

Real-time Data Infrastructure Applied to the Monitoring of Renewables Assets

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Agenda

- Presentation of EDF EN
- Needs of EDF EN Services
- PI System architecture
- Project results

EDF EN: a multi-segment player

1

Growth drivers



Wind energy

85% of the EDF EN group's total installed capacity



Solar PV energy

Objective: 500 MWp net in service by year-end 2012

2

Potential new growth drivers



Distributed solar*

Biomass

Biogas

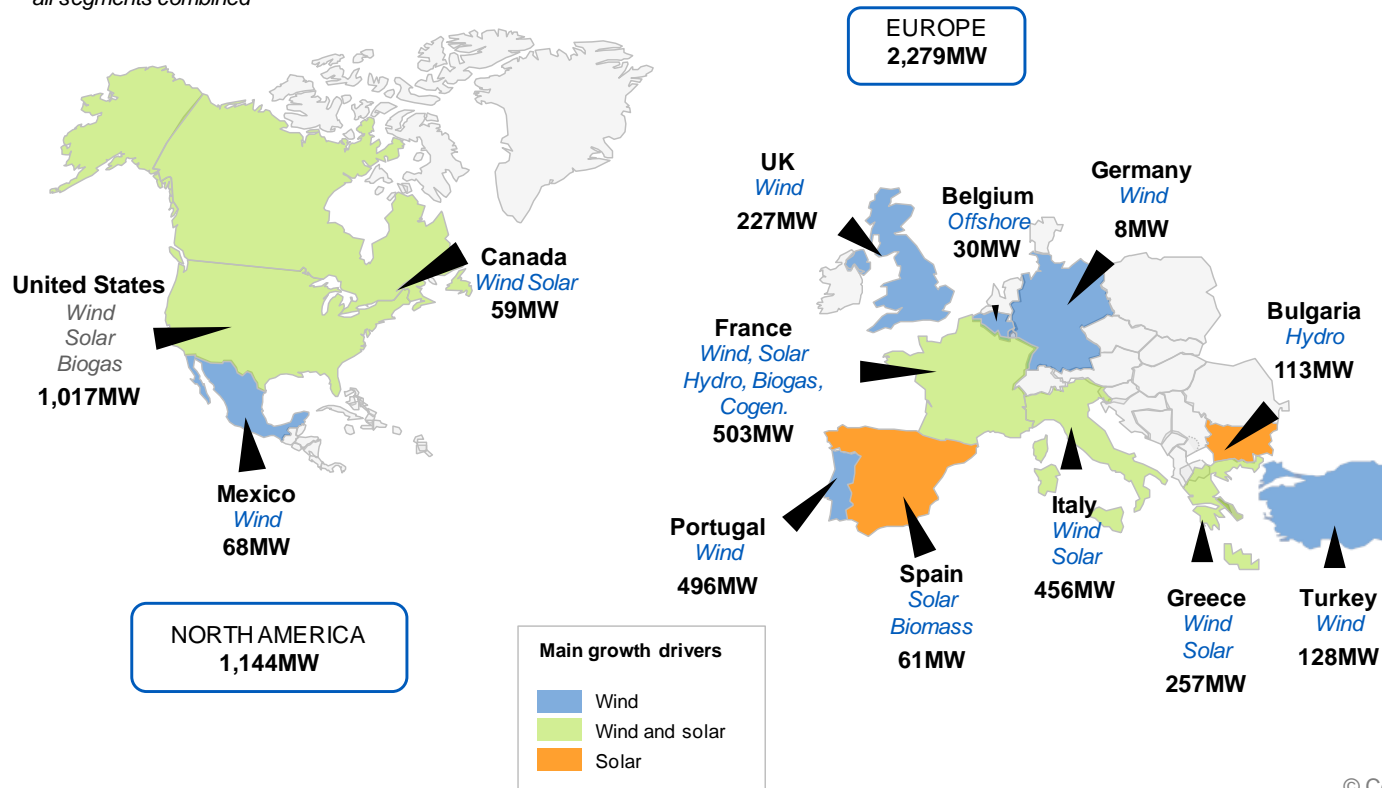
Marine Energies

Offshore

Selective developments to prepare for the future

An international footprint: 3,423MW installed in 13 countries

Gross figures by country at 12/31/2010
all segments combined



An integrated operator

Green electricity generation is our core business

Development

Construction

Generation/
Sale of assets (DSSA)

