Incomes increase in the power regulation based on PI System

Presented by
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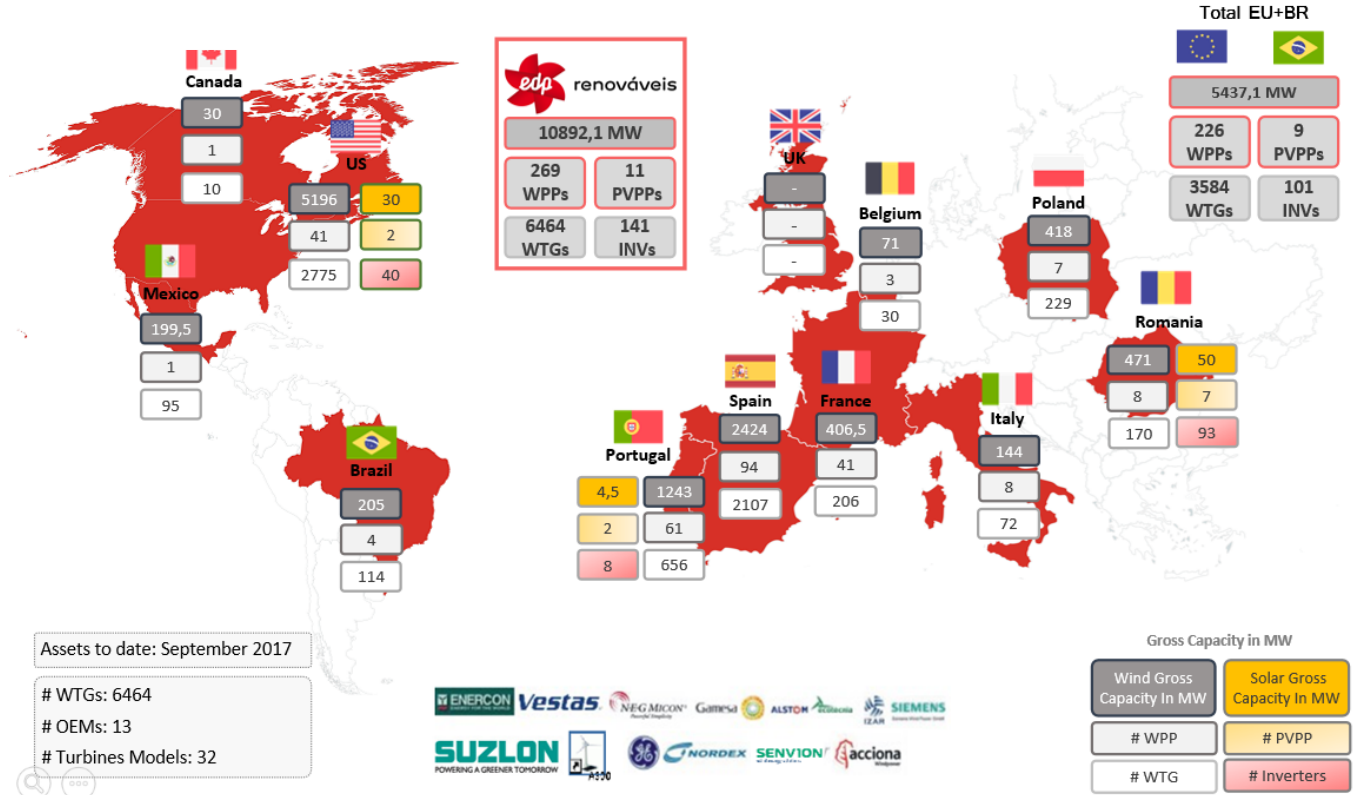
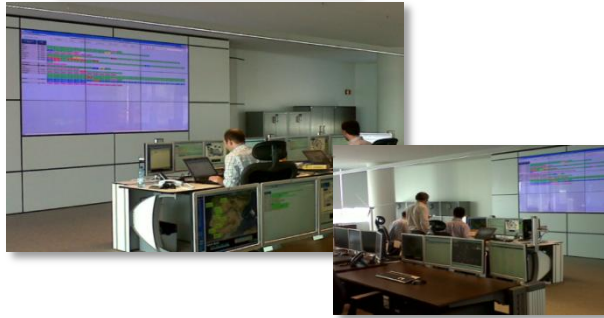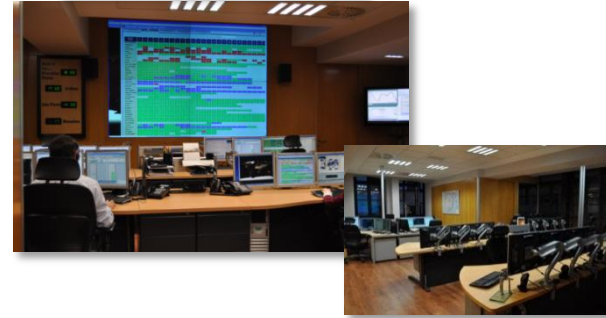# Power Regulation Management based on PI System

