



**Global Services -
Renewables**
7th March 2019

FutureWind & Marine 2019

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Brief Introduction to Iberdrola Wind Business







An Operator's Perspective Data and Asset Monitoring

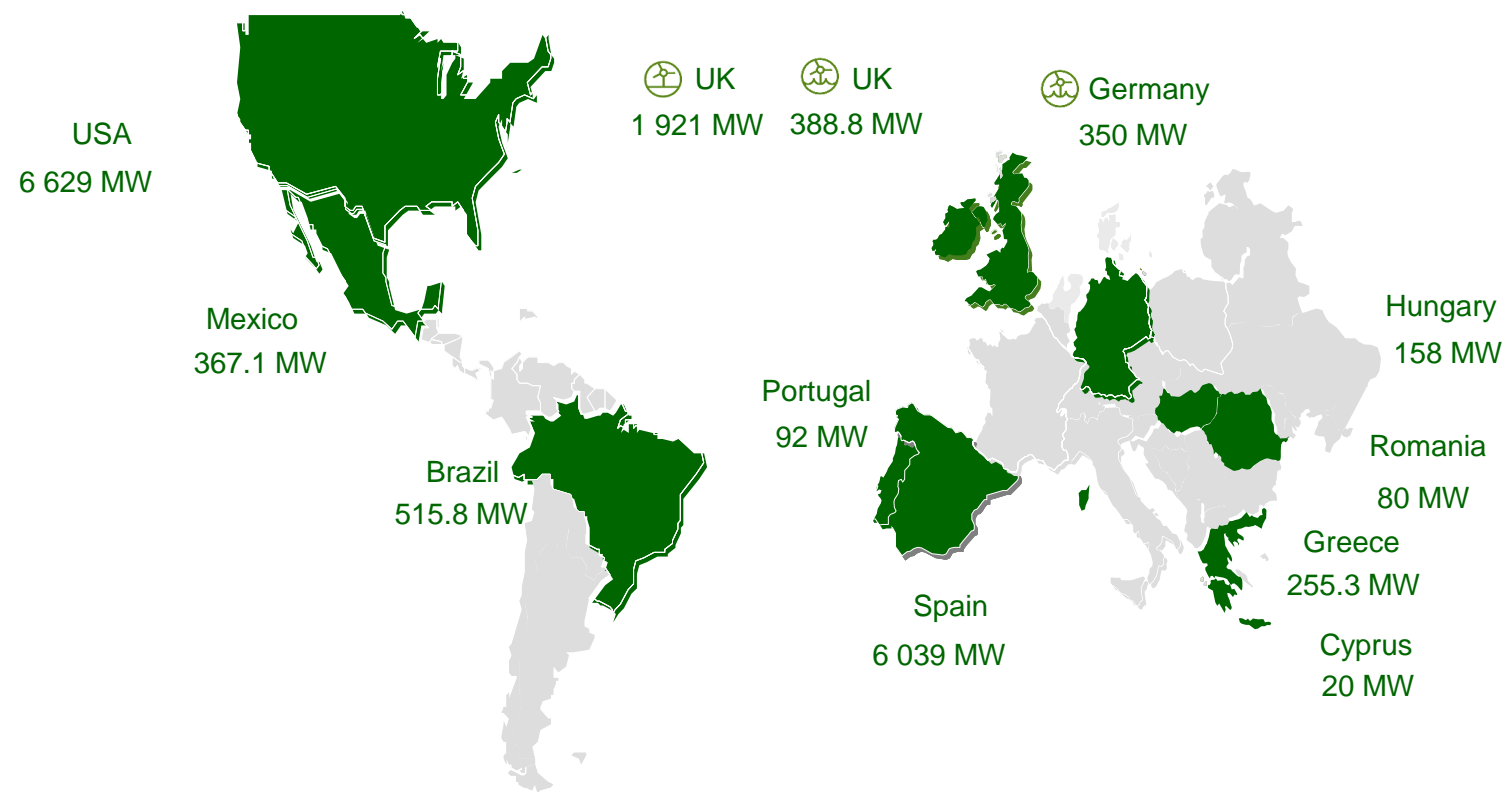
Our Solution to Data Management

ASPA...

