NEMMO Project

On the Cutting Edge of Tidal Blade Design and Materials

December 8th 2021

Ocean Energy Europe 2021 Annual Conference

Side event

Pablo Benguria, Tecnalia Research & Innovation

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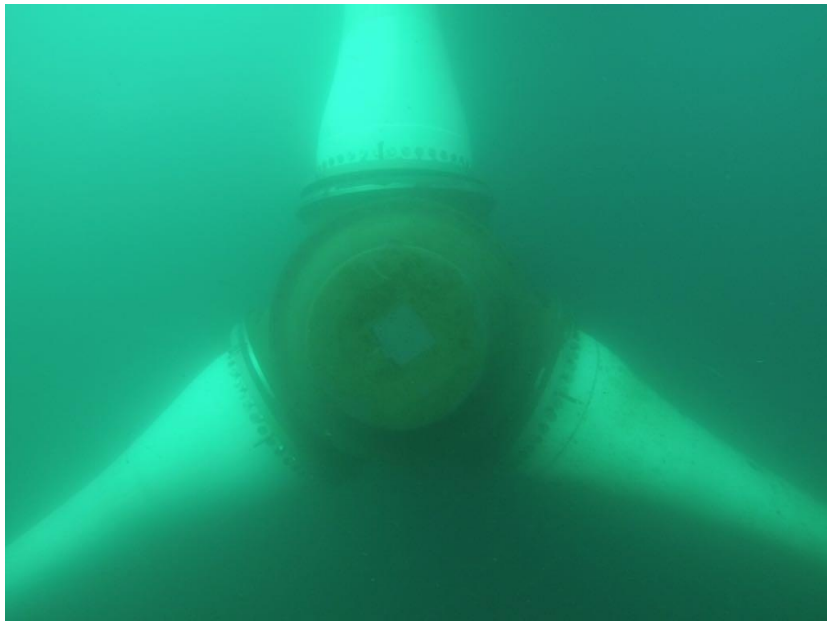
Main Goals and S&T objectives

Design, model and test downscaled prototypes of **larger, lighter** and **more durable** composite blades for >2MW floating tidal turbines to **reduce LCoE of tidal energy to €0.15/kWh**, meeting 2025 SET-Plan targets.



NEMMO is about BLADES!

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Main Goals and S&T objectives

The NEMMO project has been designed according to a **holistic approach** in which the following elements are integrated:

1. **Simulation techniques** for hydrodynamic loads and velocity profiles including cavitation vortexes.
2. Available **data from large scale off-shore demonstrators**.
3. **Novel testing procedures** to replicate the real stresses occurring on composite blades
4. Advanced technologies to increase the **mechanical**, **hydrodynamic**, **aging** and **fouling** performance of composite blades.
5. An extensive testing campaign**,** including the novel testing procedures to develop **behavioural models** for composite blades and evaluate the performance increase.
6. Innovative **methodologies to design** optimised composite blades
7. **Testing and validation to TRL 5** of the NEMMO optimized composite blade designs.

Main Goals and S&T objectives

Scientific & Technological objectives:

- ✓ **Novel blade designs** with enhanced hydrodynamic performance due to the implementation of the different solutions, **active flow control**, **materials** and **surfaces**
- ✓ **New nano-enhanced composites** with properties that increase fatigue-, impact-, cavitation- and bio-fouling resistance of novel blade designs to **prevent failures**.
- ✓ Model, design and test the **lifespan and resistance** of the new composites for tidal turbine blades.

Economic objectives

The collective result of these innovations is **70% reduction in LCoE** for tidal energy due to:

- ✓ **50% CapEx reduction** (lower material consumption and 25% lower cost of new composites),
- ✓ **2% lower Fixed Charge Rate** (increased understanding of failure and fatigue mechanisms and more durable composites with 66% higher lifespan),
- ✓ **40% reduction in O&M** (reduced cavitation wear, bio-fouling and ageing),
- ✓ **20% increase in Annual Energy Production** (enhanced hydrodynamic performance and higher inlet flow speeds for tidal turbine).

