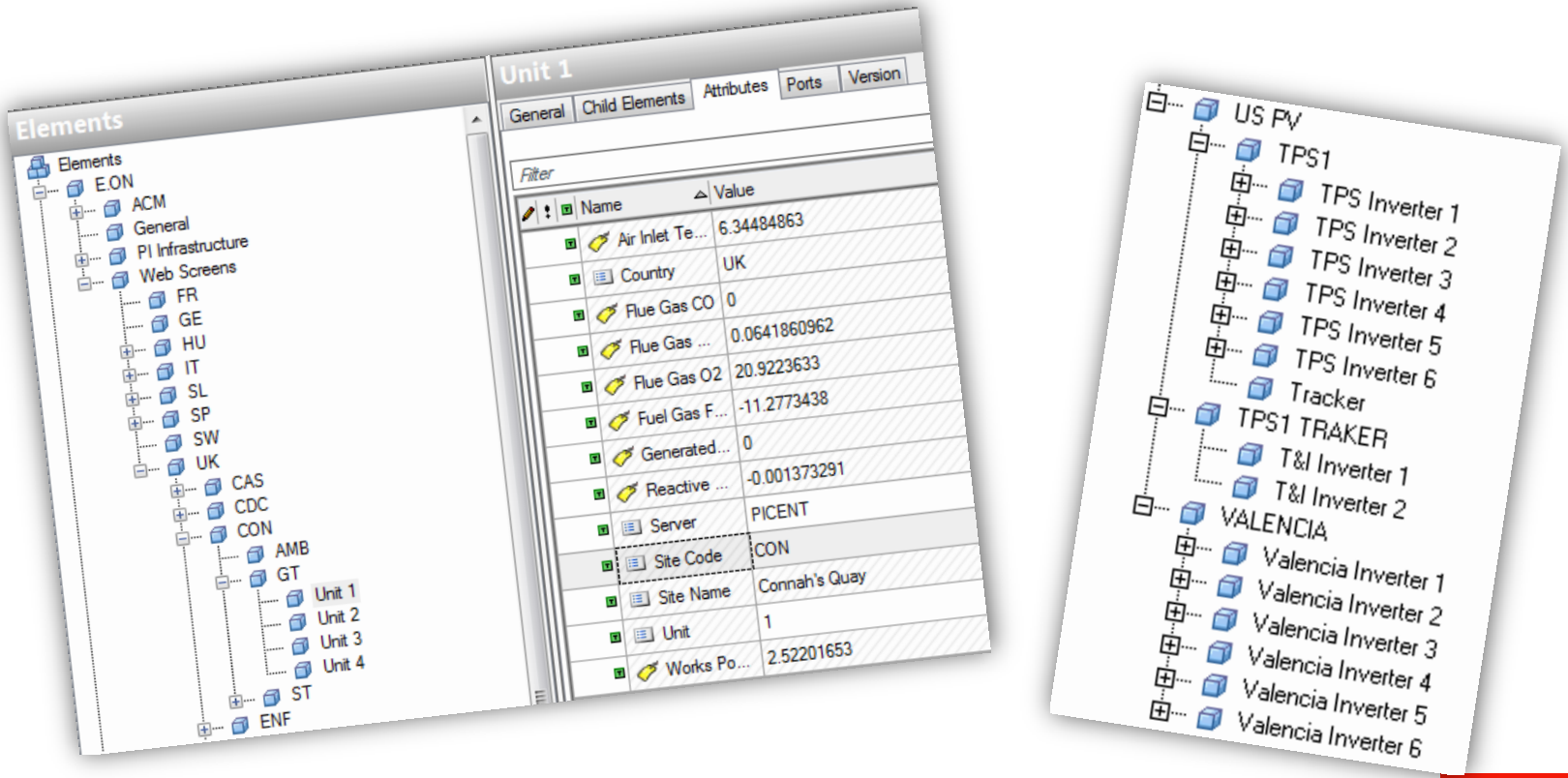
Applicationlayer

EC&R developed several applications using the capabilities of PI SDK, OLEDB and Asset Framework.



PI as standardization layer

By using the Asset Framework E.ON standardized the individual signals from the plant to a global standard.



PI System infrastructure summary

Conventional
(Nuclear, Steam, CCGT, Hydro)

- 33 PI Server
- 1 PI ACE Server
- 1 PI Asset Framework Server
- > 400.000 Tags
- 35 PI to PI Interfaces
- 5 HTML Interfaces
- 26 UFL Interfaces
- 3 RDBMS Interfaces
- > 160 individual PI ProcessBook views

Renewables
(Wind, PV)

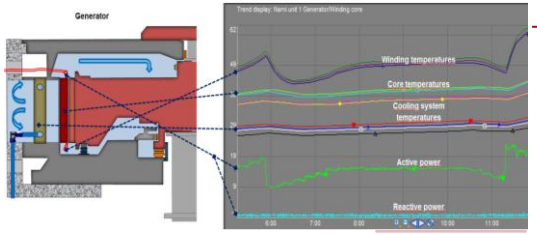
- 3 PI Server
- Over 310.000 Tags
- ~ 250 PI Interfaces (OPC, Modbus, RDBMS,PI to PI)
- > 20 PI UFL Interfaces
- 2 PI ACE Server
- 1 PI AF Server