ROMEO – Reduction in Cost of Offshore O&M

Brief Introduction to Iberdrola Wind Business

Iberdrola 16 816 MW	USA 6 629 MW	Spain 6 039 MW	UK 1 921 MW	International 1 488 MW	Offshore 739 MW
					



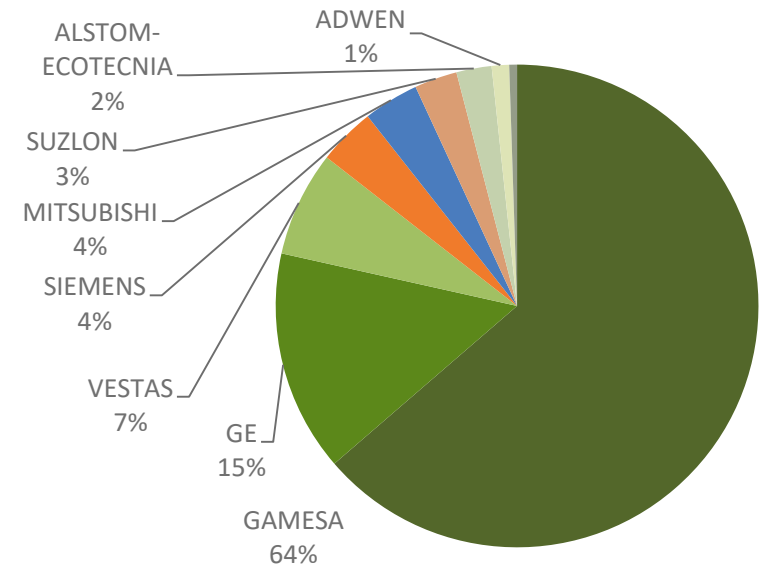
An Operator's Perspective... The Scope

The Iberdrola Fleet –

- Over 12,000 turbines globally
- 66 turbine variants across over 15 different manufactures
- Differing operating environments over 3 continents
- Many different languages and O&M Models

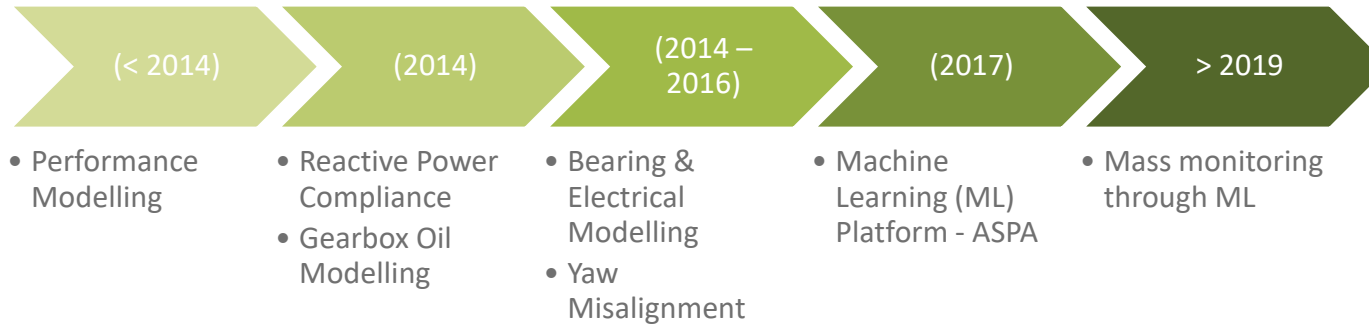
Requiring over 1200 models to cover:

- Drivetrain
- Electrical systems
- Pitch and Hydraulics
- Yaw
- Performance



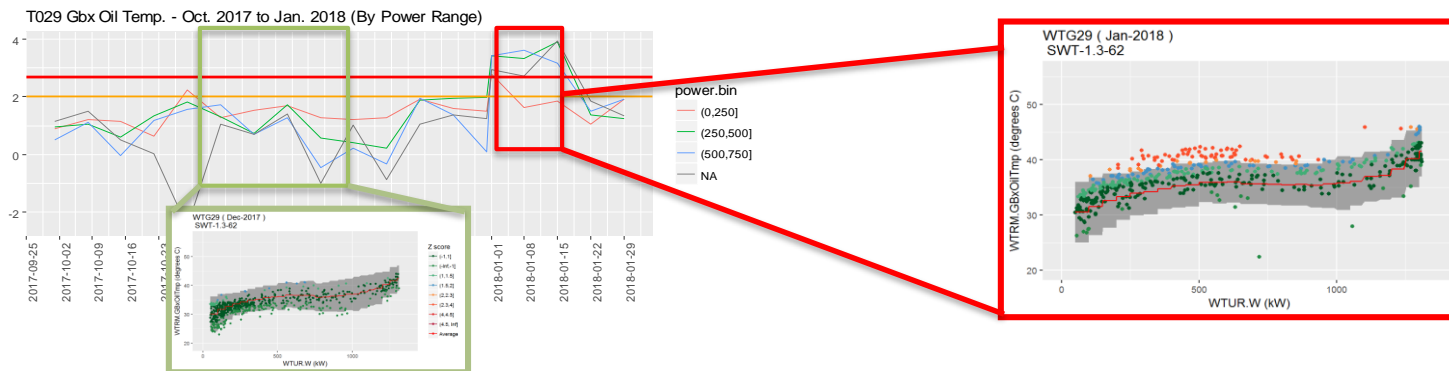
Before considering site specific condition and machine modifications...

