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## **WELCOME TO THE FINAL MAREWIND NEWSLETTER!**

### **Message from the coordinator**

The MAREWIND adventure has reached the end, and it is logic that this evokes certain sensations, mainly coming from the initial stages of the project. For Lurederra team, assuming the coordination of such a complex project, combining various different and specific technologies implied a challenge, but also excitement for such interesting research.

In a simultaneous way, progress was expected in functional nanocoatings, in novel concretes and in alternative composite formulations for blades, as well as in relation to advanced Structural Health Monitoring systems, including both internal and external strategies.

We knew that certain control was necessary in all development fronts, so sometimes we needed to juggle the tasks of the active work packages with the periodic revisions and compilation of documents.

Nevertheless, the overall feeling after four years of project is gratifying thanks to the fruitful collaboration, the high expertise of the partners and to the hard-working spirit of the consortium to fulfil all the activities.

Finally, we hope that the relevant results of the project are soon successfully integrated in offshore windmill structures, promoting the cost reduction and improving the management of resources regarding renewable energies.

**Lurederra team**

**Coordinator of the MAREWIND project**

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## Explore the final results of the MAREWIND project!



*MAREWIND Final video*

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## Overview of the MAREWIND innovation!

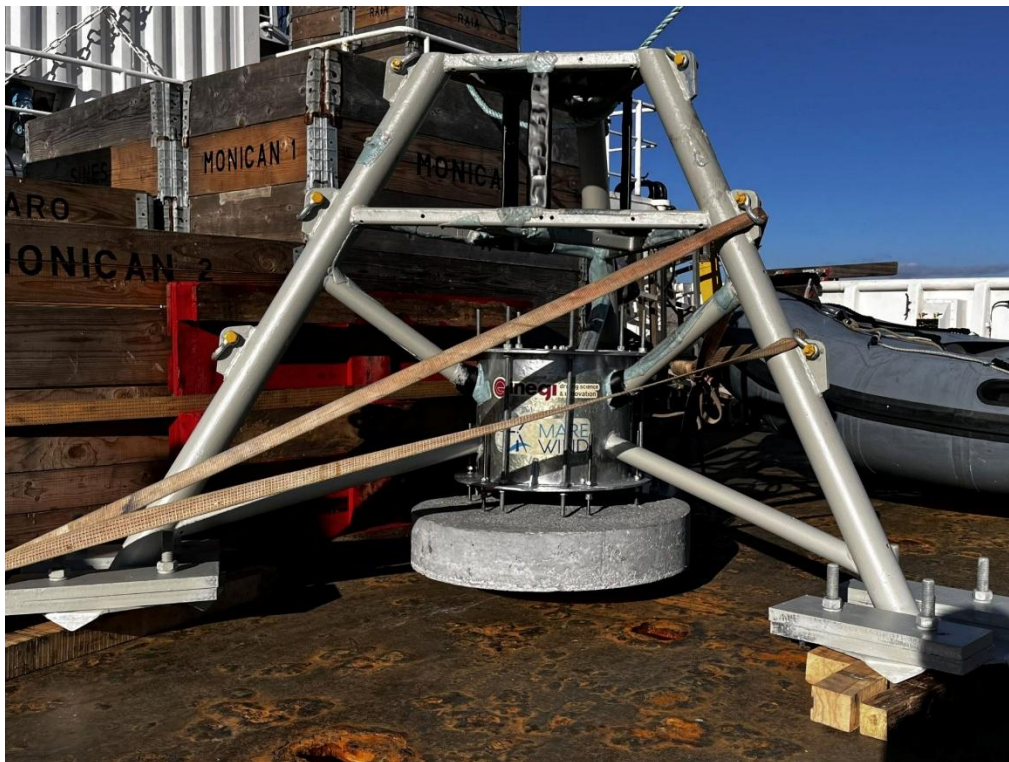
### Anticorrosion and antifouling coating

The anticorrosion coating, applied to the W2Power Floating Structure located in the Canary Islands has shown no signs of corrosion, proving the effectiveness of the solution for future applications. Additionally, these solutions have also shown significant advancements when focusing on repairing critical turbine components, treating vulnerable areas, and targeting the sections exposed to risk.



*Direct spray application system.*

The **antifouling coating**, the assessments of samples submerged in Sines (Portugal), as part of the Gravity-Based Structure (GBS), have revealed the unique attributes of the low-thickness product. These tests demonstrate its superior adhesion when compared to commercial alternatives, showcasing its potential for enhanced performance.



*Gravity-based structures (GBS).*

The MAREWIND project has developed specific functional coatings, advanced concrete formulations and novel composites as well as monitoring technologies that not only push the boundaries of functionality but also prioritise sustainability. The advancements have been done in various areas, each contributing to the overall progress of offshore wind materials.

The treated coupons embedded in frames with **anticorrosion and antifouling coatings** have been installed in offshore wind farm in Teesside (North Sea). These frames are positioned across three different exposure zones: the subsea zone, atmospheric zone, and intermediate splash conditions.

Various inspections have been run to assess the performance and durability of these innovative coatings.



*Tests conducted across atmospheric, splash zone, and subsea conditions.*

## Ultra high-performance concrete and Alkali-Activated Materials



*Concrete UHPC prototypes in floating tests with different loads*

The **Ultra High-Performance Concrete** (UHPC) is expected to outperform current commercial options, offering a durable, preventive solution during production. It also shows strong potential for maintenance and repair applications, where its durability and resilience can extend the lifespan of structures in demanding environments.