EDPR

- Renewable company with more than 10 GW
- Presence in 12 countries
- With 280 Power Plant installation
- And around 6464 Wind Turbines
- 13 Wind Turbine manufacturers
- 32 different Wind Turbine models/controllers

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10892,1 MW	
269 WPPs	11 PVPPs
6464 WTGs	141 INVs

Canada
| 30 |
| 1 |
| 10 |

US
5196	30
41	2
2775	40

Mexico
| 199,5 |
| 1 |
| 95 |

Brazil
| 205 |
| 4 |
| 114 |

UK

Belgium
| 71 |
| 3 |
| 30 |

Poland
| 418 |
| 7 |
| 229 |

Spain
| 2424 |
| 94 |
| 2107 |

France
| 406,5 |
| 41 |
| 206 |

Italy
| 144 |
| 8 |
| 72 |

Portugal
4,5	1243
2	61
8	656

Romania
471	50
8	7
170	93

Total EU+BR

5437,1 MW	
226 WPPs	9 PVPPs
3584 WTGs	101 INVs

Assets to date: September 2017

WTGs: 6464
OEMs: 13
Turbines Models: 32

ENERCON Vestas NEG MICON Gamesa ALSTOM acciona SIEMENS

SUZLON POWERING A GREENER TOMORROW GE NORDEX SENVION acciona

Gross Capacity in MW

Wind Gross Capacity In MW	Solar Gross Capacity In MW
# WPP	# PVPP
# WTG	# Inverters

EDPR

RODC-PORTO

RODC-OVIEDO

RODC-BUCHAREST

RODC-BRAZIL

ROCC-HOUSTON

Challenge

| Power regulation requirements from REE (Spanish TSO): individual, nodes, global.	**+**	New remuneration model in Spain: Power regulation to avoid losses by deviations.	**+**	Opportunity to increase the incomes participating in new markets: Ancillary Services.

Scope: Increase the production of energy taking into account fulfilling all the requirements and trying to reach the optimum in each moment
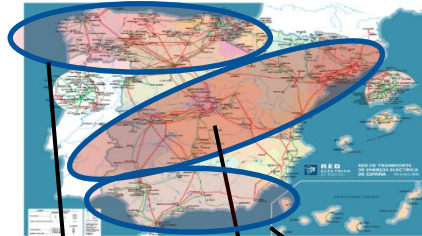
Requirements

From TSO

Individual Setpoint
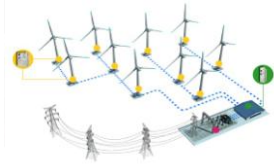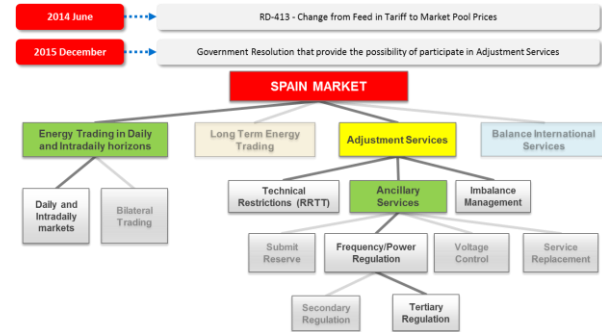

