NEOMAT

New Materials, Coatings and Processes for improving the Competitiveness of the Basque Industry in Marine Renewable Energies

Iñigo Mendikoa (TECNALIA)

VII Marine Energy Conference
Bilbao
November 9, 2021

New Materials, Coatings and Processes for improving the Competitiveness of the Basque Industry in Marine Renewable Energies

Offshore renewable energy solutions currently using traditional materials from O&G leading to high costs and environmental impact.

Overall Objective: to increase the technologies **competitiveness** and **sustainability** for offshore renewable energy sources, helping Basque companies to increase their competitive position in a growing sector.

- **Economic** and/or **environmental** benefits.
- New materials in offshore environment: **Steel**, **Concrete** and **Biobased** (sustainable polymers, wood), **sustainable coatings** for steel.

Main Innovations proposed in the NEOMAT project

- **New S355 Steels for offshore environment**

Development of new grades of steel, with **high resistance to corrosion** and **high toughness at low temperatures** for offshore applications, in order to increase the service life against corrosion of off-shore structures, and to avoid the brittleness of thick components leading to catastrophic failure.

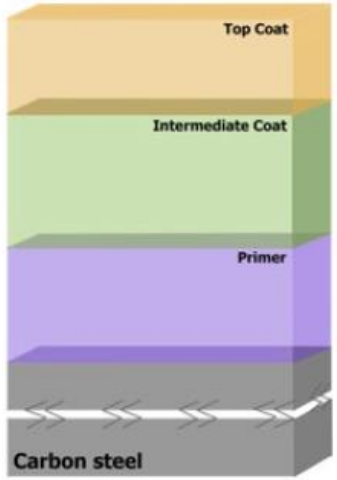
Improvement of the toughness at low temperatures and resistance against corrosion of S355 structural steel through the addition of alloys that leads to **grain size refinement** and a **homogenization of the microstructure**.

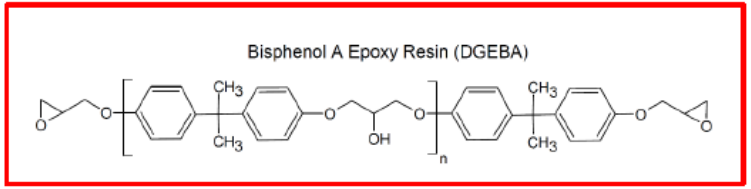
Thermodynamic software (ThermoCalc) will be used for alloys definition.

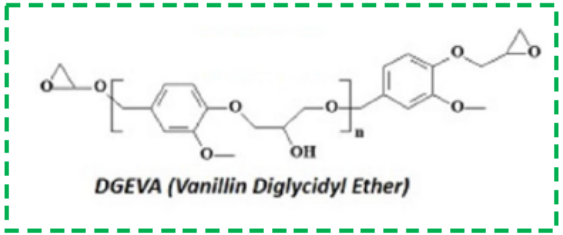
Main Innovations proposed in the NEOMAT project

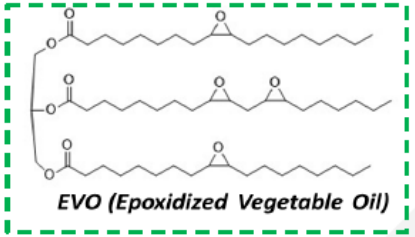
- **Sustainable coating for steel protection in offshore environment.**

Epoxy paint formulated with **biobased** components, replacing non-sustainable components currently used.
Rare-earth elements for **corrosion inhibition**.
Inclusion of **nanoparticles** providing **super-hydrophobic texture** against **biofouling**. Dispersion methods and particle size for surface roughness optimization.









Main Innovations proposed in the NEOMAT project

- **New materials based on Concrete for offshore structures**

Development of cementitious materials with **(super) hydrophobic** property and improved mechanical properties. In addition, LDH-like nanoparticles will be synthesized using the novel supercritical water technology. These nanoparticles will be added to the cement to act as inhibitors of chloride diffusion.