An Operator's Perspective Data and Asset Monitoring – Our Journey



Embedded in our O&M Management Tool our modelling has evolved:

- **Physic based**
- **Statistical**
- **Early Machine Learning**



Our models are good but could be improved... taking into account available data.

An Operator's Perspective... Framing the question

We must avoid the anecdotal evidence and cautious of industry trends...

Windiect Hill Tech: *“Planetary Bearings are our biggest problem.”*

The industry: *“Yaw Misalignment is our biggest problem.”*

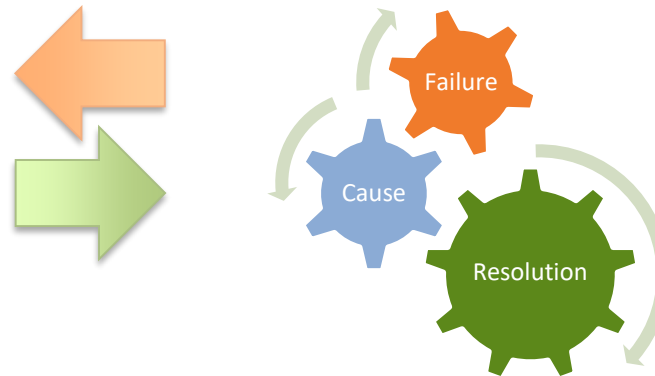
The sale person: *“Widgets are your biggest problem and we have the very tool for you”*

Me: *“The truth is in the data (it could be any one of these) and I’m not buying a tool that only detects widget failures:–*

How do we detect and prevent our top failure mode(s) using our data?”



O&M Process



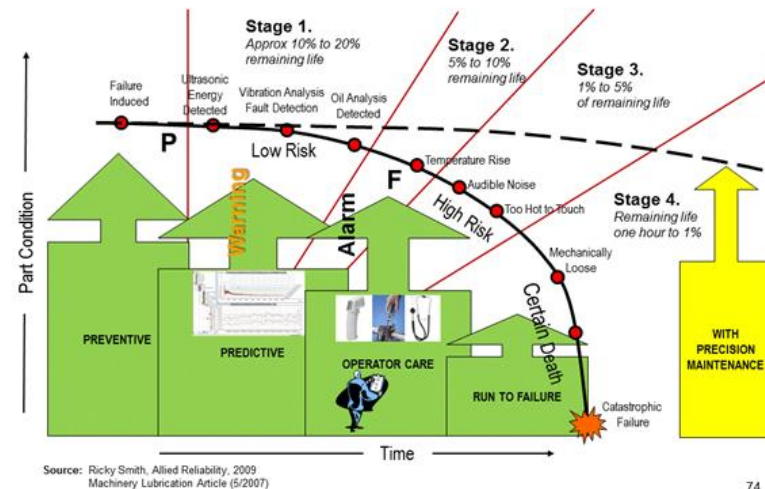
Data Capture

An Operator's Perspective... Condition Based Maintenance

We need to apply a condition based maintenance approach

- ❖ Holistic and sustainable strategies to maintain the our fleet taking into account the degradation patterns for specific failure modes

Roller Bearing Health Degradation Curve



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How does it differ from what we do now?