Operations &
Maintenance



- Prospecting for land
- Environmental impact studies
- Project management (administrative, economic and technical coordination)
- Electricity production yield assessment

- Engineering (electrical, acoustics, etc.)
- Construction works (project contracting)
- Procurement
- Logistics

- Asset management
 - Relationships with contractors
 - Production tracking
- **DSSA** (Development and sale of structured assets)

- Scheduled maintenance
- Corrective maintenance
- Purchasing/management of spare parts

- Non-recourse project financing
- Tax, treasury and financing and accounting
- Legal affairs, insurance
- Research and development

EDF EN Services

EDF EN Services is a EDF Energies Nouvelles company in charge of the operation and maintenance of wind parks and solar parks in Europe.

Today under O&M contracts on 31st of March 2011:

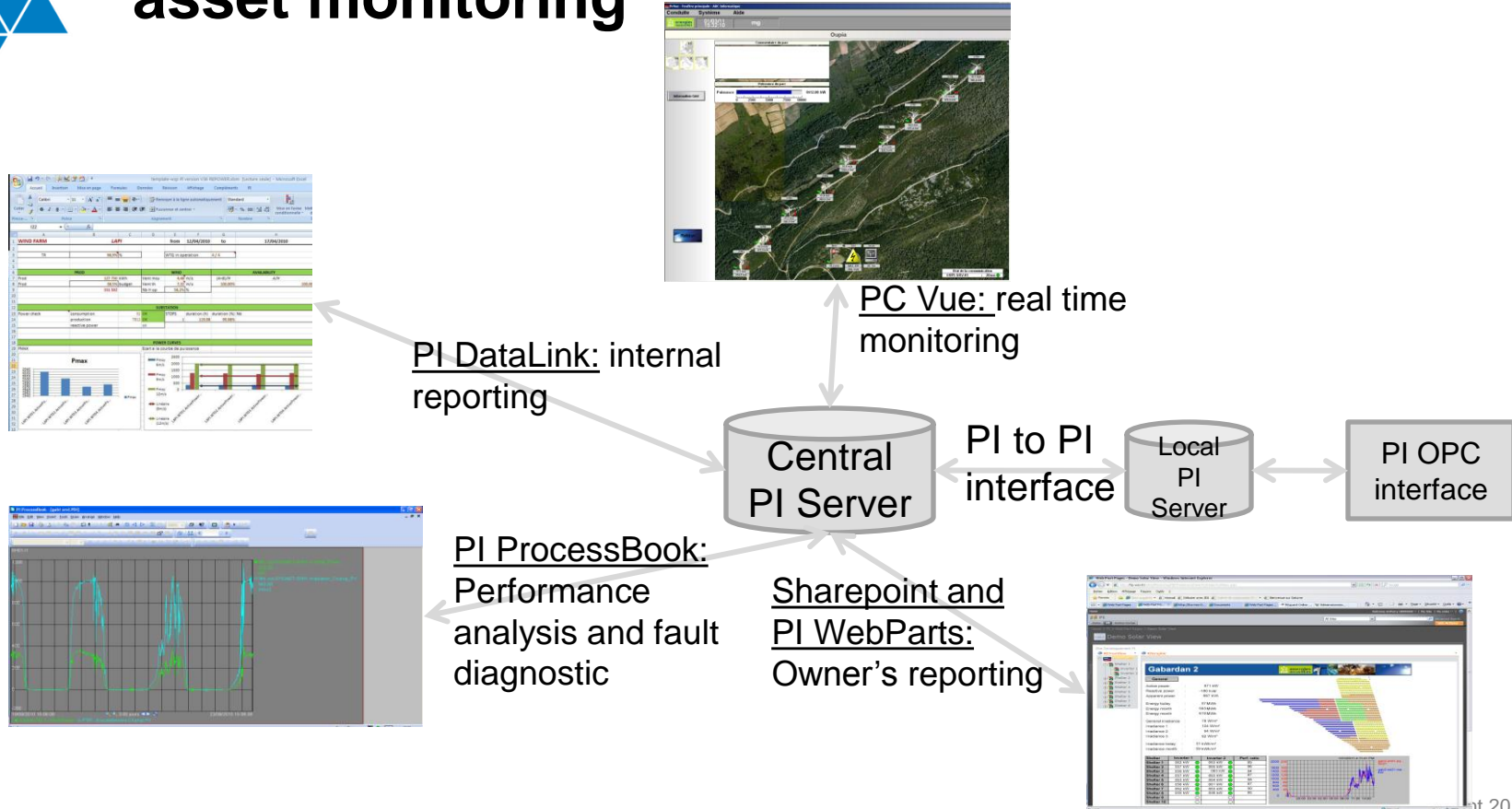
- Wind parks connected to the very high voltage grid 200 MW
- Wind parks connected to the medium voltage grid 300 MW
- Solar parks connected to the medium voltage grid 131 MW
- Industrial roof tops connected to the medium voltage grid 6 MW
- Roof tops connected to the low voltage grid 6 MW

