OSIsoft® UC2010

Real Time Information — Currency of the New Decade

Hilton San Francisco Union Square | San Francisco, CA

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Enterprise SCADA 2.0 –
A System for decentralized generation assets

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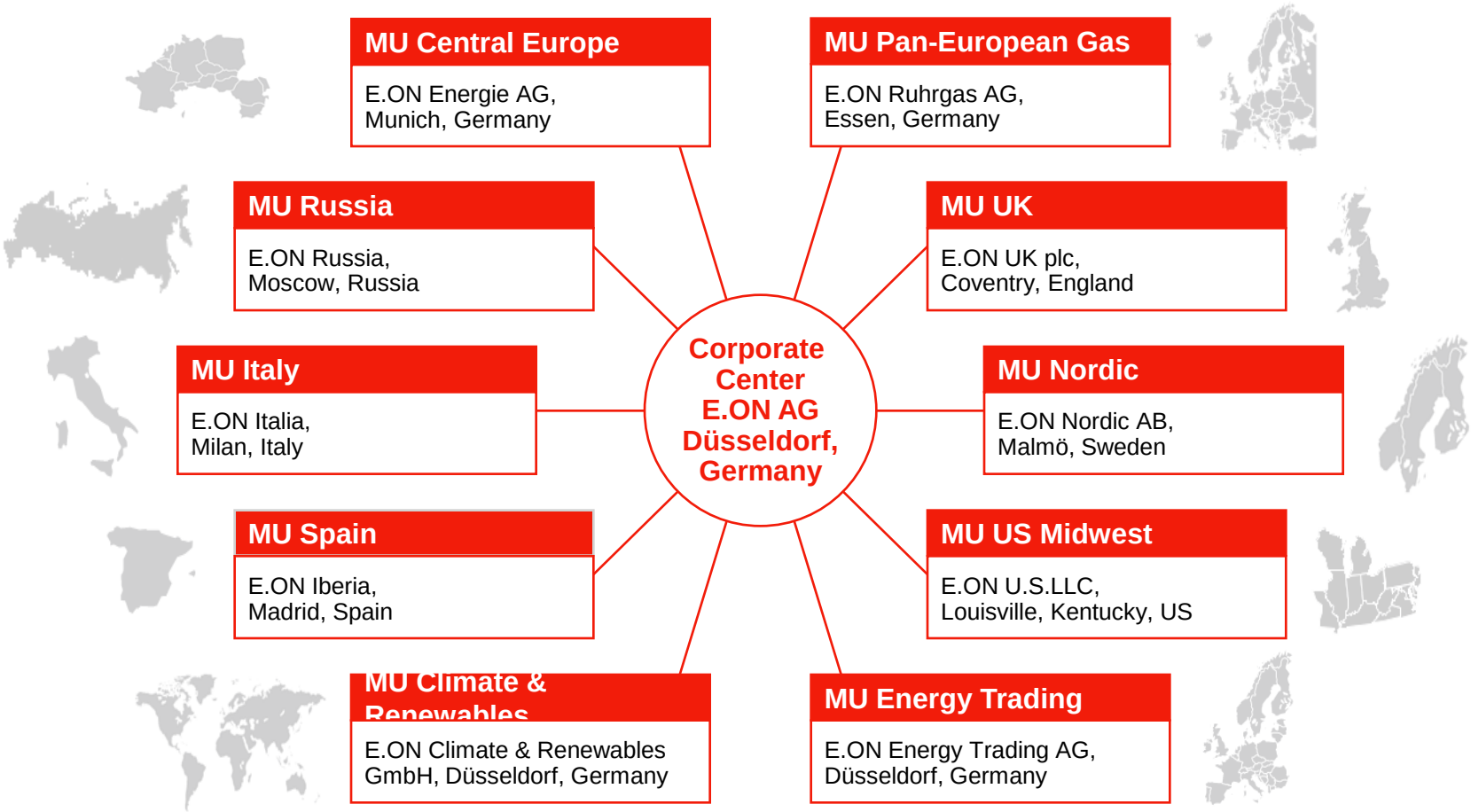
E.ON Climate & Renewables

AGENDA

- E.ON Climate&Renewables in the E.ON Group
- EC&R's Renewables strategy
- SCADA and the opportunities
- The Challenges
- The Solution
- The Result
- The Vision

E.ON Group structure

E.ON – One of The World's Largest Electricity and Gas Energy Service Providers



MU = Market Unit

E.ON – Key figures for the year 2007[1]

E.ON – One of the World's Largest Electricity and Gas Energy Service Providers

Sales	€68.7 billion
Adjusted EBIT	€9.2 billion
Electricity sales volume[2]	470.8 billion kWh
Gas sales volume[2]	1,212.5 billion kWh
Employees	87,800

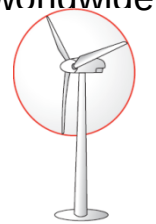
- Activities in power and gas markets all over Europe and US*
- Vertically and horizontally integrated business ranging from power generation and gas production to trading, distribution and customer sales.
- Power generation of 54 GW including nuclear (32 %), fossil (57%) and renewable energy (11%)

[1] According to the 2007 financial statements.
[2] Unconsolidated figures.
*Renewable Energy and Carbon Sourcing with worldwide activities

Global Wind Market: A rapid evolution

1996	2008	2020
Global installed wind capacity		
~6 GW	~100 GW	~900 GW

+~100,000 turbines worldwide*

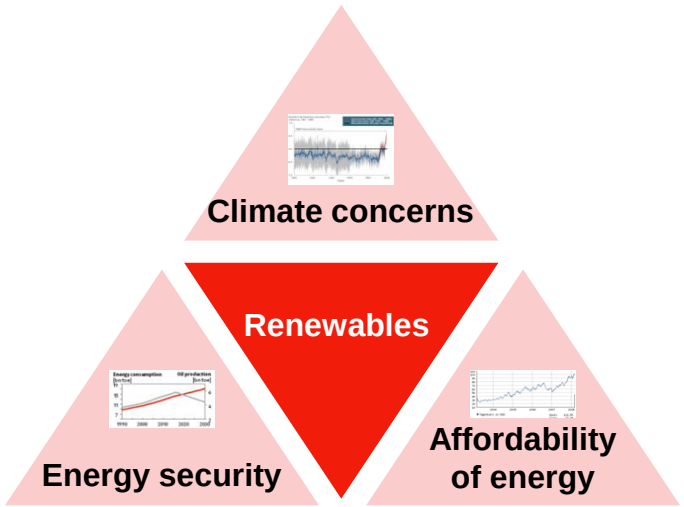


+~300,000 turbines worldwide**

From now to 2020 every 25 minutes 1 wind turbine needs to be erected

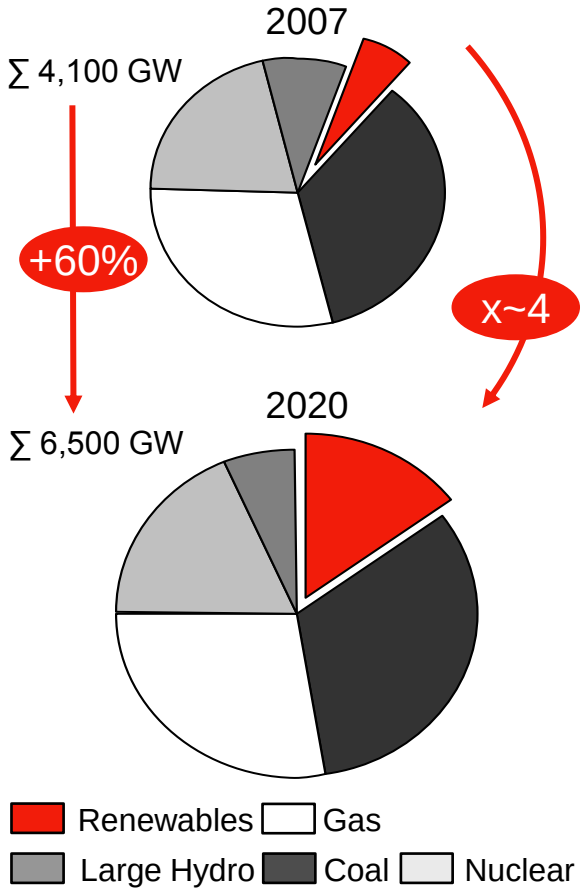
Source: BTM 2007 *Average size ~1MW ** 3MW turbine