(Nuclear, Steam, CCGT)

O&M related drivers for E.ON Hydro fleet to perform a pilot

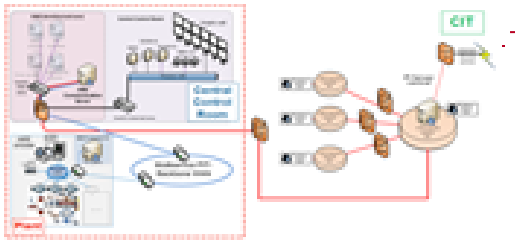
Drivers		Challenges		Actions
O&M strategy drives a move from time based to condition based maintenance	⇨	To add Online Condition Monitoring System to traditional/existing condition evaluation methods		To perform a pilot project in order to test if PI is a suitable tool for hand-ling of the challenges
Lack of long term storage of O&M data related to an equipment	⇨	To establish a long term storage of O&M data on equipment level	⇨	
Operational data without early warnings to avoid breakdowns	⇨	To use operational and historical data for preventive actions		
Fragmented data sources and storage of data relevant for O&M engineers	⇨	To make it easier for O&M engineers to access and manage relevant information for analysis and decision making		

Key deliverables from Hydro pilot project



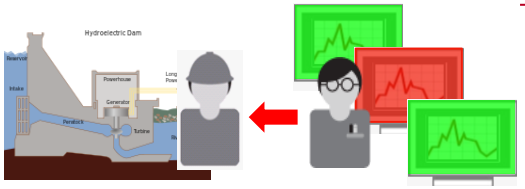
2013-14

Standardized condition indicators and **trend diagrams** for analyze and decision support of turbines, transformers and generators



2013-14

Proof of concept of **standardized IT architecture** valid for all E.ON hydro countries



2014-15

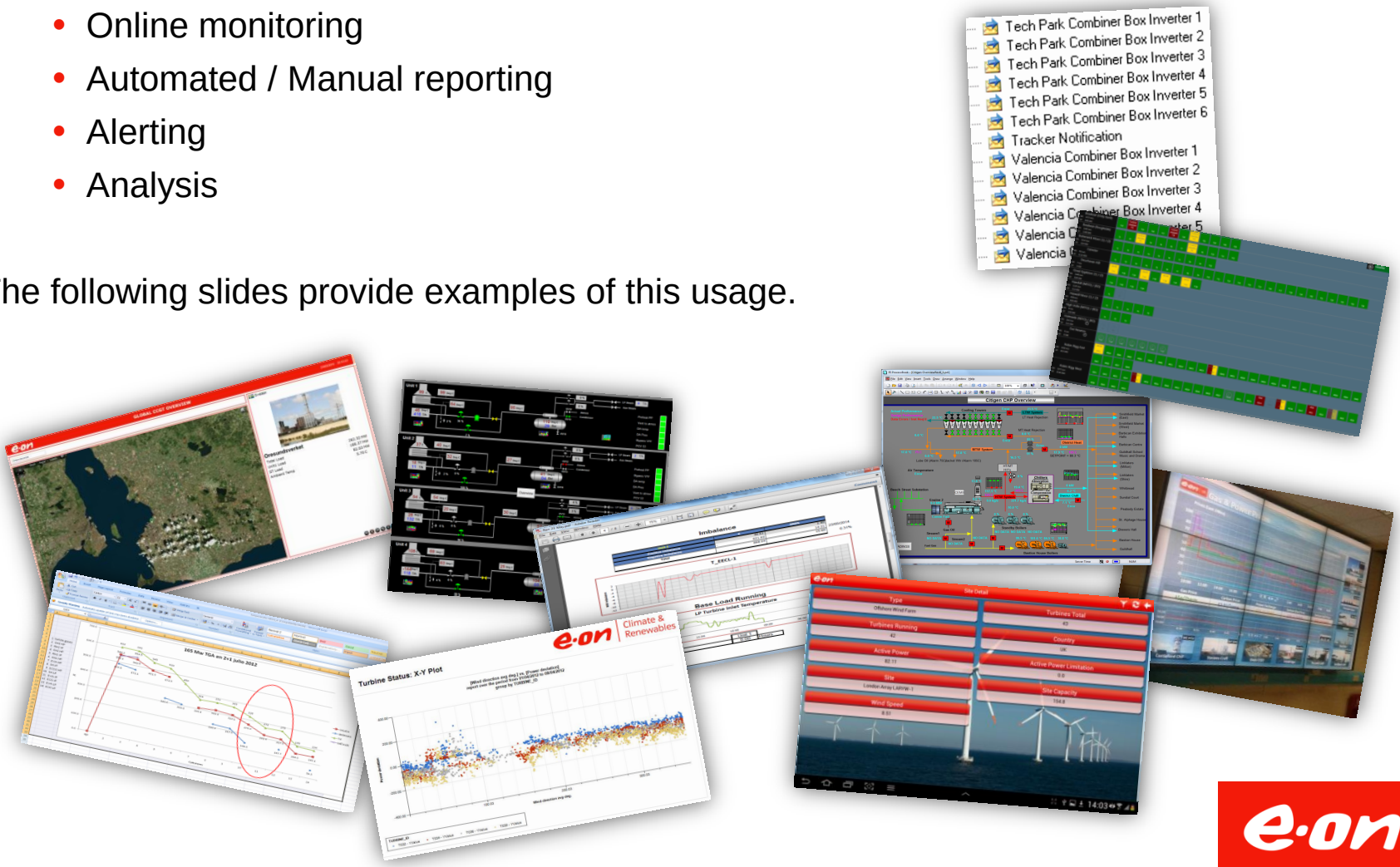
Ongoing usage/tests by **O&M engineers** to realize benefits for plants in Sweden, Germany