Node Setpoint
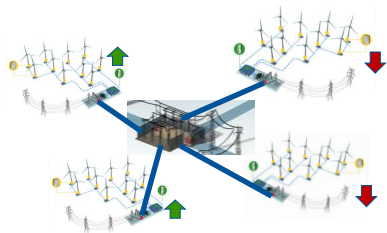
Global Setpoint

↑ High Wind

↓ Low Wind

↑ High Wind

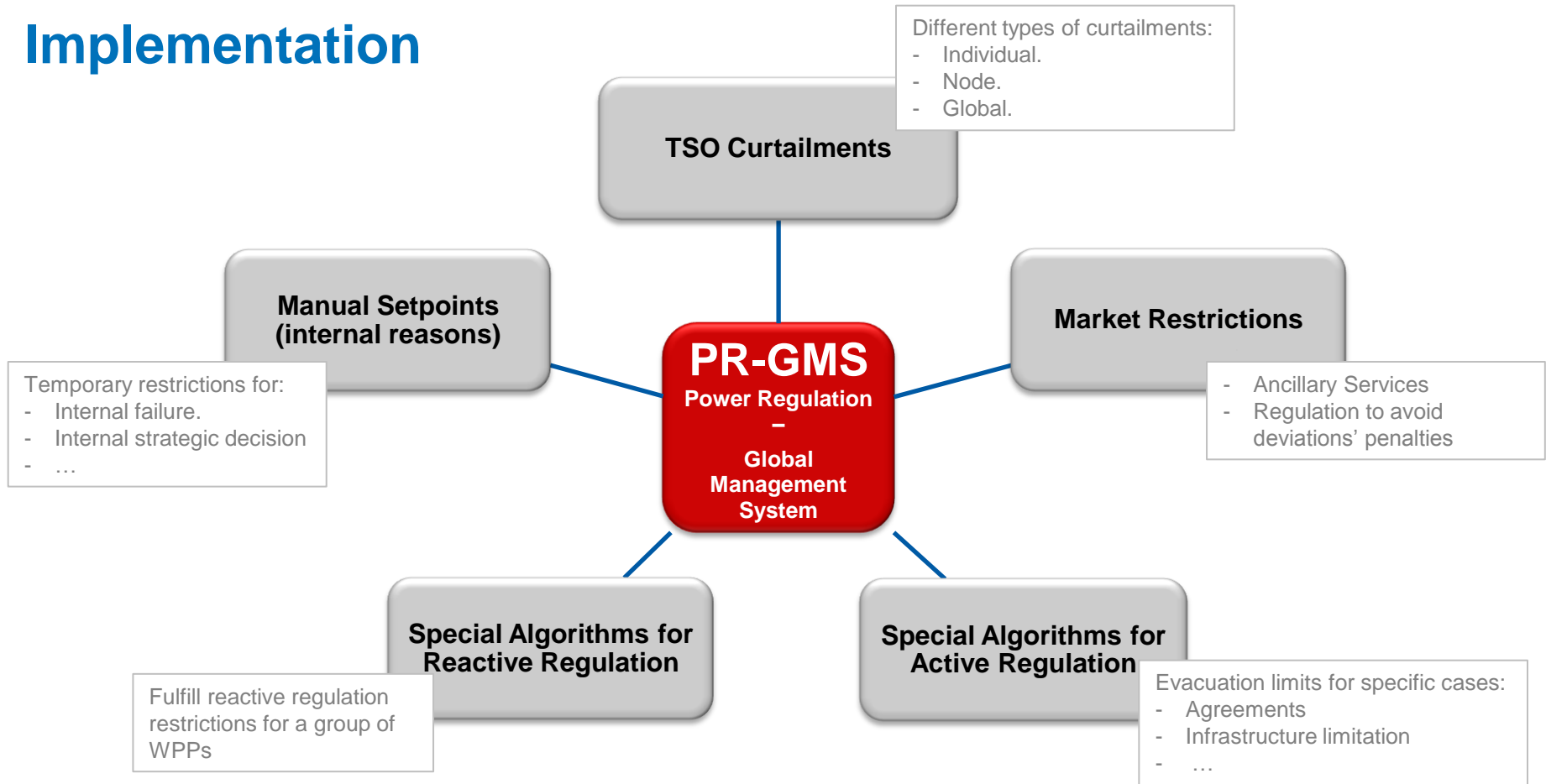## New remuneration model in Spain

An Opportunity to increase the incomes

- Daily and Intradaily market
- Ancillary Services

Key Point: Analyze the optimum setpoint to send to each WPP, taking into account all instructions from all different sources, in order to maximize the production and guarantee the fulfillment of all of them.

Implementation

Different types of curtailments:
- Individual.
- Node.
- Global.