- ✓ By reducing the siloing of information we shall use close to all the information:
 - SCADA, CMS, Oil Analysis (Online/Offline), Inspection Records etc
- ✓ Increased collaboration and working across boundaries
 - Oil analysis is useful on its own but if we know there was high vibration event before then we can be more certain of the action required

An Operator's Perspective... Your Solutions and Our Challenges

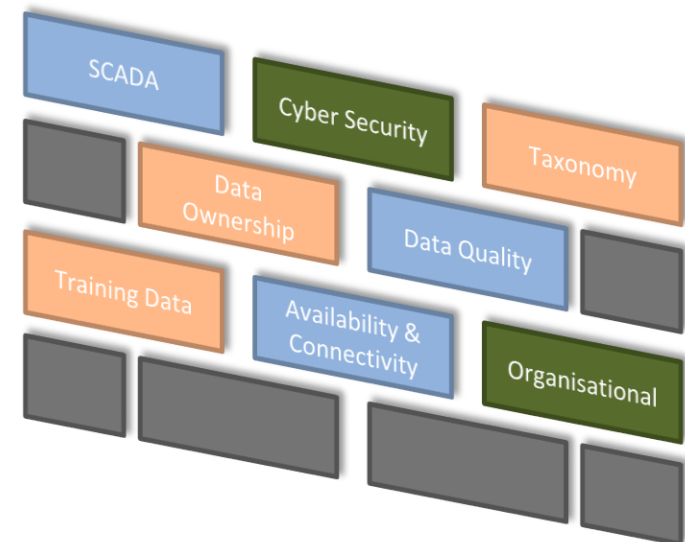
The industries answer...

Machine Learning:

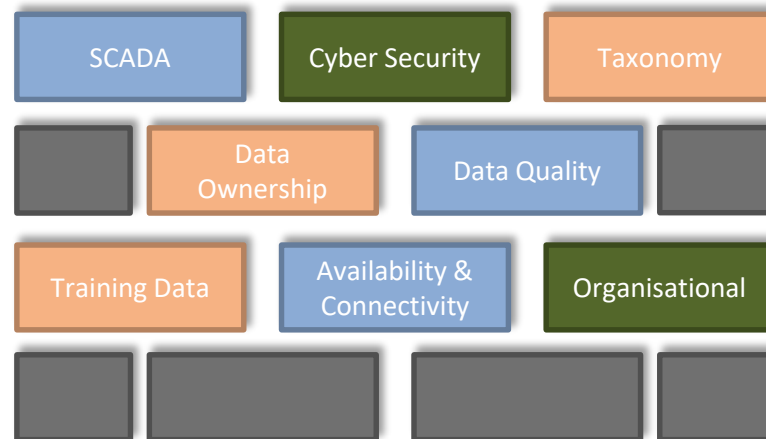
- Supervised ML
- Unsupervised ML
- Reinforcement learning

Of Course – it makes sense – lets get to work!

However, it is has not been without its barriers - our data brick wall



An Operator's Perspective... Our Challenges



The main challenges in our digital transformation through ML have been:

- SCADA Connectivity (Quick win - thanks to our Iberdrola central SCADA)
- Data ownership and intellectual property rights (Addressed through strong contract terms in TSA and SMAs)
- Data availability, quality and standardisation (SCADA engineering engagement at pre-commercial stages)

And finally – what data do we use in our model?

- Data relationship and taxonomy (One of the biggest challenges...)

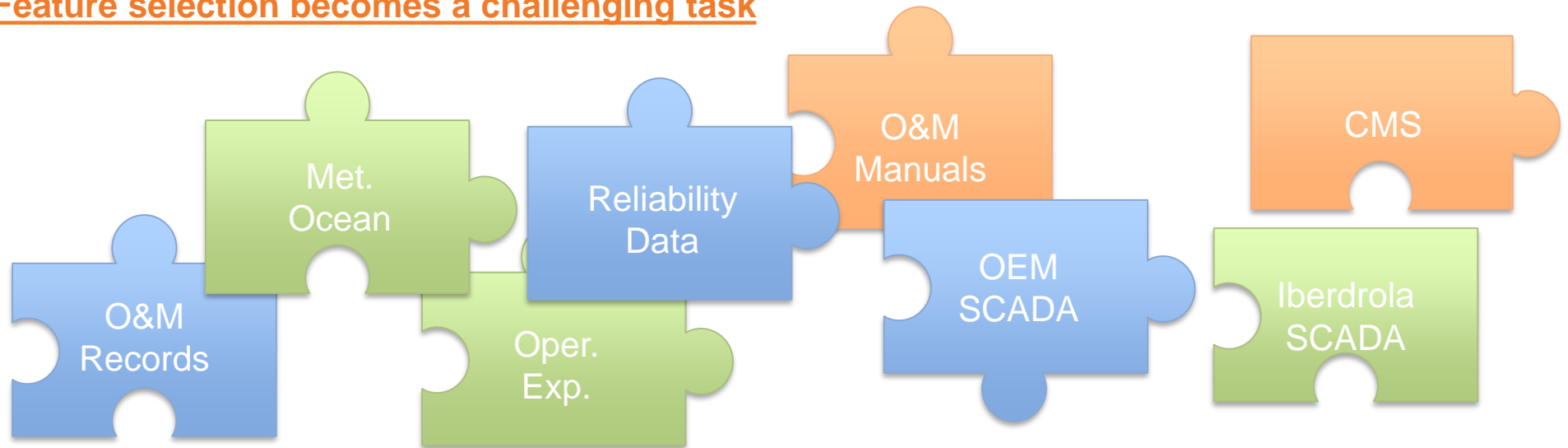
Our Global Challenge – The Data Information Model Requirement