PI data is used in different ways

The collected data is used for:

- Online monitoring
- Automated / Manual reporting
- Alerting
- Analysis

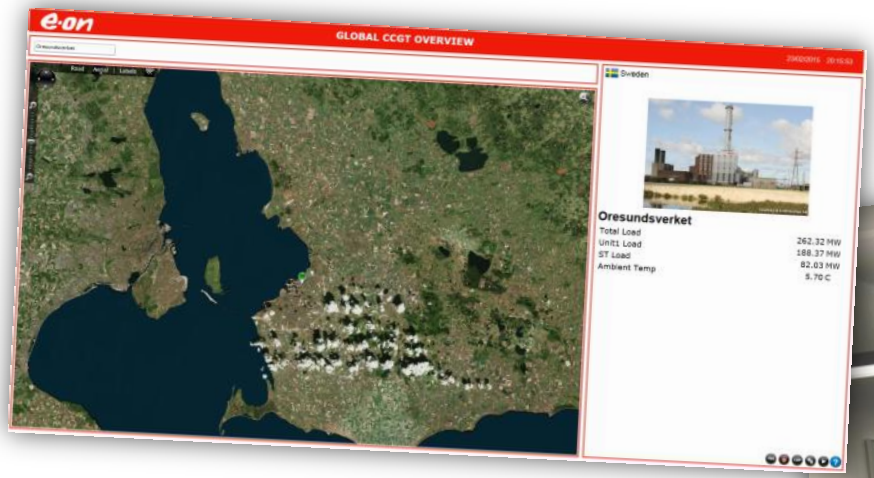
The following slides provide examples of this usage.



Example: Global Dashboards

Dashboards in plants and office locations provide at any time access to the actual production and various metrological conditions.

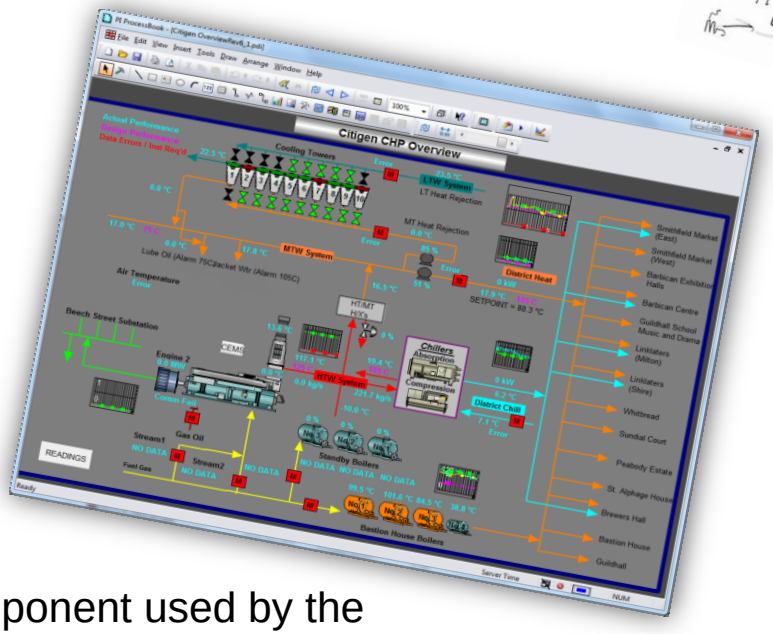
Web application based on PI WebParts and HTML5.