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Participants and consortium synergies

Participant No./Status	Participant Organisation Name/[Short Name]	Country
1 (Coordinator) / RTO	Tecnalia Research & Innovation [TECNALIA]	Spain
2.SME	Grupo INPRE Composites [INPRE]	Spain
3.RTO	Israel Institute of Technology Technion [TECHNION]	Israel
4.RTO	Dublin City University [DCU]	Ireland
5.RTO	Association Pour Le Developpement De L'enseignement Et Des Recherches Aupres Des Universites, Des Centres De Recherche Et Des Entreprises D'aquitaine [ADERA]	France
6.RTO	Fundación para el Desarrollo y la Innovación Tecnológica [FUNDITEC]	Spain
7.SME	Sagres SL [SAGRES] / Magallanes Renovables [MAG]	Spain
8.RTO	SSPA Sweden AB [SSPA]	Sweden
9.RTO	Instituto Tecnológico de Aragón [ITA]	Spain
10.SME	SP Nano Ltd. [SPNano]	Israel
11. IAG	Ocean Energy Europe [OEE]	Belgium
12. RTO	Blade Test Centre A/S [BLAEST]	Denmark

7 countries.

- NEMMO gathers **the entire value chain**:

- **2 industrial partners** that will directly commercialise NEMMO results :
  - **SPNano**: Their SP1/CNT technology is being forecasted to impact, wind energy and EV market
  - **INPRE**: composite blade manufacturer, having manufactured six 9m-long-blades for MAG.
- **8 RTD partners** to provide leading edge technological advances
- The largest **global network of ocean energy professionals (OEE)** will promote NEMMO results to their members and to potential investors and stakeholders in their European links.
- An **end user (MAGALLANES)** within the consortium facilitates early assimilation of results by industry while generating the credibility essential for market success

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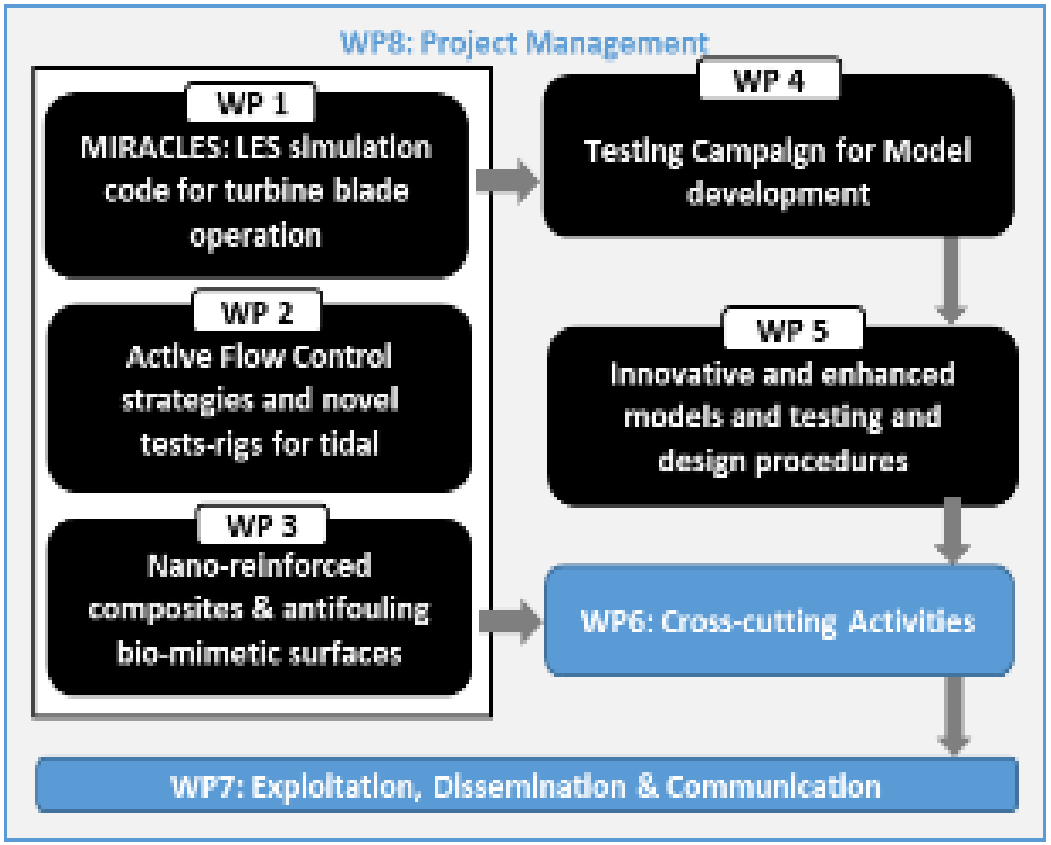
Participants and consortium synergies