TSO Curtailments

Manual Setpoints (internal reasons)

Temporary restrictions for:
- Internal failure.
- Internal strategic decision
- …

PR-GMS
Power Regulation –
Global Management System

Market Restrictions

- Ancillary Services
- Regulation to avoid deviations' penalties

Special Algorithms for Reactive Regulation

Fulfill reactive regulation restrictions for a group of WPPs

Special Algorithms for Active Regulation

Evacuation limits for specific cases:
- Agreements
- Infrastructure limitation
- …

Implementation

Central diagram — "Project Challenges" surrounded by:
- HMI Modifications and automatic sending of setpoints
- New Architecture
- New interfaces and protocols
- Adaptations and homogenization on each WPP Local SCADA
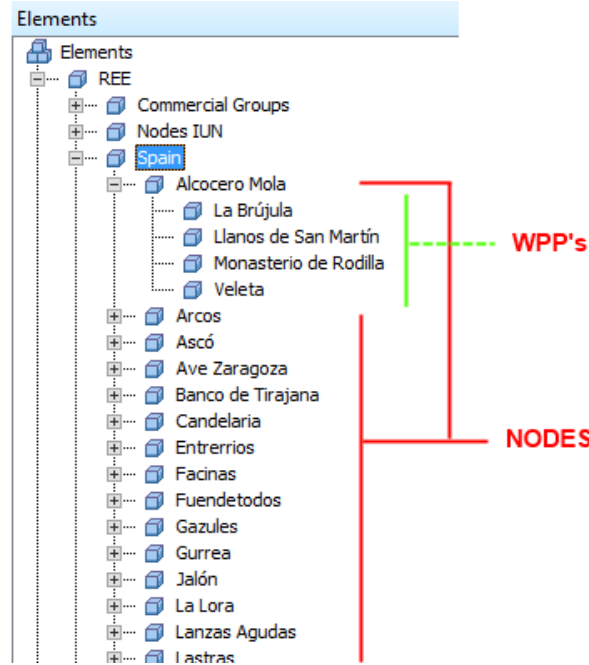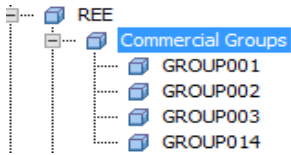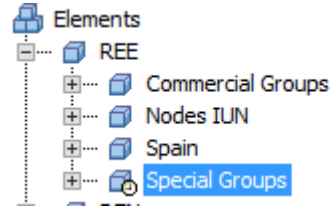- Global Algorithm (Global-Node-WPP)

Challenges

- New Architecture design based on OSI PI

- New Algorithm develop on PI AF and PI ACE

- Integration of the new system with TSOs (Spain, Portugal and, in the near future, in Romania)