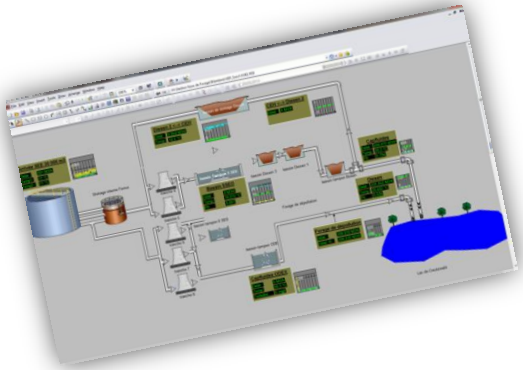
Example: Monitoring

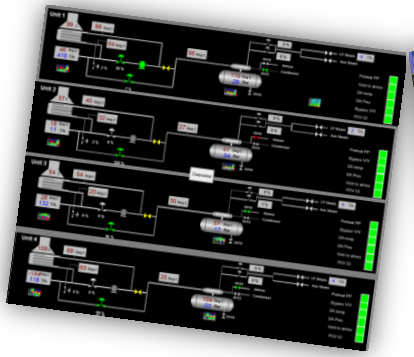
Monitoring of:

- Plant
- Availability
- Emissions
- Process safety
- Unit energy consumption



Individual screens for each plant / unit / component used by the plant based on PI ProcessBook.



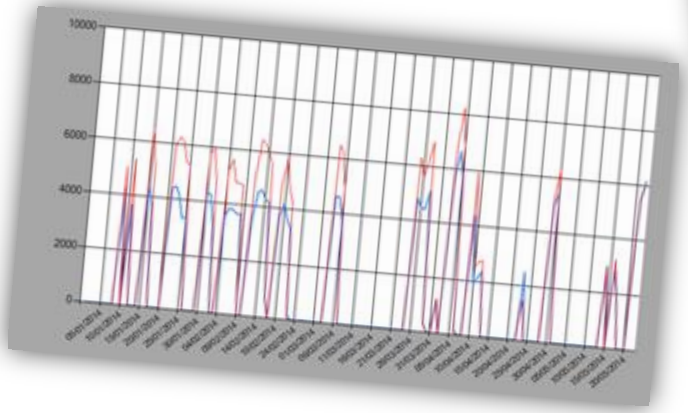


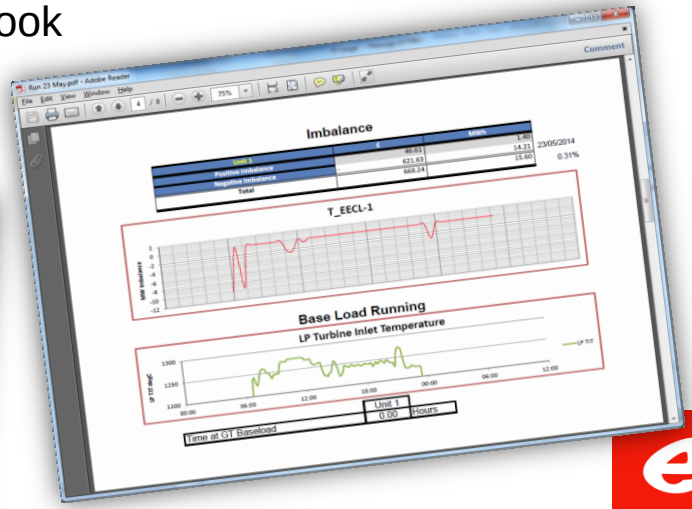
Example: Performance Analysis

Analysis of:

- Availability
- Components
- Imbalance
- Comparative trending between units and components
- Trends

Individual reports for each plant / unit / component used by site operations based on PI ProcessBook and Asset Framework

