Key Performance Indicators

Wind Farm Availability

TIME vs ENERGY

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1. Iberdrola Wind Energy Overview/Portfolio

- **> 13 500 MW** Wind Energy
- **13** Different Turbine Manufacturers
- **350** Wind Farms
- **16** Different Countries
1. Iberdrola Wind Energy Overview/Portfolio: Challenges

- Develop standard and global solutions for the Asset Management during Commercial Operation, regardless of their location or size.
  - **One company, only one way of working!**
- Create common automatic tools which facilitate the Wind Asset Management such as Standard Indicator Calculations, Stoppage Characterization, etc.
- Help detect problems in real time, in order to minimize the action times and maximize the production.
- Create corporate culture. The experiences gained, can be shared across the entire business to support overall optimization of our assets.
  - **All of this, in the same way for > 13 500 MW!**
2. Wind Farm Availability

The Availability of a Wind Farm is possibly the most popular KPI used to follow the performance of a Wind Farm.

Availability indicators:

1. Contractual Availability
2. Standard in-house Availability indicators:
   - Time-based Availability (traditional one)
   - Operational Range Time based Availability
   - Energy-based Availability

The Wind Farm Energetic Unavailability should be the final goal of the standardization on the availability indicators development process.
2. Wind Farm Availability

**Contractual Availability** signed between the owner and the turbine manufacturer. It is used to manage the agreements within the contract.

- Possible penalties depending on the figures
- Only causes attributable to the manufacturer are considered within the formula
- One Availability per manufacturer. Difficult to benchmark within the whole fleet
- Normally (today) based on Time at all Onshore sites
- Difficulties in double checking the figures. Potential problems and disagreement with manufacturers

*Is the Contractual Availability enough for checking Wind Farm Performance?*

*We do not agree.... Why?*
2. Wind Farm Availability

Standard in-house Availability indicators calculated in-house with internal procedures and development.

- **Same formula for the Whole Fleet.** All Wind Farm downtime and performance issues are characterized according to a Standard Procedure.
- **Easy and automatic calculation, independent to manufacturers** and to the SCADA data.
- **Every month all the Availability figures are automatically published in the internal reporting tools** (also standardized).
- **Easy to benchmark** areas, size, site, etc...
- **Powerful information to double check Manufacturer /Contractor Availability figures**

STANDARD AVAILABILITIES BASED ON **TIME & ENERGY** have been calculated in IBERDROLA for many years.
2. Wind Farm Availability

- **Availability based on TIME**

\[ A_{\text{Time}} = \frac{T_{\text{Operation}}}{T_{\text{Period}}} \]

**Advantages**
- EASY and Simple calculation method
- Widespread within the industry
- Able to double check with Contractor and Manufactures Availabilities

**Drawbacks**
- Unable to detect poor planning at preventive / scheduled maintenance
- Unable to take into account the impact of having wind speed, or not during corrective maintenance
- Unable to detect potential performance issues during running periods
- Not possible to evaluate the impact of partial curtailments from TSO’s

Is the Availability based on TIME enough for checking the Wind Farm Performance?

*We do not agree.... Why?*
2. Wind Farm Availability

- **Availability based on ENERGY**

\[
A_{\text{Energy}} = \frac{E_{\text{Real}}}{E_{\text{Theoretical}}}
\]

**Advantages**

- Detect poorly Scheduled Maintenance / Improved Preventive Maintenance
- Detect Performance Issues when the Wind Turbine is running
- Evaluate the impact from TSO’s curtailments
- Incentives for maintenance suppliers

**Drawbacks**

- More difficult calculation, more variables required:
  - Actual Production and Potential Generation
- Potential problems on the accuracy of the models for pot. Gen.
- Multiple methods of calculation
- New, not widespread for maintenance suppliers
3. Conclusions

- Results expected:
  - Stops
  - Running

Lost Energy:

- Stop due External Causes
- Stop due to Manageable Unavailable Time Causes
- Partial Curtailments /other External Causes
- Power Curve Performance Issues

- In-house Availability Indicators are convenient.

- Calculation within the Availability based on Time does not present Major Difficulties, for this reason is being used as a reference point for Wind Farm Performance in most cases.

- Energetic Availability goes a step further in terms of a Wind Farm performance indicator, bringing out energy losses instead of downtimes.
THANK YOU ALL
FOR YOUR ATTENTION

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