*GBS in Sines (Portugal).*

The **Alkali-Activated Materials** (AAMs) developed demonstrate durability, excellent flow capacity for molding, and strong resistance to freeze-thaw cycles. Suitable prototypes were manufactured with both concrete technologies, validated at real exposure.

## Composite technology

MAREWIND has successfully produced a 13-meter blade using an innovative composite technology from recyclable resin, incorporating a circular sustainable design, and including validation by mechanical tests in CTL (Galway).



*Successfully manufactured a 13-meter blade.*

## Structural Health Monitoring

By combining these advanced materials and **Structural Health Monitoring technology**, the project enhances resource management and structural integrity in offshore infrastructure.

Key improvements include the integration of Fiber Reinforced Polymer (FRP) bars in novel concrete formulations and the embedding of Fiber Optic Sensors across blades, gravity-based structures, and concrete structures. Additionally, external blade inspections conducted with advanced drones provide a comprehensive view of structural condition.



*AM concrete ballast Fiber  
Optic bars and sensors*



*GBS Strain sensors*



*UHPC (floating Fiber Optic bars and sensors)*



*UAVs (drones) with cameras for  
blade surface monitoring*

# MAREWIND Highlights

## MAREWIND Final event: “Sustainability and Durability Challenges in Offshore Infrastructure”



Hosted at [ACCIONA Construction](#) and facilitated by [PNO Innovation Belgium](#) and [PNO Innovation Spain](#), the workshop was a resounding success with over 100 participants attending both online and in person.

The event showcased key highlights that underscored the advancements and future direction of the offshore energy sector. Participants gained valuable insights from professionals on evolving landscape and opportunities within the future of the offshore energy market.

Expert presentations on cutting-edge innovations in durable and sustainable materials, highlighted their role in advancing on offshore infrastructures. Additionally, the event showcased solutions designed to align with the EU's 2050 climate neutrality goals, driving progress in offshore sustainability.

# The results of the MAREWIND project in a nutshell

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**DURATION**  
 1 December 2020 - 30 November 2024














**PROJECT BUDGET**  
 7.8 MEUR

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<https://www.marewind.eu/>

**CONSORTIUM**



The project has received funding from the European Union Horizon 2020 Research and Innovation Programme under Grant Agreement 101019164

**THE MAREWIND PROJECT**

Wind structures are constantly exposed to environmental factors that cause severe damage. In the offshore wind sector, these challenges are even more pronounced. Corrosion and fatigue, driven by harsh conditions, are significantly shortening the lifespan of these offshore installations.

In this context, the MAREWIND project has explored new materials, gathered experimental data, and created predictive models to enhance durability, reduce maintenance, and achieve lower environmental impact.

**Novel materials and coatings**


- Anti-corrosion coating
- Anti-fouling coating
- Durable & Sustainable concrete
- Recyclable composite technology

**Novel OIM tools**

- Non-destructive monitoring by UAVs
- Smart integrated materials
- On-site monitoring by fiber optic sensors

**IMPACT**

- Enhance durability of materials
- Reduce Offshore Energy Production Costs
- Reduce life cycle costs
- Reduce environmental impact by 35%
- Save 3.8 tCO<sub>2</sub>e in the short term
- Bring wind energy systems below 12 c€/kWh
- Decrease CO<sub>2</sub>e emissions
- Save 1.5 tCO<sub>2</sub>e in the mid-long term



**MARE WIND**

**Materials solutions for cost Reduction and Extended service life on WIND off-shore facilities**

**MAREWIND NOVEL SOLUTIONS**

**ANTICORROSION COATING**

**WFOner Floating structure**

- Surface Preparation
- Anti-Corrosion Application
- Monitoring



**Benefits:**

- Materials resistant to the marine atmosphere have shown no signs of corrosion.
- Fully compatible with the yellow paint required by offshore visibility regulations.
- Proven effectiveness of the solution for future applications.

**COMPOSITE TECHNOLOGY**

Consider use of Glass materials.

Successful implementation of a 1.5m long blade section in real wind turbine technology.

Thermal and mechanical properties have been validated in the field.

Designed with a focus on circular economy through a glass fiber reinforced resin.



**Benefits:**

- One-layer coating applied by direct spray
- No need for special surface preparation or thermal curing
- Easy application: demonstrated in real-world conditions on various windmill sections

**ANTIPOULING COATING**

Modelled performance subsequent to the use

- Lower biofouling product
- Superior adhesion when compared to commercial alternatives
- Increased mechanical properties
- Optimized design: enable efficient, strong structures



**Benefits:**

- Reduced maintenance costs
- Increased efficiency
- Longer service life

**CONCRETE**

**Ultra-High Performance Concrete**

- Increased durability (extremely high chloride penetration resistance) in harsh offshore conditions
- Improved mechanical properties enabling slender floating structures
- Cost-effective solution to reduce maintenance and repair costs



**Benefits:**

- Optimized design: enable efficient, strong structures

**Structural Health Monitoring**

Integration of Fiber Optic Structural Health Monitoring (SHM) sensors in wind turbine components

Integration of Fiber Optic sensors in blades, tower, and nacelle

Remote data collection for structural health monitoring



**Benefits:**

- Reduce costs by detecting stress or material defects early
- Enhance operational safety by identifying potential risks and reducing on-site maintenance
- Improve maintenance management through early detection
- Reduce the risk of major damage and critical situations

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