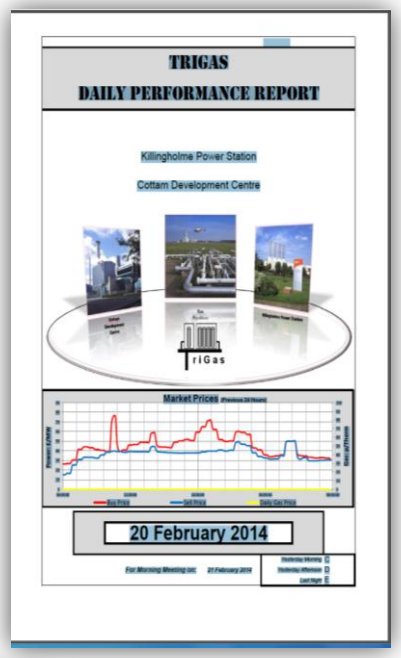




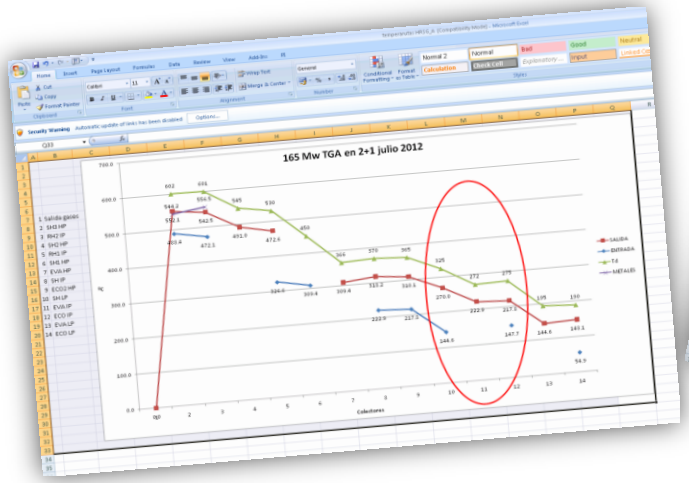
Example: Reporting

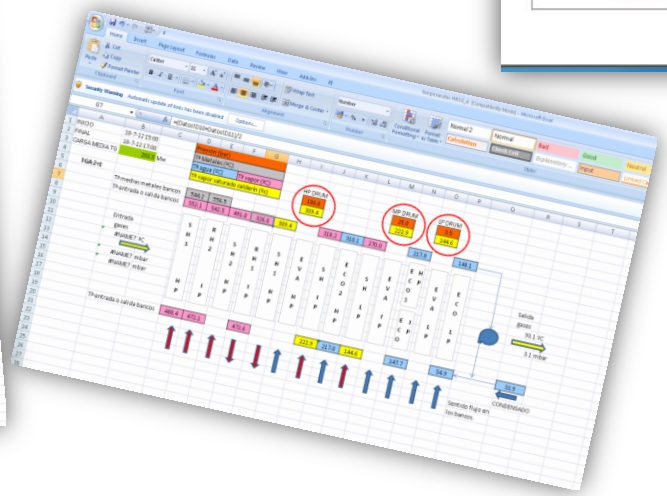
Automated daily, weekly and monthly reporting

- Emission monitoring and reporting
- Electrical generation
- Imbalance reporting
- Plant performance reporting
- Shift Reports



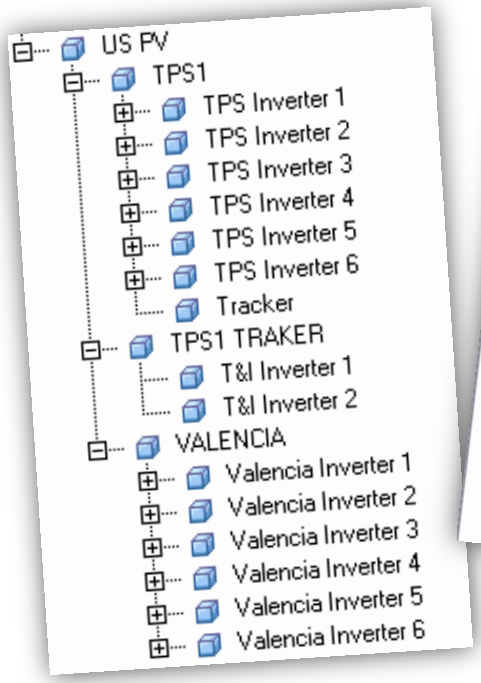
Ad hoc and automated reports using PI DataLink and Asset Framework