- Integration with current central dispatch center system (e-terra scada) through SISCO, to receive information and send setpoints
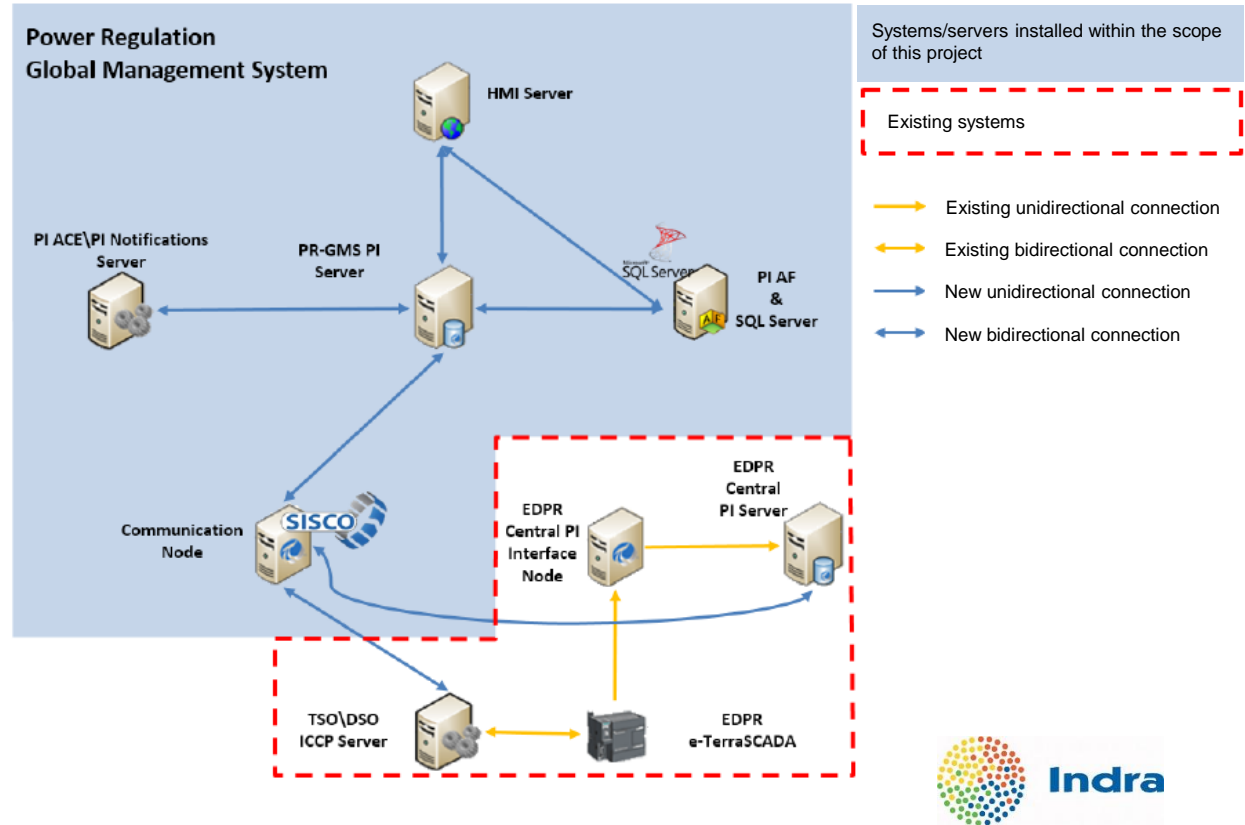
AF Structure
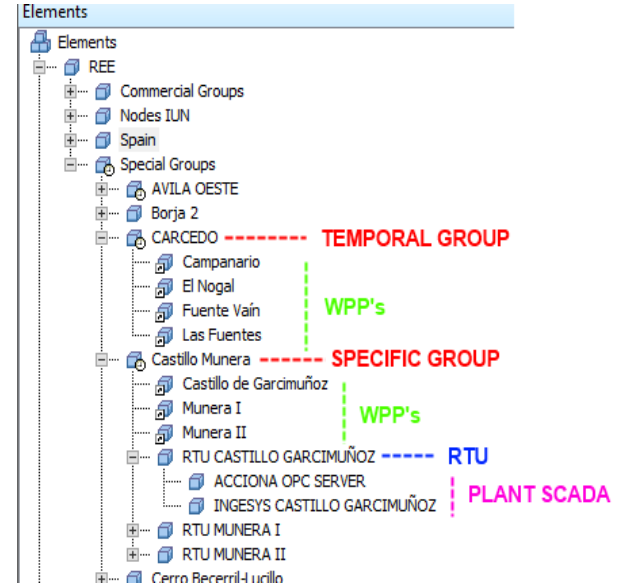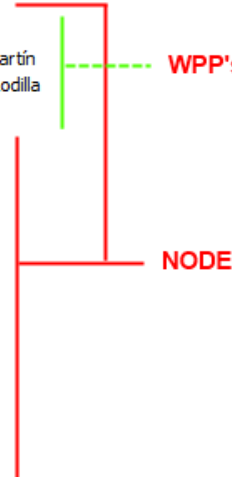
Through HMI Application we can change the AF structures dynamically and set the user permission on each of them.

Calculation

AF Analytics Calculations

- Standardization of information
- Engineering Units conversions
- Relational information incorporated
- Real time aggregations
- Rollups calc. of the entire tree

PI ACE Calculations

- Complex Calculation Algorithm
- Different Algorithm for each situation
- Execution time ad-hoc to fulfil the Req.
- Automatic configuration on HMI