EDF EN Services' centralized monitoring

- **Goal:** real time monitoring of the wind / solar / substation assets
- **Means:** PI System of OSIsoft / PCVUE
- **Project start date:** January 2009
- **Team:**
 - Pilot: Operating Control Center Manager
 - Team members: 2 PI System experts, 2 technicians
 - IT support

- **Why the PI System from OSIsoft?**
 - Archival performance
 - Multiple interfaces to data sources
 - Associated tools (Microsoft environment)

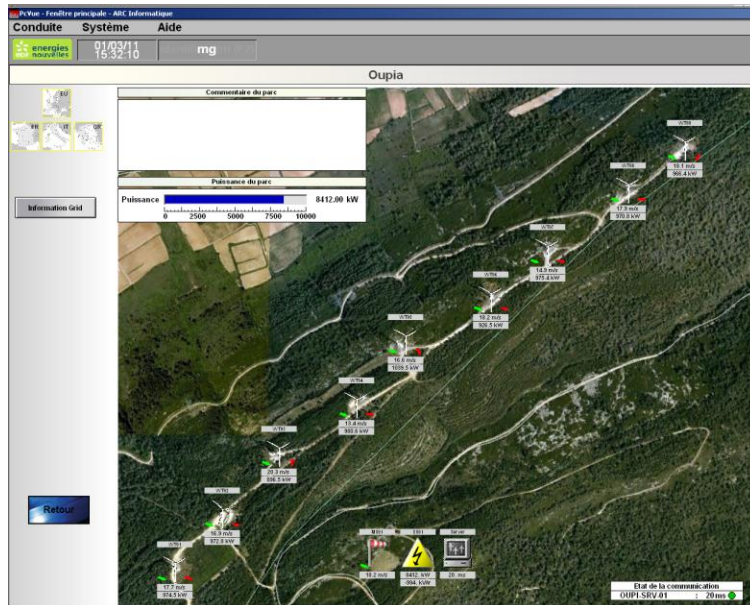
PI System from OSIsoft: a single tool for our asset monitoring