Renewables: Will play a vital role in meeting future energy challenges



- Renewables will be a major driver for reducing CO_2 emissions
- Renewables can reduce dependence on fossil fuels and help to meet increasing energy demand
- Renewables will increase price stability and thus the affordability of energy

Global generation capacity (GW)



Source: E.ON; IEA; BTM; California Institute of Technology; World Energy Council; World Energy Assessment; Roland Berger Strategy Consultants

E.ON is well positioned to succeed in the Renewables market…

Our market beliefs	What is needed to succeed	E.ON positioning
Sustainable and material growth	Capacity and capability for large-scale projects, political engagement, M&A capabilities	E.ON is in top position in a dozen countries Strong financial capacity Track record of managing large transactions
Understand technology evolution for optimum portfolio management	Technical capabilities and market insight	In-depth knowledge of energy markets and technologies Strong R&D function and capability JV with Schüco, Lunar Energy and Pelamis
Boutique to Industrial	Step change in value chain management	Operational excellence in running large-scale energy systems Deep know-how in supply chain management Extensive engineering capabilities Excellent understanding of infrastructure implications (grid management)

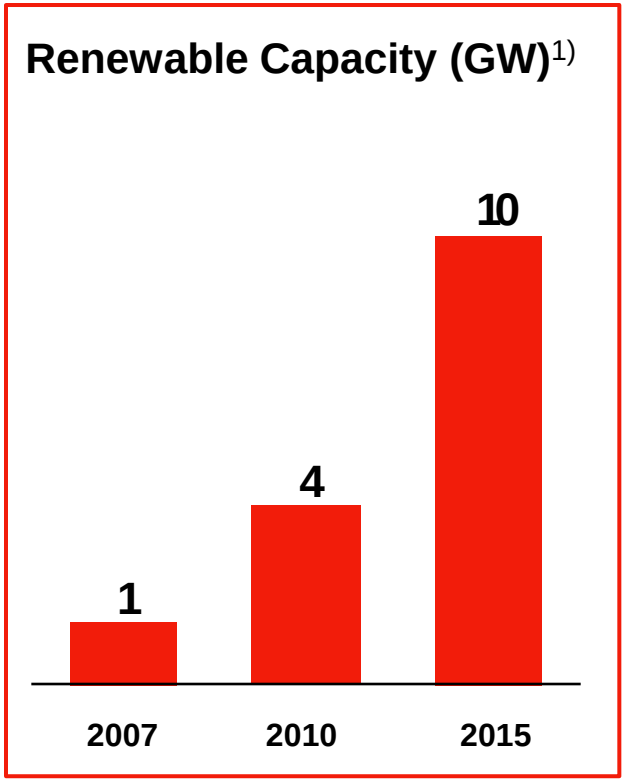
Renewables play a central role in E.ON´s strategy

E.ON s Rewables and Carbon Reduction Strategy

- Reduction of specific CO_2-emissions by 50% until 2030
- Use of Renewables and nuclear energy, highly-efficient power plants and innovative energy technologies
- Renewable energy plays central role

Setting up E.ON Climate & Renewables (EC&R)

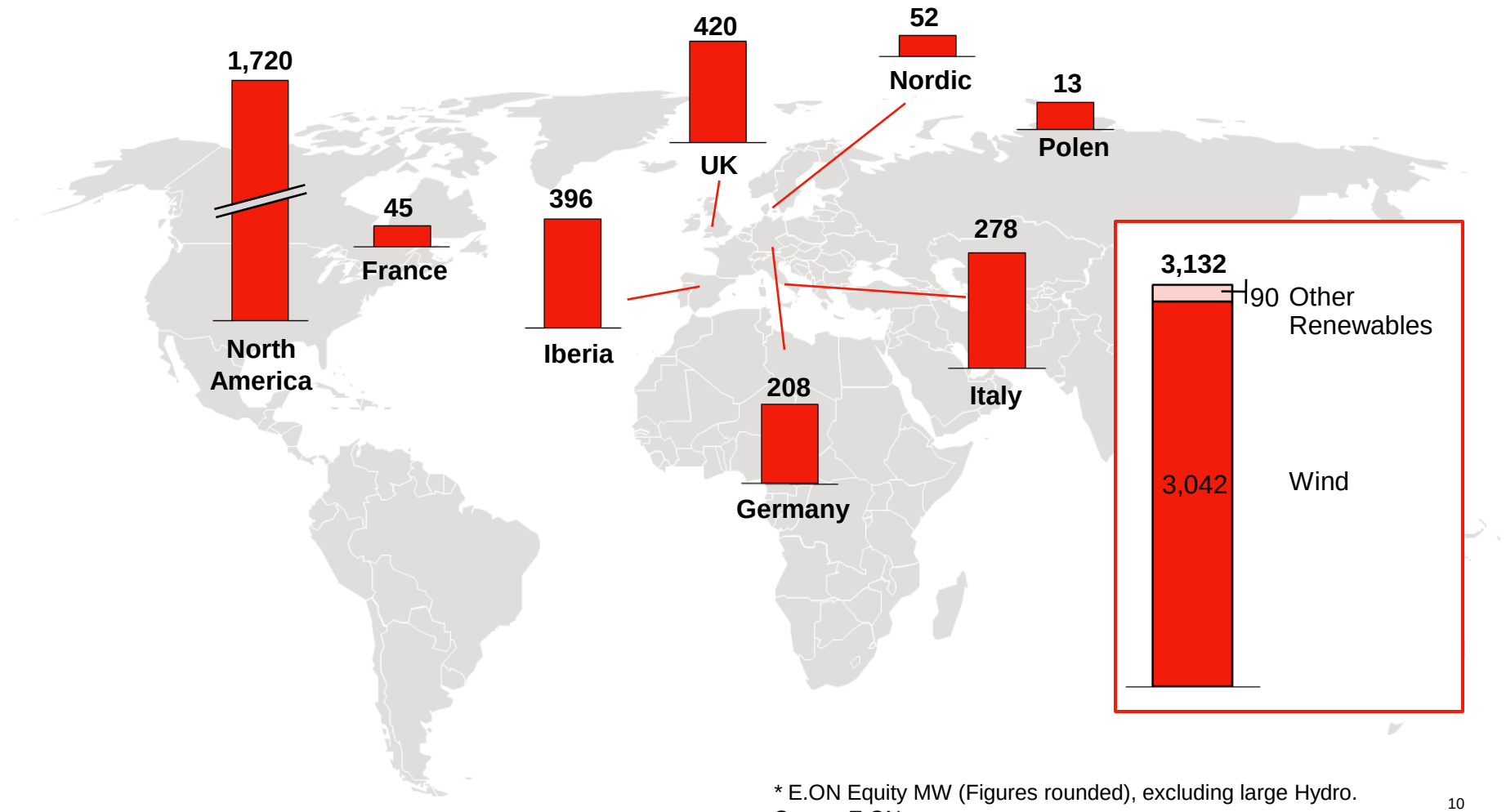
- Bundling of all activities in the fields of renewable energy and carbon sourcing
- Strong expansion of activities supported by major investments: € 6 bn. until 2010
- Expansion of renewable generation[1] from 1 GW in 2007 to 10 GW in 2015
- Long-term engagement for strong position in the global Renewables market