HMI

- Monitoring and control the Setpoint to apply

- Configure automatically the Assets and their configuration

- Separate Algorithm for each country with their own requirements

- Integration with current central dispatch center system (e-terra scada) that sends the Setpoint to each Wind Power Plant
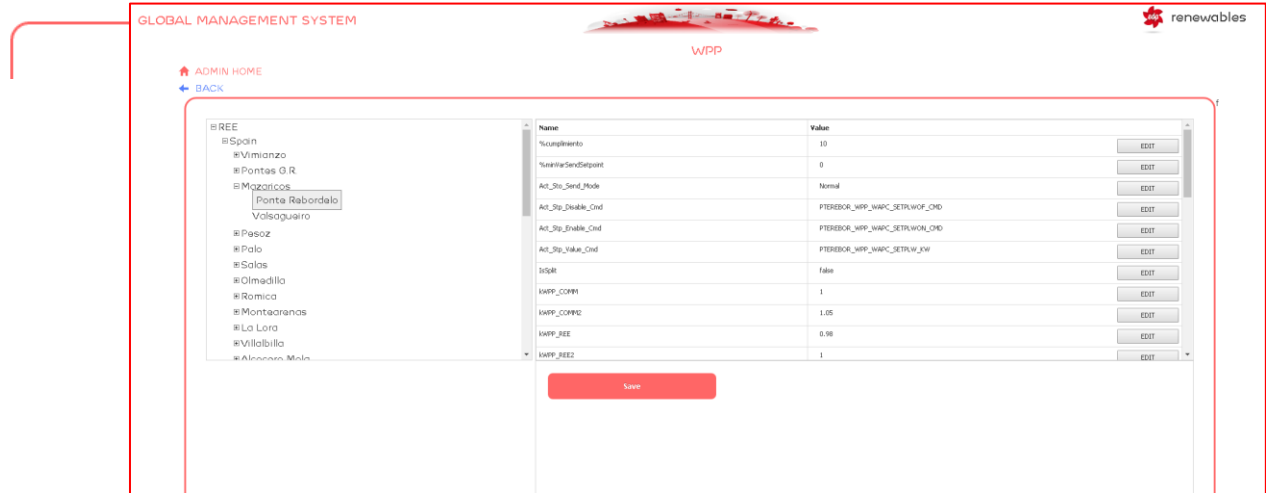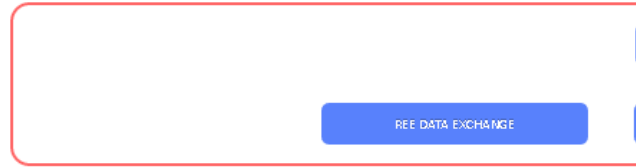
Global Optimization

- Before:
  - Application that didn't fulfill the new requirements (market restrictions).
  - Energy losses in node and overall global curtailments due to:
    - High manual intervention.
    - Setpoints to apply to each Wind Power Plant calculated in proportion to the nominal power and not to expected power.

- Now:
  - Energy Produced maximized in the Curtailment period.
  - Prevent Out of Limits situations.
  - Take into account current production and wind speed, maximizing production in each site with high wind.

Spanish Global Regulation

OLD METHOD — SETPOINT — NEW ALGORITHM

Spanish Global Regulation

OLD METHOD — SETPOINT — NEW ALGORITHM
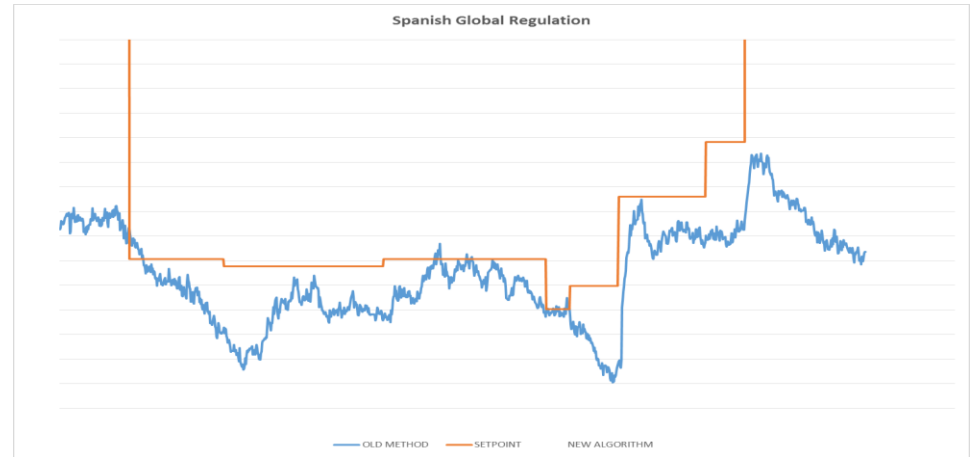
Global Management of different restrictions from different sources

Several Setpoints from different sources

REE Curtailment:
- Individual Setpoints
- Node Setpoints
- Global Setpoint

Market Restrictions
- Individual restriction
- Restrictions by group
- Global Restriction