Interfaces



Real-time monitoring by the OCC: Wind parks

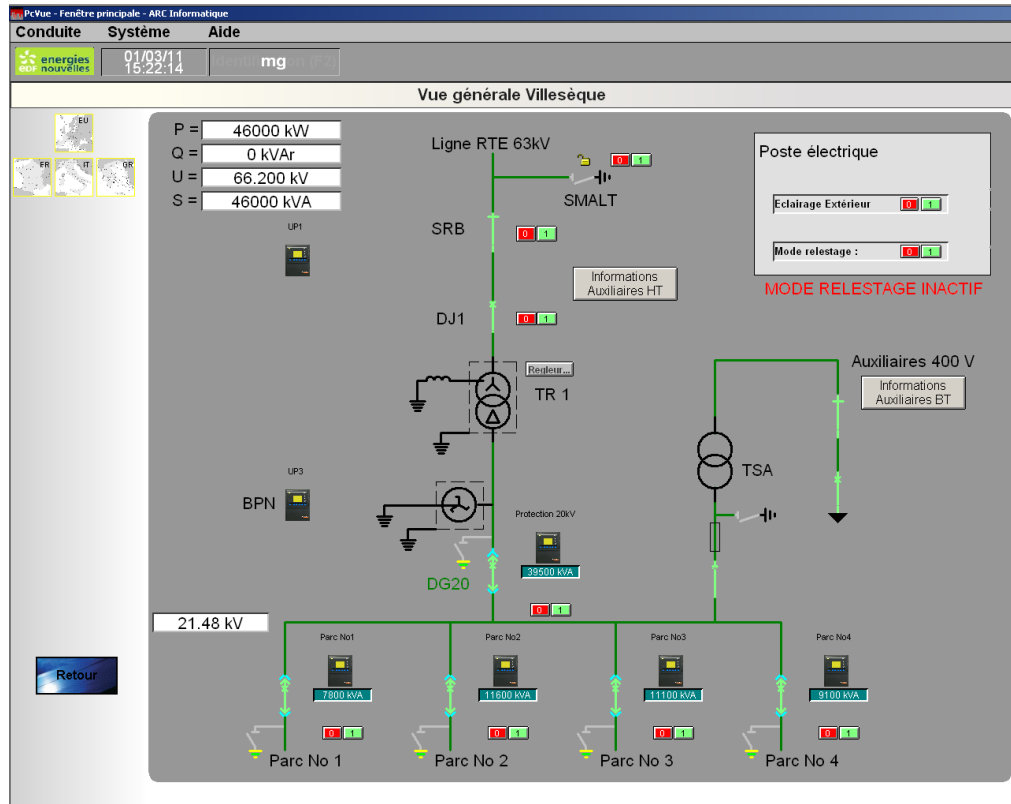


Created a « second level SCADA system » able to communicate with any kind of wind turbines, substations, or solar parks

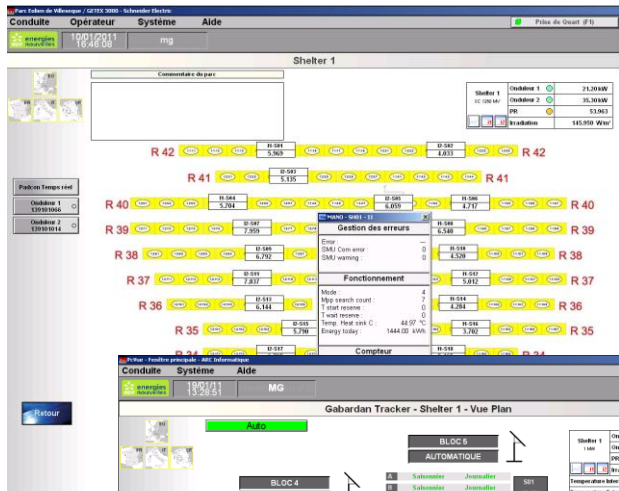
Real-time monitoring by the OCC: High voltage substation

Grid operator requirements:

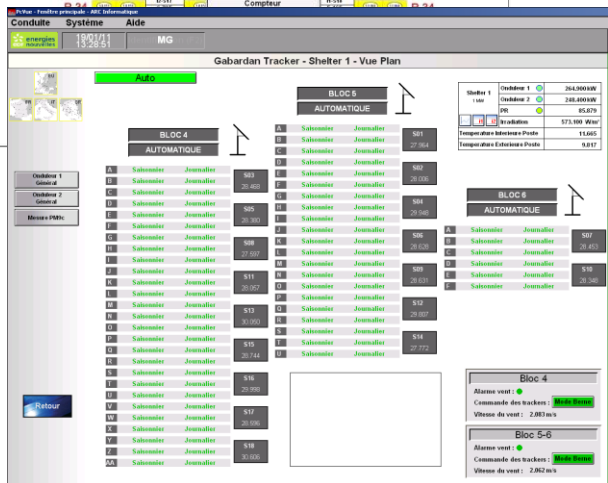
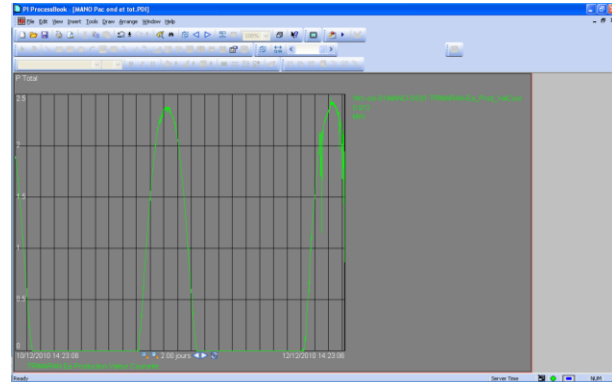
- 20 minutes response time to open or close any breaker
- Visual confirmation that the command has been working
- Voltage regulation or manual change of active or reactive power on demand