For asset monitoring we need a host of data sets each with different standards:

- IBR SCADA Data – IEC61400-25-2
- OEM SCADA – Various: Proprietary; IEC61400-25-2; or no standard coding
- CMS Data – IEC61400-25-6
- Maintenance Data – RDS-PP (VGB)
- Documentation – Various dependant of owner

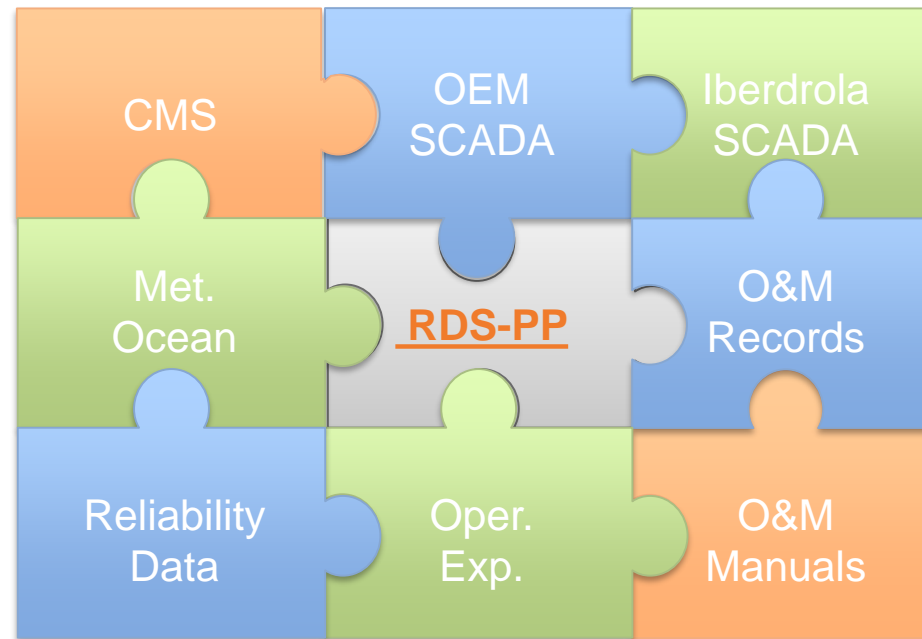
With a large fleet relationships are hard to map and the puzzle is incomplete...

Feature selection becomes a challenging task



Our Global Challenge – Our Data Information Modelling Strategy

We required a standard to capture all data – to underpin our data information model:

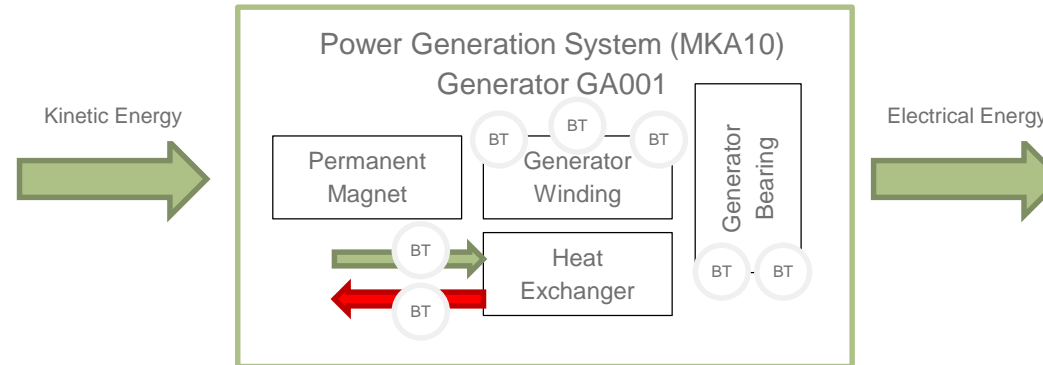


Reference Designation System for Power Plants (RDS-PP) contains standard designations for:

- **Function, Product, Location, Documentation; and**
- **Signal**

Data Information Model – An Example

Take a typical system – previously feature selection was manual and slow



RDS-PP enables signals to be grouped by function:

- **Real-time SCADA Signals – Temperature, pressure, flow rate, power etc.**
- **Historical Data – CMS Signals and Metrics; and SCADA historians.**

Queries by function/product enabling opportunities for automatic feature selection through PCA (dimensionality) reduction, LDA (classification) or PLS (regression).

