WHOLISTIC AND INTEGRATED DIGITAL TOOLS FOR EXTENDED LIFETIME AND PROFITABILITY OF OFFSHORE WIND FARMS

10 September 2024

Funded by
the European Union

PROJECT DATA

- Call: HORIZON-CL5-2022-D3-03 (Sustainable, secure and competitive energy supply)
- Topic: HORIZON-CL5-2022-D3-03-04
- Type of Action: HORIZON-RIA
- Topic budget: ~18 M€

- Acronym: WILLOW
- Project Title: Wholistic and Integrated digitaL tools for extended Lifetime and profitability of Offshore Wind farms
- EU Grant: ~5.8 M€ (100% funding ratio)
- Project start: 2023-10-01
- Project End: 2026-09-30

CONSORTIUM

Research and Technology Organisations

- Ceit (Spain) - **Coordinator**
- Flanders Make (Belgium)
- Sintef Energy Research (Norway)
- Sirris (Belgium)

University

- VUB (Belgium)

Offshore Operator

- Norther (Belgium)

SMEs

- Alerion (Spain)
- C-Cube (The Netherlands)
- TSI (Spain)
- 24SEA (Belgium)
- Wölfel (Germany)

Cluster

- Basque Energy Cluster (Spain)

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CONTEXT

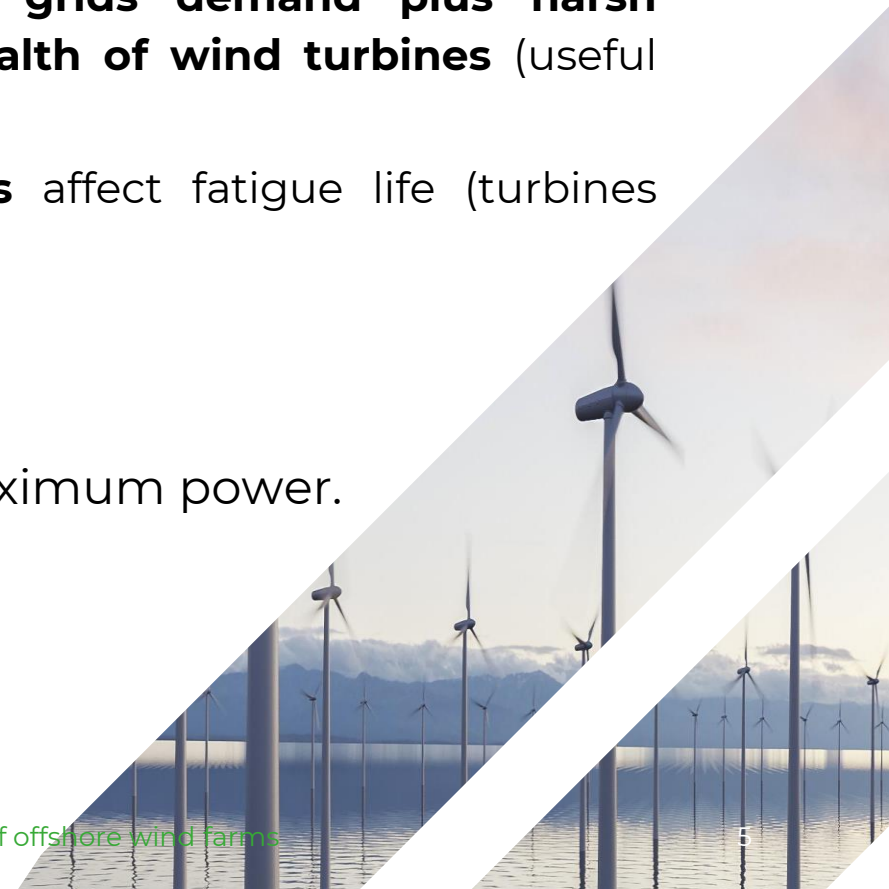
Current scheme

- Operation of offshore wind farms not ideal:
  - **Fluctuating conditions of wind availability** and **power grids demand plus harsh environmental condition** affect negatively the **structure health of wind turbines** (useful lifetime).
  - **Excessive downregulation** and **frequent start-stop events** affect fatigue life (turbines operate in off-design conditions).

How is it done today?

- Stopping a few turbines and letting the others produce maximum power.
- Downregulating each turbine by the same amount.

→ **Negative effects in fatigue life**



CHALLENGES

Current problematic

Lack of success in implementing new decision-making schemes.

Why?

- **Component degradation** and **grid integration particularly complex**.
- Offshore additional degradation rates:
  - **Corrosion** due to **moisture and salinity**.
  - **Additional loads** (waves, tides and currents).

WILLOW approach: Open-source, data-driven smart curtailment solution considering the degradation of WF structures (trade-off power production and lifetime consumption).