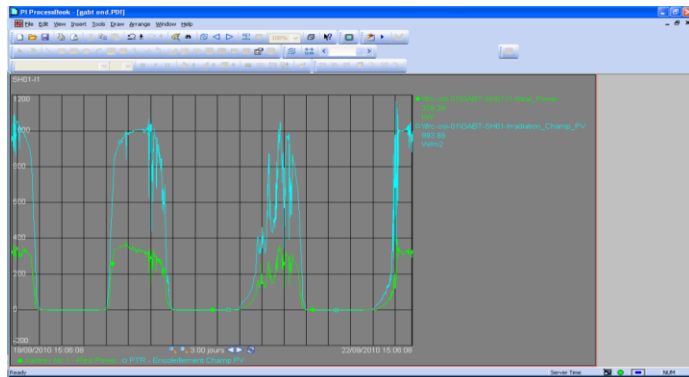
Real-time monitoring by the OCC: Solar parks



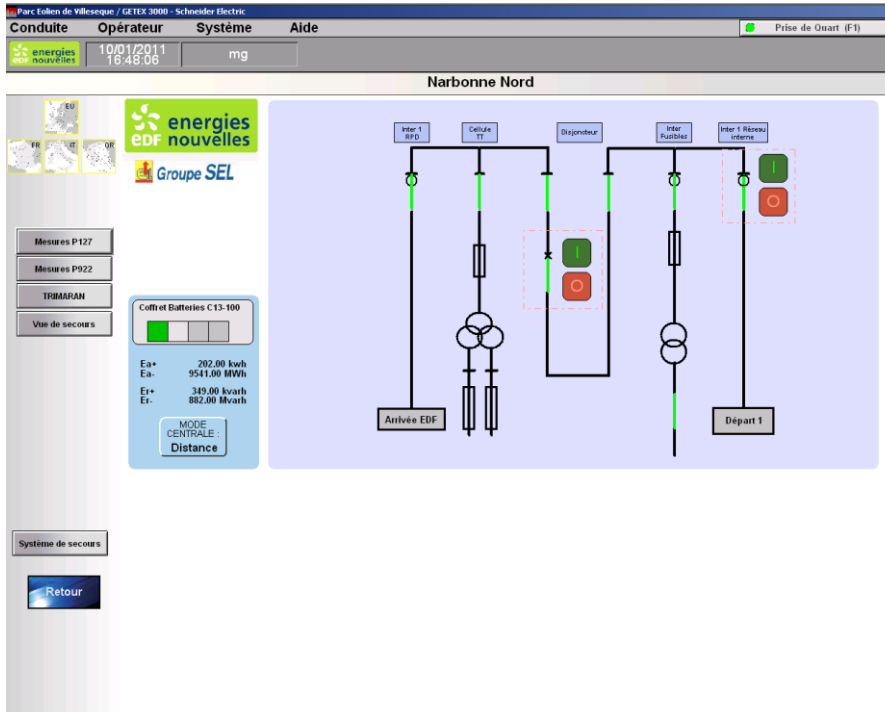
Manosque PV farm



Gabardan Tracker PV farm P/irradiation



Real-time monitoring by the OCC: Medium voltage substation



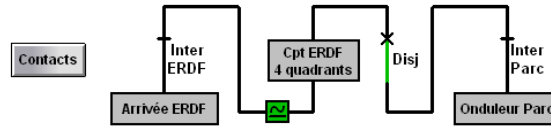
View created by the O&M IT team.
This view gives us access to:

- alarm logs
- different data P/U and I

Real-time monitoring by the OCC: Solar barns

H0780.01-1 - 018 ond - LABORDE - 144 kW

Irradiation	61 W/m ²
Horodate IO	5-Jan-11 15:00:00
Puissance Active	7 kW
Horodate TIC	5-Jan-11 15:00:00



Data sent every 2 hours. Entered into PI System with PI UFL interface.