Feature engineering is still required!

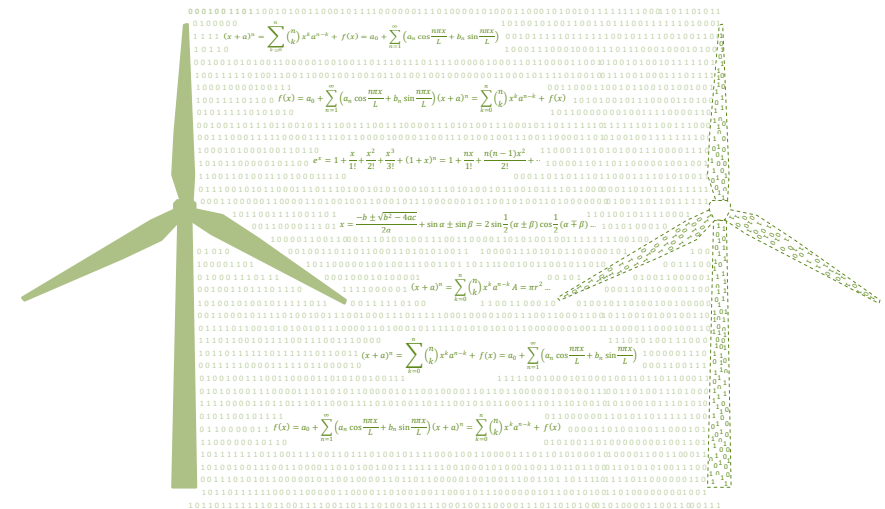
Also providing the critical link to maintenance logs for applying classifiers.

Part of the Iberdrola Digital Evolution

Project Aims:

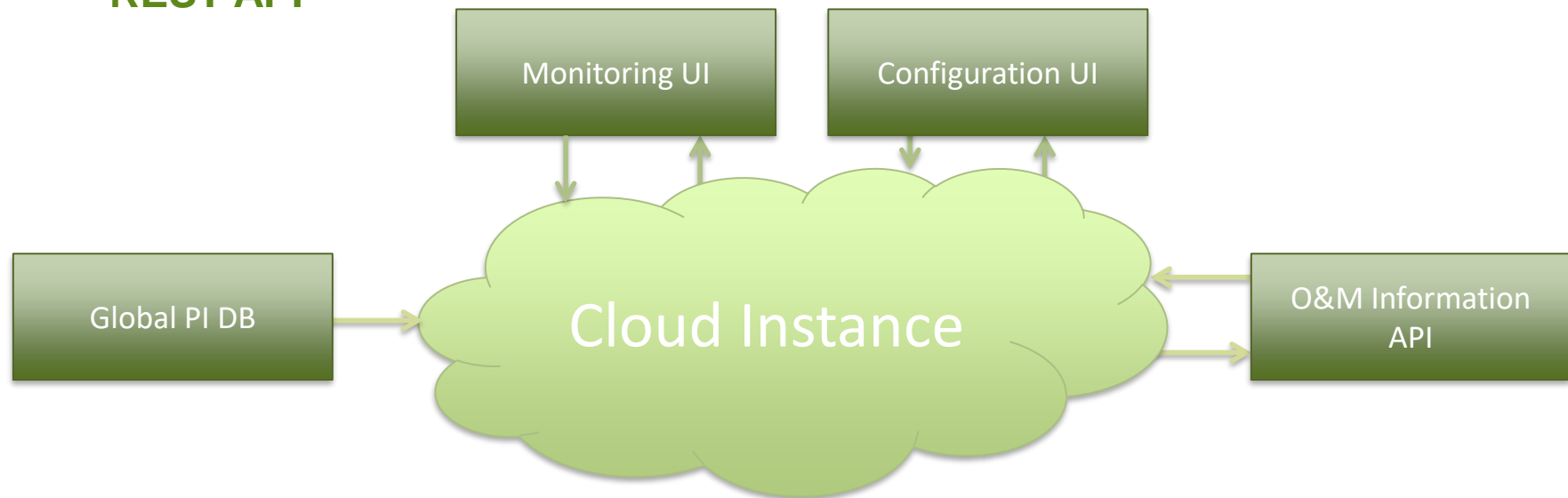
- Build a cloud analytics platform for model building and monitoring
- Apply to four windfarms (375 turbines total)
- Apply digital twin at wind turbine level
- Deploy models into online monitoring environment

Feature selection was a challenge...



