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

NEWSLETTER III
March 2026

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

5 countries | **5.8M€ budget** | **12 partners** | **36 months**

WILLOW ID

Acronym / WILLOW

Program / The European Union´s Research and Innovation Program HORIZON-CL5-2022-D3-03-04 Integrated wind farm control

Duration / October 2023 – September 2026

Main objective / WILLOW project aims to achieve an integrated system that provides an open-source, data-driven health aware curtailment strategy to the wind farm operators. This integrated wind farm control system in offshore environments will look for a trade-off between the power production and the lifetime consumption.

Partner countries / Belgium, Germany, The Netherlands, Norway and Spain.

UPCOMING EVENTS

23-26 March 2026
14th International workshop on *Application of Electrochemical Techniques to Organic Coatings*

21-23 April 2026
WindEurope Madrid

EDITORIAL

Dear WILLOWers,
It's great to have you back for a new chapter of the WILLOW Project. In this third newsletter, we share fresh updates, new insights, and a clearer view of our progress. Much of this comes from the valuable discussions at our recent Advisory Board meeting, whose feedback is helping us refine our approach and strengthen the project's direction. If you haven't had the chance to read the previous editions, we invite you to take a look

If you haven't had the chance to read the previous editions, we invite you to take a look:

- Newsletter 1: an overview of the WILLOW project, its goals, and the activities carried out in the early stages.
- Newsletter 2: the initial insights shared by the Advisory Board.

For regular updates, feel free to visit our website and follow us on LinkedIn (@WILLOW Project EU).

We hope this new edition of the WILLOW Newsletter makes for an enjoyable read. As always, we welcome any feedback or reflections you'd like to share with us.

The consortium

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ADVISORY BOARD MEETING HIGHTLIGHTS

Last December, a meeting was held in Bilbao with the members of the Advisory Board, where we reviewed the progress made in each of the project's work packages and discussed the results achieved so far.

The session took place in a hybrid format —both in person and online— and was attended by representatives from the following Advisory Board members:

Certification companies

DNV

SGS

Wind farm developers

PARK WIND
JERA GROUP

otary
OFFSHORE ENERGY

Engineering and service providers

nabla
wind hub

Nautilus
Floating Solutions

ISATI
engineering solutions

Manufacturer

EIFFAGE
SMULDERS

Association

WFO

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Coating condition and pitting corrosion continuous monitoring, prediction and standardization for OWF

Key Takeaways on Coating Degradation & Pitting Corrosion using Ultrasound sensors

Participants highlighted that, at present, there are some concerns about the need to install permanent sensors across structures. From an inspection perspective, it was noted that **covering a wider area of the structure through periodic inspections and spot checks could be an effective approach to identify potential corrosion,** followed by more focused or continuous evaluation where required.

It was also pointed out that **full structural inspections remain essential**, as it can be challenging to extrapolate the condition of an entire platform based solely on a limited number of localized measurement points.

In this context, there was **interest in the development of monitoring systems capable of detecting pitting corrosion over larger areas,** rather than focusing only on highly localized points, which could enhance early identification of degradation processes.

From a lifecycle perspective, **corrosion** was generally described as a **slow-developing phenomenon**, with a more significant impact expected towards the later stages of a turbine's operational life. Therefore, **continuous monitoring strategies may be particularly valuable when applied during the final years of operation.**

The discussion also acknowledged that **continuous pitting monitoring presents challenges**, mainly due to the unpredictable nature of pit initiation. While continuous monitoring is considered highly effective for tracking crack propagation, early identification of pit initiation locations remains a key technical challenge and an area for further development. **Identifying the regions where the structure is susceptible to pitting provides added value to asset owners**, as it allows them to focus inspections on these critical areas.