N° Ond	S/N Ond	Puissance	Status	Alarmes	Horodate
Ond 1	2000959608	394W	MPP	.....	5-Jan-11 15:00:00
Ond 2	2000959877	379W	MPP	.....	5-Jan-11 15:00:00
Ond 3	2000959294	375W	MPP	.....	5-Jan-11 15:00:00
Ond 4	2000959888	404W	MPP	.....	5-Jan-11 15:00:00
Ond 5	2000959619	405W	MPP	.....	5-Jan-11 15:00:00
Ond 6	2000959829	416W	MPP	.....	5-Jan-11 15:00:00
Ond 7	2000959323	420W	MPP	.....	5-Jan-11 15:00:00
Ond 8	2000960382	436W	MPP	.....	5-Jan-11 15:00:00
Ond 9	2000960375	389W	MPP	.....	5-Jan-11 15:00:00
Ond 10	2000960372	396W	MPP	.....	5-Jan-11 15:00:00
Ond 11	2000959872	404W	MPP	.....	5-Jan-11 15:00:00
Ond 12	2000960809	387W	MPP	.....	5-Jan-11 15:00:00
Ond 13	2000960674	366W	MPP	.....	5-Jan-11 15:00:00
Ond 14	2000960665	348W	MPP	.....	5-Jan-11 15:00:00
Ond 15	2000960677	378W	MPP	.....	5-Jan-11 15:00:00
Ond 16	2000959873	321W	MPP	.....	5-Jan-11 15:00:00
Ond 17	2000960812	337W	MPP	.....	5-Jan-11 15:00:00
Ond 18	2000960673	383W	MPP	.....	5-Jan-11 15:00:00



Data retrieval and validation by the owner: SharePoint and PI WebParts

Gabardan 2 - Shelter 1

General

- AC power : 108 kW
- DC power : 105 kW
- Uac phase 1 : 179 V
- Uac phase 2 : 178 V
- Uac phase 3 : 178 V
- Irradiance : 90 W/m²
- Module temp. : 03 °C
- Ambient temp. : 01 °C
- Overvoltage protection 1 : ON
- Overvoltage protection 2 : ON
- Overvoltage protection 3 : ON
- Overvoltage protection 4 : ON
- Overvoltage protection 5 : ON

Inverter 1

- AC Power : 55 kW AC Current : 109 A
- DC Power : 55 kW DC Current : 83 A
- Mode : 1/31/2011 4:03:00 PM MPP
- Error : 1/31/2011 4:07:00 PM ---

Inverter 2

- AC Power : 55 kW AC Current : 101 A
- DC Power : 52 kW DC Current : 82 A
- Mode : 1/31/2011 4:10:00 PM MPP
- Error : 1/31/2011 4:06:00 PM ---

S.B Current

N°	Current	N°	Current	N°	Current
S01	06 A	S11	08 A	S21	08 A
S02	05 A	S12	07 A	S22	08 A
S03	08 A	S13	08 A	S23	05 A
S04	08 A	S14	08 A	S24	
S05	08 A	S15	08 A	S25	
S06	09 A	S16	07 A	S26	
S07	08 A	S17	07 A	S27	
S08	10 A	S18	09 A	S28	
S09	08 A	S19	07 A	S29	
S10	09 A	S20	07 A	S30	

Graphs: A line graph shows power (kW) over time from 20:00 to 14:00 on 1/31/2011. A bar chart shows irradiance (W/m²) over time.

Solar Report V1

Excel Web Access - Solar report V1

Start Time: 1/24/2011
End Time: 1/31/2011

TR meter	100%	Inverters in operation	16
PROD		SUN	
Prod	133,480 kWh	Ray global	13.4 kWh/m ²
Prod	I\VALUE!	Ray. th	I\VALUE! kWh/m ²
Performance ratio		AVAILABILITY	
E syst (kWh)	123,031 %	STOPS	duration (h)
E pv (kWh)	11,546	0	77.12
Gogpv (h)	12	45.90%	
PR %	86.4%		