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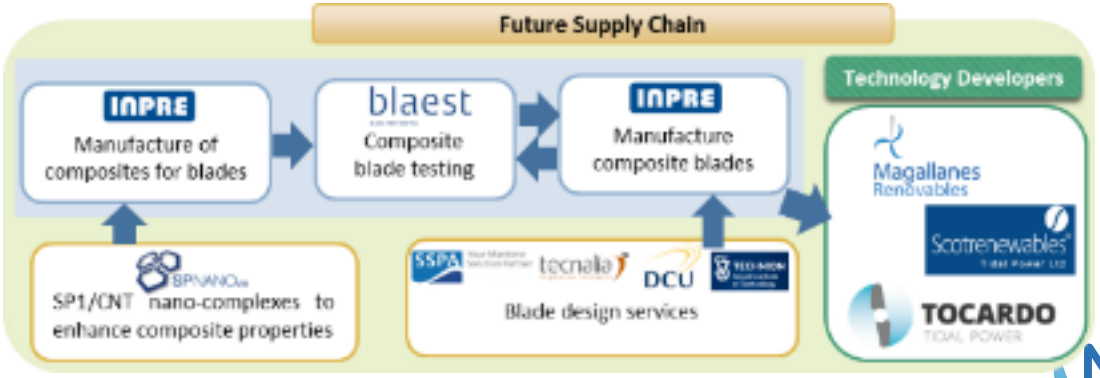
Expected results

From a **business perspective**, the following industrial activities and services are expected to be generated:

- ✓ **Services**:
  - **Simulation and composite blade design services** for the composite blade manufacturing industry based on the novel LES MIRACLES codes and generated models
  - **Testing of tidal composite blades** provided by research and testing centres according to novel testing procedures.

- ✓ **Products**
  - **Nano-enhanced composites** for tidal energy devices, increasing efficiency and enabling scale-up over 2MW.
  - **Optimized blades design** for tidal generators.
  - **Novel coatings** with enhanced harsh marine environment conditions



Future NEMMO supply chain

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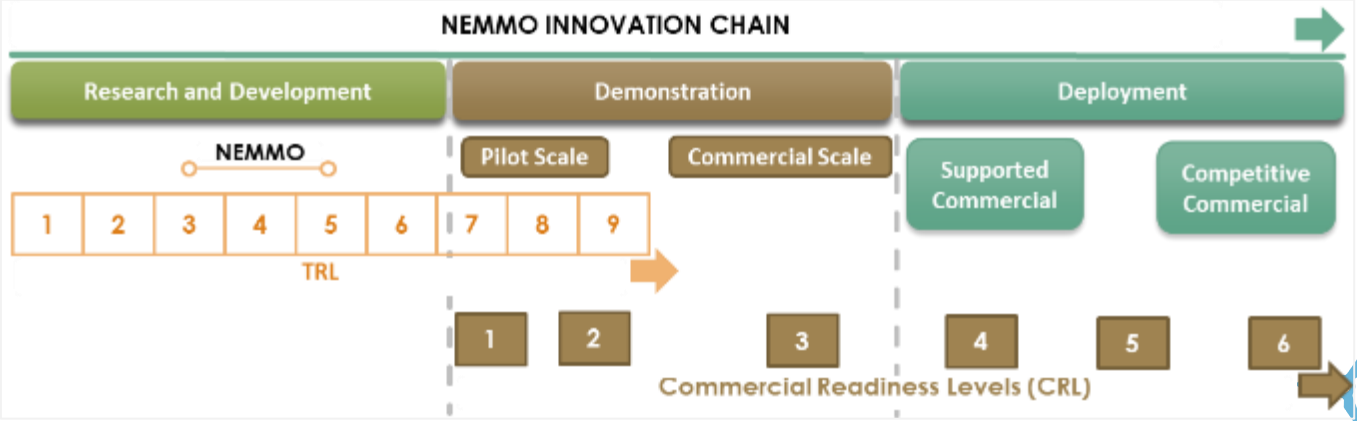
Expected results

- ✓ **By 2022**, NEMMO innovations will have been **validated at TRL 4-5**, generating evidence of increased hydrodynamic performance and reliability of blades and potential to lower LCOE and meet SET-Plan targets for tidal energy.
- ✓ This will allow for:
  - ➢ **development and testing at full-scale** of tidal turbine blades and test-rigs
  - ➢ **validation** of models and novel designs
  - ➢ evaluation of **new composite material performance at real scale**.
- ✓ The demonstration at full-scale will cost **around €15 million**. This investment is planned to be raised from public funding such as EC or from private venture capitalists or a combination of both.
- ✓ **By 2025**, the time the consortium plans to reach the market, we expect the EU ocean energy supply chains to have fully paved the way for easier commercialisation of NEMMO innovations.



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Thank you for your attention!

Pablo Benguria (Project Coordinator)

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 815278.

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