Global Management

Specific Algorithms
- Power limit shared by several WPPs

Manual Setpoints
- Individual setpoint by any internal reason

— REE Setpoint — Power — Market Setpoint
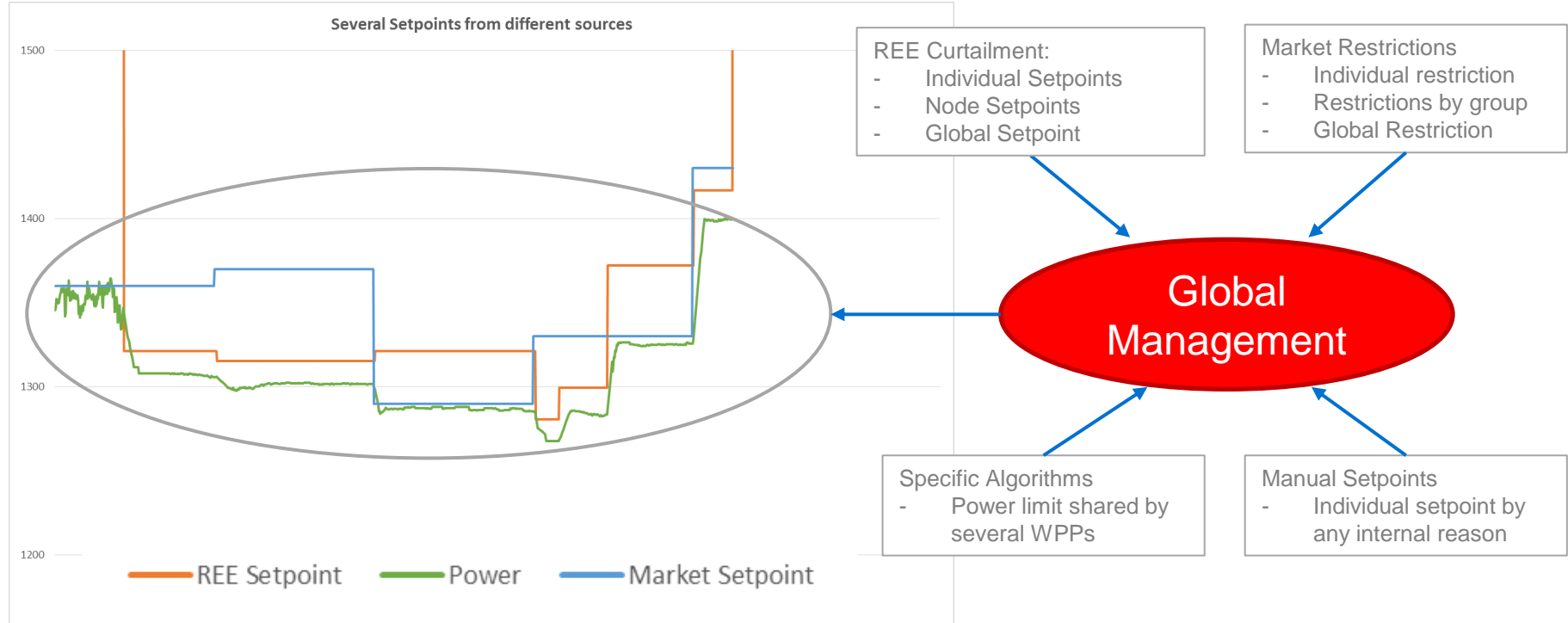
Results

Modifications of the previous System	▪ HMI Adaptations and Modifications ▪ Higher automation in sending of setpoints ▪ Management of all Wind Power Plants independently of the manufacturer ▪ Option of introduce manual setpoints as an input for the algorithm ▪ More information to be able to make faster decisions by the operator
Centralized Management of Special Algorithms	▪ Centralization of special active/reactive algorithms ▪ Included as another input to the general algorithm ▪ Detailed parametrization of the algorithms for future modifications
Management of TSO curtailments, market restrictions and any other restriction	▪ **Fulfill with TSO curtailment orders in function of the instructions (individual, node, global)** ▪ **Fulfill with the results of the markets, regulating power if necessary.** ▪ **Fulfill with any other restriction (internal failures, special cases or agreements, etc.)** ▪ **Manage all types of restrictions at the same time, calculating and sending automatically to each wind power plant the optimal setpoint to comply with all of them and maximize the production.** ▪ **Reduce the energy losses during restrictions periods on 50%**

Enterprise Agreement = Partnership

- A collaborative path towards customer success with OSIsoft products

- Extends across an entire portfolio of assets as opposed to a "buy as you go" plan

- The focus of the enterprise agreement is returning value to EDP
  - Workshops (AF, Architecture, etc.) and training plan
  - Field Service Activities
  - Access to Center of Excellence
  - Enterprise Program Manager
  - Asset Monitoring