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Key Takeaways on Coating degradation using Electrochemical sensors

TOPIC	KEY POINTS DISCUSSED
BI AND PI DATA FLUCTUATIONS	**Variations in the range of 10–20%** were discussed. These **fluctuations are mainly linked to temperature effects.** The system is designed to present a conservative, worst case scenario to avoid underestimating potential risks.
DASHBOARD INTEGRATION AND APIS	The **possibility of integrating the dashboard into existing systems**, including the use of APIs for custom dashboard development, was raised. It was noted that **potential collaboration and business models** to enable this type of integration **are currently being explored.**
SPREAD IN ASSET PROGNOSIS RESULTS	A widespread in early prognosis results was identified. This was explained by the limited amount of data available at the initial stages of installation. **As operational time increases and more data is collected, uncertainties are expected to decrease and results to converge.**
IDENTIFICATION OF CRITICAL MEASUREMENT AREAS	**Determining the most critical monitoring locations** was discussed as a **complex task.** Corrosion exposure can vary significantly between wind farms, between turbines within the same site, and across different structural areas, making early identification challenging.
STRUCTURAL CRITICALITY VS. COATING DEGRADATION	It was emphasized that **critical areas** are not necessarily those with the weakest coating, but rather **the fatigue critical structural zones that are most sensitive to corrosion.** Fatigue calculations were highlighted as essential to ensure structural integrity under operational loads.
INSPECTION AND MONITORING STRATEGY	It was agreed that **effective inspection planning** typically involves **close collaboration with structural design teams,** who have detailed knowledge of the most critical areas of the structure and can help prioritize monitoring efforts.

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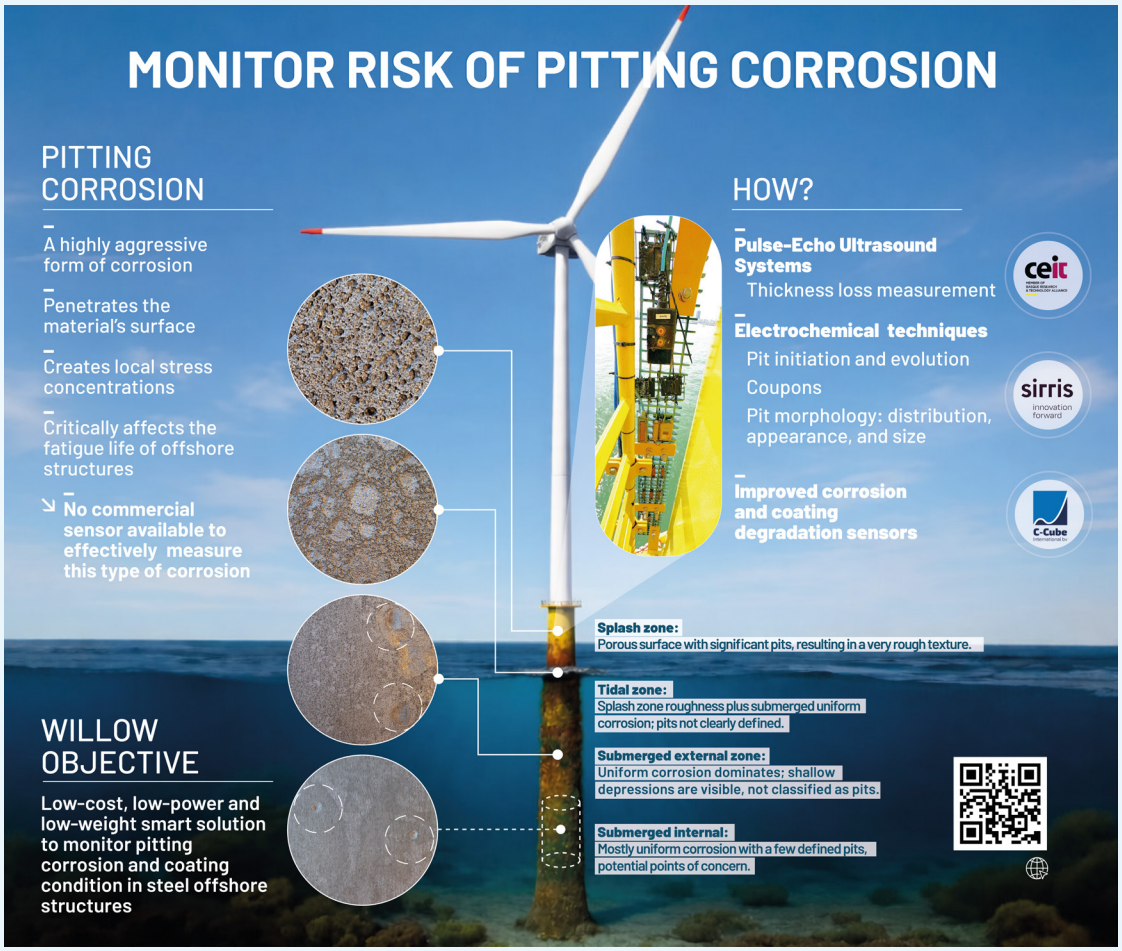
Key Takeaways on Pitting Corrosion using Electrochemical and Miscellaneous Methods

01.

