# Reducing the Cost of Offshore Wind Energy through Advances in Blade Protection

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**Authors**

Prof Trevor Young,
University of Limerick

**Project Partners**

Dr Edmond Tobin, SETU
Dr Joseph Mohan, TUDublin
Dr William Finnegan,
University of Galway

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**Contact details**

**e:** trevor.young@ul.ie
linkedin.com/in/trevor-m-young-4661462a



## Abstract

With continued expansion of the wind industry, both onshore and offshore, significant challenges exist with erosion and fouling of wind turbine blades. Both phenomena significantly impact energy generation and operational costs. Leading edge erosion from droplet impact and biofouling/contamination lead to increased maintenance costs and significant Annual Energy Production (AEP) losses up to 25%. SPOTBlade addresses these issues by developing novel mitigation strategies for erosion and fouling protection of offshore turbine blades. The impact of the research will lead to a reduction in the levelized cost of energy, offering a more cost-effective model for offshore wind turbine installations.

## Research Outcomes

Research has focused on understanding damage mechanisms, evaluating protection systems, and developing mitigation strategies. Experimental testing of leading-edge protection (LEP) materials is underway using the WARER test facility, where test coupons are shown in Figure 1, contributing to a landmark comparison of European rain erosion test facilities. Novel coatings have been developed and tested for anti-biofouling properties, showing promising initial results, such as improved antimicrobial performance with eucalyptus oil. Advanced models are being developed to predict rain erosion, incorporating factors like Irish climatic conditions and material properties. These outcomes provide critical data for evaluating and selecting effective blade protection systems, offer new strategies to reduce AEP loss and maintenance requirements from fouling, and deliver tailored prediction tools for more effective maintenance planning, directly addressing key technical and economic challenges in the current wind energy landscape.

## Recommendations

The research highlights the potential for significant cost savings and improved efficiency through effective blade protection. Research gaps exist in the identified mitigation strategies, including advanced LEP systems, effective repair strategies for offshore conditions, and novel anti-contamination coatings. Leveraging the developed erosion prediction tools tailored to Irish climate conditions can inform maintenance planning and policy decisions. The project's outcomes offer opportunities for commercialisation, providing specialise research infrastructure and contributing to the viability of Ireland's wind energy sector.

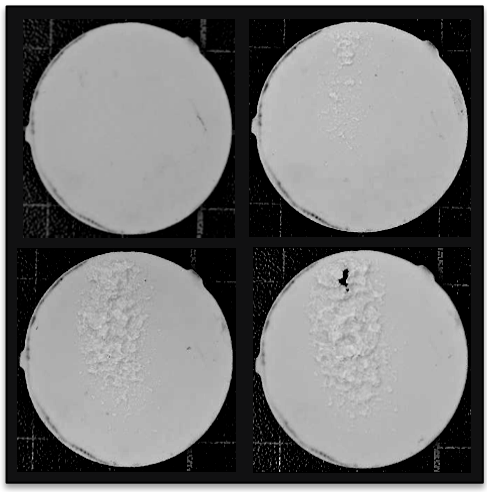

**Figure 1: Test coupons for LEP materials at various stages during the erosion testing**

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