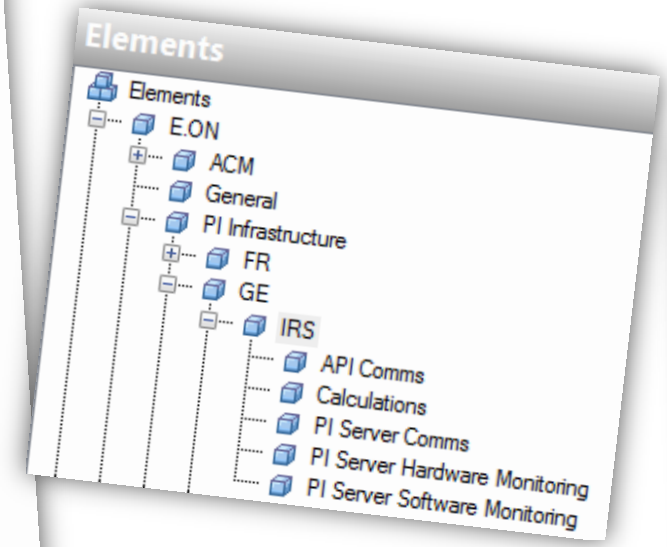


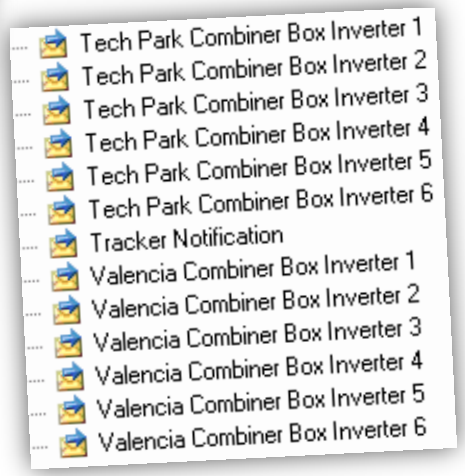


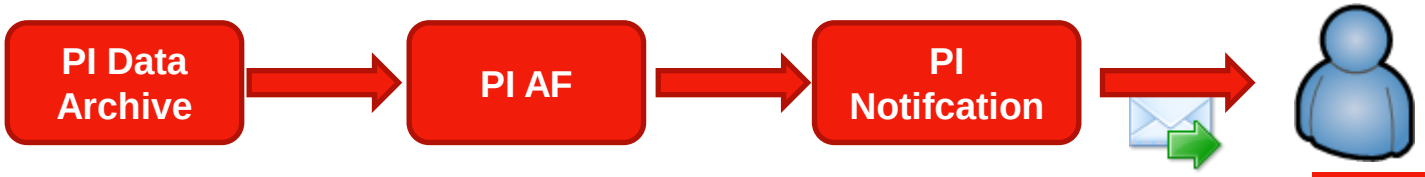
Example: Alerting

PI Notifications is used to alert on defined conditions.







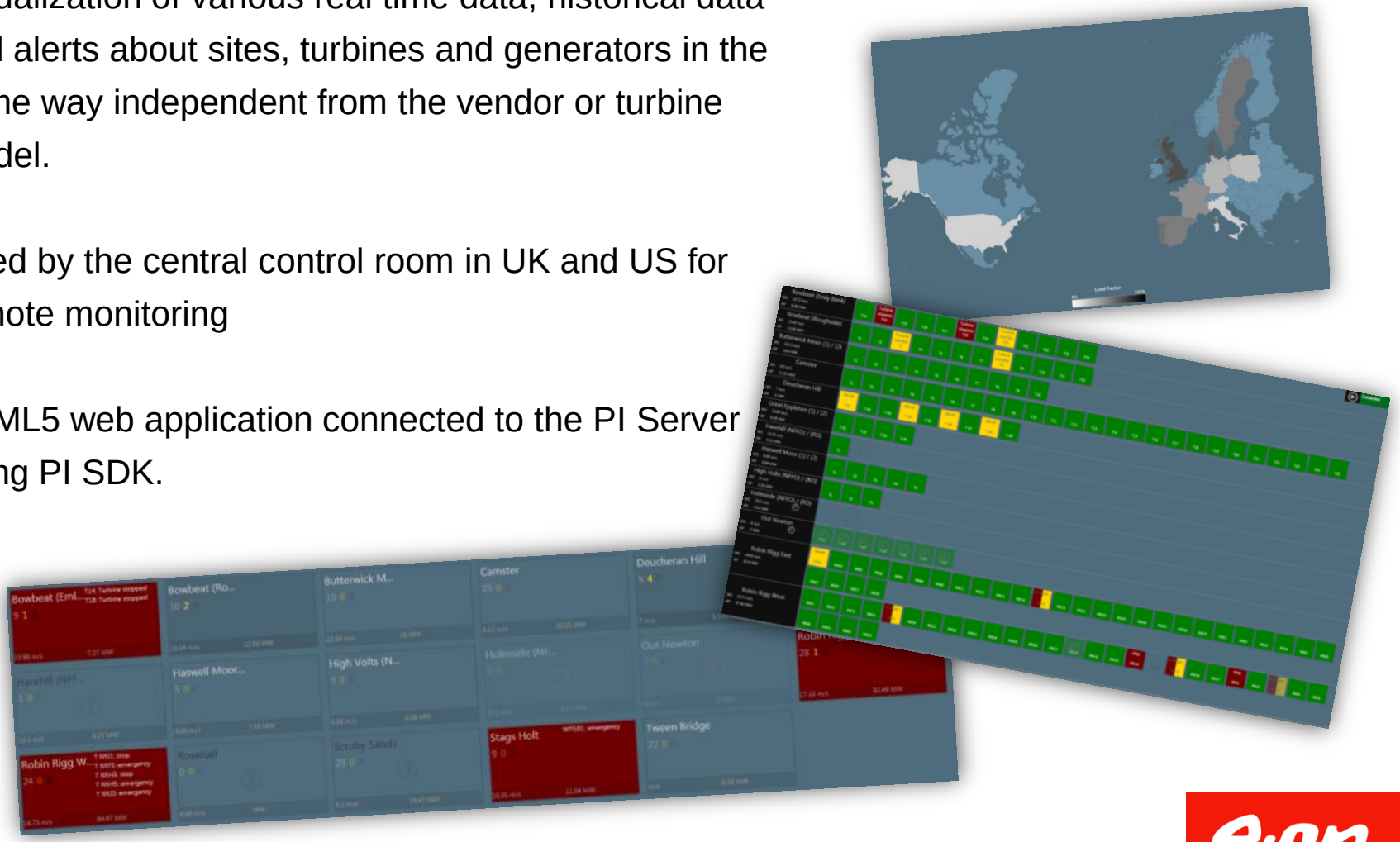


Example: Windfarm Monitoring

Visualization of various real time data, historical data and alerts about sites, turbines and generators in the same way independent from the vendor or turbine model.

Used by the central control room in UK and US for remote monitoring

HTML5 web application connected to the PI Server using PI SDK.