During the discussion, questions were raised regarding the **influence of material anisotropy on measurement results.** It was explained that the ultrasound sensor provides highly localized measurements, focusing on specific areas of the material. As such, while it **delivers valuable information at the measurement point,** it is not intended to predict how or where corrosion may evolve across the structure over time.

02.

The conversation also addressed whether corrosion is assumed to propagate uniformly in all directions within the material. It was noted that, in most towers, **corrosion behaviour can vary due to different environmental and operational impacts.** This variability can be observed, for example, in checkpoints equipped with ICCP data, where different potential responses are detected. However, it was also acknowledged that validating this behaviour across multiple locations remains challenging, as installing sensors in numerous positions is not always feasible.



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Towards fleetwide lifetime assessments

Key Takeaways

This part of the session provided an update on the ongoing work toward fleetwide Damage Equivalent Load (DEL) predictions for lifetime assessments—a key metric supporting the health-aware curtailment strategy within the WILLOW project.

As part of the discussion, several thoughtful questions were raised, fostering a constructive and forward looking conversation:

"Is it feasible to access time series data with a resolution below 10 minutes?"

The standard API currently provides 10-minute time series, aligning with common offshore wind practices where guaranteed access to 10-minute SCADA data is the industry norm. At the same time, **exploratory work is being carried out regarding access to higher-frequency data via a "FAST API".** This remains outside the WILLOW scope, but the exploratory efforts aim to understand future possibilities.

"How closely do the measurements reflect actual operating conditions?"

Historically, as measured loads have tended to be lower than as designed levels. In more recent wind farms, however, **measured loads and frequencies are increasingly consistent with design expectations.** This means that, for the latest assets, operational conditions not fully reflected in the design phase become more relevant, such as the more dynamic curtailment strategies applied to turbines today.

"How is uncertainty assessed in comparison with the predictions?"

Uncertainty has also been highlighted in initiatives such as JIP OWILIFE, where it is considered a key topic. From a design perspective, **uncertainty and reliability are accounted for through factors such as the Design Fatigue Factor (DFF).** Looking ahead, the project aims to explore how uncertainty assessments could be performed using monitoring data by applying similar principles to those used in design, including the role of the DFF.

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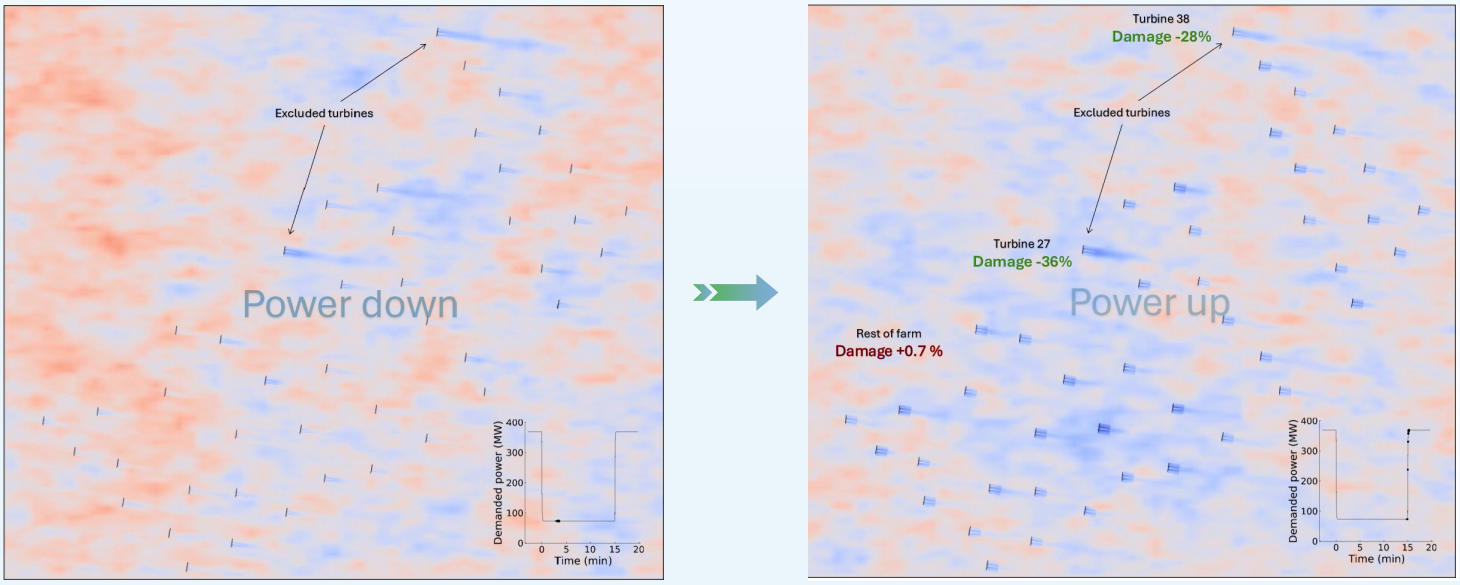
Key Takeaways