A **self-healing** concrete will also be considered to protect steel reinforcements and possibly improve fatigue life of the concrete structure.

The dosage of these concrete types will be studied so that it has the appropriate rheology for **3D printing**.

Main Innovations proposed in the NEOMAT project

- **New Sustainable materials for offshore environment**

New polymeric formulations based on **biomaterials** for application in matrices, adhesives, and protective coatings for composites. Petrochemical based materials (epoxy, polyester) to be substituted.

Higher **recyclability**, materials not dependent on petrochemical components price, healthier jobs, etc.

This material is expected to have similar mechanical properties for recyclable turbine **blades**. Other uses for offshore renewable energy devices in contact with the sea will be studied.

Main Innovations proposed in the NEOMAT project

- **New Sustainable materials for offshore environment**

Engineered wooden materials (Cross Laminated Timber CLT, Laminated Veneer Lumber LVL) for structural functionality are also studied for offshore application.

Different biobased possible protection solutions will be analysed and tested providing long term service in **offshore environment**.

Main Innovations proposed in the NEOMAT project

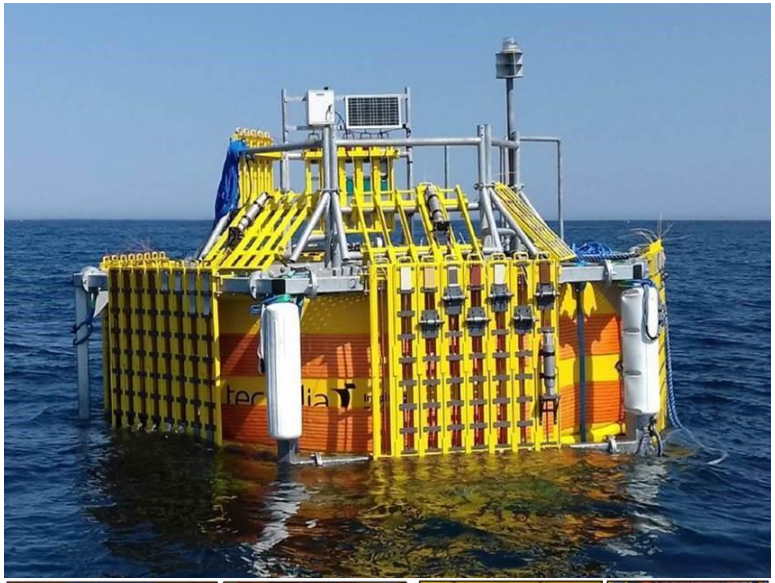
- **New degradation tests for materials in offshore environment**

Understand the degradation rates and mechanisms that occur on different materials in the offshore environment.
Definition of an **accelerated cyclical test** that allows to reproduce with fidelity and in a reasonable time the degradation in offshore environment.