Example: Mobile application

Basic information of each site: technology, country, site name and real time data

Technician section for maintenance & navigation

Available for both wind and non-wind sites.

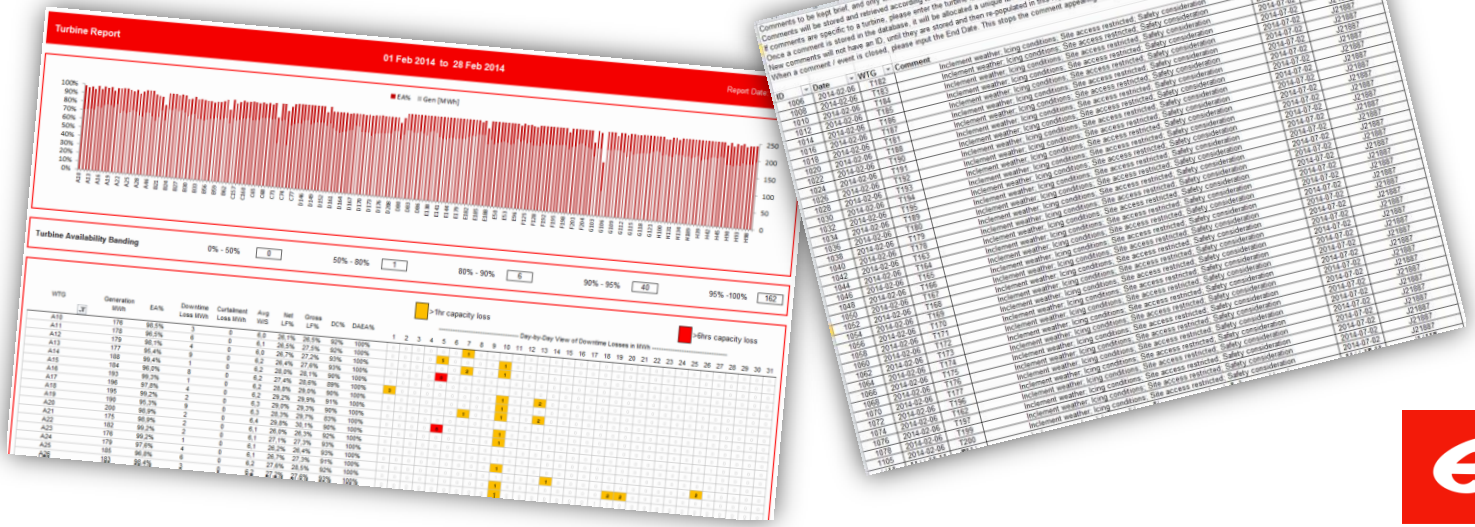
Native android application with a REST webservice connect to the PI Server using PI SDK

Example: Daily KPI Reporting

Report is specifically for site operations and fleet analyst.

It contains operational information, and is used to highlight current performance, turbine issues and other site technical markers

Daily report with data from the PI Server using the PI OLEDB Provider.