During the discussion, one question focused on the decision making process behind curtailment actions. The idea was whether, instead of choosing only between curtailing or not curtailing, it would be possible to apply something in between, such as a **certain percentage of curtailment or a smarter approach that considers the damage assessment.**

It was explained that, although market constraints often make it difficult for the operator to freely decide when to curtail, **technically it is possible** to make more detailed decisions at lower operational levels. These kinds of adjustments can help improve the overall operation of the wind farm, although they are usually medium to long term objectives.

Effect of excluding two abnormally damaged turbines for curtailment, compared with current practice



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Participation in conferences

WINDFORCE 2025

17 June 2025

Bremerhaven, Germany

C-CUBE did a presentation on coating and corrosion monitoring for predictive maintenance and lifetime extension in offshore wind, highlighting the ongoing work within the project.

WESC 2025

27 June 2025

Nantes, France

WESC 2025
24 - 27 JUNE | NANTES, FR

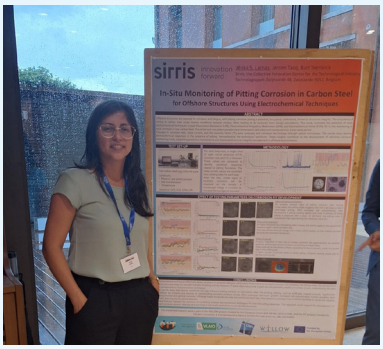
VUB and FLANDERS MAKE presented updates on the project at the Wind Energy Science Conference.

EMCR 2025

16 June 2025

Venice, Italy

SIRRIS presented in the Electrochemical Methods in Corrosion Research conference the poster “In-situ monitoring of pitting corrosion in carbon steel for offshore structures using electrochemical techniques” showcasing the latest achievements of the project.



ENLIT EUROPE 2025

18-20 November 2025

Bilbao, Spain

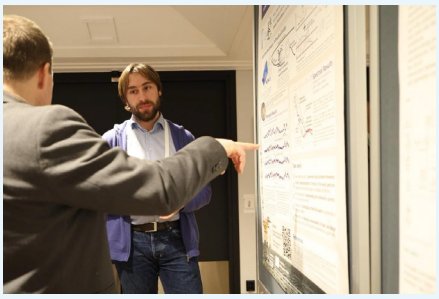
WILLOW was present in the EU Projects Zone at ENLIT EUROPE. BASQUENERGY Cluster delivered a presentation during the “Digital Technologies for RES” session on the 18th, and we also had a stand in the EU Projects Zone.

DEEPWIND 2026

15 January 2026

Trondheim, Norway

SINTEF presented the poster “Long turbulent synthetic wind time series for offshore wind farms simulation” during the DeepWind Conference.