1) Excluding large hydro (approx. 6,000 MW in 2008)

Focus on the most attractive markets: current footprint

Installed renewables capacity as of April 2010 (MW)*



* E.ON Equity MW (Figures rounded), excluding large Hydro.
Source E.ON

Portfolio management: Focus on promising technologies

Technology roll out | **First commercial plants** | **Proof-of-concept & technology tracking**

EC&R technology selection criteria:

- Scalability
- Growth potential
- Financial attractiveness
- Wider E.ON Group interest
- Closeness to E.ON capabilities

Deep dive technology analysis

Wind Onshore

Wind Offshore

Large biogas / bio-methane, Large inland biomass

Solar / thin film applications

Large coastal biomass

Solar / CSP

Wave / tidal

Alpha Ventus

Offshore-pilot project in the German North Sea

Key figures:

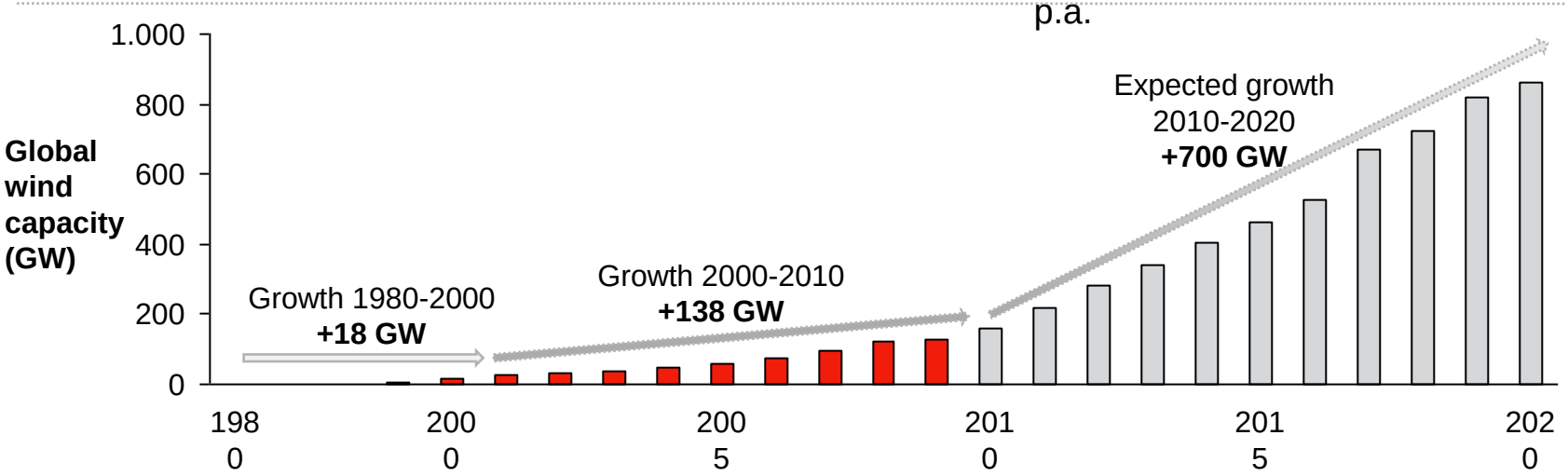
- 45 km off the island Borkum
- 60 km off the German coast
- 30 m platform height
- Foundation of 750 t weight fixed with piles of 35 m length and 100 t weight

Picture:
Offshore-transformer station

Renewable Energies – from Boutique to Industrial

Wind energy as a perfect example for the industry development

	1980 to 2000	Since 2000
Growth:	• < 1 GW p.a., regional	• > 10 GW p.a., worldwide
Players:	• " True believer" and niche supplier	• International suppliers and industrial players (e.g. utilities)
Project Size:	• Kilowatt scale	• Gigawatt scale
Turnover:	• <€10 bn, p.a.	• ~€160 bn (2008); ~€400 bn (2020e), p.a.