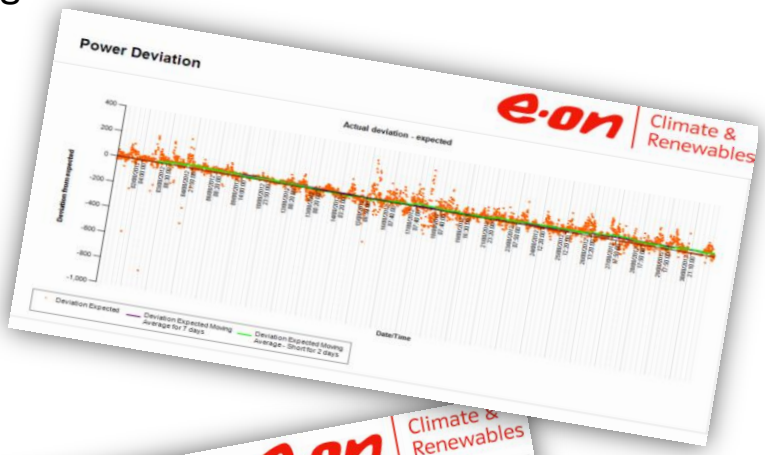


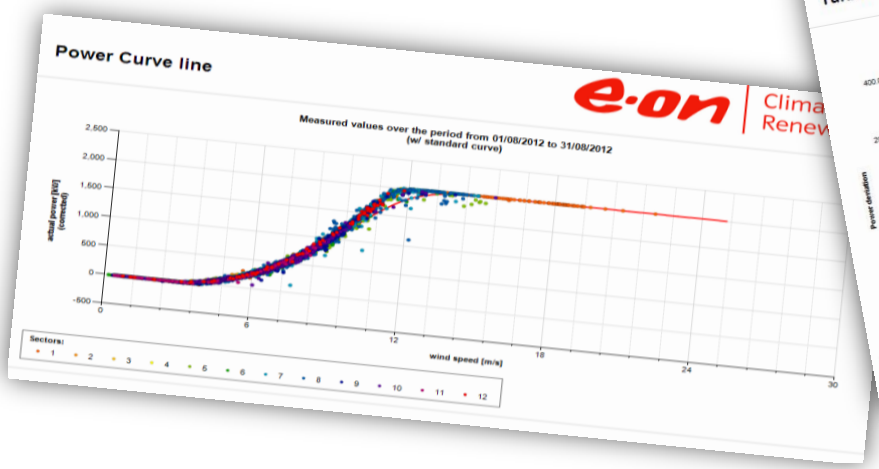
Example: Performance Analysis

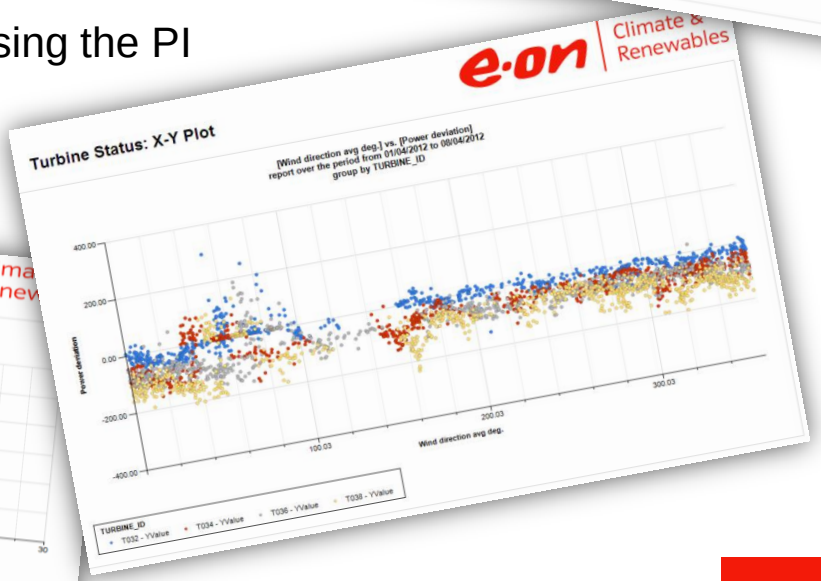
Perform high quality turbine analysis by using various analytical techniques and methodologies.

Efficient and effective identification of any relative over performing or under performing turbines within the Renewables Fleet.

Webportal with data from the PI Server using the PI OLEDB Provider.







Users working with PI about the value…

"…PI is an essential part of our routine maintenance and plant operation routines. Without PI this plant would fall back to looking at maintenance using DCS HDSR taking us back many years…."

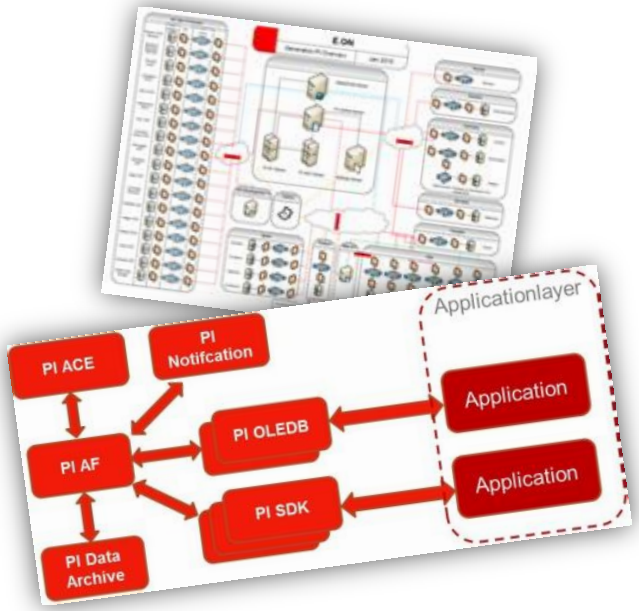
"…We use PI on a daily basis to watch run ups and monitor plant issues. We use it for root cause analysis and advanced condition monitoring…."

"…PI is mainly used as a data historian, some people use it to develop process book screens but its main usage is to retrieve data for monthly reports…"

"…Before the implementation of PI, all the maintenance data needing were downloaded via DCS by operation team, right now the maintenance people are able, from their PCs, to create customized data collection, saving time and giving more efficiency to the process..."

Summary

"… applying the different requirements for both worlds enabled us to use the PI System in the most valuable way. We now have the necessary tools to get more out of the data and to continuously improve…"



Business Challenge

- Applying business needs for the renewable and conventional world by taking the individual requirements into account.

Solution

- Conventional: Install a PI Server in each plant and grant access to the plant operations
- Renewables: Implement a global architecture and provide customized solutions based on PI Tools

Results and Benefits

- Reliable indicators and processes in real time
- Improved accessibility and sharing of information
- One consistent system across all plants for renewables and conventional

THANK YOU FOR YOUR ATTENTION

ANY QUESTIONS?

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