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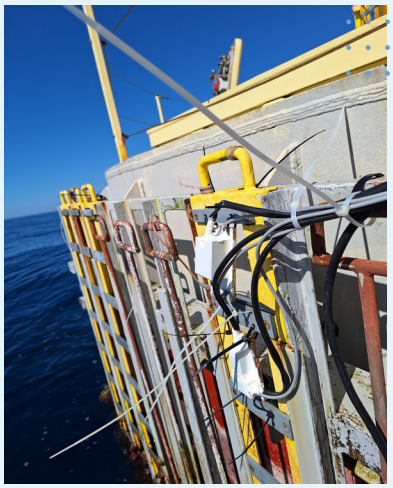
Project news

Installation of CEIT sensors in the HARSHLAB

September 2025



CEIT installed its three sensors and a UWB 4G gateway in the floating offshore laboratory HARSHLAB (operated by Tecnalia). A one year test campaign is now underway.

Mudline corrosion experiment completed

October 2025

SIRRIS, in collaboration with Antwerp Underwater Solutions, installed a frame on the seafloor at the Blue Accelerator test site in April. On 9 October, a second pipe was successfully mounted onto the original underwater frame. The second pipe is equipped with corrosion sensors that are now monitoring and collecting data on seabed corrosion.

Deployment of TSI's Hydrophone at Norther OWF

October 2025

TSI, in collaboration with the Flanders Marine Institute (VLIZ), installed its hydrophone near a turbine at the Norther offshore wind farm in Ostend to study whether the presence of electromagnetic fields influences the behaviour of marine fauna in the area.

Joint workshop with the sister projects

November 2025

On 5 November, we hosted a joint workshop with our sister projects SUDOCO, ICONIC and TWAIN, all funded under the same European Commission call. The session allowed us to share progress, exchange insights and explore new collaboration opportunities in integrated wind farm control.

Pilot sessions with wind farm operators

December 2025

24SEA and VUB met with Norther, Otary RS NV and JERA Nex bp to align expectations for the proof of concept on fleet wide load and lifetime monitoring. Initial farm wide lifetime plots were shared, prompting useful operator feedback on key load cases. In parallel, 24SEA delivered online training on the new API, enabling near real time access to load predictions for further analysis.

Check these and more WILLOW stories in:

willow-project.eu/news

CEIT is a private and non-profit Technology Centre in the Basque Country to enhance the competitiveness of the industry across different sectors through applied research projects that generate advanced solutions based on scientific and technological excellence.

One of the aims of the ICT Division at CEIT, is to develop low-cost advanced ad-hoc smart solutions based on ultrasound technology to provide precise and valuable information about corrosion (uniform and localized) and coating degradation of the offshore structures and components in operation.

In previous projects like WATEREYE,coordinated by CEIT, a smart ultrasound-based solution was developed to **quantify the thickness loss from uniform corrosion with a precision around 1um**, validated on typical steel materials withstandard offshore coatings. Furthermore, **CEIT developed a network of four fixed ultrasound-based sensor nodes andone mobile integrated into a drone.** The whole solution was designed carefully to fulfil the required specifications, including low cost embedded electronics for excitation and signal processing, an optimized wireless link for offshore environment, and robust prototypes capable of operating for years in harsh environments.

These achievements demonstrated how this kind of solutions allows to apply predictive maintenance strategies to the offshore structures and components in operation. Thus, critical failures can be detected in an early stage and OPEX can be reduced drastically.

CEIT's Role in the WILLOW project

CEIT, as the WILLOW Project Coordinator, manages the project and leads WP2, which focusesdesigning a smart structural health monitoring system for offshore wind turbine towers, transition pieces, and foundations. **The system monitors loads, pitting corrosion, and coating degradation using physical and virtual sensors combined with ML techniques.** CEIT specifically contributes to the design of an ultrasound-based solution to quantify the evolution of the pitting corrosion and the coating degradation based on the coating thickness.

CEIT works very closely with SIRRIS and C-CUBE in the integration of the CEIT's ultrasound system with C-CUBE's solution with the aim of developing a unique ultrasound/ electrochemical coupon which will improve C-CUBE service in the monitoring of corrosion and coating degradation. On top of that, **the data coming from these sensors will feed the corrosion prognosis models developed by FMAKE to enhance the corrosion predictions.**

Samples with pitting and uniform corrosion, and CEIT's bonded transducer embedded in the white box

The goal of this work is to reduce uncertainty on lifetime prediction and lifetime extension decisions by providing reliable and valuable data for decision makers.

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We hope that you enjoyed the WILLOW Newsletter and already look forward to the next editions.

The consortium

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