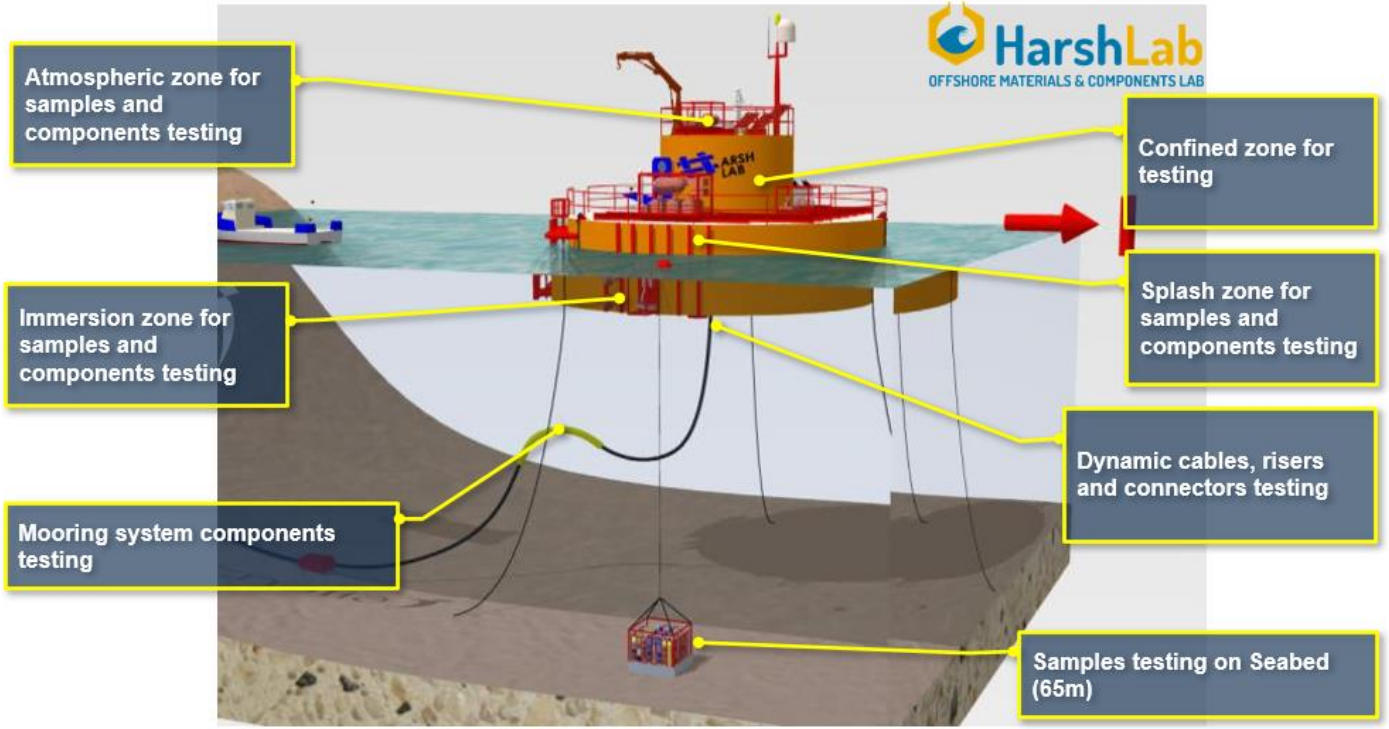
- **Characterization of biofouling in relevant biogeographic regions and maintenance strategies**

Characterize the macrofouling-forming communities in different marine bioregions of the world.
Define **maintenance strategies** for the most appropriate materials and structures depending on the area, type of material and coating.