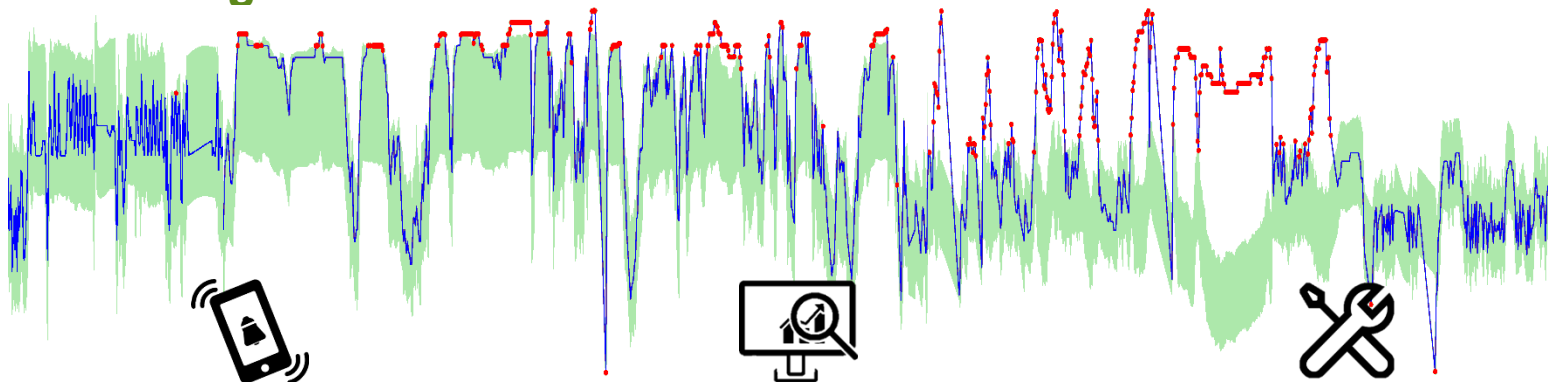
Solution:

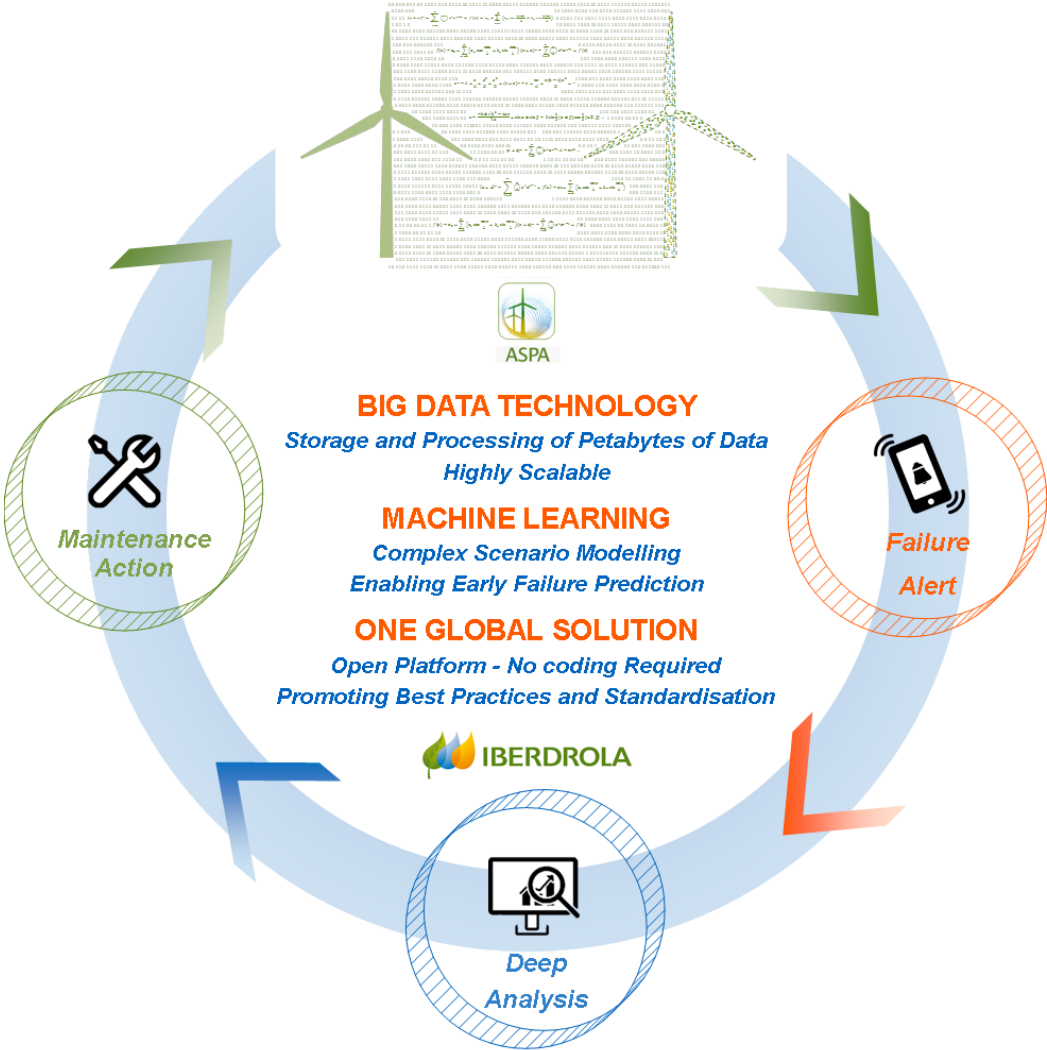
- A cloud instance with
 - Secure gateway to Iberdrola Data
 - Cloud DB's (Timeseries, Asset, Alert Notification)
 - Configuration UI
 - Monitoring UI
 - REST API