Next Step: PI Integrator for Business Analytics

Data

Reduce the time to get it
Powered by PI Asset Framework

People

Access for everyone
In user's tool of choice

Integration

Effortless
Self Service UI / Centrally Managed

Systems

Any System
Standard & Native Integrations
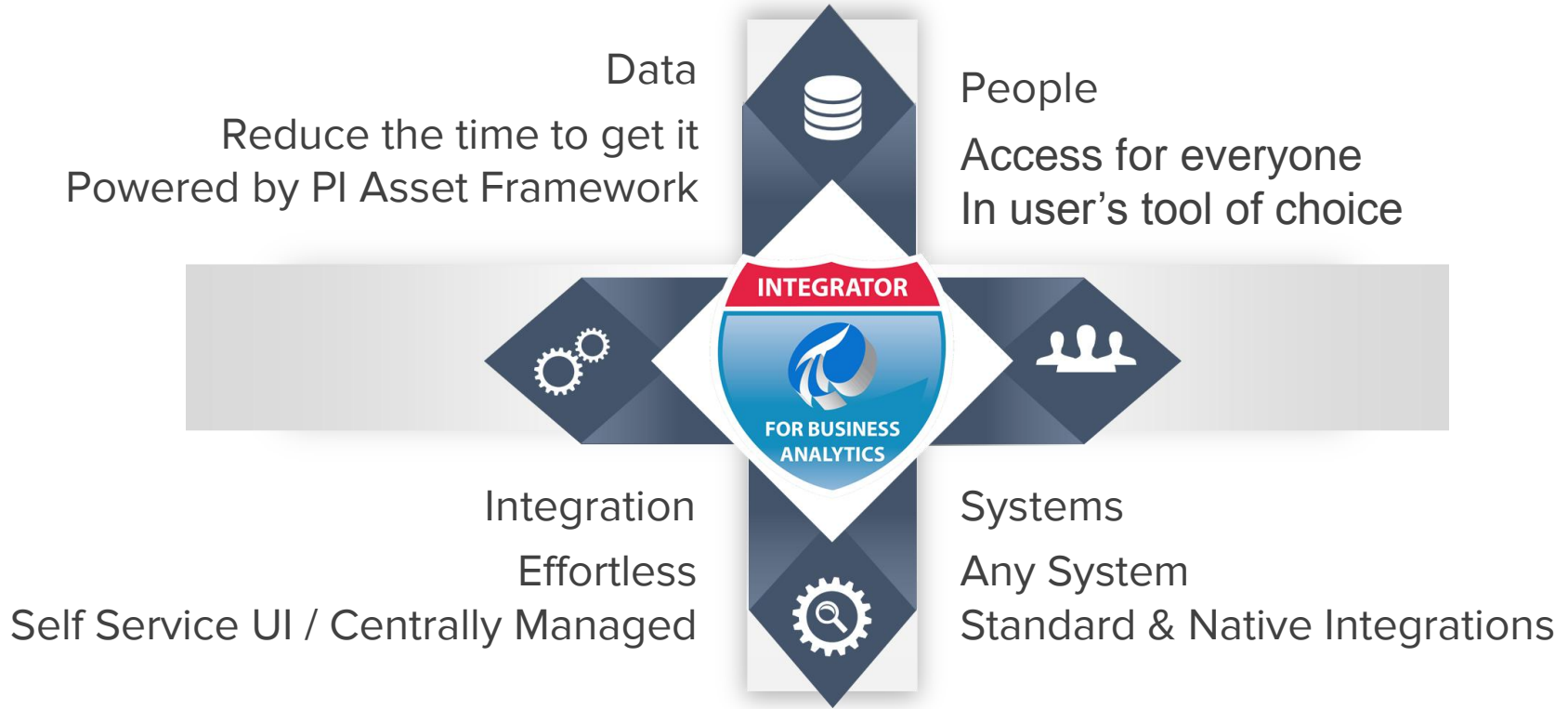
Incomes increase in the power regulation based on PI System

COMPANY and GOAL

EDPR manages more than 10.000MW of wind energy, and must comply with the grid codes of several countries. Its objective is to maximize the production in all scenarios, complying with all technical requirements and with the market rules.

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CHALLENGE

Increase the production of energy taking into account the fulfillment of all the requirements, trying to reach the optimum in each moment

- Maximize the production in scenarios with power regulation requirements.
- Comply with REE (Spanish TSO) setpoints and market instructions.

SOLUTION

A Power Regulation Management System based on PI System in real-time, receives restrictions from different sources and sends calculated setpoints

- "PI system help us to implement a complex algorithm to decide the optimum setpoint for each power plant and run it on real time"

RESULTS

Reduction of energy losses during restrictions periods on 50%

- Management of different types of restrictions at the same time with less intervention of the operators.
- Reduce deviations of the instructions and energy sold.

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Questions

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감사합니다

Danke

谢谢

Merci

Gracias

Thank You

ありがとう

Спасибо

Obrigado