HarshLab floating testing lab at Bimep



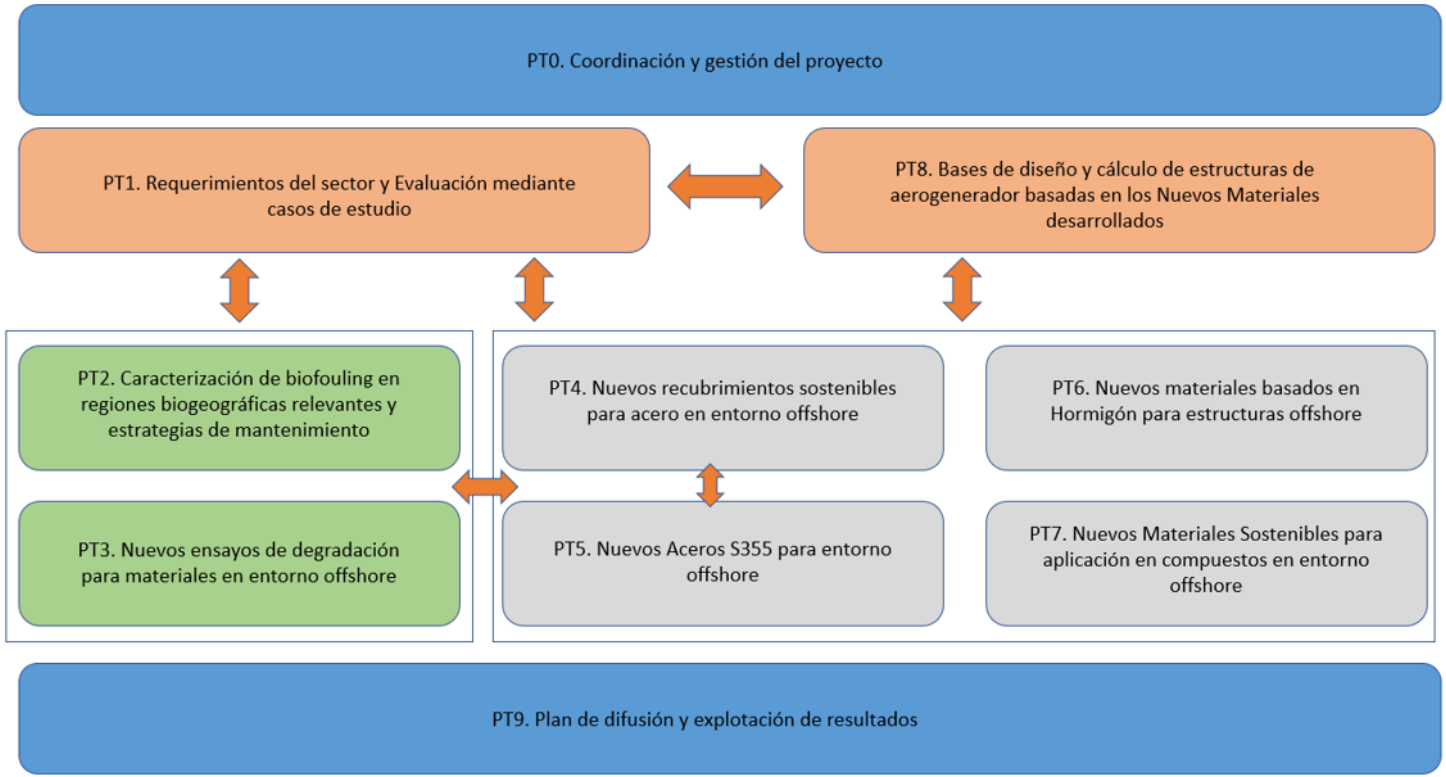
HarshLab testing possibilities



Assessment: Case studies

Case Study	Objective	Expected Impact
1. **Floating structure for offshore wind**	Study the integration of innovations related to steel and its coating, and concrete, to estimate the benefits of these new materials in a case of floating wind power	Reduction of costs and environmental impact of offshore wind floating structures, meeting the expected service life
2. **Monopile for fixed offshore wind**	Study the integration of the new coatings, steel and concrete in the design of monopile and tower characterizing the effect of environmental loads impact on the structure, as well as the loads in the monopile-tower joint	Cost and environmental impact reduction through the use of new materials. Optimization of the monopile design to the specified service life, adjusting safety factors
3. **Wind turbine elements based on biobased materials**	Study the integration of new biobased materials mainly for the manufacture of wind turbine blades. Study possible use of these materials in other elements in sea water	Reduction of environmental impact by replacing materials of non-sustainable origin with biobased materials of similar mechanical capacity and higher recyclability

Workplan


PT0. Coordinación y gestión del proyecto
PT1. Requerimientos del sector y Evaluación mediante casos de estudio
PT8. Bases de diseño y cálculo de estructuras de aerogenerador basadas en los Nuevos Materiales desarrollados
PT2. Caracterización de biofouling en regiones biogeográficas relevantes y estrategias de mantenimiento
PT4. Nuevos recubrimientos sostenibles para acero en entorno offshore
PT6. Nuevos materiales basados en Hormigón para estructuras offshore
PT3. Nuevos ensayos de degradación para materiales en entorno offshore
PT5. Nuevos Aceros S355 para entorno offshore
PT7. Nuevos Materiales Sostenibles para aplicación en compuestos en entorno offshore
PT9. Plan de difusión y explotación de resultados