Results:

- **Monitoring of a sample of our windfarms worldwide**
- **Model groups per turbine template containing**
 - **Template build on processes (mechanical/electrical)**
 - **Estimates for most process variables**
 - **Fault tolerant input data through imputation**
- **Configuration UI**
 - **Intuitive web-based model design – no coding required**
 - **Automatic meta-parameter tuning**
 - **Modelling validation suite**





ROMEO - A Horizon 2020 Project

An approach by industry partners for Condition Based Maintenance

ROMEO PROJECT CALL – Horizon 2020

Program	Horizon 2020 – LCE13 2016.
TOPIC	Solutions for reduced maintenance, increased reliability and extended life-time of off-shore wind turbines/farms
Type of action	Innovation Actions - Only one winner
Status	Year 2 of 5 (Commencement June 2017)

Participants:



ROMEO PROJECT

Substantial Reduction in O&M Offshore Wind Farms Costs

- Δ Availability (by reducing WTG failures leading to downtime)
- \downarrow O&M costs (by reduction of maintenance activities).

Through **Condition Based Maintenance**

- New O&M Tools/Models
- New smart O&M strategies
- Advanced O&M good practices guidelines



Teeside (EDF)



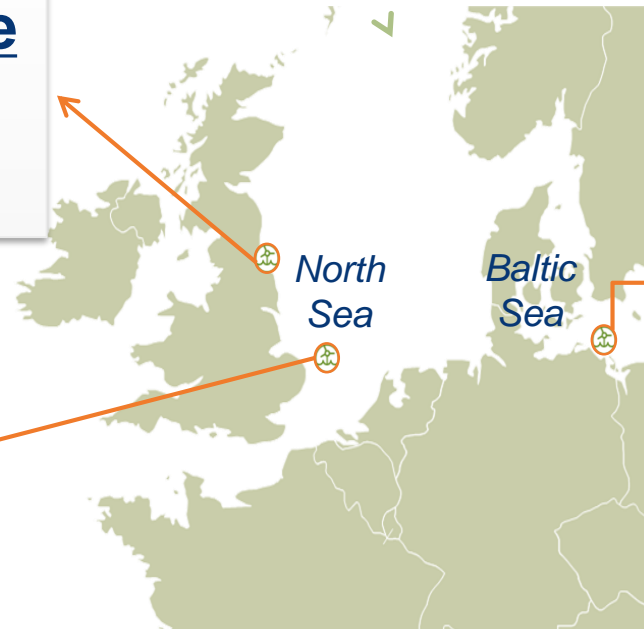
62,1MW
Q3 2013



EA1



714MW
Q2 2020



Wikingen



350MW
Q4 2017

***“In a world of talkers,
be a thinker and a doer”***

Destin Sandlin – Smarter Every Day

Questions...