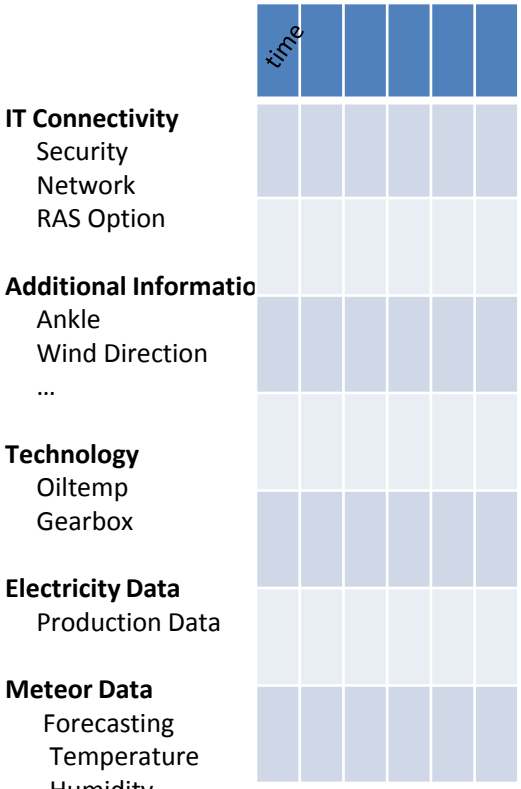
Sources: GWEC, EER

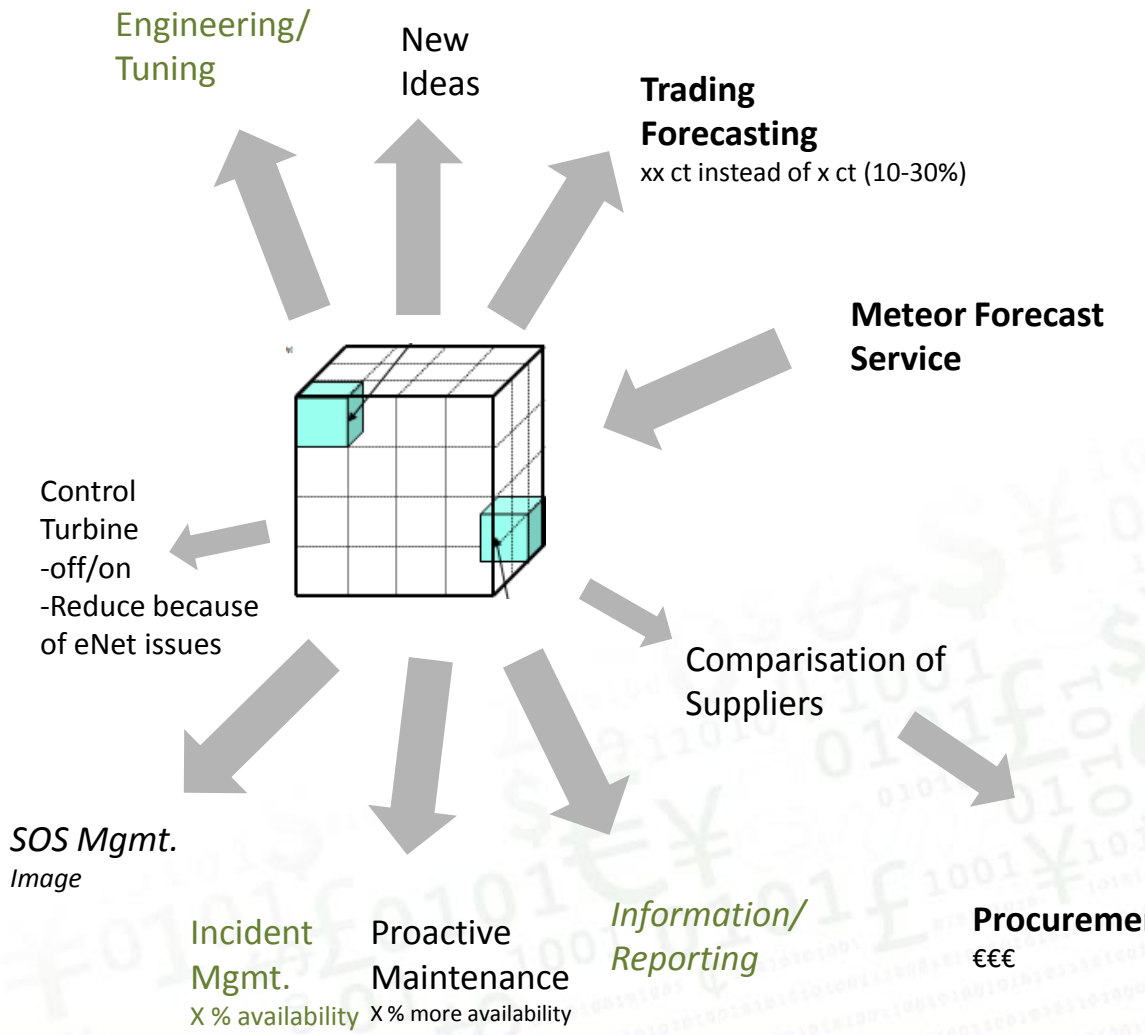
SCADA Brainstorming

SCADA areas and potential

less Control more Management

Is a Wind Turbine maintenance more like a
a.) coal power plant ?
or
b.) like a airplane engine ?

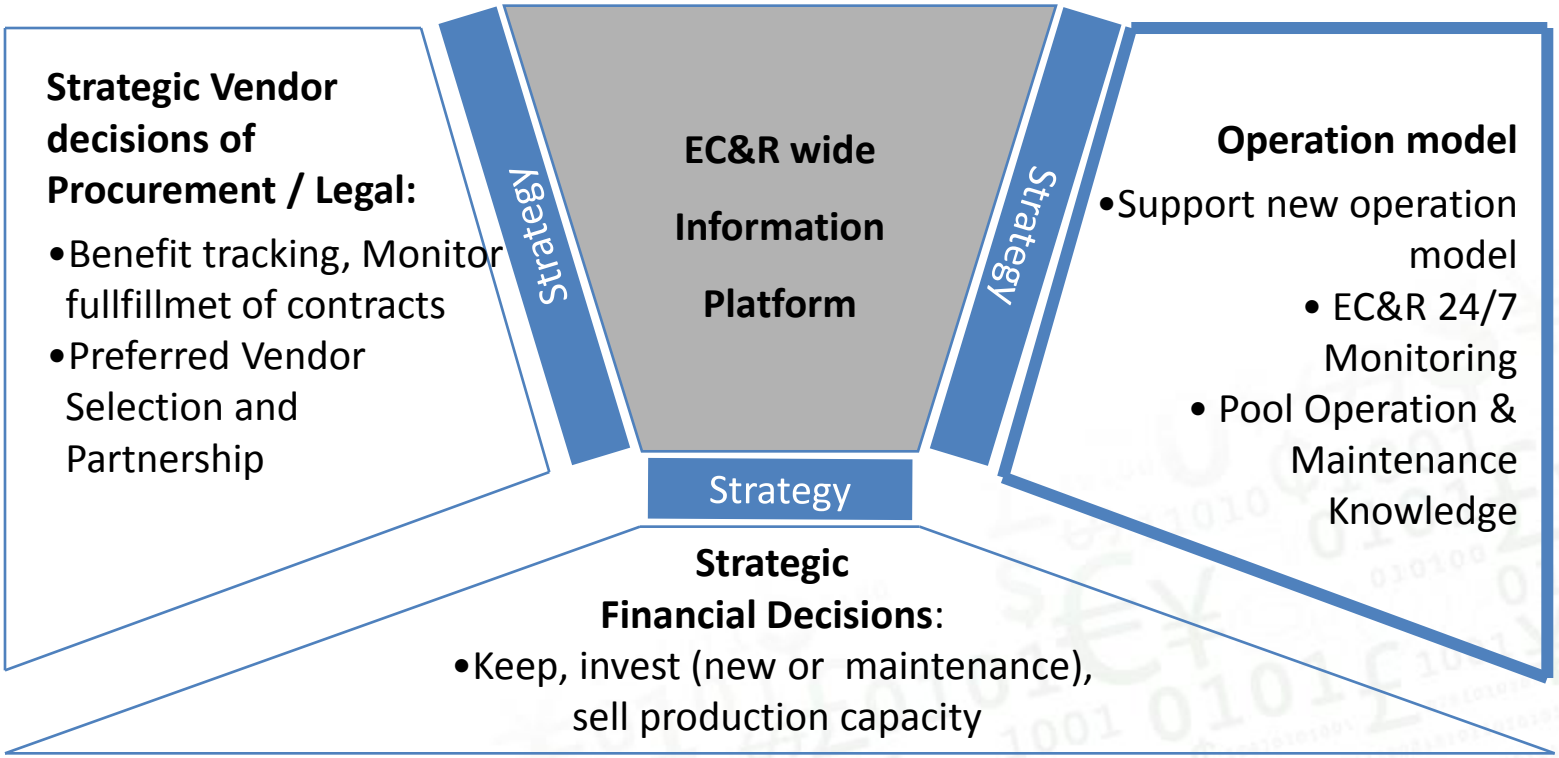




Why do we need an EC&R wide Information Platform

E.ON Corporate Value

Build Leadership EBIT
Corporate Social Responsibility
Marketing Communication
Agile operational planning



BUSINESS CHALLENGES

Smart Operations in Utilities is about:

Globally **Interconnecting**

Instruments & field devices to business processes in real-time,

incorporating analytics, predictive modeling and sharing **intelligent** information across the entire value chain

Real-time information about production, equipment and performance across the organization

Business Model Innovation and competitive edge by use of sophisticated predictive performance algorithms

Automatic actions in the field and in business process with or without human interventions

Implementation Challenges

-**Security /Compliance /Warranty**

-**Connectivity e.g. Bandwith and reliability**

-Remote Maintenance Models

-Regional “best-practice”

