



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

10 September 2024



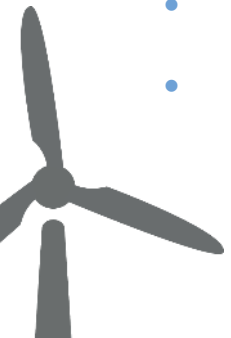
**Funded by
the European Union**



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)





INDEX

01

Context &
Challenges

02

Objectives

03

Work Packages
& Activities

04

Advisory
Board

05

Outcomes

06

Expected
Impacts





CONTEXT

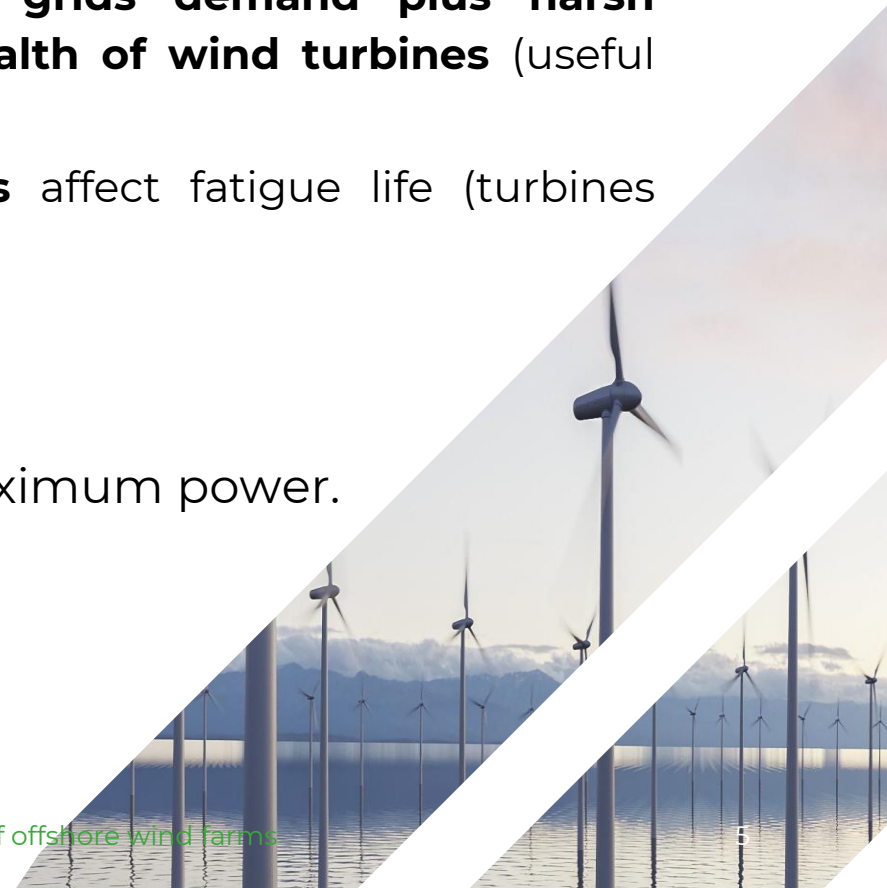
Current scheme

- 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.





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





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.





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

THANK YOU!



Ainhoa Cortés



+34 943 212 800



acortes@ceit.es



willow-project.eu



ALERION



Funded by
the European Union