OBJECTIVES

- Global **Structural Health Monitoring** (SHM) based on loads, accelerations, images, thickness losses considering fatigue, pitting corrosion and coating degradation by using physical and virtual sensors combined with Machine Learning (ML) techniques.

- **Prognosis tools** by combining SCADA and SHM data, using physical models and ML methods.

  → To predict the consumed lifetime and the remaining useful life.

- **Decision-making support tool** for smart power dispatch in curtailed conditions and O&M scheduling.

WORK PACKAGES

Cluster Energía
BASQUE ENERGY CLUSTER

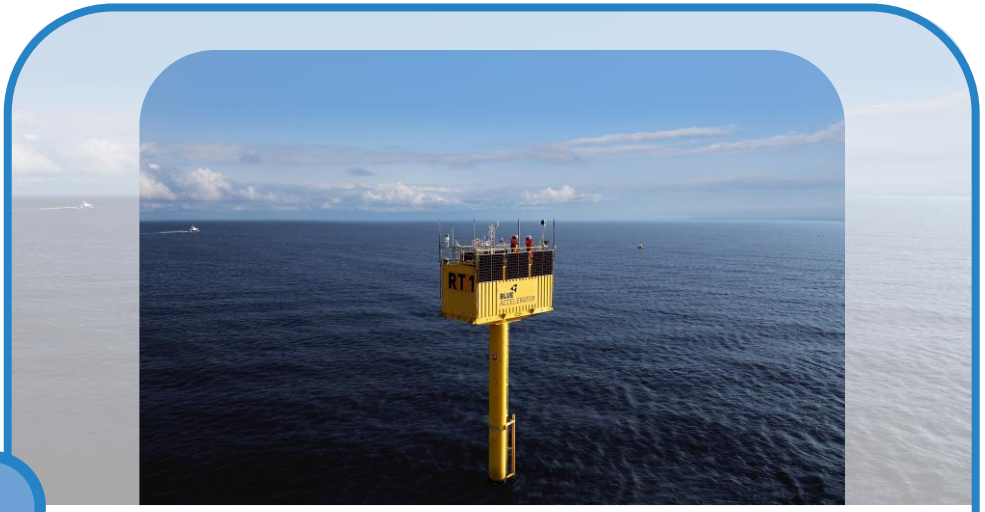
Communication, dissemination and exploitation

ACTIVITIES → USE CASE

NORTHER OFFSHORE WIND FARM

- **44** wind turbines (WT).
- Max. capacity **370 MW**.
- Belgian **North Sea**, 23 km from Belgian port of Zeebruges.
- **Use case**: when **WTs** are being **curtailed**, that is when they are **forced below the expected power output** at the occurring environmental conditions.

ACTIVITIES → OFFSHORE TEST BENCHES



1

BLUE ACCELERATOR

- **Maritime innovation and development platform and test site** for research, new coatings and monitoring solutions.
- Located at **500 m off the port of Ostend** in Belgium.
- It consists of a monopile with a powerhouse on top, and a surrounding seabed test area of 220 m around the platform.

2

HARSHLAB

- **Largest floating test laboratory for offshore industry**.
- It is moored in Biscay Marine Energy Platform (BIMEP), situated in the Gulf of Biscay, **3 km in front of the village Armintza** (Biscay), north of Spain.
- Equipment, new materials and coating can be evaluated in a wide variety of conditions ranging from atmospheric to seabed.

ADVISORY BOARD

aeroblade

capital energy

DNV

ISATI GLOBAL SOLUTIONS

nabla wind hub

Nautilus Floating Solutions

otary OFFSHORE ENERGY

PARK WIND JERA GROUP

EIFFAGE SMULDERS

SGS

WFO

OUTCOMES

1

Open-source data-driven tools to:

1. Decrease energy costs on operation
2. Increase total wind farm output
3. Parallel evaluation of operational risks

2

Digital and physical tools, as well as interoperable frameworks and controls for enhanced **data collection, analysis, and operation**.

3

Better informed decisions by operators on:

1. Farm-wide system optimisation
2. Lifetime extension
3. Decommissioning

4

LCOE reduction in line with the SET Plan targets, through increased in Remaining Useful Lifetime of substructures.

EXPECTED IMPACTS

Maintenance costs

Corrosion cost represents 18% of maintenance costs.

→ Reduction of 50% on the inspection costs.

Design & Operating life

Potential of 5+ additional years of operating life.

→ 20% of lifetime extension in WFs designed with 25 years of lifetime.

Environmental impact

Expectation of reducing noise pollution by 4%.

Levelized cost of energy (LCOE)

Up to 10% reduction of LCOE, between 3.5 and 4.5 €/MWh.

WILLOW

Wholistic and integrated digital tools for extended lifetime and profitability of offshore wind farms

THANK YOU!

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