-Existing vendor contracts and reluctance to adopt customer standards

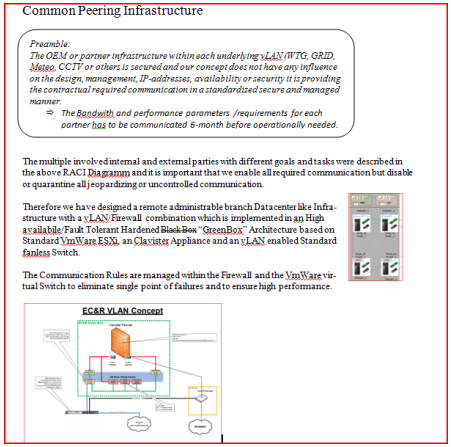
-(missing) Trust in IT and project runtimes

-limited Data or Information’s to calculate/prognose BC

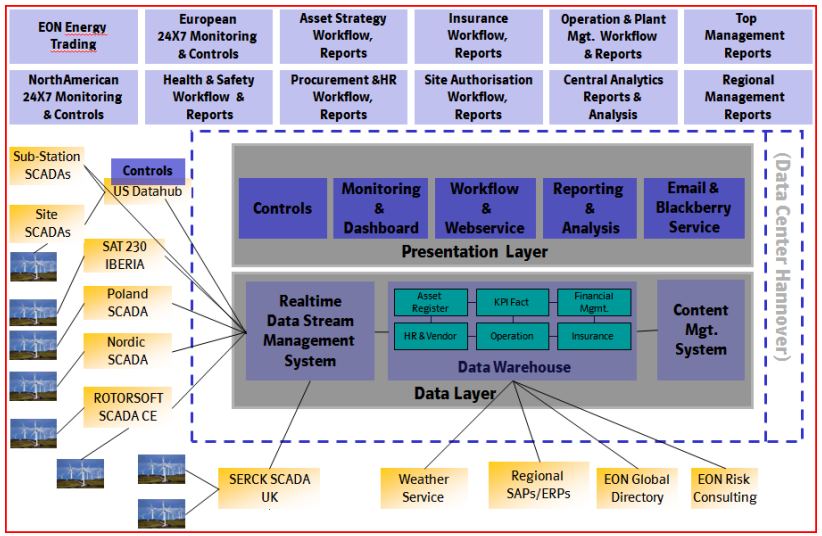
-Regional vs. global Responsibility

-Complex, multiple responsibilities and mashed dependencies

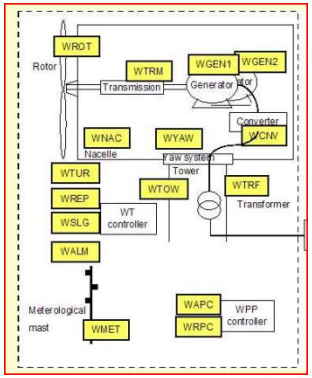
Our SCADA SOLUTION



„Green Box“
Peering Infrastructure Standard

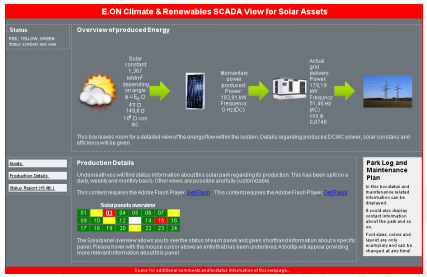


„The Platform“
Standard‘s and central Datastore



„prepared for the Future“
OSIsoft direct IEC 61400-25
Turbine Controller Interface

„The Applications“
Custom view‘s



…. XML-Xchange
Import, Export, Reports…

Our *No1.* SOLUTION Partner

OSIsoft

Custom Enterprise Agreement

- fast and coordinated rollout of Interfaces through OSI Engineers
- like „cloud computing „ operation and maintenance of the CENTRAL OSIsoft PI Server and Interface nodes. (Monitoring, Service, Update, Health Check …)
- plannable and fixed/ ramped licence payment aligned with the rollout
- easy access to informations via training, tools and special interest group membership
- long term partnership with strategic planning cycles

Which challenges are addressed/solved with OSIsoft

-**single** Datastore with up to 1.000.000 Tags/second (In and Out)

-**standard** local **bi**lateral Datalogger with up to 1 week buffering and reliable compressed (90%) communication with standard interfaces to connect to different Systems and Tools.

-**dedicated** „consultant/service“ team to rollout and monitor the Systems and dataflow.

-**Partnering** in piloting/preparing New Interfaces/Philosophies
e.g. European IEC 61400-25 Turbine Controller Connect
(No local SCADA System involved 1:x Interface API ….)

Alternates

-**multiple 15+** distributed, synched and linked SQL Databases with **local staff** and **redundant regional Datalinks**.

-**200+ Individual** and custom interfaces

-**redundant** HighBandwith **Connectivity**

-build up a central data **analyst team**

-No brainstorming partner and creating Islands or not creating enough customer Power to influence !

Our *further* SOLUTION Partner's

ESXi virtualisation Platform for the remote Sites and the Datacenter
- Fault Tolerance and High Availability Features to ensure Data consistency and remote administration and support without Application or OS mirroring or synchronisation.
- Remote Sites with a „low cost virtual *branch* Datacenter" to enable 99,999% Availability and Zero Downtime Hardware maintenance/replacement.
-Hardware Independancy through virtualisation layer even in a 25 year timeframe (5+ replacements).
-OS installed on a 4GB rockedised /Waterresisdant readonly USB-Stick.
-USB-KEY and single Hardware virtualisation.

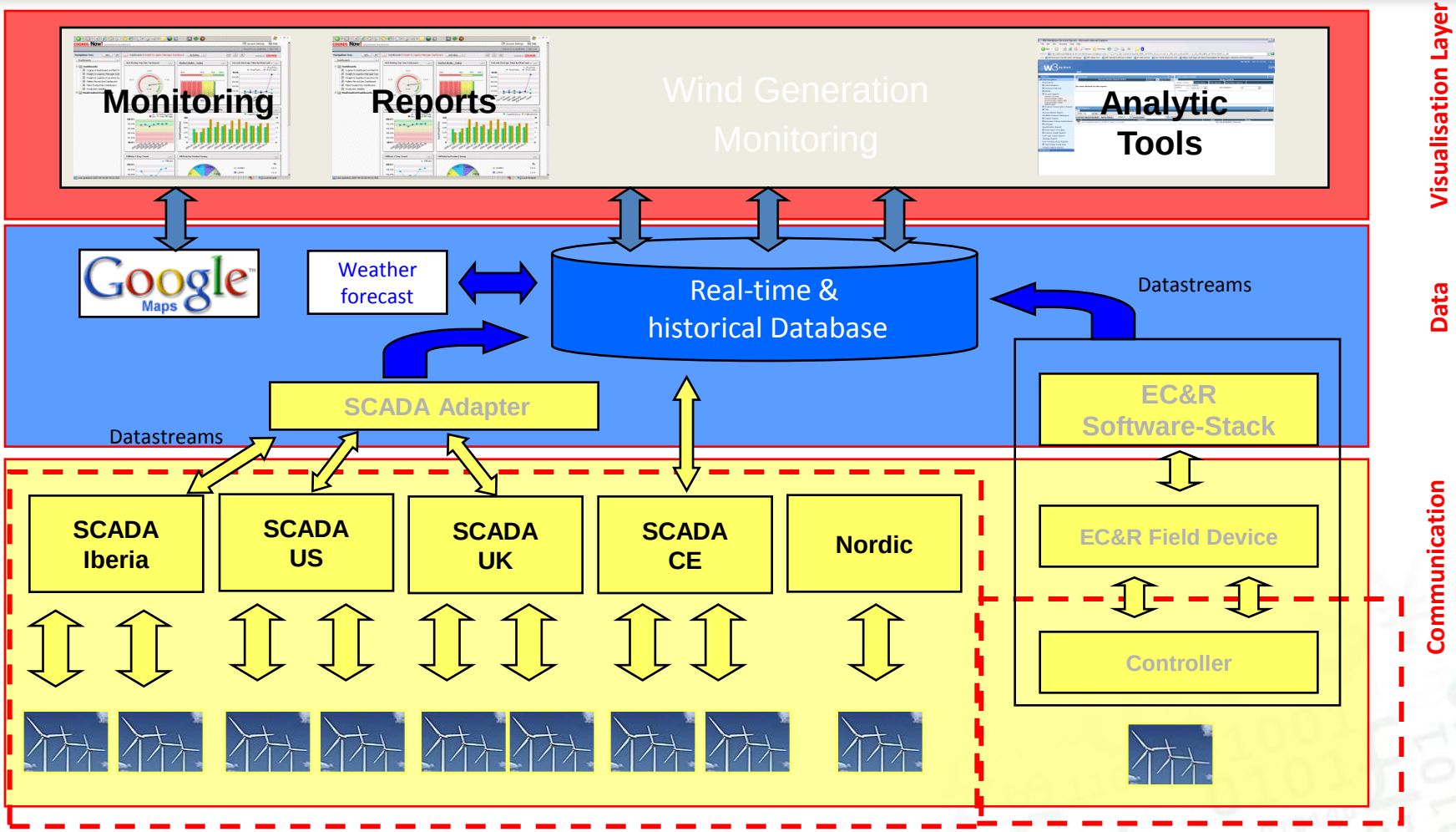
Open (compatible with all competitors e.g. CISCO) and Certified Firewall technology deployed as VmWare Appliance to utilize the High Availability of the Platform.