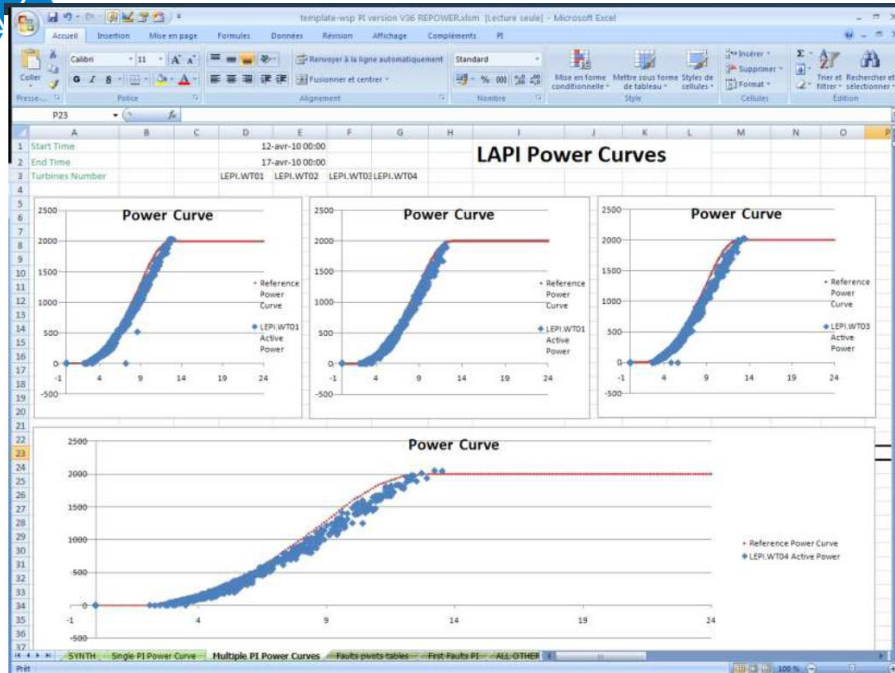
Bar Chart: Shows production (kWh) over time from 24-Jan-2011 to 30-Jan-2011. The y-axis ranges from 0 to 80,000 kWh.

INVERTERS

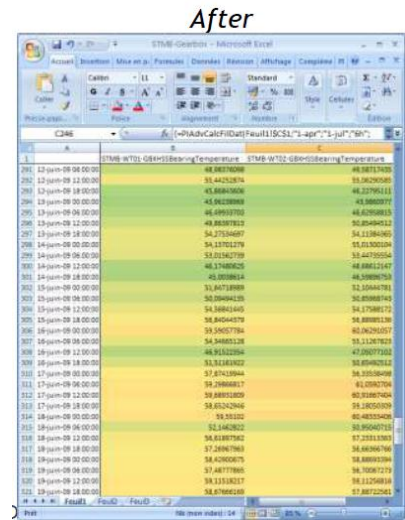
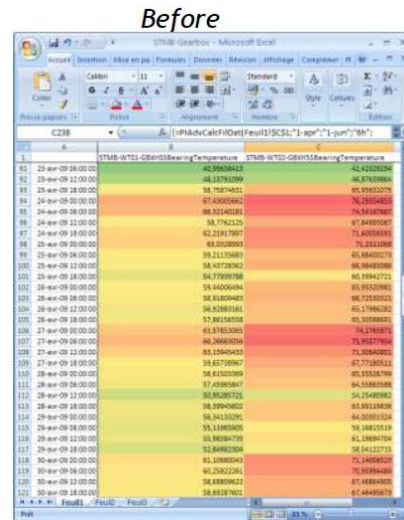
	Prod. kWh	TR prod %	Stops - Nb	Stops - Dur h	Availability %	T1 - avail h	TR Status %	T2 - avail h	T3 - ava
Sh1-inv1	8220.67	99.96	11	3.18	98.6%	35.49	100	36.00	0.00
Sh1-inv2	8026.10	99.96	94	12.38	98.5%	35.45	100	36.00	0.00
Sh2-inv1	8494.26	99.96	27	3.36	98.7%	35.52	100	36.00	0.00
Sh2-inv2	8711.03	99.96	23	3.33	98.6%	35.47	100	36.00	0.00

Performance analysis: PI DataLink

Gearbox oil temperature validation before and after replacement



Wind turbines power curves



Future Plans and Next Steps

Management scorecard

Data models with PI AF

Continue deploying PI System on all of our assets

Questions

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Thank you