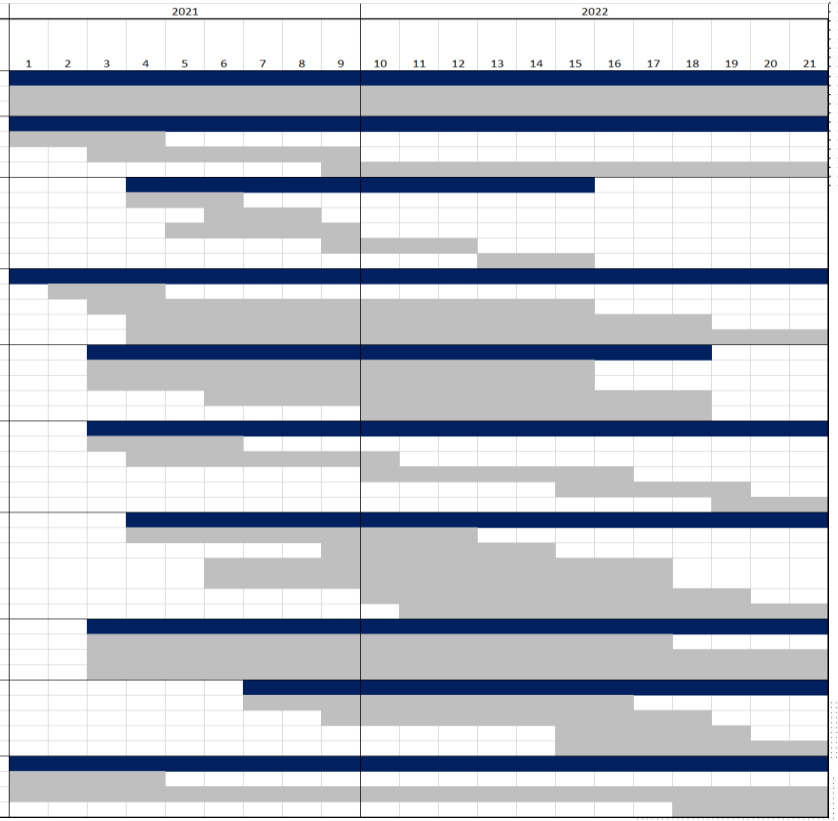
Consortium and main roles

- **TECNALIA**
  Lead, overall assessment, new degradation tests, concrete materials.
- **AZTI**
  Biofouling and maintenance strategies
- **TECNUN**
  Mechanic tests, digital models for assessment and validation
- **UPV-EHU**
  Structural Bio-based materials for offshore environment
- **POLYMAT**
  Sustainable coating for steel protection
- **SIDENOR I+D**
  New S355 Steels for offshore environment, dissemination & exploitation

tecnalia
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Time Schedule 2021-2022