VmWARE *White Box* Hardware with international next day replacement and peripheral exchnage.
HP Procurve Fanless vLAN enabled devices.

Opensource commuity featured iSCSI and DRBD SAN System expandable through modules e.g. IP bonding.

Google earth the other „cloud service" as the transferable GIS standard.

International Project Management, System Integrator and Rollout support.



„The Platform“

Standard‘s and central Datastore

Common Peering Infrastructure

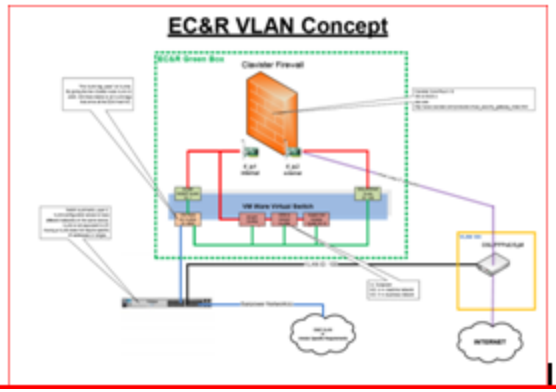
Preamble:
The OEM or partner infrastructure within each underlying vLAN (WTG, GRID, Meteo, CCTV or others is secured and our concept does not have any influence on the design, management, IP-addresses, availability or security it is providing the contractual required communication in a standardized secure and managed manner.

- ⇨ *The Bandwith and performance parameters /requirements for each partner has to be communicated 6-month before operationally needed.*

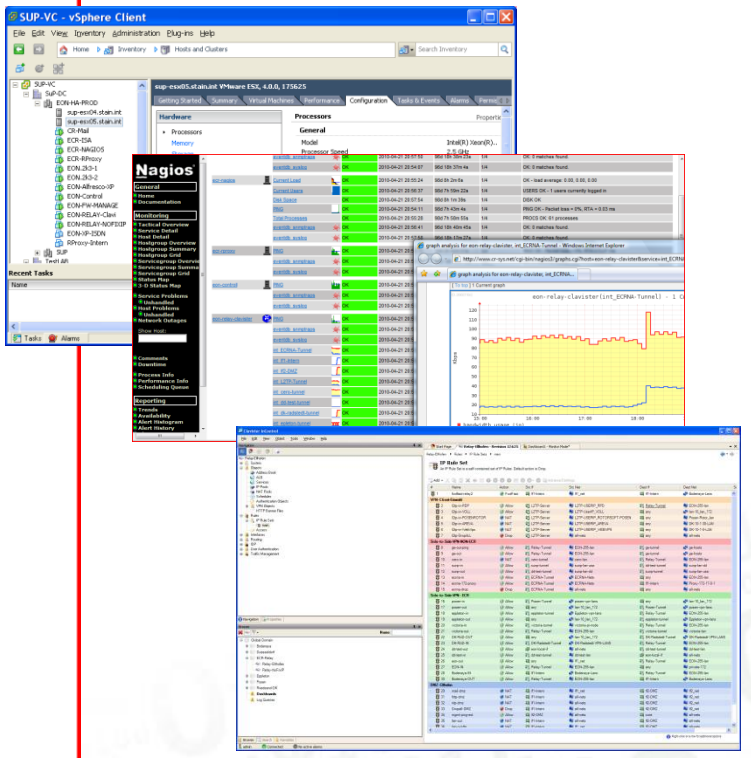
The multiple involved internal and external parties with different goals and tasks were described in the above RACI Diagramm and it is important that we enable all required communication but disable or quarantine all jeopardizing or uncontrolled communication.

Therefore we have designed a remote administrable branch Datacenter like Infrastructure with a vLAN/Firewall combination which is implemented in an High availabile/Fault Tolerant Hardened ~~Black Box~~ "GreenBox" Architecture based on Standard VmWare ESXi, an Clavister Appliance and an vLAN enabled Standard fanless Switch.

The Communication Rules are managed within the Firewall and the VmWare virtual Switch to eliminate single point of failures and to ensure high performance.



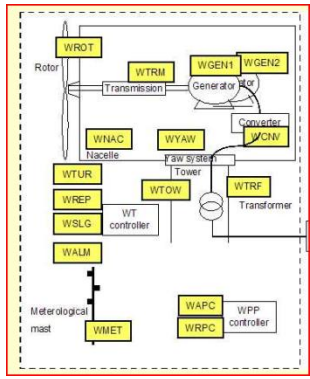
System Monitoring Components



„Green Box"

Peering Infrastructure Standard

-Repower and Bachmann are ready to pilot the IEC 61400-25 Interface
-EC&R and OSI are planning the



„prepared for the Future“
OSIsoft direct IEC 61400-25 Turbine Controller Interface

OPC vs. IEC 61-400 25

To streamline the Systems in the Field, to utilize the central Datastore there is a concept to split functionality between the Windcontrollers and the Central Datacenter and to utilize the embedded Bachmann virtual IPC for the local SCADA Control functionality.

The challenges are

-To use an existing System to communicate with the **multiple** Controller API‘s in realtime
➔ OSIsoft

-To enable the ECR Central system with the needed „Repower Reporting/Control Functionality“
➔ ECR

-To provide local Control via the Controller WebService
➔Repower

The Pilot-Workstream Matrix demonstrates how workstream activities are mapped to Pilots.

● Indicator for complexity

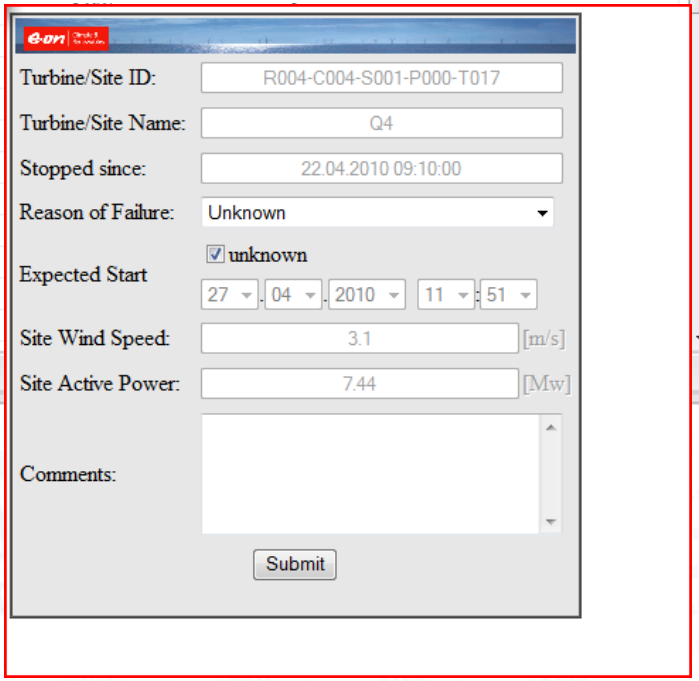
Workstream \ Pilot	(1) Operator Screens	(2)KPI Reports & Analysis	(3) Supervisory Control	(4) Maintenance	(5) Park Connect Portugal	(6) Park Connect Poland	(7) Park Connect Nordic	(8) Financial Metrics	(9) Insurance Contracts	(10) Solar & biogas	(11) Forecasting
Presentation Layer											
Screens and Workflow	●●●	●	●●●	●●●	●	●	●	●●	●●	●●	●●
Rules and Logic	●●	●●	●●●	●●●				●	●●●	●	●
Standard and Customized Reporting		●●●	●	●	●	●	●	●●●	●●●	●●	●●
Drill Down Analysis		●●●			●	●	●	●●		●●	●●
Information Integration Layer											
ECR Information Model	●●●	●●●	●●●	●●●	●●	●●	●●	●●●	●●●	●●●	●●●
Error Codes & Events	●●●	●●	●●●	●●●	●	●	●			●●	●●
Master Data Inventory	●●●	●●●	●●●	●●●	●	●	●	●●	●●●	●●	●●
Data Tag Mapping	●●●	●●	●●●	●●●	●●●	●●●	●●●		●	●●	●●
Data Layer											
Field & Park Connect	○○	○○	○○○	○○○	○○○	○○○	○○○			○○	○○
IT-Infrastructure Monitoring	○○○	○	○○○	○○○	○○○	○○○	○○○			○	○
Communication Infrastructure	○○○	○	○○○	○○○	○○○	○○○	○○○			○	○
Server Infrastructure	○○○	○○	○○○	○○○	○○○	○○○	○○○	○	○	○○	○○
SAP											
SAP Globe								○○○			
SAP PMI Integration				○○○							
Document Management		○○									

EC&R Lost Production

Turbine/Site Planned Stop

Reload Data

Region	Country	Site	Turbine	Shutdown Since	Acknowledge	Expected Start	Expected Duration	Loss Of Pow..	Loss Of Revenue(€)	Reason of Shutdown	Comments
⊞ Region: America (43 Entry) | Loss Of Power(MW): 0 | Loss Of Revenue(€): 0											
⊞ Region: Iberia (16 Entry) | Loss Of Power(MW): 0 | Loss Of Revenue(€): 0											
⊟ Region: United Kingdom (40 Entry) | Loss Of Power(MW): 1075727680 | Loss Of Revenue(€): 10757276.799999998											
United Kin...	UK	Blyth	Turbine 1	24.02.2010 10:40	NO			971808704 MW	9718087.04		
United Kin...	UK	Lowca	Turbine 6	23.03.2010 20:55	NO			101865776 MW	1018657.76		
United Kin...	UK	Lowca	Turbine 4	28.03.2010 19:25	NO			2053200 MW	20532		
United Kin...	UK	Askam	Turbine 6	11.04.2010 12:55	NO						
United Kin...	UK	Bowbeat	Turbine 15	11.04.2010 12:55	NO						
United Kin...	UK	Hare Hill	Turbine 2	11.04.2010 12:55	NO						
United Kin...	UK	Royd Moor	Turbine 13	11.04.2010 12:55	NO						
United Kin...	UK	Siddick	Turbine 6	11.04.2010 12:55	NO						
United Kin...	UK	Bowbeat	Turbine 4	11.04.2010 13:10	NO						
United Kin...	UK	Bowbeat	Turbine 8	11.04.2010 13:10	NO						
United Kin...	UK	Robin Rigg East	Turbine 2	11.04.2010 15:55	NO						
United Kin...	UK	Robin Rigg East	Turbine 6	11.04.2010 15:55	NO						
United Kin...	UK	Robin Rigg East	Turbine 11	11.04.2010 15:55	NO						
United Kin...	UK	Robin Rigg East	Turbine 17	11.04.2010 15:55	NO						



EC&R Wind Farm Monitoring

e·on Climate & Renewables

Global > Iberia > Spain

E.ON PPA Sp

Site Name	Active Power (MW)	Active Power (%)
Magallón	28.14 MW	70.35 %
Mallén	16.51 MW	55.03 %
Mingorrubio I	1.00 MW	3.85 %
Páramo de Poza	--	--
Pax	35.73 MW	90.23 %
Pico Gallo	18.88 MW	77.38 %
Planas de Pola	--	--
Remolinos a	--	--
San Juan de Bargas a	36.40 MW	81.25 %
Santa Quiteria	--	--
Sierra de Tineo	12.39 MW	28.16 %

Geographical Overview | Power Production Table | Wind Farm Data Table | E.ON Portfolio | System Status

Alert Logging | **Log Book**

Date	Region	Country	Site	Turbine	Created By	Title
2010.03.02 00:03:00	Iberia	Spain			guest	Restarting Sat230 client (PI int...
2010.02.22 00:02:00	Iberia	Spain			guest	Test AHUE 22.02.2010

Comment

Add New

EC&R Wind Farm Monitoring

e·on Climate & Renewables

Global > United Kingdom > UK

E.ON PPA UK

Site Name	Active Power (MW)	Active Power (%)
Scroby Sands	16.34 MW	27.23 %
Stags Holt	3.94 MW	21.89 %
Rheidol	0.46 MW	19.17 %
Deucheran Hill	2.70 MW	17.14 %
Out Newton	0.72 MW	7.91 %
Bowbeat	0.15 MW	0.48 %
Royd Moor	0.01 MW	0.15 %
Askam	0.00 MW	0.00 %
Bessy Bell	--	--
Blood Hill	--	--
Blyth	0.00 MW	0.00 %

Geographical Overview | Power Production Table | Wind Farm Data Table | E.ON Portfolio | System Status

Alert Logging | **Log Book**

Date	Region	Country	Site	Turbine	Created By	Title
2010.04.08 00:04:00	United Kingdom	UK			uk	ggff
2010.02.22 00:02:00	United Kingdom	UK			Uk	
2010.02.22 00:02:00	United Kingdom	UK			Uk	new log entry for uk
2010.02.21 00:02:00	United Kingdom	UK			UK	UK-Country test entry
2010.02.21 00:02:00	United Kingdom	UK	Out Newton		UK	Out Newton Log entry