TECNALIA	AZTI	TECNUN	UPV-EHU	POLYMAT	SIDENOR		NEOMAT	Meses Inicio	Meses Fin
X	X	X	X	X	X	**PT0.**	**Coordinación y gestión del proyecto**	1	21
X	X	X	X	X	X	T0.1	Seguimiento técnico del proyecto	1	21
X	X	X	X	X	X	T0.2	Seguimiento administrativo del proyecto	1	21
X	X	X	X	X	X	**PT1.**	**Requerimientos del sector y Evaluación mediante casos de estudio**		
X	X					T1.1	Definición de requerimientos del sector de las energías renovables marinas	1	4
X		X			X	T1.2	Definición de Casos de Estudio	3	9
X	X	X	X	X	X	T1.3	Evaluación del impacto en el ámbito de las energías offshore	9	21
X	X					**PT2.**	**Caracterización de biofouling en bioclimas relevantes y estrategias de mantenimiento**		
X	X					T2.1	Definición de las zonas biogeográficas objeto de estudio	4	6
	X					T2.2	Caracterización del macrofouling en diferentes zonas biogeográficas del mundo	6	8
	X					T2.3	Identificación de los principales organismos causantes de la degradación de las estructuras sumergidas	5	9
	X					T2.4	Caracterización de los modos de fallo causados por los organismos	9	12
X	X					T2.5	Propuesta de estrategias para el diseño y mantenimiento de estructuras de ERM con respecto al biofouling marino	13	15
X				X	X	**PT3.**	**Nuevos ensayos de degradación para materiales metálicos en entorno offshore**		
X				X	X	T3.1	Selección de materiales y estrategias de protección	2	4
X	X					T3.2	Estudio de los mecanismos iniciales de degradación y su velocidad en medio marino real (HarshLab)	3	15
X						T3.3	Diseño de ensayos en laboratorio acelerados	4	18
X	X			X	X	T3.4	Ejecución y validación de los resultados	4	21
X				X		**PT4.**	**Nuevos recubrimientos sostenibles para protección de acero en entorno offshore**		
X					X	T4.1	Formulación pintura biobasada	3	15
				X		T4.2	Síntesis de nuevos inhibidores de la corrosión	3	13
X				X		T4.3	Incorporación de nuevos inhibidores de la corrosión	6	18
X						T4.4	Incorporación de nanopartículas para conseguir texturizado super-hidrofóbico	10	18
X					X	**PT5.**	**Nuevo Acero S355 para entorno offshore**		
X					X	T5.1	Estudio teórico y diseño de aleaciones	3	6
X					X	T5.2	Fabricación de aleaciones a escala de laboratorio	4	10
X					X	T5.3	Fabricación de los nuevos grados de acero diseñados con resistencia mejorada frente a la corrosión y alta tenacidad	10	16
X				X	X	T5.4	Caracterización de los nuevos grados de acero	15	19
X					X	T5.5	Selección de nuevos grados de acero con resistencia mejorada frente a la corrosión y alta tenacidad a bajas temperaturas	19	21
X		X				**PT6.**	**Nuevos materiales basados en Hormigón para estructuras offshore**		
X						T6.1	Preparación de material cementicio (super)hidrófobo	4	12
X						T6.2	Estudio del diseño de pasta de cemento hidrófoba que tengan las propiedades adecuadas para su impresión 3D	9	16
X						T6.3	Síntesis del sistema autorreparable y estudio del diseño de pasta de cemento con el sistema autorreparable que tengan las propiedades reológicas adecuadas para su impresión 3D	6	17
X		X				T6.4	Desarrollo de hormigón de alta resistencia para impresión 3D	10	19
X		X				T6.5	Subestructura semilla flotante modular de hormigón impresa en 3D	11	21
X			X			**PT7.**	**Nuevos Materiales Sostenibles para aplicación en compuestos en entorno offshore**		
X			X			T7.1	Resinas sostenibles para infusión de palas y otros componentes del aerogenerador	3	17
X			X			T7.2	Adhesivos biobasados reciclables para la unión de componentes en palas y otros elementos del aerogenerador	3	21
X						T7.3	Utilizacion de elementos de madera en entorno marino	3	21
X		X				**PT8.**	**Bases de diseño y cálculo de estructuras de aerogenerador basadas en los Nuevos Materiales desarrollados**		
X		X				T8.1	Caracterización mecánica de nuevos materiales para estructuras de aerogenerador	7	16
X		X				T8.2	Modelos digitales de elementos finitos para los nuevos materiales	9	18
X		X				T8.3	Validación experimental de la modelización y simulación numérica de nuevos materiales	15	19
X		X				T8.4	Desarrollo de soluciones mixtas multimaterial para la ejecución de elementos estructurales del aerogenerador	15	21
X	X	X	X	X	X	**PT9.**	**Plan de difusión y explotación de resultados**		
X	X	X	X	X	X	T9.1	Plan de difusión	1	4
X	X	X	X	X	X	T9.2	Actividades de difusión	1	21
X	X	X	X	X	X	T9.3	Plan de explotación	18	21



ESKERRIK ASKO
GRACIAS
THANK YOU
MERCI

inigo.mendikoa@tecnalia.com

blogs.tecnalia.com

eu es en

www.tecnalia.com