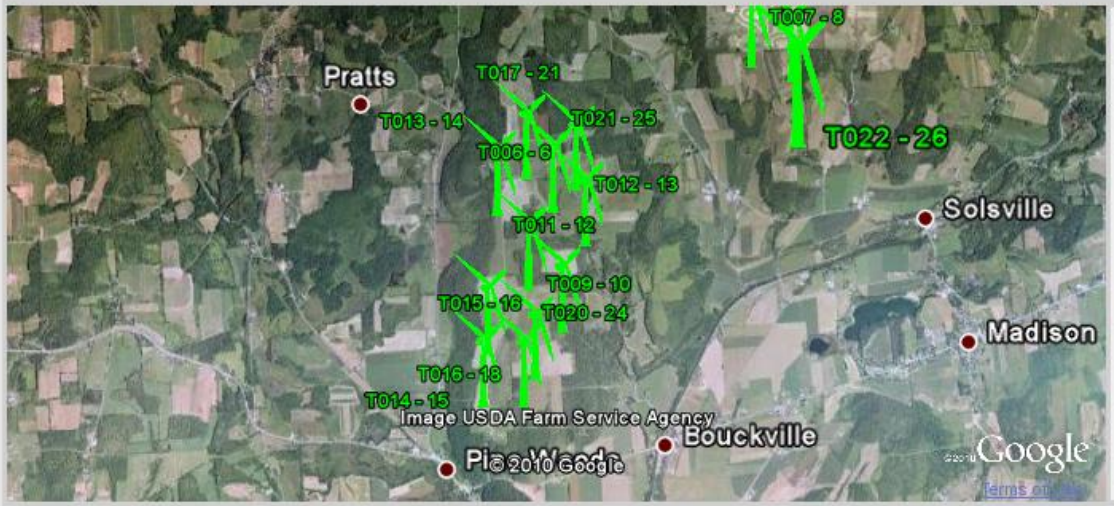
Comment

Add New

EC&R Wind Farm Monitoring

e·on Climate & Renewables

Global > America > US > Munnsville



Park Run | CSV Report

Park Pause | CSV Report Specific Dates

Met Station

Site Wind Speed	3.45	m/s
Site Wind Direction	304	°
Site Ambient Temperature	--	°C

Statistics

Power Factor	--
Turbine Total	23
Number of Faulted Turbine	0
Number of Turbines with No Comms	0
Number of	4

Grid Measurement Status

Site Active Power 0.8 MW

HV Network Diagram | Access Direction

Geographical Overview | Histogram Overview | Turbine Data

Alert Logging | **Log Book**

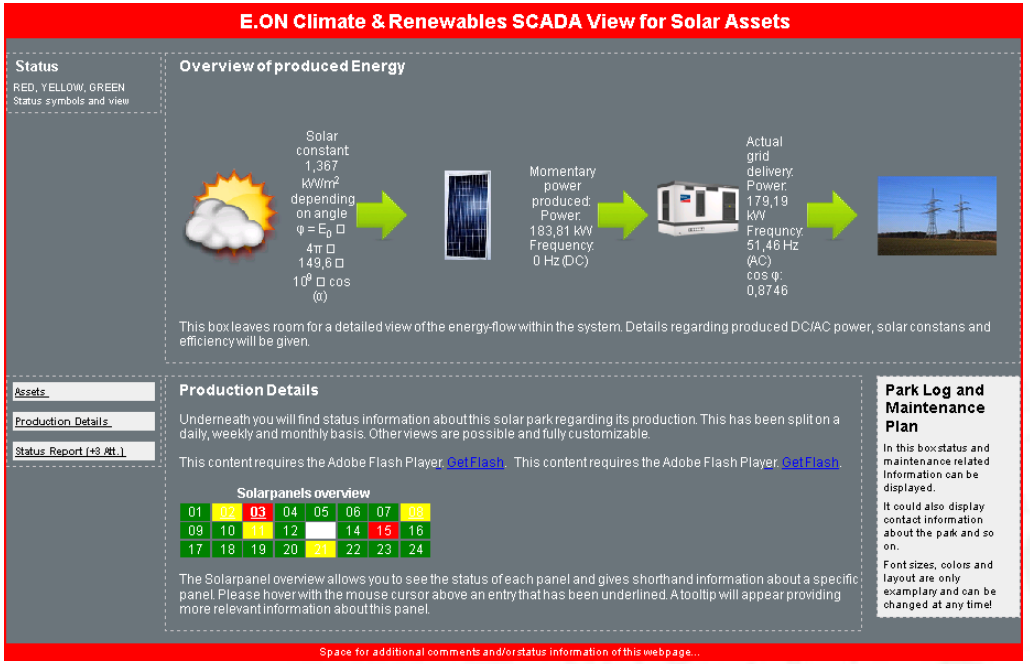
Date	Region	Country	Site	Turbine	Created By	Title

Comment

Add New

EC&R‘s OneWind Strategy ready to support Solar …

Central SCADA System started
-with wind and will support
all Power Production technologies .
-Individual screens and functions to fit
best for the specific technology and
EC&R‘s Information and Operation Models.
-Technical Monitoring of all System‘s and
Devices (Power Converter, Grid, IT,
Measures and Control Systems).
-Interface to automate and scale control
functionalities.
-Single Database for Reporting and Analysis.
-Secure Architecture for Data-Exchange with
other/external Data- or Service Supplier.
-Standardised Technology Concept for Generation Facility
LAN, Communication, Firewall, Security and Systems).



Example of a Solar view within the SCADA System.

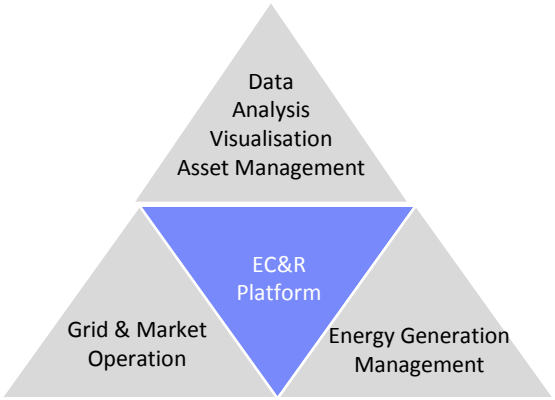
Achievements

- Global System implemented in 8 month, below budget and increased savings
- Centralized Global Platform
  - Usage of **Cloud Computing** where possible
  - Highly **Scalable**
  - Service Oriented Architecture - **SOA**
  - Open Solution single EC&R **Datamodel**
  - Open/Community technologies e.g. Java, Vmware, Ubuntu
- High Availabilty for all components
- 24/7 Monitoring and Support
  - OSIsoft PI and Interfaces
  - VPN and Central Firewall
- Application as Matrix Organisation enabler
- Original data access for Reporting and analytics as “One Version of the Truth”
- Global visibility and comparison of Assets

EC&R Platform-Building Blocks (Vision)

Data Management
Historical Analysis & Data
Insurance Information
Condition Monitoring
Enterprise Application Access
Scheduled & adhoc Reports

EC&R Platform
Reference Semantic Model
Visualisation & Analytical toolset
Global Industry Standards
Configurable Event Rule Engine
Service Oriented Architecture



Grid & Market Operation
Energy Forecasting
Energy Scheduling
Settlemement
Curtailment Tracking
Commercial Controls

Energy Generation Management
Site & Turbine Monitoring & Controls
Sub-Station Scada Interface
Generator Management
Predictive Analysis & Optimisation
Alarm & Event Processing

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Thank you